ENCYCLOPÆDIA BRITANNICA

Fourteenth Edition, Revised

1966

v11: HAL-IMP

ENCYCLOPÆDIA BRITANNICA

THE UNIVERSITY OF CHICAGO

The Encyclopædia Britannica
is published with the editorial advice of the faculties
of The University of Chicago and of a
committee of members of the faculties of Oxford, Cambridge
and London universities and of a committee
at The University of Toronto

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"LET KNOWLEDGE GROW FROM MORE TO MORE
AND THUS BE HUMAN LIFE ENRICHED."

A New Survey of Universal Knowledge

ENCYCLOPÆDIA BRITANNICA

Volume 11

HALICARNASSUS *TO* IMPALA

ENCYCLOPÆDIA BRITANNICA, INC.

WILLIAM BENTON, PUBLISHER

CHICAGO · LONDON · TORONTO · GENEVA · SYDNEY · TOKYO

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1966

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PRINTED IN THE U.S.A.

Library of Congress Catalog Card Number: 66-10173

FOUNDED A.D. 1768

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HALICARNASSUS *TO* IMPALA

HALICARNASSUS (modern BODRUM in southwestern Turkey), an ancient Greek city of Caria, situated on the Ceramic gulf facing south. Its inhabitants claimed that it had been founded from Troezen in the Peloponnese. Herodotus, himself a Halicarnassian, relates that in early times the city participated in the Dorian festival of Apollo at Triopion near Cnidus but was expelled in consequence of the offensive conduct of its victorious athlete Agasicles; yet Halicarnassus appears thoroughly Ionic in its literature and culture.

Possessing a large sheltered harbour, the city occupied a key position on the sea routes. Though not itself large, it became the capital of the small despotate whose most famous ruler was a woman, Artemisia, who won the admiration of Xerxes at the battle of Salamis (480 B.C.). It was a favoured station of the Athenian fleet after the revolt of the allies in 412, and under Mausolus it became the capital of the Carian principality (*c.* 370 B.C.). The city at this time received a great wall circuit, public buildings and a secret dockyard and canal, while its population was swollen by the enforced transference of the inhabitants of the neighbouring Lelegian (non-Greek) towns.

On the death of Mausolus in 353 his widow and sister, Artemisia the younger, constructed in Halicarnassus a monumental tomb (the Mausoleum) that was reckoned as one of the seven wonders of the world. It stood on a platform about 337 ft. square; of its sculptures, which were attributed to leading artists of the age, some damaged statues and many frieze slabs, mainly of a battle between Greeks and Amazons, survive (in the British museum, London). Nothing now remains above ground on the spot. According to the elder Pliny the building was rectangular in plan and measured 411 ft. in circumference, with 36 columns and a pyramidal roof crowned by a sculptured chariot and four, the total height being 140 ft. The design of the building is not altogether clear; many reconstructions have been proposed.

Under the Persian commander in chief (Memnon of Rhodes), Halicarnassus stubbornly resisted Alexander the Great in 334 B.C. and suffered severe damage when the garrison troops evacuated the town quarters. It was then subject in turn to the dowager satrap Ada, Asander, Antigonus I (Monophthalmus), who garrisoned it in 311, and Lysimachus (after 301). It was under the Ptolemies of Egypt between 281 and 197 B.C., but thereafter independent. Between 62 and 58 B.C. it was sacked by pirates. In early Christian times it was a bishopric. Among its famous citizens were the epic poet Panyassis and Dionysius, critical writer and rhetorician in Rome in the time of Augustus.

The site was extensively excavated for the British museum by C. T. Newton in 1856–58 and A. Biliotti in 1865. Much of the great wall circuit is preserved; and remnants of the gymnasium, a late colonnade and a temple platform may be seen among the hamlets of the modern town of Bodrum (also rock-cut tombs with multiple burial chambers). But the ancient remains are eclipsed by the spectacular pile of the castle of the Knights of St. John, founded by the grand master Philibert de Nailhac about A.D. 1400, abandoned in 1522 and subsequently garrisoned by the Ottomans.

See C. T. Newton and R. P. Pullan, *A History of Discoveries at Halicarnassus, Cnidus and Branchidae,* 2 vol. (1862–63); G. E. Bean and J. M. Cook, "The Halicarnassus Peninsula" in *Annual of the British School at Athens,* vol. 50, pp. 85 ff. (1955). (JO. M. CO.)

HALIDE EDIB ADIVAR (1883–1964), Turkish author, was a pioneer of the emancipation of women in Turkey. Born in Istanbul and educated by private tutors and at an American college there, she was soon actively engaged in literary, political and social movements. Her novel *Veni Turan* (1912; German trans., *Das neue Turan,* 1916) portrays the nationalistic trends of the period. After educational work in Syria during World War I she and her husband, Adnan Adivar, joined the Nationalists and she served as a corporal in Anatolia. During 1925–38 she traveled extensively, lecturing in Paris, London, the United States and India. She became professor of English literature at Istanbul university (1939) and a member of parliament (1950–54). Her early novels, such as *Handan* (1912), are studies in the problems of the educated women of her day. Later books, such as *Ateshten Gömlek* (1922) and *Zeyno nun Oglu* (1926), are concerned with war in Anatolia and renascent Turkey. Novels of her third phase, such as *Sinekli Bakkal* (1936; originally written in English as *The Clown and His Daughter*) and *Döner Ayna* (1953), are character studies and well-drawn portraits of Turkish society. Other books written in English include her *Memoirs* (1926) and *Conflict of East and West in Turkey* (1936). She died in Istanbul on Jan. 9, 1964. (F. I.)

HALIDON HILL, BATTLE OF. With this battle, fought on July 19, 1333, the English king Edward III began his triumphant military career in Scotland and France. When Edward besieged Berwick on behalf of his vassal, Edward Balliol (*see* BALLIOL), the defenders agreed to capitulate unless relieved by July 20, 1333. Thus forced to fight a pitched battle to relieve the town, Sir Archibald Douglas, regent for the young David II, found its approaches blocked by the English on Halidon hill. Elaborating upon the tactics used at the battle of Dupplin (*q.v.*), Edward had dismounted the three divisions of his army and posted archers on the wings of each to harass the attackers by enfilade fire. Having also dismounted, the three divisions of the Scottish host were riddled with arrows as they advanced across swampy ground and then struggled uphill. Those who reached the English lines were soon overcome. Mounting their horses, the English hunted the fugitives till dusk. The next day Berwick surrendered. But although Balliol was reinstated, Scottish resistance continued and ultimately prevailed.

See J. H. Ramsay, *Genesis of Lancaster*, vol. i (1913); R. Nicholson, "The Siege of Berwick; 1333," *Scottish Historical Review*, vol. xl (1961). (R. G. NI.)

HALID ZIYA USHAKLIGIL (1865–1945), Turkish author, was the first true exponent in Turkey of the novel in its contemporary European form. Born in Istanbul of a western Anatolian family and educated at a French school in Izmir, he founded the newspaper *Hizmet* in which was serialized his early work: essays, translations from the French and several sentimental novels. Two of these, *Bir Ölünün defteri* (1889) and *Ferdi ve Shürekasi* (1894), revealed his potentialities. The hero of his novel *Mai ve Siyah* (1897), published in the periodical *Servetifünun*, was the spokesman for the "new literature" movement. His masterpiece, *Ashk-i Memnu*, appeared in 1900 and was followed by many more novels and a series of short stories. His characters and situations, though mainly limited to westernized upper-class circles, are drawn from experience. In his short stories he depicts the everyday scenes of Turkish life. (F. I.)

HALIFAX, CHARLES MONTAGUE, EARL OF (1661–1715), British statesman, a prominent if unpopular member of the Whig Junto, was born at Horton, Northamptonshire, on April 16, 1661, into a cadet branch of the Montagues, earls of Manchester. At Trinity college, Cambridge, his brilliance attracted the attention of Isaac Newton and he was elected to a fellowship. Meanwhile, his poems had given him a reputation in London literary circles, and in 1687 he and Matthew Prior published "The Country Mouse and the City Mouse," a witty parody on Dryden's solemn "Hind and the Panther." He married Anne, dowager countess of Manchester, in 1688 and was elected member of parliament for Maldon in 1689.

Vain, hot-tempered and malicious, "the Little Man" was on bad terms with most of his contemporaries at one time or another, but his financial genius and his ability in debate carried him to the top. He was appointed a lord of the treasury in 1692, and he speedily introduced new methods of financing the war with France (1689–97) by public loans which culminated in the foundation of the Bank of England in 1694. In that year he was appointed chancellor of the exchequer, and was recognized as an equal member, with Sir John Somers (afterward Lord Somers), Thomas Wharton and Edward Russell, of the Whig Junto. Elected member for Westminster in 1695, he at once pushed through a scheme of national recoinage, which is still a subject of controversy; but the continued success of the Bank of England left William III, who detested him, with no choice but to appoint him first lord of the treasury in 1697. The departure of Edward Russell and Thomas Wharton to the lords left him undisputed leader of the commons, but in the first peacetime session of the reign (1697–98) he was obliged to conduct a brilliant but wearying rearguard action against constant opposition.

Whig losses in the elections of 1698 and the withdrawal of the king's confidence cooled his enthusiasm for commons politics still further and he resigned in 1699. Montague was created Baron Halifax in 1700, and the attempt to impeach him and the other Junto peers for their complicity in William's partition treaties failed (1701). Under Queen Anne the Junto's hopes were focused on the Hanoverian succession: Halifax went to Hanover in 1706 to confer the Garter on the elector, the future George I, and speedily won his full confidence and favour. Henceforward George regarded him as his most able and influential supporter in England, and on his arrival in 1714 to assume the crown he at once appointed Halifax first lord of the treasury and created him earl. Halifax died childless on May 19, 1715.

A fluent if uninspired poet himself, Halifax was also a great patron of letters. Addison, Congreve and Prior were all indebted to him and he secured the mastership of the mint for Newton. He was president of the Royal society (1695–98). His collected poems were published in 1715 and reprinted in Samuel Johnson's *English Poets*. (J. P. K.)

HALIFAX, EDWARD FREDERICK LINDLEY WOOD, 1ST EARL OF (1881–1959), British statesman who was viceroy of India from 1925 to 1931 and foreign secretary in the period culminating in the outbreak of World War II, was born at Powderham castle, Devon, on April 16, 1881. He was the fourth son of the 2nd Viscount Halifax, a well-known churchman and a leader of the Anglo-Catholic movement, whose family had been established in Yorkshire for generations. He was educated at Eton and Christ Church, Oxford, being elected a fellow of All Souls college, Oxford, in 1903.

Wood entered parliament as Conservative member for Ripon, Yorkshire, in Jan. 1910, and for the next 30 years had a most successful career in politics. His grave manner and his air of aristocratic detachment counted in his favour, but some who knew him well regarded him as a very astute politician. During World War I he served for a time with the Yorkshire dragoons in France, but was assistant secretary to the ministry of national service from 1917 to 1918. Before 1925, when he was appointed viceroy of India and raised to the peerage as Baron Irwin, he was successively undersecretary of state for the colonies (1921–22), president of the board of education (1922–24) and minister of agriculture (1924–25). He was viceroy until 1931. On his return from India he again became president of the board of education (1932–35). He succeeded to his father's viscountcy in 1934. Thereafter he was lord privy seal (1935–37), leader of the house of lords (1935–38) and lord president of the council (1937–38), before being appointed foreign secretary on Feb. 25, 1938, on Anthony Eden's resignation from Neville Chamberlain's government.

Halifax had been close to Chamberlain long before he became foreign secretary, and when Chamberlain resigned in May 1940 he hoped Halifax would succeed him as prime minister. In fact, the issue was decided otherwise at a meeting between Chamberlain, Halifax and Churchill. Halifax remained foreign secretary for the first seven months of Churchill's ministry, but in Dec. 1940 he was named British ambassador to the U.S.

Halifax's career thus had three notable phases: as viceroy, as foreign secretary and as ambassador. His term of office in India coincided with a period of intense nationalist ferment among Hindus and Muslims alike, but his own deep concern with religious faith (like his father, he was a devout high churchman) enabled him to work on terms of understanding with Gandhi, the most powerful figure among Indian nationalists at that time. Halifax accelerated the processes of constitutional advance by using his great influence to that end both during his viceroyalty and after. His tenure of the foreign office was the most controversial period of his career, for by accepting this appointment he identified himself completely with Chamberlain's policy of "appeasement" toward Hitler. As lord privy seal he had visited Hitler and Goering in Nov. 1937, and he accompanied Chamberlain on a visit to Mussolini in Rome in Jan. 1939. As ambassador to the U.S. he gave great service to the Allied cause during World War II, in recognition of which he was created earl of Halifax in 1944. Named British delegate to the San Francisco conference in March 1945, he attended the first sessions of the United Nations. His resignation as ambassador became effective on May 1, 1946. In 1957 he published a volume of recollections *Fullness of Days*. He died at Garrowby hall, near York, on Dec. 23, 1959. (J. F. B.)

HALIFAX, GEORGE MONTAGU DUNK, 2ND EARL OF (1716–1771), English statesman, the son of George Montagu, 1st earl of Halifax, was born on Oct. 5 or 6, 1716, and succeeded his father in 1739. He became president of the board of trade in 1748 and took an active interest in colonial development, helped to found Halifax, Nova Scotia, which was named after him, and in several ways rendered good service to trade, especially with North America. He was lord lieutenant of Ireland from March 1761 to March 1763 and for a time concurrently first lord of the admiralty, from June to Oct. 1762, in Lord Bute's administration and then became secretary of state for the northern department, transferring to the southern department in 1763. Halifax signed the general warrant under which John Wilkes was arrested in 1763 and for this he had to pay damages in 1769. He was mainly responsible for the exclusion of the name of Augusta, princess dowager of Wales, from the regency bill in 1765, a move which exacerbated George III's relations with the Grenville ministry and led to its demise a few weeks later. Halifax was lord privy seal during 1770 in the ministry of his nephew, Lord North, and was again secretary of state for the northern department during 1771 from January until his death on June 8.

HALIFAX, GEORGE SAVILE, 1ST MARQUESS OF (1633–1695), English statesman and political writer known as "The Trimmer," because of his seemingly opportunist principles, was born at Thornhill, Yorkshire, on Nov. 11, 1633, and succeeded his father, Sir William, as 4th baronet on Jan. 24, 1644. Too young to take any part in the Civil War, in which Sir William was prominent on the royalist side, he spent his early years partly in travel, with a private tutor, in France and Italy, and partly in retirement at Rufford abbey, Nottinghamshire, which he was to make the principal seat of his family. In the spring of 1660 he was returned as member for Pontefract to the convention which recalled the king, but there is nothing to suggest that he made any strong impression on contemporaries during this, his sole appearance in the house of commons. He was created Baron Savile of Eland and Viscount Halifax in Jan. 1668.

For this promotion Halifax was indebted partly to his extensive estates and connections with the great families of Talbot, Wentworth and Coventry, but partly also, it may be presumed, to the influence of the 2nd duke of Buckingham, then at the height of his power, with whose fortunes he and other young Yorkshiremen had chosen to associate themselves. To Buckingham he certainly owed his local offices of justice of the peace, deputy lieutenant and colonel in the militia. When, however, the duke embarked on the policy which ultimately led to the secret treaty of Dover, Halifax began to draw away from him. Although admitted to the privy council in 1672 and sent on a mission to Louis XIV in connection with the Anglo-French attack on the Dutch, Halifax remained faithful to the principles of the triple alliance and therefore opposed to the existing government. On the other hand, when Charles II reversed his policy and gave the chief place in his counsels to the earl of Danby, Halifax proved equally unready to accept what seemed to him the extravagances of the new regime. He strenuously opposed Danby's non-resisting test bill, by which members of both houses of parliament, and all holding office under the crown, were to be required to subscribe to a declaration that it was unlawful, upon any pretense whatsoever, to take up arms against the king, and to swear that they would not, at any time, endeavour the alteration of the government either in church or state. He denounced the court's attempt to control public opinion by suppressing the coffeehouses; and he condemned the policy of continuing the Cavalier parliament in existence long after it had ceased to be representative of national feeling. Thus early did he adopt that policy of "trimming," or balancing between opposing factions, with which his name came to be inseparably connected.

Halifax had been dismissed from the privy council on Jan. 7, 1676, for criticizing the government's measures against the coffee sellers, but on April 21, 1679, on the complete remodeling of the council associated with the name of Sir William Temple, he was again admitted, ingratiated himself with Charles II, and for some time thereafter enjoyed a position of considerable power and dignity. He was created earl of Halifax on July 16, 1679, marquess of Halifax on Aug. 22, 1682, and lord privy seal on Oct. 27, 1682. During these years his ambition was to secure the establishment of a truly national government on a moderate basis, and the chief dangers he had to provide against were the Catholic-despotic developments threatened by the probable succession of James, duke of York; on the one hand, and on the other the semirepublican designs of those who wished to exclude the duke altogether from the throne. His greatest personal triumph was the defeat of the exclusion bill in the house of lords on Nov. 15, 1680; but he proved unable to devise any generally acceptable substitute for the policy of exclusion, and as the duke's influence increased after 1682 his own inevitably declined. Toward the close of Charles's reign a reaction seemed to be developing which might have led to his restoration to power, but all prospect of this disappeared with the death of the king on Feb. 6, 1685. Appointed lord president of the council by James, he was retained in office only to give an appearance of moderation to a government which was rapidly tending toward extremes. On Oct. 21, as a result of his refusal to support the repeal of the Test and Habeas Corpus acts, he was summarily dismissed.

For the next three years Halifax remained in retirement, criticizing James's designs, as they revealed themselves, in the political pamphlets on which his fame so largely rests. In his *Letter to a Dissenter*, published in 1687, he warned Nonconformists of the danger of placing their trust in the king's promises of toleration; and in his *Anatomy of an Equivalent*, which appeared a year later, he demonstrated the absurdity of relying on any substitute for the safeguards of the established religion which already existed. Meanwhile he kept in touch with the more moderate among those who were contemplating resistance; but actual revolution he deprecated. The king's designs, he confidently maintained, were bound to fail of themselves, and all that was necessary was to wait.

When William of Orange landed in England and civil war seemed inevitable Halifax was thus in a strong position to mediate between the king and the prince, and exerted himself to the utmost, first to induce them to accept a reasonable accommodation, and then, after the flight of James, to set up a provisional government which might negotiate with either or both. Only when all such expedients had failed did he boldly take the side of William, and it was largely as a result of his efforts in the convention parliament of 1689 that William and Mary were accepted as king and queen. On him, as speaker of the lords, fell the duty of formally requesting the prince and princess to accept the crown.

To contemporaries it appeared that the reappointment of Halifax to his old office of lord privy seal and his acceptance as chief minister of the crown were natural consequences; but in actual fact the favour which Halifax enjoyed with William was not so much because of his services at this time as to the similarity of their political outlook. William was as anxious as Halifax for a reconciliation of parties based on a policy of "trimming," and hoped through Halifax to achieve that end. Only when it became apparent that in the heated atmosphere of the time such a policy was impracticable did his confidence in Halifax begin to waver, and even then it was Halifax who on Feb. 11, 1690, tendered his resignation, not William who required it. Thereafter Halifax was to be found mainly in opposition to the government of the moment. Toward the close of 1694 his health began to fail, and on April 5, 1695, he died suddenly at Halifax house. He was succeeded by his second and only surviving son William (1665–1700), with whose death on Aug. 31, 1700, the peerage became extinct.

The high reputation of Halifax among moderns is due to the fact that the political principles which guided his conduct and inspired his writings are such as would now be generally approved; but in his own day these principles were regarded with little favour. The moderation which he consistently advocated was denounced as treachery by every group of partisans who hoped to enlist his support, and not infrequently he had to withstand attacks from opposite sides at once. He lacked the practical capacity, and indeed the inclination, to organize a band of followers in support of his principles, and suffered from serious personal weaknesses which exposed him to the criticism of his numerous enemies. His passion for titles, leading to his rise from the dignity of baronet

to that of marquess, seemed scarcely in accordance with his high professions of disinterestedness. His inordinate love of applause cast doubt on the sincerity of his most brilliant speeches. His tendency to see both sides of a question made him unready, even at a time of crisis, to take any resolute action. Few statesmen of comparable capacity have had less direct influence on the actual events of their time.

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HALIFAX, capital of Nova Scotia, Canada, and leading commercial, industrial and cultural city of the province, is on a rocky, boot-shaped peninsula, 4½ mi. long and 2 mi. wide. The harbour proper, on the east side of the peninsula, has extensive berthing facilities, while the inner harbour, Bedford basin, 6 mi. long and 4 mi. wide, is deep enough for the world's largest ships. Pop. (1961) city 92,511; metropolitan area 183,946. Included in the metropolitan area is the city of Dartmouth (*q.v.*), linked to Halifax by the mile-long Angus L. Macdonald suspension bridge completed in 1955.

The harbour of Halifax was noted by Champlain in 1605 but was not exploited until 1698 when the French established the fishing station, Chebucto, on McNab's Island. Plans were drawn up for a large fortress at Chebucto, but mainland Nova Scotia was lost to the English in 1713 and the French subsequently constructed a fortress (Louisbourg) on Cape Breton Island. Seeking a counterpoise to Louisbourg, Edward Cornwallis founded Halifax in 1749, naming it after the president of the Board of Trade and Plantations. For many years Halifax was little more than a military garrison, with forts and Martello towers (*q.v.*) strategically located throughout the area. Prince Edward, Queen Victoria's father, and others fortified Halifax until it had the strongest defenses outside of Europe. Halifax was an imperial army and naval base until 1906 when the defenses and dockyard were taken over by the Canadian government. Because of its strategic position it was Canada's largest and most important naval base during World Wars I and II.

Although the city has never been besieged, it has had more than its share of disaster during wartime. In 1917 the French steamship "Mont Blanc," laden with TNT, explosive acid and benzine, collided in the Narrows with the Norwegian steamer "Imo." The explosion that followed killed nearly 2,000 people and seriously injured an equal number. Windows were rattled 60 mi. away and an anchor shaft, weighing 1,000 lb., was hurled over 2 mi. from the scene. Much of the north side of the city was devastated, with property damage amounting to $35,000,000. A similar holocaust almost occurred in 1945, but the periodic explosions were not so great and they took place in Bedford basin well away from the populated areas.

Halifax is a leading Canadian port, particularly during the winter months, with fish, fish products, lumber and agricultural products being its major exports. It is the Atlantic terminus of the Canadian National railway and the Dominion Atlantic railway, the latter a part of the Canadian Pacific system. The area is served by two airports, one across the harbour at Eastern Passage, and an international airport at Kelly Lake, 20 mi. N.E. of Halifax.

Industries of Greater Halifax include foundries, oil refining, shipbuilding, fish processing, and the manufacture of candy and food products, rope and twine, paint and varnish, clothing, electronic equipment and furniture. There are ship and aircraft overhauling facilities.

Among many prominent historic buildings are St. Paul's (Anglican) church, built in 1750, with many interesting memorial tablets and graves of celebrated Nova Scotians; Government house, erected in 1900, the residence of the lieutenant-governor; Province house, completed in 1819, the provincial legislative building; and the Old Clock, regarded as a Haligonian symbol, built on the side of Citadel Hill in 1803. Educational institutions include Dalhousie university (founded 1818), to which is affiliated the University of King's college (Anglican, founded 1789); St. Mary's university (Roman Catholic, founded 1841); Mount St. Vincent college, for women (Roman Catholic, chartered 1925); and Nova Scotia Technical college (founded 1909). Other interesting features are Citadel Hill, the Public Gardens, Point Pleasant park and Ft. Needham.

See T. Raddall, *Halifax, Warden of the North* (1948). (C. W. RD.)

HALIFAX, a municipal, county and parliamentary borough in the West Riding of Yorkshire, Eng., 191 mi. N.N.W. from London and 8 mi. S.W. from Bradford by road. Pop. (1961) 96,073.

It lies in a hilly district on the Hebble, a tributary of the Calder which forms the southern boundary. The steep left bank of the Hebble restricts urban development, and Beacon hill, rising sharply to 850 ft., overlooks the town. Road and railway bridges span the valley, the principal one being North bridge, opened in 1871. The main part of the town is situated on the slope of a long declivity facing east on the right bank of the stream. After World War II extensive suburban development took place on the northern side of the town, in the elevated district of Illingworth and at Mixenden in the Wheatley valley.

In Saxon times Halifax formed part of the extensive manor of Wakefield held by Edward the Confessor. After the Norman Conquest the manor of Halifax (Feslei in Domesday Book) was granted to William, earl of Warenne and Surrey, who made a gift of Yorkshire churches, including Halifax, to the Cluniac priory at Lewes in Sussex. The church was dedicated to St. John the Baptist, patron saint of wool weavers. The cloth trade has been plied in Halifax from an early date—the first record of a weaver being in 1275. In the alnagers' accounts for 1473–75 Halifax parish had the largest cloth production in the West Riding, a position it retained for three centuries. The late survival of the Halifax Gibbet law was ascribed traditionally to the need for safeguarding the kerseys left on tenter frames in the open fields. The inhabitants retained the power to behead anyone found guilty of stealing cloth "of the value of thirteen pence halfpenny" or more. The celebrated gibbet, similar to the Scottish maiden and French guillotine, operated without human handling, a rope drawn by horse or sheep pulling out the pin to release the blade. The last of the executions, which took place on market days, was in 1650. The stone platform may still be seen at Gibbet hill. The blade is in the possession of the lord of the manor of Wakefield. During the Civil War Halifax was garrisoned by parliament although in 1643 royalist troops occupied it for six months.

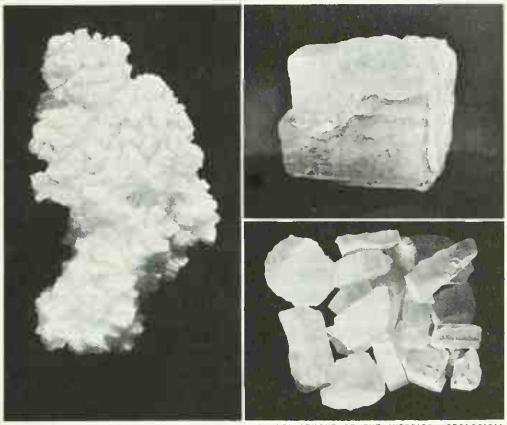
Built largely in the 19th century, Halifax is a development of the industrial era, though some older buildings remain. The parish church is Perpendicular and two earlier churches are traceable—the first of Norman origin and the second of the Early English period. Features of the church are the western tower completed in 1482, unique Commonwealth windows of plain glass with beautifully designed leading and some fine woodwork. Among the public buildings are the town hall in the Palladian style, designed by Sir Charles Barry, opened in 1863; the central library and Bankfield museum housed in Victorian mansions; and Shibden hall, a 15th-century timbered house with the Halifax and West Riding Folk museum on its grounds. Heath grammar school was founded in 1585 with a royal charter. The Piece hall (opened in 1779), where woolen piece goods were lodged and sold, is preserved as an ancient monument. Wainhouse tower, an octagonal tower with staircase and balconies, is a familiar landmark in the borough.

Halifax, an industrial town, is prosperous because of its manifold trades. It is a centre of the woolen and worsted industries, other textile products being cotton, silk, rayon and moquette. The manufacture of carpets is important and other industries include iron and steel, wire drawing, brewing and confectionery. Halifax specializes in the production of machine tools and also manufactures boilers, card clothing and cash registers. Freestone and fire clay are abundant in the neighbourhood. The town is well equipped with gardens and parks, the most notable being Savile park, an expanse of 72 ac. of grassland. There are numerous charitable endowments, the earliest, the Waterhouse charity, dating from 1635. The town is the regimental depot of the duke of

Wellington's regiment, which has been accorded the freedom of the borough. There are literary and artistic associations with Sir Thomas Browne, Daniel Defoe, Laurence Sterne and the Brontës.

Halifax was first represented in parliament in 1654 but lost the seat after the Restoration. The Reform act of 1832 gave the town two members. It was a borough by prescription but was not incorporated until 1848; the county borough was created in 1888 and one member is returned to parliament. (F. C. P.)

HALITE, the mineralogic name for naturally occurring sodium chloride, common or rock salt. It occurs in well-formed cubic crystals, which occasionally exhibit hopper-shaped depressions. Halite also occurs commonly in granular masses. Although it is



BY COURTESY OF (LEFT AND BOTTOM RIGHT) U.S. DEPARTMENT OF THE INTERIOR, GEOLOGICAL SURVEY; (TOP RIGHT) WARD'S NATURAL SCIENCE ESTABLISHMENT, INC.

FORMS OF HALITE: (LEFT) CUBIC SALT CRYSTALS FROM SILVER PEAK MARSH, NEV.; (TOP RIGHT) CUBIC CLEAVAGE IN CRYSTALLINE MASS OF HALITE FROM DETROIT, MICH.; (BOTTOM RIGHT) LARGE PLATES OF ROCK SALT FROM MINE IN GENESEE COUNTY, N.Y.

characteristically colourless, it may exhibit brownish, bluish, and other tints. The mineral is characterized by high solubility in water, distinctive salty taste, low specific gravity (2.16), and cubic cleavage.

Most halite occurs in bedded deposits formed by evaporation of bodies of salt water. Deposits range from a few feet to hundreds of feet in thickness and from a few tens of square feet to thousands of square miles in area. The deposits are characteristically associated with beds of limestone, dolomite, shale, and not uncommonly are interbedded with gypsum, anhydrite, and other soluble sodium, potassium, magnesium and calcium salts.

Such deposits are widely and abundantly distributed throughout the world, notably in the U.S.S.R., Germany, Poland, France, Spain and the U.S. In the U.S. very extensive deposits occur in New York, Ohio, Michigan and Pennsylvania and in Kansas, Colorado, Oklahoma, Texas and New Mexico. Halite also occurs along the Gulf of Mexico and the Mediterranean sea, in Rumania and in the U.S.S.R. in large pluglike bodies termed salt domes. Petroleum and sulfur are frequently associated with such domes.

Halite is an essential raw material for the preparation of soda ash, the production of sodium and chlorine compounds in the chemical industry, preservatives in the food-processing industry and for a host of other purposes. *See* also SALT: *Rock Salt;* SALT DOME. (D. M. H.)

HALL, ASAPH (1829–1907), U.S. astronomer and discoverer of the two satellites of Mars, was born on Oct. 15, 1829, at Goshen, Conn. In 1863 he was appointed professor in mathematics at the U.S. Naval observatory, Washington, D.C. This position he held until his retirement in 1891. From 1895 to 1901 he was professor of astronomy at Harvard. At the naval observatory Hall had the 26-in. equatorial telescope under his charge from 1875 to 1891. His work with it was chiefly in three fields: planetary observations and the orbits of their satellites; observations of double-star orbits; determinations of the stellar parallax. In each of these fields Hall's extensive observations were of great value. His most spectacular achievement was the discovery in 1877 of the two satellites of Mars, whose orbits he calculated. He died at Annapolis, Md., on Nov. 22, 1907.

See G. W. Hill, *Biographical Memoir of Asaph Hall* (1908), which contains a full bibliography of Hall's scientific writings.

HALL, BASIL (1788–1844), British naval officer and traveler, fellow of the Royal society, was born on Dec. 31, 1788, the son of the geologist Sir James Hall of Dunglass, and entered the navy in 1802. He accompanied Lord Amherst's embassy to China, publishing in 1818 his *Account of a Voyage of Discovery to the West Coast of Corea, and the Great Loo-Choo Island.* In 1820 he sailed for service in South America, describing his experiences in *Extracts from a Journal Written on the Coasts of Chili, Peru, and Mexico, in the Years 1820, 1821, 1822* (2 vol., 1824). Leaving the navy he then undertook further travels and published *Travels in North America in the Years 1827 and 1828* (3 vol., 1829). His *Fragments of Voyages and Travels* (9 vol., 1831–33) throws interesting light on the British navy. Hall died in Haslar naval hospital on Sept. 11, 1844. (H. M. Ws.)

HALL, CARL CHRISTIAN (1812–1888), Danish statesman whose name is linked with the Schleswig-Holstein question (*q.v.*), was born at Christianshavn, in Copenhagen, on Feb. 25, 1812. He was trained in the law and was from 1848 one of the leaders of the National Liberal party. An attractive and convincing debater with an amiable humour, he was also esteemed in conservative circles. He wanted to organize the middle class into a political party and tried to avoid serious dissensions in the question of Danish constitution. Like most Liberals, he wanted the duchy of Schleswig (Slesvig) to be more closely bound to Denmark than to the entirely German Holstein, but accepted the so-called *helstatsforfatning*—the idea of a single state with a common *rigsraad* (1855). Having been minister of public worship from Dec. 1854 in P. G. Bang's cabinet, he became prime minister on May 13, 1857, and was also foreign minister from July 1858.

As the German confederation objected to the constitution of 1855, Hall suspended its validity as far as Holstein was concerned; but the *rigsraad* continued to legislate for Denmark and Schleswig, since Hall regarded the closest possible union between Denmark and a Schleswig freed from all risk of German interference as the essential condition for Denmark's independence. Having tried in vain to reach agreement with the Germans by negotiation, he resigned on Dec. 2, 1859, but returned to power on Feb. 24, 1860. Though Denmark had no guarantee of help from Sweden-Norway or from other states, in 1863 Hall carried through a proposal for a new common constitution for Denmark and Schleswig, which the new king, Christian IX, signed hesitatingly on Nov. 18. Now at the height of his popularity, Hall rejected the Prussian protest and the efforts of the powers to get the constitution annulled or to suspend its operation. Then an attempt to form a new cabinet failed, and Hall declined to join the government formed by D. G. Monrad on Dec. 31, 1863. When the war of 1864 had brought defeat, Hall after some hesitation supported acceptance of the peace treaty by which the duchies were ceded to Prussia and Austria. When the Franco-German War broke out in 1870 he favoured a policy of alliance with France. As minister of public worship (May 1870–July 1874) he worked for educational reforms. He opposed the parliamentary demands of the Liberal party and in 1879 was chosen as chairman of the Conservative party in the *folketing,* but was forced to retire by serious illness. He died in Copenhagen on Aug. 14, 1888.

See V. C. S. Topsöe, *Politiske Portraetstudier* (1878); Erik Möller, *Helstatens Fald* (1958). (F. Sk.)

HALL, CHARLES FRANCIS (1821–1871), U.S. explorer who led three arctic expeditions, was born in Rochester, N.H., in 1821 and emigrated as a young man to Ohio. His enthusiasm for arctic exploration led him to attempt to organize several expeditions in search of Sir John Franklin's lost party, but it was not until 1860 that he acquired funds to carry out his ambitions. He landed alone from a United States whaleboat in latitude 63° N.,

longitude 65° W. in Frobisher bay and spent two years exploring the area first discovered by Martin Frobisher in the 16th century. He became friendly with Eskimos who greatly assisted him in his later travels. In 1862 he returned to the United States and wrote *Arctic Researches and Life Among the Esquimaux* (1864). Financed by Henry Grinnell, he returned to the arctic in 1864 and, in company with Eskimos, explored in the eastern arctic for five years, discovering much information about the fate of Franklin's expedition and obtaining a number of relics of the party. In 1871 he commanded a United States government-sponsored expedition which sailed in a naval vessel, "Polaris," to attempt to reach the north pole. Ice conditions were very favourable and "Polaris" was able to reach latitude 82° 11′ N., longitude 61° W., then the furthest north point reached by a vessel. During the homeward voyage a number of sledge journeys were made and on the return from one of these Hall died suddenly, on Nov. 8, 1871.

(L. M. Fs.)

HALL, CHARLES MARTIN (1863–1914), U.S. inventor, was born at Thompson, O., on Dec. 6, 1863, and graduated at Oberlin college in 1885. While still at college he became interested in the problem of devising a cheap process for the reduction of aluminum. Working with such apparatus as the Oberlin laboratory afforded, he invented, eight months after his graduation, the electrolytic process which forms the basis for industrial mass production of the metal (*see* ALUMINUM: *Production of the Metal*). The next three years were spent perfecting his process and interesting capitalists. In 1888 the Pittsburgh Reduction company (later the Aluminum Company of America) began to manufacture aluminum, and in 1890 Hall was made its vice-president. The invention made aluminum a common article of commerce, for which new uses continue to be found. Hall's death occurred in Daytona Beach, Fla., on Dec. 27, 1914. The fortune resulting from his invention was bequeathed chiefly to educational institutions, Oberlin receiving gifts totaling more than $3,000,000.

See *Memorial Volume to Charles M. Hall* (1915).

HALL, EDWARD (*c.* 1498–1547), English historian whose *Chronicle* was one of the chief sources of Shakespeare's history plays, is said to have been a Londoner by birth. Educated at Eton and at King's college, Cambridge, he became common sergeant of London in 1533 and undersheriff in 1535. He was also member of parliament for Wenlock (1529) and Bridgnorth (1542) in Shropshire. Hall's great work, of which the full title is *The Union of the Two Noble and Illustre Famelies of Lancastre and Yorke*, he bequeathed in manuscript to the printer Richard Grafton, who began to print it in 1547 and published the first edition in 1548 and the second in 1550. The value of the *Chronicle* in its early stages is not great, but it is very considerable for the reign of Henry VIII and its literary quality is higher than that of most chronicles of the time.

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(N. D.)

HALL, GRANVILLE STANLEY (1844–1924), U.S. psychologist, one of the most influential of the pioneers in American psychology, was born at Ashfield, Mass., on Feb. 1, 1844. He did much to give the science of psychology a broad base, directing into the psychological currents of his time the ideas of Charles Darwin, Wilhelm Wundt, Sigmund Freud and others. Hall was the first president of Clark university (1888–1920) and at the same time professor of psychology there. At Clark he established the first institute of child psychology in the United States. Many of the studies issuing from this institute employed the questionnaire method, staunchly advocated by Hall as a psychological tool. One of the first psychological laboratories in the United States was founded by Hall in 1883 at Johns Hopkins university, where he served as lecturer and professor of psychology from 1881 to 1888. He was a leading spirit in the founding of the American Psychological association and its first president (1892). He launched four psychological journals—the *American Journal of Psychology* (1883), the *Pedagogical Seminary* (1891), the *Journal of Applied Psychology* (1915) and the *Journal of Religious Psychology and Education* (1902)—and published 489 works in nearly all the major areas of psychology. Among his most important published works are *Adolescence; Senescence, the Last Half of Life; Youth; The Contents of Children's Minds on Entering School;* and *Founders of Modern Psychology*. A great teacher, Hall had many illustrious students, among them John Dewey, Joseph Jastrow, James McKeen Cattell, Henry Goddard, E. C. Sanford and Lewis Terman. He died at Worcester, Mass., on April 24, 1924.

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(H. L. K.)

HALL, SIR JAMES (1761–1832), Scottish geologist and physicist, the founder of experimental geology, was born at Dunglass on Jan. 17, 1761. He was educated first at Cambridge and then at Edinburgh university, becoming an intimate colleague of James Hutton, whose views with regard to intrusive rocks he demonstrated experimentally. He reproduced by simple fusion and slow cooling the minerals and textures of the original dolerites of his experiments, and in subsequent researches he studied the effect of heat and pressure on calcium carbonate. In these investigations he showed that chalk could be converted into marble comparable with natural examples. The results of his experiments were brought before the Royal Society of Edinburgh and have become classics in the literature of experimental petrology. He was also greatly interested in architecture and during 1807–12 he was M.P. for Michael, Cornwall. He died on June 23, 1832, at Edinburgh.

(C. E. T.)

HALL, JAMES (1793–1868), U.S. author, particularly successful in sketching life in the French settlements of the Illinois country and in interpreting such authentic figures as the backwoodsman, *voyageur* and Indian-hater, was born in Philadelphia, Pa., Aug. 19, 1793. A versatile figure, he was a soldier in the War of 1812, a lawyer and circuit judge, a newspaper and magazine editor, state treasurer of Illinois (1827–1831), a banker in Cincinnati, O., and a writer of history and fiction. During his twelve years in Illinois (1820–1832) he lived at Shawneetown and Vandalia and played an important role in literary and cultural activities. In 1828 he compiled the first western literary annual, the *Western Souvenir*, and he edited the *Illinois Monthly Magazine* (1830–1832) which he continued at Cincinnati until 1836 as the *Western Monthly Magazine*. Much of the material in these periodicals he supplied himself although he consistently encouraged western contributors. He compiled statistical volumes on the steamboating and economic history of the Ohio valley. He died in Cincinnati on July 5, 1868.

Hall wrote an interesting travel book, *Letters from the West* (1828); one novel, *Harpe's Head* (1833); a readable survey of western exploration, *The Romance of Western History* (1857); and several volumes of short stories. Tales like "Pete Featherton" and "A Legend of Carondelet," which find a place in many anthologies, early established Hall as a short-story writer of distinction. His best stories appear in *Legends of the West* (1832) and *Tales of the Border* (1835).

See John T. Flanagan, *James Hall, Literary Pioneer of the Ohio Valley* (1941).

(J. T. Fn.)

HALL, JAMES (1811–1898), U.S. stratigraphic geologist and invertebrate paleontologist, was born at Hingham, Mass., on Sept. 12, 1811. He acquired his early education through his own efforts and gained admission to Rensselaer school, later Rensselaer Polytechnic institute, at Troy, N.Y. As a student he collected and identified more than 900 species of plants. He spent his summers and all of his limited finances doing field work. After his graduation in 1832 he became librarian at Rensselaer institute and later in the same year an assistant professor; subsequently he became professor of chemistry, natural science and geology. Stephen Van Rensselaer became interested in Hall and sent him to make

geological explorations in the St. Lawrence valley.

In 1836 he was appointed one of four geologists on the geological survey of the state of New York which had been established just before that time. Although the youngest of the group, his report, *Geology of New York*, part iv (comprising the survey of the fourth district, 1843), has endured with authority as a classic of geological literature.

Eventually Hall became state geologist and director of the Museum of Natural History of Albany. Through various periods when state support was withdrawn from geological work, he carried it on at his own expense and it was only through his sacrifice that the continued publication of the *Palaeontology of New York* (1847–94) was made possible. These volumes, the results of his chief work, contained descriptions of the invertebrate fossils of that state. He was also at one time state geologist of Iowa (1855–58) and of Wisconsin (1857–60).

His publications, dating from 1836, include more than 260 scientific papers and 35 books, dealing with numerous phases of geology and paleontology of the different regions of the United States and Canada, including reports on the geology of Oregon and California (1845), of Utah (1852), Iowa (1859) and Wisconsin (1862). He was a charter member of the National Academy of Sciences and received the Wollaston medal from the Geological Society of London in 1858.

Hall was regarded as a great teacher as well as collector. In his 86th year he journeyed to St. Petersburg to take part in the International Geological congress and then joined the excursion to the Ural mountains. He died at Echo Hill, Bethlehem, N.H., on Aug. 7, 1898.

HALL, JOSEPH (1574–1656), English bishop, moralist, controversialist and satirist, a notable figure in literature in his own right and as the opponent of Milton and of some importance in the history of ideas both as a churchman and as a moral philosopher. He was born at a farm near Ashby-de-la-Zouch, Leicestershire, on July 1, 1574. Destined for the ministry, he was educated, under Puritan influences, at the Ashby school and in 1589 entered Emmanuel college, Cambridge, then a strongly Puritan college. He had a successful academic career; he was elected for two years running to the university lectureship in rhetoric; and he won a name by his two volumes of satires. But he felt called to the active ministry and accepted Sir Robert Drury's offer of the rectory of Hawstead, Suffolk, and took up his duties there on Dec. 2, 1601. Apart from a visit to Belgium (1605) his leisure at Hawstead was spent, he tells us, in "writing books to buy books." His writings brought him to the notice of Prince Henry and he was appointed a domestic chaplain to the prince and resigned Hawstead (1608) to take up the cure of Waltham Holy Cross, Essex. While absent as chaplain to an embassy to France (1616) he was made dean of Worcester, and on his return he accompanied King James on the visit to Scotland in 1617. He was one of the representatives of the king at the synod of Dort (1618). Consecrated bishop of Exeter on Dec. 23, 1627, he was repeatedly suspected of Puritan leanings by Archbishop Laud, but accepted Laud's suggestion to write *Episcopacy by Divine Right* (publ. 1640) against Puritan attacks on episcopacy. In 1641 he engaged in pamphlet controversy with Puritan opponents. On Nov. 15, 1641, he was translated to the bishopric of Norwich but was for four months imprisoned with the other bishops in the Tower of London before he went to his new see. Deprived of most of his episcopal revenues in 1643 he was finally ejected from his palace and retired to a small house at Higham, near Norwich, where he lived until his death on Sept. 8, 1656.

As a man of letters Hall is remarkable for his versatility and his innovations. The *Contemplations* (151 meditations on the moral and spiritual implications of biblical stories; 1612–26) are not perhaps especially original except for their "Senecan" prose—a clear, curt, pointed style of which Hall was one of the foremost English practitioners, though he could use a full, sonorous style on occasion. In other literary forms, however, he was a pioneer. Although he was not the first to write formal satire in English, his *Virgidemiarum. Six Books* ("six books of harvests of rods") are the first English volumes of satire successfully modeled on Latin satire. The first three books, of "toothless satires" (1597), deal with the defects of contemporary literature, abuses in the professions and ostentation in social life. The last three books, of "biting satires" (1598), deal with graver social, moral and economic evils. Although much of his material is derived from books, Hall's work is lively and original. The satire is sharply and often wittily pointed; the couplets, often balanced and enclosed, anticipate the satiric heroic couplets of Dryden; and the pictures of Elizabethan life are vivid and striking. The satires were immediately popular and inaugurated a series of satirical books of which the most notable were John Marston's.

Hall was certainly the first to emulate Theophrastus in English when he published (1608) a volume of *Characters of Vertues and Vices* (pithy and witty delineations of such types as "The Flatterer" or "The Good Magistrate"), and he claimed to be an innovator with his volumes of *Epistles* imitating Seneca's *Moral Epistles*. Original and entertaining also, in spite of Milton's scorn for it, is Hall's Latin satire, *Mundus Alter et Idem* (*c.* 1605). An early example of the imaginary voyage, it is influenced by Rabelais, and itself influenced Swift's *Gulliver's Travels*. Finally, beginning with *Meditations and Vows Divine and Moral* (1605), Hall continued to write meditations for the rest of his life, and here too he showed the way to later writers, enriching the manner and extending the scope of the meditation.

His clash with Milton began in 1641, when, in reply to Hall's *Defence* against "Smectymnuus" (a name made up of the initials of the Puritan divines who had attacked his *Humble Remonstrance to the High Court of Parliament*), Milton wrote *Animadversions*. This provoked a writer on Hall's side (perhaps his son) to turn (in *A Modest Defence*) Milton's technique of unpleasant imputation upon Milton himself, thus stinging Milton into *An Apology* (1642), containing even worse invective, but also precious passages of autobiography. In this Anglican-Puritan conflict, Hall was a moderate, pleading for unity among fellow Christians and for a brotherly tolerance in place of embittered strife about nonessentials. He did not appreciate how strong in such Puritans as Milton was the passion for individual liberty of speech and religious thought, he was bewildered by their readiness to reject established authority and he did not share their confidence in the ability of the common man to govern a church or to extemporize prayer worthy of public worship; but he was prepared, in the interests of peace, to make compromises on church government and on liturgy.

As a moral philosopher Hall achieved a European reputation for his Christianization of Stoicism and became widely known as "the English Seneca" and "the Christian Seneca." In a series of works beginning with *Heaven upon Earth* (1606) he expounded a neo-Stoicism by which men might achieve "true Peace, and Tranquillity of mind." This, discarding the pagan elements of Stoicism, adds to the philosophy of Seneca the Christian doctrines of Grace and Redemption and the efficacy of Faith.

Hall's satires and *Contemplations* were read and appreciated throughout the 18th and 19th centuries; in the 20th century scholars took an increasing interest in his moral and meditative work and in his place in the development of English prose.

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HALL, MARSHALL (1790–1857), English physiologist, founder of the theory of reflex actions, was born on Feb. 18, 1790, at Basford, near Nottingham, the son of a cotton manufacturer. He studied medicine at Edinburgh and became resident house phy-

sician to the Royal infirmary there. This appointment he resigned after two years to visit the medical schools of Paris, Berlin and Göttingen. He then settled at Nottingham, where he became physician to the General hospital, and in 1826 removed to London. Hall's principal works are: *Diagnosis* (1817); *Mimoses* (1818), on the disease states designated as bilious, nervous, etc.; *Observations on Blood-Letting* (1830); and *Experimental Essay on the Circulation of the Blood in the Capillary Vessels* (1831), in which he showed that the blood vessels intermediate between arteries and veins bring the blood into contact with the tissues. His most important work in physiology was concerned with the theory of reflex action, embodied in a paper "On the Reflex Function of the Medulla Oblongata and the Medulla Spinalis" (1832), supplemented in 1837 by another "On the True Spinal Marrow, and the Excito-Motor System of Nerves." He died at Brighton on May 11, 1857.

HALL, ROBERT (1764–1831), English Baptist clergyman and an outstanding preacher, was born on May 2, 1764, at Arnesby, near Leicester, where his father, Robert Hall (1728–91), was pastor of a Baptist congregation. Ending his studies at Aberdeen university he became classical tutor at the Baptist academy, Bristol. In 1790 he became pastor of a church at Cambridge, where he remained for 15 years and made a great reputation for his fine, often outspoken sermons. He advocated freedom of the press, was influenced by the French Revolution to speak against corrupt government and in 1791 supported the reformer and scientist Joseph Priestley against hostile public opinion.

HALL, a meeting place, entry, or passageway, ranging in size from a large reception room in a public building to a corridor or vestibule of a house. For the feudal society of medieval Europe, the hall was the centre of all secular activities. Originally it was used for cooking and sleeping by large groups of people, as well as for the activities it still shelters when it is used as courtroom, banquet room, or place of entertainment. Beginning as a rectangular, barnlike structure, the hall probably evolved from the prehistoric wood-framed tribal dwellings of northern Europe. Early examples had much in common with contemporary churches, employing a rhythmic structural system of three or more bays. The larger halls were divided by two rows of posts or stone columns into a nave and aisles. The rough stones of the fireplace were set near the centre of an earth floor strewn with an unsanitary layer of rushes to provide insulation. Smoke found its way out through the open roof framing at the gable ends or by means of a louver, near the centre of the ridgepole, protected by a wooden turret. The doors were opposite the end of the building reserved for the lord and his family. Eventually this area was distinguished by a low platform or dais, and a partial ceiling was brought forward the full width of the end wall behind it to form a canopy overhead. Dating from the 12th century, the remains of the bishop's palace at Hereford and the timber roof at Leicester castle are probably the oldest surviving fragments of gabled feudal halls.

FROM CHRISTOPHER HUSSEY'S "ENGLISH COUNTRY HOUSES OPEN TO THE PUBLIC" (1951). REPRODUCED BY PERMISSION OF COUNTRY LIFE, LTD., LONDON

INTERIOR OF THE GREAT HALL OF PENSHURST PLACE, KENT, ENGLAND; ABOUT 1341

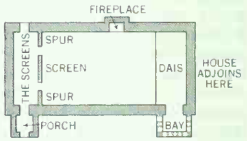
As a defense against marauders halls were placed to take advantage of terrain and were often protected by moats or palisades. In Norman castles and English border fortresses the hall was part of the principal stone tower, built over a vaulted storage room with wooden beams supporting rooms above. Until the 14th century the medieval town house consisted of an undivided all-purpose living room, or hall, over a street-level shop area. In the country the hall began to evolve into the manor house in the 13th century as smaller rooms were added at the ends of the great central space. A low structure was built against the end wall for cooking and storage of supplies.

FROM CHRISTOPHER HUSSEY'S "ENGLISH COUNTRY HOUSES OPEN TO THE PUBLIC" (1951). REPRODUCED BY PERMISSION OF COUNTRY LIFE, LTD., LONDON

RUFFORD OLD HALL, LANCASHIRE, ENG.; EARLY TUDOR

A centre door leading to the kitchen was flanked by the hatches or doors to the pantry and buttery. As the outside doors were placed opposite each other in the long walls at this end, a passageway was formed which was provided with porches and wooden screens to protect the rest of the hall from drafts. Behind the dais a two-story structure was annexed with a solar or private room over a storage basement accessible from it. The solar was entered from an outside ladder or stair and communicated with the hall by means of a window or peepholes. Later, more secure conditions and the desire for privacy and for more easily heated rooms led to the development of living quarters on the lower floor, with entrances directly into the hall. As the end structures were extended they were linked with scattered service buildings and the gatehouse to form courts on one or both of the long sides of the hall.

From the 14th century halls were built with uninterrupted interiors spanned by great timber roofs. The aisled type was retained only in monastic hospitals where it was convenient to continue to place beds in the side bays. At Westminster hall the Norman interior supports were removed and a hammerbeam roof (*q.v.*) installed. A series of halls in northwestern England retained only the pair of columns nearest the doors to support a great wooden arch and light wooden screen walls blocking the aisles. A large freestanding screen like that at Rufford Old hall provided further protection from drafts. But the typical 15th- or 16th-century hall was entered through doors in a screen structure that terminated in the ornamented parapet of a musicians' gallery installed over the low passageway ceiling. The large fireplace and its chimney were built into a side wall. The dais was extended at one or both ends to provide a large bay which from the exterior appeared to balance the porch. It had full-length mullioned windows supplementing the traditional openings high in the side or end walls. With the development of the separate dining room and the decline of the old social order at the end of the middle ages began the descent of the hall in domestic architecture to its present status of entrance and passageway. However, towns, guilds, colleges and other organizations built halls rivaling those of the barons. The names of many public buildings reflect the fact that a ceremonial reception room is their major feature.



FROM HUGH BRAUN, "AN INTRODUCTION TO ENGLISH MEDIAEVAL ARCHITECTURE" (1951); REPRODUCED BY PERMISSION OF FABER & FABER, LTD.

LATE MEDIEVAL BANQUET HALL

BIBLIOGRAPHY.—Hugh Braun, *An Introduction to English Mediaeval Architecture* (1951); Frederick H. Crossley, *Timber Building in England* (1951); Christopher Hussey, *English Country Houses Open to the Public* (1951). (S. W. J.)

HALLADJ, AL- (ABU AL-MUGHITH AL-HUSAIN IBN MANSUR IBN MAHAMMA AL-BAIDAWI, known in Persian, Turkish, Indian and Javanese literature by the abridged version of MANSUR) (*c.* 857–922), celebrated Muslim mystic and thinker, was born in Persia, at Tur, near Baida and Shiraz, but taught in Arabic. He led the adventurous, wandering life of a seeker for true knowledge and an apostle of religious unity of creed. He made the pilgrimage to Mecca three times and to Jerusalem once. In Baghdad he became the spiritual director of high functionaries at the Abbasid court, and later was prosecuted as an alleged follower of the revolutionary party of the Isma'ili Karmatians (*q.v.*). He was imprisoned for eight years between two trials and finally was condemned for

teaching the validity of "spiritual pilgrimage" to God, as to a friend inside the heart or as to the innermost true personality of man, summed up in the saying *Ana al-haqq* ("I am the Creative Truth"). He was executed in Baghdad on March 26, 922.

His excommunication by Muslim lawyers was never fully recognized, and he has been rehabilitated by independent thinkers such as Daylami, al-Ghazzali and Ibn 'Aqil, and by viziers in power, such as Ibn al-Muslima; and lauded by such prominent mystics as Kilani, Ruzbehan Baqli, Fakhr Farisi, Farid ud-din 'Attar and Jalal-ud-din Rumi. Al-Halladj seems to have been a *shuhudi* (believer in testimonial monism) rather than a *wujudi* (believer in existential monism, such as Ibn 'Arabi). According to Mohammed Iqbal (d. 1938), he was a kind of Promethean, or even Nietzschean, personality.

See L. Massignon (ed.), *Akhbar al-Hallaj*, 3rd ed. (1957). (Lo. M.)

HALLAM, the name of a family of Anglo-U.S. actors and theatrical managers associated with the beginnings of the professional theatre in America. LEWIS HALLAM (1714–1756) was sent to the American colonies by his brother, WILLIAM HALLAM, manager of a London theatre. With Lewis Hallam were his wife, MRS. SARAH HALLAM, and their son, LEWIS HALLAM (1740–1808). Their first appearance in the new world was at Williamsburg, Va., where, on Sept. 15, 1752, they presented *The Merchant of Venice*. This production marked the first appearance of a professional acting company in the American colonies. The following year they built the first theatre in New York city. After the elder Lewis Hallam died the company re-formed under David Douglass, whom Mrs. Hallam married. It was in this company that Lewis Hallam the younger first became a leading man. In 1775 the war forced them into temporary retirement in Jamaica. Ten years later the company returned under the leadership of Lewis Hallam, Mrs. Hallam having died and David Douglass having retired. For the next 25 years the younger Hallam managed and acted with various companies throughout the United States. He was an accomplished actor but was known as a quarrelsome manager. He died in Philadelphia in 1808. ISABELLA HALLAM (1746–1826), a daughter of the elder Lewis Hallam, was, as Mrs. Mattocks, a well-known actress in England. (S. W. H.)

HALLAM, HENRY (1777–1859), English historian, best known for his authoritative *Constitutional History of England* (1827), was born at Windsor, Berkshire, on July 9, 1777. He was educated at Eton and at Christ Church, Oxford, and after graduating in 1799 was called to the bar. The inheritance of an estate in Lincolnshire in 1812, and his appointment to the sinecure of commissioner of stamps enabled him to devote himself to historical study. His first important work, *The View of the State of Europe During the Middle Ages* (1818; supplementary notes, 1848), traces the history of France, Italy, Spain, Germany and the Greek and Saracenic empires and devotes chapters to the development of the feudal and ecclesiastical systems and the free political system of England. The *Constitutional History* covers the period from Henry VII's accession to that of George III and shows Hallam's wide knowledge and conscientious handling of evidence, but it is somewhat marred by his tacit assumption that the 19th-century theory of the Constitution was the right one for previous centuries. His *Introduction to the Literature of Europe During the 15th, 16th and 17th Centuries* (1837–39) shows a similar range and desire for accuracy. Hallam was rewarded by George IV in 1830 when, together with Washington Irving, he received a medal for historical eminence. Throughout his life he was a sincere Whig supporter and an advocate of the abolition of the slave trade. He died at Penshurst, Kent, on Jan. 21, 1859. His son, Arthur Henry Hallam (d. 1833) is the A.H.H. of Tennyson's *In Memoriam*.

HALLAM, ROBERT (d. 1417), bishop of Salisbury and English representative at the council of Constance, was educated at Oxford and was chancellor of the university from 1403 to 1405. In the latter year the pope nominated him to be archbishop of York, but the king objected. In 1407, however, he was consecrated by Gregory XII at Siena as bishop of Salisbury. At the council of Pisa in 1409 he was one of the English representatives. On June 6, 1411, Pope John XXIII made Hallam a cardinal, but there was some irregularity and his title was not recognized. At the council of Constance (*q.v.*), which met in Nov. 1414, Hallam was the chief English envoy. In the discussions that led up to the deposition of John XXIII he had a leading share. With the trials of John Huss and Jerome of Prague he had less concern. Under King Henry V's direction, he gave the emperor Sigismund vigorous support in the endeavour to secure a reform of the church, before the council proceeded to the election of a new pope. Hallam died suddenly, on Sept. 4, 1417.

HALLAND, a *län* (county) of southern Sweden, lies on the west of Småland and on the shores of the Kattegat. Pop. (1960) 170,060. Area 1,904 sq.mi. The *län* extends for 100 mi. north-to-south but does not reach inland more than 30 mi. It is crossed by the Viska, Ätra, Nissa and Laga rivers which, although short, descend sharply from the Småland plateau and were early exploited for hydroelectricity. The narrow coastal plain of fertile clays between granite outcrops is used by rail and road routes between Göteborg and Malmö. The county town, Halmstad, is the only centre with a population over 20,000, although Laholm, Falkenberg, Varberg and Kungsbacka all date back to medieval times. There are brick, tile and engineering works. The coast line is smooth with few anchorages. (A. D. O'D.)

HALLÉ, SIR CHARLES (originally CARL HALLE) (1819–1895), German-born English pianist and conductor, founder of the Hallé orchestra, was born at Hagen, Westphalia, on April 11, 1819. He studied at Darmstadt and in Paris, where he assumed the French form of his name and became friendly with Chopin, Liszt and Berlioz. He married Désirée Smith de Rilieu in 1841. In Paris he gave chamber concerts, but the revolution of 1848 drove him to England where he settled in Manchester, at first as a pianist and teacher. In 1850 he was appointed conductor of the Gentlemen's concerts and in 1858 he began to give regular concerts with the orchestra he had formed for the Art Treasures exhibition the previous year. This was the beginning of the famous Hallé orchestra, whose conductor he remained for the rest of his life. He also conducted opera and concerts in other cities and for many years gave piano recitals in London. In 1888 he was knighted and in the same year he married the Czech violinist Wilma Norman-Neruda (1839–1911). He was the first principal of the Royal Manchester College of Music, which was founded, largely through his efforts, in 1893. He died in Manchester on Oct. 25, 1895.

See C. E. and Marie Hallé, *Life and Letters of Sir Charles Hallé* (1896); C. Rigby, *Sir Charles Hallé* (1952). (H. RU.)

HALLE (known as HALLEANDER SAALE to distinguish it from the small town of Halle in North Rhine-Westphalia), a city of Germany which after partition of the nation following World War II was located in the German Democratic Republic. It is the chief town of a district (*Bezirk*) of the same name and lies 361 ft. above sea level in a sandy plain on the right bank of the Saale river, which there divides into several arms, 21 mi. N.W. from Leipzig. Pop. (1961 est.) 276,191.

Halle is first mentioned as a fortress erected on the Saale in 806. In 968 Halle, with its valuable saltworks, was given by the emperor Otto I to the newly founded archdiocese of Magdeburg, and in 981 Otto II gave it a charter as a town. From the first there were separate jurisdictions for the *Halloren* (or "salt-workers") and the German settlers in the town. The conflict of interests and jurisdictions led to the usual internecine strife during the middle ages, and both groups resisted the pretensions of the archbishops. In the 13th and 14th centuries Halle was a member of the Hanseatic league (*q.v.*). Its liberty perished, however, as a result of the internal feud between the democratic guilds and the patrician owners of the saltpans. In 1478 a demagogue member of the town council, with his confederates, opened the gates to the soldiers of the archbishop. The townsmen were subdued, and to hold them in check the archbishop built the castle of Moritzburg. Notwithstanding the efforts of the archbishops of Mainz and Magdeburg, the Reformation found an entrance into the city in 1522. After the peace of Westphalia in 1648 the city was passed to the house of Brandenburg.

Its situation at the junction of railway lines from Berlin, Breslau, Leipzig, Frankfurt am Main, the Harz country and Hanover has developed the commercial and industrial importance of Halle.

It consists of the old, inner town and two small towns, Glaucha in the south and Neumarkt in the north. The centre of the town is occupied by the market square, on which stand the medieval town hall (restored in 1883) and the Gothic Marienkirche, dating mainly from the 16th century, with two towers connected by a bridge. In the square is a bronze statue of Handel, the composer, a native of Halle. Among the churches the St. Moritzkirche, dating from the 14th century, with fine wood carvings and sculptures, and the cathedral (belonging since 1689 to the Reformed or Calvinist Church), built in the 16th century, are worthy of note. The castle of Moritzburg, formerly the residence of the archbishops of Magdeburg, was destroyed by fire in the Thirty Years' War, with the exception of one wing. The university was founded by the elector Frederick III of Brandenburg (afterward king of Prussia) in 1694, was closed by Napoleon in 1806 and again in 1813, but in 1815 was re-established and united with the University of Wittenberg. It has long been recognized as one of the principal seats of Protestant theology.

The industries of Halle include sugar refining, machine building, printing, dyeing and coal mining (soft brown coal) and the manufacture of spirits, malt, rubber, cement, paper, chicory and petroleum products.

During World War II Halle was taken by U.S. forces on April 19, 1945, after four days of street fighting, during which it suffered much damage. It was included in the Soviet occupation zone, prior to the establishment of the German Democratic Republic in 1949.

HALLECK, FITZ-GREENE (1790–1867), U.S. poet, was a leading member of the Knickerbocker group, and known both for his satirical and romantic verse. He was born at Guilford, Conn., July 8, 1790, and died there Nov. 19, 1867. He was an employee in various New York city banks, including that of John Jacob Astor. In collaboration with Joseph Rodman Drake he contributed the satirical "Croaker Papers" to the *New York Evening Post* in 1819, and on the death of his friend he wrote the moving tribute beginning "Green be the turf above thee." *Fanny* (1819), his longest poem, was a satire on social climbers. Other popular favourites were the feudal romance "Alnwick Castle" (1822), "Burns" (1822, publ. 1827), the often recited "Marco Bozzaris" (1823, publ. 1825), "Red Jacket" (1828) and "Young America" (1865). Strongly influenced by Scott and Byron, he was a poet of slight but genuine gift.

His *Life and Letters* by J. G. Wilson appeared in 1869. His *Poetical Writings* were edited by Wilson in the same year. *See* also N. F. Adkins, *Fitz-Greene Halleck* (1930).

HALLECK, HENRY WAGER (1815–1872), U.S. general and jurist, was born at Westernville, Oneida county, N.Y., in 1815. Upon graduation from the U.S. Military academy in 1839 he was commissioned in the engineers, and in 1844 he was sent by the government to visit the principal military establishments of Europe. After his return, Halleck delivered a course of lectures on the science of war, published in 1846 under the title *Elements of Military Art and Science*, a later edition of which was widely used as a textbook by volunteer officers during the American Civil War. On the outbreak of the Mexican War in 1846, he served with the expedition to California and the Pacific coast, acting for several years in California as a staff officer, and as secretary of state under the military government, and in 1849 he helped to frame the state constitution of California. In 1854 Captain Halleck resigned his commission and took up the practice of law with great success. On the outbreak of the Civil War he returned to the army as a major general, and in Nov. 1861 he was charged with the supreme command in the western theatre of war.

There can be no doubt that his administrative skill was mainly instrumental in bringing order out of chaos in the hurried formation of large volunteer armies in 1861, but the strategical and tactical successes of the following spring were due rather to the skill and activity of his subordinate generals, Grant, Buell and Pope, than to the plans of the supreme commander. In July, however, he was called to Washington as general in chief of the armies. At headquarters his administrative powers were conspicuous, but he proved to be utterly wanting in any large grasp of the military problem; the successive reverses of McClellan, Pope, Burnside and Hooker in Virginia were not infrequently traceable to the defects of the general in chief. In March 1864 Grant was appointed to replace him, Halleck becoming chief of staff at Washington. This post he occupied with credit until the end of the war. Halleck's position as a soldier is easily defined by his uniform success as an administrative official, his equally uniform want of success as an officer at the head of large armies in the field, and the popularity of his theoretical writings on war. While his interference with the dispositions of the commanders in the field was often disastrous, his services in organizing and instructing Union forces were of high value. He died at Louisville, Ky., Jan. 9, 1872.

Besides *Military Art and Science*, Halleck wrote *Bitumen, Its Varieties, Properties and Uses* (1841); *The Mining Laws of Spain and Mexico* (1859); *International Law* (1861; new ed., 1908); and *Treatise on International Law and the Laws of War, Prepared for the Use of Schools and Colleges*, abridged from the larger work. He translated Jomini, *Vie politique et militaire de Napoléon* (1864) and De Fooz, *On the Law of Mines* (1860).

HÄLLEFLINTA (a Swedish word meaning "rock flint"), a white, gray, yellow, greenish or pink fine-grained rock found in Scandinavia consisting of an intimate mixture of quartz and feldspar. Many examples are banded or striated; others contain porphyritic crystals of quartz which resemble those of the felsites and porphyries. Mica, iron oxides, apatite, zircon, epidote and hornblende may also be present in small amounts. The more micaceous varieties form transitions to granulite and gneiss. Hälleflinta under the microscope is very finely crystalline, or even cryptocrystalline, resembling the felsitic matrix of many acid rocks. It is essentially metamorphic and occurs with gneisses, schists and granulites, especially in the Scandinavian peninsula, where it is regarded as being very characteristic of certain horizons. Of its original nature there is some doubt, but its chemical composition and the occasional presence of porphyritic crystals indicate that it has affinities to the fine-grained acid intrusive rocks. In this group there may also have been placed metamorphosed acid tuffs and a certain number of adinoles (shales, contact-altered by intrusions of dolerite). The assemblage is not a perfectly homogeneous one and includes both igneous and sedimentary rocks, but the former preponderate. Rocks very similar to the typical Swedish hälleflintas occur in the Tirol, Galicia and eastern Bohemia.

HALLEL, a Jewish liturgical term designating Ps. cxiii–cxviii, as read in synagogue services on festive occasions. The theme is faith in and gratitude for divine providence. These hymns or psalms were recited by the Levites in the services of the Jerusalem Temple, probably with the refrain "Hallelujah" ("Praise ye the Lord"). Later the term meant Ps. cxxxvi, used in the daily morning service. In modern times the Hallel is often recited in English antiphonally.

See S. Singer and I. Abrahams, *The Authorised Daily Prayer Book* (1922).

HALLER, ALBRECHT VON (1708–1777), Swiss anatomist and physiologist, notable for, among many other contributions, his conceptions of the nature of living substance and of the action of the nervous system, was born at Bern on Oct. 16, 1708. Prevented by ill-health from joining in sports, he developed an amazing precocity. He studied medicine at Tübingen under Camerarius, and then at Leiden under Boerhaave and Albinus, graduating in 1727 with a thesis that proved the so-called salivary duct to be merely a blood vessel. After visiting London, Oxford and Paris, in 1728 he went to Basel, where the awakening of his interest in botany led him to begin a collection of plants which was afterward the basis of his great work on Swiss vegetation. About the same time he wrote his poem "Die Alpen," included in the first edition of his *Gedichte* (1732).

In 1730 Haller began to practise as a physician in Bern, but the fame of his botanical and anatomical researches led to his appointment, in 1736, to the chair of medicine, anatomy, surgery and botany in the newly founded University of Göttingen. He held this post for 17 years, conducting at the same time a monthly journal (the *Göttingische gelehrte Anzeiger*), to which he is said to have contributed about 12,000 articles on almost every branch of knowledge. In 1753 Haller resigned his chair and returned to Bern,

where he prepared his *Bibliotheca medica,* the botanical, surgical and anatomical parts of which he lived to complete; wrote three philosophical romances, *Usong* (1771), *Alfred* (1773) and *Fabius and Cato* (1774), expounding his views on various types of government; produced among other medical works, the justly famed *Elementa physiologiae corporis humani* (1757–66); and fulfilled various municipal and state duties. Haller died in Bern on Dec. 12, 1777.

Among Haller's most important contributions to medicine may be named his recognition of the mechanism of respiration and the automatism of the heart; his admission of the use of bile in the digestion of fat; his descriptions of the development of the embryo; his work on the anatomy of the organs of generation, of the brain, of the heart and of many imperfectly known arteries; and above all his classification of the bodily parts as sensible and insensible, irritable and nonirritable, together with his noteworthy demonstration that sensibility and irritability are independent, the former being a property of tissues endowed with nerves, the latter a peculiarity of all muscular tissue, independent of the nerves proceeding to it and surviving in severed parts.

Apart from the works mentioned above, Haller's chief writings are *Enumeratio methodica stirpium Helveticarum* (1742); *Icones anatomicae* (1743–54); *Disp. anatomicae Selectiores* (1746–52); *De respiratione experimenta anatomica* (1747); *Opuscula botanica* (1749); *Opuscula pathologica* (1754); an edition of Boerhaave's *Artis medicae principia* (1769); and *Disp. chirurg. collectio* (1777).

See J. G. Zimmermann, *Das Leben des Herrn von Haller* (1755); and the detailed biography in L. Hirzel's edition of the *Gedichte* (1882).

HALLEY, EDMUND (1656–1742), English astronomer who observed the comet of 1682 now called by his name, was born in London on Oct. 29, 1656, and was educated at St. Paul's school, London, and at Queen's college, Oxford. His first paper, concerning planetary orbits, was published in the *Philosophical Transactions* of the Royal society in 1676. He formed a friendship with John Flamsteed, who had been appointed astronomer royal in the preceding year, and was often in his company, helping him and Robert Hooke to design and construct the Greenwich observatory. Halley also assisted Flamsteed in his observations. Influenced by Flamsteed's great project of forming an accurate catalogue of northern stars, Halley proposed to do the same in the south, and obtaining an introduction, through Charles II, to the East India company, he left Oxford without a degree in Nov. 1676, and sailed to St. Helena in a ship of that company. At St. Helena he catalogued more than 300 stars, observed a transit of Mercury (Nov. 7, 1677) and made numerous pendulum observations. He also named a new constellation, Robur Carolinum, in honour of Charles II, but this is no longer recognized by celestial cartographers.

Upon his return to England in 1678 he was granted the degree of M. A. by the University of Oxford and began a friendship with Sir Isaac Newton, which resulted in his publication, at his own expense, of Newton's *Principia.* This work's debt to Halley was well expressed by Augustus De Morgan: ". . . but for him, in all human probability, that work would not have been thought of, nor when thought of written, nor when written printed." Halley calculated the orbit of the comet of 1682, and his correct prediction of its return in 1758 was the first application of Newton's laws of motion.

His work on comets involved the calculation of orbits for all those for which sufficient observations existed, and, as well as making the important discovery that some comets are periodic, he noticed that their orbital planes are distributed at random, in sharp distinction to those of the planets. Under instructions from the admiralty he commanded the war sloop "Paramour Pink" from 1698 to 1700 on the first sea voyage undertaken for purely scientific purposes and again in 1701 during a survey of tides in the English channel. In 1703 Halley was appointed Savilian professor of geometry at Oxford and in 1720 he succeeded John Flamsteed as astronomer royal. Although then in his 64th year, he undertook to observe the moon through an entire revolution of its nodes (18 years), and actually carried out his purpose. Halley also detected the proper motions of the stars (1718), the acceleration of the moon's mean motion (1693) and the long inequality of Jupiter and Saturn. He indicated first in 1679 and again in 1716 a method extensively used in the 18th and 19th centuries for determining the solar parallax by means of the transits of Venus. He died at Greenwich on Jan. 14, 1742.

As an observational astronomer Halley was much inferior to Flamsteed and his astronomical observations remained largely unreduced and unpublished. His genius lay in discussing large bodies of data and reducing them to some kind of order. His *Breslau Table of Mortality,* published in 1693, is one of the first attempts to found tables of annuities on a basis of fact. He was the originator of graphical methods of representing on maps the geographical distribution of the physical features of the earth; the first meteorological chart appeared in 1688 and the first magnetic chart in 1701. The magnetic charts, constructed from all available observations augmented with many of his own made in England and on sea voyages, were of great practical value and were used for many years after his death.

Halley's principal works are *Catalogus stellarum Australium* (1679), the substance of which was embodied in the third volume of Flamsteed's *Historia coelestis* (1725); *Synopsis astronomiae cometicae* (Eng. trans., *A Synopsis of the Astronomy of Comets,* 1705); *Astronomical Tables* (1752); and 81 papers scattered through the *Philosophical Transactions* of the Royal society. To these should be added an edition of the *De sectione rationis* (1706) and the *Libri conicorum* of Apollonius of Perga (1710). Two books of the *De sectione rationis* and three of the *Libri conicorum* were known only in Arabic and Halley, after learning this language for the purpose and with some help from an Arabic scholar, produced a translation including a restitution of some passages in which the Arabic text was corrupt. One lost book was restored from a summary given by Pappus and from references to it elsewhere in Apollonius. Halley also edited an unauthorized version of Flamsteed's *Historia coelestis* in 1712.

See also references under "Halley, Edmund" in the Index volume.

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HALLGRÍMSSON, JÓNAS (1807–1845), one of the greatest and most popular poets of Iceland, was born on Nov. 16, 1807, at Hraun in Öxnadalur in the north of the country. He began his education at the school of Bessastadir, near Reykjavík, from which he graduated to the University of Copenhagen in 1829. He first studied law and afterward turned to science and literature. Hallgrímsson returned to Iceland in 1837 and engaged in scientific research in the island with the support of the Danish government until 1842. He then returned to Copenhagen, to remain in Denmark until his death on May 26, 1845.

Valuable as was Hallgrímsson's work as a scientist, he is remembered chiefly as a poet. His poetry is predominantly lyrical, and he excels in descriptions of Icelandic scenery. He greatly admired the romantic poets, especially Heinrich Heine, and adapted and translated much foreign poetry into Icelandic. Hallgrímsson's interest in romantic poetry led him to revolt against and criticize the *rímur,* narrative poems in traditional, artificial form, composed in stereotyped metres and phrases, which had long been popular in Iceland. He strove to purify and to simplify the language of poetry as Wordsworth did in England. Hallgrímsson's poetry is filled with patriotism and with a love of nature, and some of it was inspired by stories of ancient Icelandic heroes as well as by the *Edda* and other medieval poetry.

Much of Hallgrímsson's poetry was published in the periodical *Fjölnir,* which he, together with other Icelandic students, founded in Copenhagen in 1835. He was also the author of critical works and of short stories in prose, some of which were published in *Fjölnir* after his death.

See the complete works of Hallgrímsson, published under the title *Rit,* 5 vol. (1929–36); also Richard Beck, *History of Icelandic Poets, 1800–1940* (1950). (G. T.-P.)

HALLMARK is a series of symbols stamped on an article of gold or silver to denote that it conforms to one of the legal standards. These standards define the maximum proportion of base metals which may be alloyed with pure gold or silver for hardening or other purposes. The presence of a hallmark on an article indicates that it has been sampled and tested at an authorized assay office. Most articles are required by law to be hallmarked before sale, although there are certain exemptions (*e.g.*, gold rings other than mourning or wedding rings).

Hallmarking in Great Britain dates from the reign of Edward I. A statute of 1300 provided that no gold or silver should be sold until tested by the "Gardiens of the Craft" and struck with the leopard's head. The London Guild of Goldsmiths (later the Worshipful Company of Goldsmiths) has since that date been responsible for the assay and marking of plate in London. The word hallmark means literally a mark applied at Goldsmiths' hall. There are now also assay offices at Birmingham, Chester, Sheffield, Edinburgh and Glasgow. (J. S. Fs.)

In the United States, there are no hallmarks on silver or gold objects, since there is no history of guild or government regulation comparable to that of Great Britain. Local regulatory practices were established in New York, Boston, Mass., Baltimore, Md., and elsewhere in the late 18th and early 19th centuries, but no consistent system of symbols was adopted. Maker's marks appear, usually consisting of the initials or name of the maker. Beginning in the early 19th century the words coin (900 parts fine silver to 100 parts alloy) and sterling (925 parts fine silver to 75 parts copper) were stamped on silver objects and in 1906 the use of the words became subject to federal regulation. The purity of gold is given in carats, pure gold being 24 carats; its marking is also subject to federal regulation. (X.)

MARKS ON SILVER

The history of the symbols making up a complete hallmark on modern silver (fig. 1) is as follows.

Town or Assay Office Mark.—The leopard's head, first known as the king's mark, indicated that a silver article was of sterling standard; *i.e.*, containing at least 92.5% fine silver. When the lion passant was introduced as the standard mark (*see* below), the leopard's head was retained as the London town mark. In 1478 a crown was added (*see* fig. 2); but since 1821 the head has remained uncrowned. Provincial offices, when subsequently recognized, had their own distinctive town marks (fig. 3).

Maker's Mark.—This was introduced by a statute of 1363. At first a device was used, examples being a fish, a key or a fleur-de-lis, often taken no doubt from the sign outside the goldsmith's shop. Gradually, it became the practice for the maker to use the initials of his Christian and surnames, either alone or in conjunction with a device.

In 1697, when the Britannia standard was introduced (*see* below), the adoption of the first two letters of the maker's surname was made compulsory. The previous form of mark was revived in 1720 when the sterling standard was restored. The new mark, however, was struck on articles made in the Britannia standard. In 1739 a statute ordered all silversmiths to substitute for their two existing forms of mark a single one with the initials of their Christian and surnames in new characters.

Manufacturers are obliged to register their marks at the assay office to which they submit their wares. The original significance of the maker's mark has been lost to some extent by the occasional use of the registered mark of the subsequent retailer in place of that of the manufacturer.

Date Letter.—The assaying of plate was entrusted to one of the wardens of the London Goldsmiths' company, who held office for one year. It is probable that it was in order to identify the warden responsible for assaying a particular ware that an alphabetical date-letter system was introduced (fig. 4). Such a system is known to have existed as early as 1478. The letter was changed annually and, on completion of one alphabet, the character of the letters or the shape of the surrounding shield was altered. This practice has been adopted by all British assay offices. The London office uses the alphabet from A to U omitting the J and changes the date letter each May. At the Birmingham, Sheffield and Chester offices, the alphabets selected are of 25 letters; the change is made each July.

The date letter denotes the year of assay and marking, not necessarily that of manufacture, although in most cases these are the same. Occasionally an old ware which has not been previously submitted is sent to be marked so that it can be sold legally.

Standard Mark or Marks.—*Sterling Standard.*—The lion passant (fig. 5[A]) was introduced in 1544 and is used by all the English offices to denote that a silver article is of the sterling standard. At Edinburgh the sterling standard mark is a thistle and at Glasgow a thistle and a lion rampant (fig. 5[B]).

Britannia Standard.—In 1697 the standard of wrought plate was compulsorily raised to 95.84%. This step was taken to prevent silversmiths from melting coins for their raw material. The figure of Britannia and a lion's head erased replaced the lion passant and leopard's head respectively on silver of this standard which was known as Britannia or New Sterling. The higher silver content resulted in a softening of the alloy. Consequently, it proved to be not entirely suitable for domestic plate and in 1720 the old standard was restored together with the former marks. Articles which are made occasionally in the higher standard are struck with the Britannia marks (fig. 5[C]). For this standard the English provincial offices use their normal town marks in conjunction with the figure of Britannia. The Edinburgh and Glasgow offices include the lion's head erased with the figure of Britannia and their own town marks.

Additional Marks.—The following are sometimes found on silver.

Duty Mark.—From 1784 a duty imposed on plate was collected by the assay offices on behalf of the commissioners of customs and excise. To signify that the duty had been paid, a mark consisting of the sovereign's head in profile was struck in addition to the usual symbols. The duty was finally abolished in 1890 (in 1798 in respect of watchcases), the mark then becoming obsolete. Silver of this period therefore normally bears the head of one of the following: George III (fig. 6[A]), George IV, William IV, Victoria (fig. 6[B]).

Silver Jubilee Mark.—A special mark of the crowned heads of King George V and Queen Mary was authorized in 1935 to commemorate their silver jubilee (fig. 6[C]). This was not a compulsory mark but was struck by the assay offices at the manufacturer's request on silverware made in 1933, 1934 and 1935.

Coronation Mark.—A special voluntary mark was authorized by Queen Elizabeth II to commemorate her coronation (fig. 6[D]). It represented the crowned head of the sovereign and was struck on wares bearing the date letter for 1952–53 or 1953–54.

MARKS ON GOLD

The fineness of gold alloys is usually expressed in carats, pure gold being 24 carats. The legal standards for gold plate prior to 1798 were as follows: 1300–1477, 19½ carats (80% gold); 1477–1575, 18 carats (75%); 1575–1798, 22 carats (91.66%). The hallmarks used were identical to those on silver. An act of 1798 authorized an additional standard of 18 carats which was marked with a crown and the figure 18. The lion passant continued to be struck on 22-carat gold until 1844 when a crown and the figure 22 were substituted. At Edinburgh a thistle and at Glasgow a thistle and a lion rampant take the place of the crown.

In 1854 lower standards of 15, 12 and 9 carats (62.5%, 50% and 37.5% gold) were permitted. The prescribed marks were the carat figure and its decimal equivalent. In 1932 the 15- and 12-carat standards were abolished in favour of one of 14 carats (58.5%). (*See* fig. 7.)

The maker's mark and town mark on gold wares are the same as for sterling silver except that a York rose replaces the crown at the Sheffield office. The date letter is frequently surrounded by a shield of a different design.

The duty and coronation marks are also to be found on gold.

PROVINCIAL, SCOTTISH AND IRISH MARKS

Provincial.—Under a statute of 1423, York, Newcastle, Lin-

A B C D

FIG. 1.—EXAMPLES OF HALLMARKS ON MODERN SILVER: (A) MAKER'S MARK; (B) TOWN MARK; (C) STANDARD MARK; (D) DATE LETTER

FIG. 2.—LEOPARD'S HEAD (LONDON)

FIG. 4.—DATE LETTER (BIRMINGHAM, 1952-53)

A B C

FIG. 5.—(A) EARLY FORM OF LION PASSANT; (B) STERLING STANDARD MARKS (GLASGOW); (C) MODERN BRITANNIA MARKS (LONDON)

A B C D

FIG. 6.—(A) DUTY MARK (GEORGE III); (B) DUTY MARK (VICTORIA); (C) SILVER JUBILEE MARK (GEORGE V AND MARY); (D) CORONATION MARK (ELIZABETH II)

ASSAY OFFICE	TOWN MARK
LONDON	LEOPARD'S HEAD (ON STERLING SILVER)
	LION'S HEAD ERASED (ON BRITANNIA SILVER)
BIRMINGHAM	ANCHOR
CHESTER	THREE WHEAT SHEAVES AND A SWORD (CITY ARMS)
SHEFFIELD	CROWN
EDINBURGH	CASTLE
GLASGOW	TREE, BIRD, BELL, FISH AND RING (CITY ARMS)

FIG. 3.—MODERN TOWN MARKS FOR SILVERWARE OF BRITISH MANUFACTURE

CARAT	PER CENT GOLD	STANDARD MARKS	ASSAY OFFICES
22	91.66	22	LONDON, BIRMINGHAM, CHESTER, SHEFFIELD
		22	EDINBURGH
		22	GLASGOW
18	75.0	18	LONDON, BIRMINGHAM, CHESTER, SHEFFIELD
		18	EDINBURGH
		18	GLASGOW
14	58.5	14 ·585	LONDON, BIRMINGHAM, CHESTER, SHEFFIELD, EDINBURGH, GLASGOW
9	37.5	9 ·375	

FIG. 7.—STANDARD MARKS FOR GOLD WARES IN GREAT BRITAIN

ASSAY OFFICE	TOWN MARK
LONDON	SIGN OF THE CONSTELLATION LEO
BIRMINGHAM	EQUILATERAL TRIANGLE
CHESTER	ACORN AND TWO LEAVES
SHEFFIELD	SIGN OF THE CONSTELLATION LIBRA
EDINBURGH	ST. ANDREW'S CROSS
GLASGOW	DOUBLE BLOCK LETTER F INVERTED

FIG. 8.—SPECIAL TOWN MARKS FOR FOREIGN WARES IMPORTED BY GREAT BRITAIN

EXAMPLES OF BRITISH HALLMARKS FOR GOLD AND SILVER WARES

coln, Norwich, Bristol, Salisbury and Coventry were allowed to assay and mark plate, although there is no evidence that this was ever carried out in the last two cities. Assay offices existed, however, at Chester, York, Exeter and Newcastle in the 18th and 19th centuries. Offices in Birmingham and Sheffield were opened in 1773, the responsible bodies being "The Guardians of the Standard of Wrought Plate in Birmingham" and "The Guardians of Wrought Plate within the Town of Sheffield."

Marks have been found on antique silver which have been ascribed to other provincial towns; *e.g.*, Barnstaple, Hill, Plymouth and Taunton. Although such pieces are sometimes of great interest, their marks were probably not applied by any recognized office.

Scottish.—An act of 1457 provided for the election in Edinburgh of a deacon to be responsible for controlling the standard. The marks of the maker and deacon were to be stamped on all gold and silver plate. The town mark for Edinburgh, a castle, was added in 1485. In 1681, after a date-letter system had been introduced, the deacon's mark was replaced by the initials of the assay master. This was discontinued in 1759 with the introduction of the thistle as the mark to denote the standard. Plate has been marked in Glasgow since the 17th century but it is improbable that an authorized assay office was established there before 1819. Marks occasionally found on Scottish silver have been attributed to Aberdeen, Arbroath, Dundee, Greenock, Wick, etc.

Irish.—At Dublin a charter of 1637 prescribed a crowned harp mark indicating the standard and a maker's mark. A date letter was also used. These marks became statutory in 1729. The date letter, however, is often missing on Dublin marked silver of the 18th century and an act of 1729 provided primarily for a duty on gold and silver. A further mark consisting of the figure of Hibernia was struck to denote that duty had been paid. In 1807, after the union with Great Britain, the mark of the sovereign's head was added. It was discontinued in 1890 when the plate duty was abolished. The figure of Hibernia has been retained.

The symbols used on gold are the figure of Hibernia, the date letter and the following standard marks: 22 carats, crowned harp; 20 carats, plume of feathers; 18 carats, unicorn's head; 14 carats, "14.585"; 9 carats, "9.375." Irish marks applied after 1922 are not recognized in the U.K.

MARKS ON IMPORTED WARES

Many countries outside the United Kingdom have a system of plate marks but these are not legally recognized in the U.K. Imported foreign wares were first required to be hallmarked by the Customs act, 1842. The importer's mark replaced the maker's mark. The same marks were in use until 1867 when a capital letter F was added. In 1904 distinctive marks were authorized for imported wares (fig. 8). The standard marks consist of the decimal equivalent in the case of silver and the carat figure followed by the decimal equivalent in the case of gold. By the Hall-marking of Foreign Plate act, 1939, wares manufactured abroad more than 100 years before being imported or being sold in the U.K. are exempted from assay and marking.

HALLMARKING PRACTICE AND LAW

Assay Office Procedure.—Manufacturers normally send their wares to an assay office complete except for final polishing. Representative scrapings are taken from every article and accurately assayed by chemical methods. Articles which pass are stamped with the appropriate symbols of the hallmark, but any which are below the lowest standard are required by law to be broken before being returned to the manufacturer. An exception is made in the case of a substandard foreign ware. The importer or owner has the option of exporting such a ware within one month. (*See* Assaying.)

Hallmarking Offenses.—Forgery of hallmarks is a felony. On conviction an offender is liable to a maximum penalty of 14 years' imprisonment. Transposition of hallmarks from one ware to another is likewise a felony as is the sale, with guilty knowledge, of wares bearing forged or transposed marks. Where an addition or alteration to a hallmarked article is intended the law requires that it shall be submitted again to an assay office. Additions of base metal are not allowed, nor is it permitted to add gold or silver of a lower standard than the original ware.

The sale or offering for sale or export of a ware that has not been hallmarked, unless it has been specifically exempted, is an offense, the penalty for which is a fine. Foreign wares, if imported by a dealer, must be hallmarked at the time of entry into the country by arrangement with the customs authorities. The obligation is waived in the case of a private person who makes a statutory declaration that he does not intend to sell such wares.

See also Silver and Gold Work; Sheffield Plate.

(J. S. Fs.)

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HALL OF FAME. The Hall of Fame for great Americans, which honours U.S. citizens who have achieved lasting distinction or fame, stands at the summit of University Heights on the uptown campus of New York university. (For the National Baseball Hall of Fame at Cooperstown, N.Y., *see* Baseball.) A national shrine, the open-air colonnade looks down on the northern limits of New York city, and stands high over the Hudson and Harlem river valleys, facing the New Jersey Palisades. The Greco-Roman colonnade, designed by the architect Stanford White, is a semicircular granite corridor, 630 ft. long and a little over 10 ft. wide. In its original design it was an architectural foreground for the three university buildings which it half encircles—the Hall of Philosophy, the Gould Memorial library and the Hall of Languages. Bronze portrait busts of men and women who have left indelible marks on the history and culture of the United States are placed, facing each other, between the simple columns. Below each bust is a recessed tablet which commemorates the person honoured.

The founder of the Hall of Fame was Henry Mitchell MacCracken, chancellor of the university when the campus was being created in the 1890s. Chancellor MacCracken enlisted the interest of Helen Miller Gould Shepard, who, in memory of her father, Jay Gould, had already provided funds for the erection of the Gould Memorial library and a dormitory (Gould hall); with her aid the Hall of Fame was established in 1900. It does not restrict its posthumous honour to any one class; it includes persons of achievement in many fields. Writing at the time of the dedication ceremonies in 1901, MacCracken said, "The Hall of Fame will teach youth that leaders in science and scholarship may be as great as military and naval heroes." He said he had in mind a monument that "would overrule sectional and partisan outcry." Among this distinguished group are Washington, Lincoln, Jackson and other U.S. presidents, Henry Clay and Daniel Webster, Henry Ward Beecher, and Booker T. Washington. The busts of Robert E. Lee and Ulysses S. Grant stand side by side in the colonnade.

New York university, through its senate body (the chief administration and the deans of the colleges), acts as trustee of the Hall for the nation. The choices are entirely in the hands of the electoral college, made up of approximately 100 men and women from every state in the union, and from every field of endeavour. The electors, many of whom may one day be elected to the shrine themselves, are appointed by the director and are ratified by the university senate. Presidents Grover Cleveland, Theodore Roosevelt, Woodrow Wilson, and the educator Alice Freeman Palmer were electors honoured posthumously by election to the Hall.

Any man or woman who was a citizen of the United States, native or acquired, who made his home in the United States, and who has been deceased 25 years or more is eligible for election. Nominations open to the public on April 1 preceding an election year, and close on April 1 of the election year. Elections are held every five years (1955, 1960, 1965, etc.). No more than seven persons may be elected at any given time. Election to the Hall is achieved by a majority count of the electors voting. The results

are usually announced publicly on Nov. 1 of the election year. Formal unveiling ceremonies, with active civic and national participation, are held for each of the persons elected. The cost of the ceremony, and of the bronze likeness and the memorial tablet, is borne by interested individuals or associations dedicated to memorializing the person honoured.

U.S. portrait sculptors are invited to submit photographs of their work to the director for consideration by the Hall of Fame Art committee before a commission for a bronze bust is granted. Sculptors represented by original works in the colonnade include Daniel Chester French (Nathaniel Hawthorne), James Earle Fraser (Augustus Saint-Gaudens), Chester Beach (Walt Whitman), Frederick MacMonnies (James A. Whistler), Richmond Barthé (Booker T. Washington) and Malvina Hoffman (Thomas Paine).

There is no mortuary suggestion either in the architecture of the Hall or in its operation. It serves many who seek primarily to familiarize themselves with the great men and women of the country. To guard against any melancholy thought, a former director, Robert Underwood Johnson, placed over the wrought-iron gates at the northern entrance of the colonnade the words, "Enter with joy that those within have lived," and over the gates at the southern entrance, "Take counsel here of beauty, wisdom, power."

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(R. W. So.)

HALLOWEEN (in medieval times ALL HALLOWS), kept on Oct. 31, the eve of All Saints' day (*see* ALL SAINTS, FESTIVAL OF), was the Celtic festival at the end of summer named Samhain, in contrast with May day (Beltane; *q.v.*), the festival at the beginning of summer, these marking the two main seasons of the Celtic year. Oct. 31 was also the eve of the new year in both Celtic and Anglo-Saxon times and one of the ancient fire festivals. It was connected with the return of herds from pasture, and its importance is indicated by the renewal of laws and land tenures, the rekindling of fire for the coming year, the practice of divinations and its association with the dead, whose souls were supposed to revisit their homes on this day. Since November ushers in the darkest and most barren half of the year, the autumnal festival acquired sinister significance, with ghosts, witches, hobgoblins, fairies and demons of all kinds roaming abroad.

The Celtic festival was primarily a pastoral observance, but, as agriculture was frequently combined with herding, some of the rites associated with the harvest home and the killing of the corn spirit at the reaping of the last sheaf found a place in Samhain. Thus, the crops as well as the flocks and herds had to be protected from demonic influences that were rife at the turn of the year. It was the time to placate the supernatural powers controlling the processes of nature. Coupled with this were fire rites, divinations, funerary practices and masquerades, partly serious and partly frivolous in their later development as Halloween passed into the realm of folk observances. In Scotland traces of an expiatory sacrificial rite have survived in the case of both Halloween and the Beltane fires.

In addition, Halloween was thought to be the most favourable opportunity for divinations concerning marriage, luck, health and death, differing in manner in the various parts of Britain. It was the only day on which the help of the devil was invoked for such purposes. In Scotland young people assembled for games to ascertain which of them would marry during the year, and in what order the marriages would occur. Even the name, occupation and hair colour of the future spouse were determined. Sometimes resort was made in secret to a barn, where a sieve or winnowing fan was used to perform the action of winnowing corn. After repeating this three times the apparition of the future husband or wife was supposed to pass through the barn. Young women sowed hemp seed on plowed land at midnight on Halloween, repeating the formula, "Hemp seed I sow, who will my husband be, let him come and mow." Looking over her left shoulder she might see the figure of the future spouse. Apples and a sixpence were put into a tub of water, and he who succeeded in extracting either of them with his mouth without using his teeth, or in pinning one of the apples with a fork, was destined to have a lucky year. Most of the numerous Halloween divinations in connection with apples, originally of sacred and symbolic significance, have become games played by children. In the north of England Oct. 31 is observed as "mischief night" marked by tiresome tricks with no serious underlying purpose, meaning or history.

Immigrants to the United States, particularly the Irish, introduced secular Halloween customs that became popular in the late 19th century. Mischief making on this occasion by boys and young men took such forms as overturning sheds and outhouses and breaking windows, and damage to property was sometimes severe. In later years the occasion has come to be observed mainly by small children, who go from house to house demanding "trick or treat"; the treat is generally forthcoming and the trick rarely played. The common symbol of Halloween, the jack-o'-lantern (the name is probably derived from that for a night watchman), is a hollowed-out pumpkin carved in the appearance of a demonic face and with a lighted candle inside. In Scotland a turnip was used for the jack-o'-lantern, but the native pumpkin was soon substituted in the United States.

By contrast with these frivolous customs, it was on Halloween that the general assembly, or open-air parliament (*Freig*), was held at Tara in Celtic Ireland, celebrated once in every three years with special solemnities lasting for two weeks. At it the laws were renewed and the annals and genealogies written up. The proceedings opened with sacrifices to the gods at Tlachtgha in County Meath, the victims being consumed by fire. All household fires had to be extinguished on that night and rekindled from the fire of Tlachtgha, a tax being extracted for each fire lighted in this manner. In the Isle of Man all tenures had to be renewed on Nov. 1, called Hogunnas, and at the law courts in London an ancient rent service, dating from about the 13th century, has survived in the custom by which the city solicitor, as the agent of the corporation of London, renders to the queen's remembrancer a token rent for a piece of land called the Moors in Shropshire, and for a tenement known as the Forge in the parish of St. Clement Danes in London.

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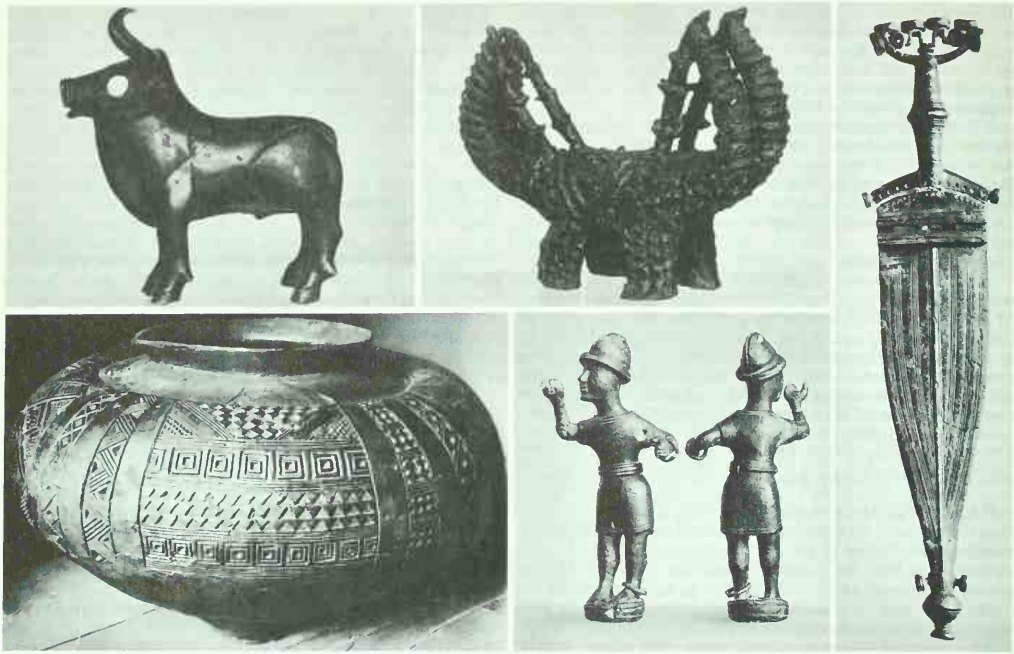
(E. O. J.)

HALLSTATT, a term used generally to designate the Early Iron Age in central and western Europe, derives its name from the famous prehistoric cemetery and salt mine at Hallstatt in upper Austria. This place is not the cradle of the earliest Iron Age culture but the site where objects characteristic of it were first identified. There, between 1846 and 1899, more than 2,000 graves were found. The majority fall into two groups, an earlier (*c.* 1100/1000 to *c.* 800/700 B.C.) and a later (*c.* 800/700 to 450 B.C.). Hallstatt became an important settlement in the first Iron Age. Both cremation and inhumation were practised, the latter slightly preponderating. The cremation graves are on the whole the richer and, viewed in the mass, contain older objects than the inhumation burials, but this should not be pressed too strictly, for the two rites overlapped chronologically. Most of the types of grave furniture are found elsewhere in phase C and D burials (*see* below), but objects of a peculiar character occur as well. The pottery unearthed by the earlier excavators was practically all destroyed. Nearby lies the prehistoric salt mine where salt was extensively obtained. A number of shafts were sunk, often to a considerable depth, sometimes at a steep angle. Because of the preservative nature of the salt, their implements, parts of their clothing and even (at Hallein as well as at Hallstatt) the bodies of the miners themselves have come to light.

Typology and Art.—P. Reinecke divided the Hallstatt period into four phases, A, B, C, D, equating the first of these with the period of the urnfield culture. C. Schumacher regarded the latter as comprising the last phase of the Bronze and the first of the Iron Ages. Others have held that Hallstatt A and B are in reality the latest Bronze Age and that the Iron Age did not begin until Hallstatt C, while others regard it as the last period of the Bronze Age. The fourfold division is adhered to in the following account.

Phase A.—Iron, though known, is rare, but Villanovan influences



BY COURTESY OF (TOP LEFT, TOP CENTRE, BOTTOM CENTRE) NATURHISTORISCHES MUSEUM, PRAHISTORISCHE ABTEILUNG, VIENNA; (RIGHT, BOTTOM LEFT) WÜRTTEMBERGISCHES LANDESMUSEUM, STUTTGART

HALLSTATT PERIOD OBJECTS, 7TH–5TH CENTURY B.C.

(TOP LEFT) BRONZE BULL FROM BYCISKALA, MORAVIA, HEIGHT 3 IN.; (TOP CENTRE) CLAY VOTIVE FUNERARY ANDIRON FROM SOPRON, HUNG., LENGTH 11¾ IN.; (RIGHT) BRONZE DAGGER AND SHEATH; (BOTTOM LEFT) POTTERY VESSEL, HEIGHT 5½ IN.; (BOTTOM CENTRE) BRONZE WARRIOR, HEIGHT 3⅛ IN.

are already apparent. The rite is cremation in cemeteries of flat graves (or under very low mounds). The pottery in southwest Germany is thin walled, of various forms, some betraying strong metallic influence. The large urns often contain a number of smaller vessels. Farther east (Stillfried, Mariarast, etc.) the Silesian influence (Lusatian B) is noticeable in much of the pottery. Among the metal objects are: antennae, Ronzano and other bronze swords; razors and knives; compound fibulae and, in the east, harp and simple bow brooches; torques; pins; and the so-called "Old Italian" bronze vessels: cups, vessels with "sun boat and swans," etc.

Phase B.—This phase, if it can be said to have a general chronological significance, is marked by the reassertion of the old Bronze Age population of southwest Germany over the comparatively newly come urnfield peoples. It is confined to the more western regions. The tumulus again becomes common; cremation is the usual rite. The pottery (sometimes polychrome) is extremely well made and of various forms. The urns are often globular in body and with funnel-shaped necks and influenced by Hallstatt A and older Bronze Age forms. The chief metal objects which have been found are the slender bronze Hallstatt sword with winged or slightly scrolled chapes and the vase-headed pin.

Phase C.—Iron is first in general use. The rite is mixed; the tumulus prevails. The pottery is both polychrome and unpainted (often with polished graphite slip). In the west the urns are more onion-shaped than in phase B; the Bronze Age chip carving (Kerbschnitt) reappears. In the east (Moravia, eastern Austria, etc.), where the culture of D is not represented, this phase probably lasted longer. The urns (graphite or polychrome) often have high conical necks; the so-called "moon idols," their horns often ending in beasts' heads, are very characteristic. Among the many metal types are: long, heavy iron and bronze swords with beautifully scrolled chapes; the winged Hallstatt axe; long bronze girdle mounts with *repoussé* ornamentation; various types of pins; fibulae, rare in the west (spiral spectacle and half-moon brooches), and in the east, these and other types; bronze vessels (broadly ribbed bucket and other types); chariot-and-horse-harness—among the latter, the pointed tutulus, a type which occurs in the warrior's tomb at Corneto and gives a synchronism with Italy.

Phase D.—Not represented in eastern Austria, etc., but lasts until the appearance of the La Tène (*q.v.*) period in other areas. The tumulus prevails; the rite is mostly inhumation. The pottery, which is not common, degenerates; the urns are derived from C forms but are less crisp in profile. Among the metal objects are: the dagger-sword (sometimes one-edged) with "horseshoe" or antennae hilt; pins are rare, brooches common (the drum, cup and the later variants of the bow and serpentine fibulae); a variety of ring ornaments: ear-, neck-, arm- and footrings; girdle mounts, shorter than in C, sometimes in pierced work; bronze vessels, among them the narrowly ribbed bucket and, in upper Italy and the Veneto-Illyrian zone, situlae with figured motifs in friezes, stylized scenes from everyday life. Early archaic Greek vessels appear in the west, Pertuis, Grachwyl, etc. Amber occurs in C and D, gold mostly in D; ivory, lignite, jet and coral are not unknown, the last being found in D.

Hallstatt art, with the exception of the Veneto-Illyrian situla style, is severely geometric in feeling; the advances made were on technical rather than aesthetic lines. It reveals indirect connections with the Greek Dipylon art, but developments of older Bronze Age elements are more prominent. There is a general tendency toward the extravagant, the baroque. The Greek orientalizing influence is hardly felt. Even the figural motifs are geometric in feeling as is shown by urns from Oedenburg and many of the girdle mounts; these are mainly confined to the Austrian area. The typical bird motif, probably derived from Italy, may perhaps be traced back to late Helladic times in Greece. Plant

patterns are very rare and strongly stylized (Urmitz). Among the other motifs are lozenges, triangles, concentric circles, arcs, chevrons, "garlands," herringbone groups of parallel lines (sometimes grooved) and occasionally the swastika, triskele and meander, etc. Contrasts in colour and the breaking up of smooth surfaces were in favour. The arrangement of figures in pairs is very characteristic. In phase C pottery are found designs grouped in a circular field around a star or cross or arranged in bands. Generally speaking, the arrangement consists in mechanical repetitions and a rigid regard for symmetry, rather than in the treatment of the design as an organic whole. Compared with the art of the northern Bronze Age or of the La Tène period, the Hallstatt style is lifeless and sterile. *See* also ARCHAEOLOGY: *The Iron Age in Europe;* EUROPE: *Archaeology.*

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(J. M. DE N.; X.)

HALLUCINATION is a psychological term for the perception of objects with no reality or the experiencing of sensations in the absence of the usual cause. In effect, a hallucination is a perception within or of a person's fantasy that is mistakenly ascribed, by the person who experiences it, to sources outside. Hallucination must be distinguished from illusion, which is the misinterpretation of actual stimulation of the sense receptors. The commonest hallucinations are auditory (including voices, mutterings, laughter, cries, bells, shots, etc.) and visual (which may be of everyday persons, animals, objects, scenes, or something strange, unearthly and horrible). Hallucinations of smell, taste, movement or of the visceral and cutaneous senses are not uncommon; hallucinations of several kinds may be experienced simultaneously.

Hallucinations are common and normal in ordinary dreaming and on going to sleep or waking up (hypnagogic and hypnopompic hallucinations, respectively). They may also appear during periods of deep preoccupation or great fatigue and are facilitated by profound emotion or urgent need. Under conditions of excitement, fear, ecstasy or tense anticipation, many persons report seeing and hearing things they would otherwise correctly identify as coming from their own fantasies. The content of hallucinatory experience is determined in substantial part by and is dynamically related to the person's personality organization, ideas, needs and fears. Hallucinations among persons with delusions are nearly always supportive of and in keeping with the delusions.

Hallucinations appear as symptoms in certain disorders of the central nervous system (*e.g.,* delirium tremens) and in psychosis (*e.g.,* the schizophrenias), and can be produced by certain hallucinogenic (or psychotomimetic) drugs (*see* NEUROPHARMACOLOGY AND PSYCHOPHARMACOLOGY). The organized perceptual experiences produced by electrical or other stimulation of the temporal lobe of the brain resemble hallucinations in that the normal external stimuli are missing but differ in that the subject usually recognizes their unreality. (H. F. HT.)

HALM, FRIEDRICH: *see* MUNCH-BELLINGHAUSEN, ELIGIUS FRANZ JOSEPH, FREIHERR VON.

HALMAHERA ("motherland"; also DJAILOLO), an island of Indonesia in the administrative district of Ternate, Maluku Utara (North Moluccas), lies just below the equator and about 128° E. It consists of four peninsulas enclosing three great bays: Kau (northeast), Buli (east) and Weda (southeast). Its total area is 7,565 sq.mi. In 1954 its population was about 54,000. The northern peninsula is connected with the others by an isthmus, only 5 mi. wide, on the western side of which lies Dodinga bay. In the mouth of this bay are the two islands Ternate and Tidore (*qq.v.*), whose political importance exceeds that of the larger island. Of the four peninsulas of Halmahera the northern and the southern are reckoned to the sultanate of Ternate, the northeastern and southeastern to that of Tidore; the former has 11, the latter 3 districts. The four peninsulas are traversed in the direction of their longitudinal axes by mountain chains 3,000 to 5,000 ft. high, covered with forests rich in a great variety of trees. The mountain chains, from which spurs extend to the coast, are frequently interrupted by plains. The western and northern parts of the mountain chain of the northern peninsula are volcanic, the volcanoes continuing the line of those of Makian, Moti, Ternate and Tidore. Two volcanoes along this western coast are active and one, GamKonora (5,364 ft.), is active on the north. Coral formations on heights in the interior would indicate oscillations of the land in several periods, but a detailed geology of the island is wanting. There are numerous small rivers and several lakes, and near Weda is a beautiful stalactite grotto. Halmahera is the largest island of the Ternate group of the Moluccas (*q.v.*).

The ancient indigenous population, collectively Alfur (*q.v.*), appears to have been Papuan but there has been much admixture with Malay peoples, especially in the coastal areas. The inhabitants of the interior are tall and well built with dark brown skin and blue-black wavy hair, worn long by both men and women. Their religious practices are animistic. They live mostly by hunting, fishing and extraction of sago from the palm groves in the marshy valleys. The native languages in the southern part of the island belong to the Malay-Polynesian group, with linguistic affinities to western New Guinea; the languages of the northern part (including Ternate, Tidore and Morotai) form a group by themselves, which cannot satisfactorily be related to any other linguistic stock. The traditional house type in northern Halmahera is octagonal in shape, in contrast to the rectangular form of the Malay house. The village consists of one-family houses grouped around a square, in the middle of which is the temple. Head-hunting was common in the past.

The coastal peoples include many elements from surrounding islands. Their economic level is not much higher than that of the interior tribes, although they cultivate rice on temporary forest clearings and grow coconuts. Many men lead a roving life of fishing, including trepang and pearl shells, collecting of forest produce such as wild nutmeg, dammar gum and rattan, or hunting deer, wild pigs or plumed birds, often far beyond the home island. They are easygoing folk, with little interest in material well-being beyond the bare necessities of life. Islam and Christianity (Protestant missions) have converted part of the population, at least nominally. But the relations with the spirits of the dead still mold the thoughts and actions of the living and no task is undertaken without communicating with the ancestors.

The chief town is Patani (Gamsungi) with about 3,000 inhabitants in 1956, and other ports are Galela, Tobelo, Kau and Weda and Wajabula in Morotai. Galela is a considerable settlement, situated on a bay of the same name on the northeast coast in a well-cultivated plain which extends southward and inland.

About 11 mi. N.E. of the northern peninsula is the considerable island of Morotai (268 sq.mi.), which is more than 50 mi. long and from 13 to 26 mi. wide, with mountains reaching 4,100 ft. (the Sabatai range) and several rivers. There are some Muslims and Christians among its population which numbered about 10,000 in 1954. During World War II Morotai was a military base for the Japanese; later captured by the Allied forces it was developed into an important air base. To the west of the southern peninsula lie the island of Batjan (*q.v.*) and other islands.

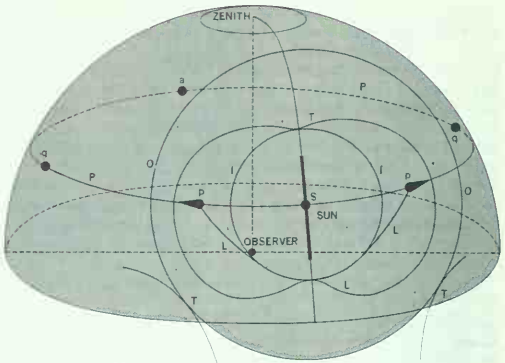
The Portuguese and Spaniards were better acquainted with Halmahera than with many other parts of the archipelago; they sometimes called it Batu Tjina, and sometimes Moro. It was circumnavigated by one of their vessels in 1525. The name (Djailolo) was really that of a native state, the sultan of which had the chief rank among the princes of the Moluccas before he was supplanted by the sultan of Ternate about 1380. His capital, Djailolo, lay on the west coast on the first bay to the north of that of Dodinga. The Dutch obtained a footing in Halmahera with the aid of their ally, the sultan of Ternate, and when they severed relations with this chief in 1683 the lands in Halmahera under the suzerainty of Ternate came under Dutch influence. By their treaty of 1660 with the sultan of Tidore, they became overlords of all Tidorese fiefs

and this opened up to them that part of Halmahera under Tidorese influence. In 1876 Danu Hassan, a descendant of the sultans of Djailolo, raised an insurrection in the island against the authority of the sultans of Tidore and Ternate and would probably have been successful but for the intervention of the Dutch. The Moluccas were captured by the British in 1810 and given back in 1814 to the Dutch, who transferred sovereignty to the Republic of Indonesia in 1949. (J. O. M. B.)

HALMSTAD, a seaport of southwestern Sweden, chief town of the *län* (county) of Halland, on the eastern shore of the Kattegat, 123 km. (76 mi.) S.S.E. of Göteborg. Pop. (1960) 39,064. The town lies at the mouth of the Nissa river, with a harbour and roads giving safe anchorage. There are modern public buildings, such as the town hall, and most have been decorated by the Halmstad school of surrealist painters. The centre of the town has several old buildings, including wood-beamed houses from the 17th century. The castle is the residence of the *län* governor. In the main town square stands the sculptor Carl Milles' fountain "Europa and the Bull." There are many pleasant parks and a large area of preserved natural forest (the Gallows Hill). Railways run to Göteborg, Nässjö and Malmö. A daily car ferry connects with Aarhus in Denmark and there are air services to Stockholm. Tylösand, about 5 mi. W., is a popular seaside resort with modern hotels and a fine golf course. The chief industries of Halmstad are engineering, brewing, and the manufacture of cloth, felt and other textiles and leatherware. There are ironworks, foundries, brickworks and paper and cardboard factories. The principal exports are timber, wood pulp, paper, machines, corn and iron ore. The imports are coal and oil, pig iron, scrap iron, limestone and farming implements. Smoked Halmstad salmon is a speciality. The oldest town privileges date from 1307 and Halmstad appears to have been frequently chosen as the meeting place of the rulers and delegates of the three northern kingdoms. The fortifications are mentioned first in 1225 and parts of them are still preserved. The town within the walls was destroyed by fire in 1619. Until 1658, when it was ceded to Sweden, the *län* was Danish territory. (I. Rh.)

HALO, a luminous circle or a segment of a circle with the sun or moon in its centre caused by ice crystals in the atmosphere and produced by the refraction or reflection of light rays striking or passing through the crystals. Halos of well-developed form are rare except in higher latitudes and in polar regions, where they attain great brilliance and considerable complexity, being accompanied by small coloured arcs or luminous columns or pillars. The similar phenomenon caused by diffraction by water or ice particles generally is referred to as a corona.

Parts of Halo.—The phenomenon of a halo as seen from the ground is represented schematically in the figure. The fundamental features of a halo are two circles surrounding the centre of illumination (S), the "inner" halo (I) and the "outer" halo (O), having radii of about 22° and 46°, respectively. Their inner contour is sharp and shows a distinct red tint. The spectral sequence of colours fades rapidly toward the outer, diffuse edge of the circle. Passing through the centre (S) and parallel to the horizon, a luminous white ring, the parhelic circle (P), can occasionally be seen with a number of bright coloured spots that are the images of the sun or moon (p). Of these images the most pronounced are situated at the intersections of the inner halo and the parhelic circle and are known as parhelia (mock suns or sun dogs) or as paraselenae (mock moons). They are quite brilliant when the sun is on the horizon. Their inner edges, directed toward the sun, are red, the outer edges are blue and they are extended into an arc. For higher sun elevation they retain the same elevation as the sun, but their angular distances from the sun increase up to 45° for the sun elevation of 60°. Their angular width, as well as their brilliance, decreases with increasing sun elevation. The parhelia at the intersection of the outer halo and the parhelic circle are seen only on rare occasions. Other images on the parhelic circle are the paranthelia (q) and the anthelion (a). Paranthelia are situated 90°–140° from the sun on the parhelic circle while the anthelion is located at the antisolar point as a patch of white light often exceeding in size the apparent diameter of the sun.



FROM G. DIETZE "EINFÜHRUNG IN DIE OPTIK DER ATMOSPHÄRE"

HALO AND RELATED PHENOMENA AS PROJECTED ON THE SKIES BY THE OBSERVER (IN THE CENTRE OF THE SPHERE). (AFTER G. DIETZE)

Among other features occasionally observed are two different types of arcs. "Arcs of Lowitz" are two convex arcs (L in the figure) tangential to the inner halo, named after J. T. Lowitz, who first described these phenomena in 1794. Similar arcs can be seen as tangential to the visible upper and lower parts of inner and outer halos (T in the figure). On some occasions the arcs tangential to the inner halo seem to be prolonged and, for higher sun elevation, joined to give the appearance of a luminous closed curve.

Conditions of Formation.—The first step to a proper explanation of the halo and related phenomena was that of René Descartes who ascribed their formation to the effect of ice crystals. His explanation was pursued further by Henry Cavendish, Thomas Young, J. G. Galle and A. Bravais; Bravais demonstrated the general validity of the theory in his classical treatise about the halos published in the *Journal de l'École royale polytechnique* (1847).

The fundamental form of ice crystals in high level clouds (cirrostratus) or of those floating in lower levels in sub-zero weather is a hexagonal prism, either elongated as a needle or flattened like a thin plate. The rays of the sun or moon penetrate the crystals under three main refracting angles: 120° between two adjacent faces, 60° between two alternate faces and 90° between the prism face and the base. If a myriad of such crystals falls in any manner between the sun and observer, there will always be some prisms whose alternate faces are traversed by the sun's rays and these rays will be refracted. The deviation of the refracted rays from the incident direction depends on the angle of incidence. Among the large number of crystals occur crystal faces with all possible orientations and hence the refracted rays will fill up the range between the minimum and maximum deviation for 60° refracting angle. The rays will be crowded close to the minimum deviation and there will be no refracted rays between the minimum deviation and the sun. Furthermore, the minimum deviation increases for shorter wave lengths, being smallest for the red light (22°). All the refracted rays will then form a circle, with sharp inner boundary of a red tint. In this way Edmé Mariotte, 17th-century physicist, explained the characteristic feature of the inner halo. Cavendish similarly explained the existence of the outer halo as the consequence of refraction under 90° refracting angle; the minimum deviation in this case is 46°.

For the occurrence of these two halos no special arrangement of ice crystals is necessary. The circular shape of the halo indicates indeed all possible orientations of the symmetry axes of the prisms or plates. Nevertheless, certain arrangements of the ice crystals will predominate, for they will tend to fall with the axis so oriented as to offer the least resistance to their motion—a prolongated prism tending to keep its axis vertical, a plate-shaped crystal to keep its axis horizontal. If the axes of prolongated prisms are vertical and the sun is at the horizon, the refraction of the sun's rays by the alternate faces will produce the sun image at the same elevation as

the sun, at an angular distance between the minimum and maximum deviation corresponding to the refracting angle of 60°. In this way the origin of parhelia and their characteristic features are explained. If the axes of the crystals deviate slightly from the vertical direction, the images of the sun will be moved from the parhelic circle, producing the arcs of Lowitz. When the sun's rays traverse the alternate faces of thin plates with their axes in a horizontal direction, a similar phenomenon will be produced, but above and below the sun. With all possible orientations of the horizontal axes of thin plates, a continuous series of parhelia will form the tangential arcs of the inner halo. The tangential arcs to the outer halo are due to the refraction through the faces inclined at 90°; these arcs are more brilliant than those at the inner halo.

Some of the features described above and indicated in the figure can be explained as due to the reflection of the sun's rays either externally or internally from the faces or bases of the prism. Young explained the parhelic circle as caused by the reflection from the vertical faces of the long prisms and from the bases of the short ones. Reflections from the faces or bases slightly deviated from a horizontal position will produce a vertical pillar through the sun (*see* figure) observed on rare occasions. All features due to the reflection can be distinguished from those due to the refraction; they appear white, without the colouring always present with refraction. The paranthelia (q) and the anthelion (a) may be explained as being caused by two internal or two external reflections. The paranthelia will appear when the reflecting faces are inclined at 120°. Double internal reflection by an equilateral triangular prism would produce a single coloured image on the parhelic circle about 98° from the sun. The anthelion can be explained as being caused by two internal reflections of solar rays by a hexagonal prism of ice having its axis horizontal and one of the diagonals of its base vertical. The emerging rays are then parallel to their original direction and form a light spot on the parhelic circle opposite the sun. With the more complicated structure of the ice crystals other rare forms of halo may be produced.

Systematic observations of halos for 22 years (in the Netherlands) indicate the inner halo as the most frequent (in 209 days in a year at the average); the next are parhelia (71) and the tangential arcs to the inner halo (59). (Z. S.)

HALOGENS, a term applied to the chemical elements fluorine, chlorine, bromine and iodine because of the great similarity of their sodium salts to ordinary sea salt (Gr. *hals,* "salt," and *gen,* "to produce"). These four elements show a great resemblance to one another in their general chemical behaviour and in that of their compounds, while their physical properties show a gradual transition. Some of the properties of the halogens are tabulated below.

Some Properties of the Halogens

Name	Fluorine	Chlorine	Bromine	Iodine
Symbol	F	Cl	Br	I
Atomic number	9	17	35	53
Atomic weight	18.9984	35.453	79.909	126.9044
State at 70° F.	gas	gas	liquid	solid
Boiling point °C.	−188	−34.7	58	183
Colour of gas	light yellow	green-yellow	red	violet
Electron affinity (Electron volts)	3.58	3.75	3.53	3.22

The halogens constitute main Group VII of the periodic system. Their atoms, having seven valence electrons, all readily combine with an additional electron to form a stable negative ion having a completed octet. The electron affinity given in the table is a measure, in electron volts, of the tendency for this reaction to occur with the atoms of the gaseous element. Fluorine is the most reactive (the best oxidizing agent) and iodine the least (*see* OXIDATION AND REDUCTION). Fluorides are formed with the greatest evolution of energy and are the most stable. Conversely, fluorine is prepared in the free state with the greatest difficulty and iodine with the least.

In the elementary state the halogens exist as diatomic molecules, the sharing of electrons by a pair of atoms satisfying in part their electron affinities. The binary compounds of the halogens, except their oxides, are known as halides. The halides of the metals are solid saltlike substances and with a few exceptions, notably among the fluorides, soluble in water. The halide ions are colourless. The hydrogen halides are colourless gases, very soluble in water, forming strongly acid solutions. The halides of nonmetallic elements are volatile, reactive and generally decomposed by water.

In alkaline media the halogens, with the exception of fluorine, may be readily oxidized, the maximum state of oxidation being plus seven. While the oxygen-containing salts are fairly stable, the corresponding acids are not. The relative activity of the halogens in the oxidized state is reversed from that for the reduced state as halide ions. For example, chlorine will displace elementary iodine when added to potassium iodide solution, but iodine will displace chlorine from potassium chlorate, forming the more stable potassium iodate. That is, of the halide ions, iodide is the best reducing agent, and of the halogenates, chlorate is the best oxidizing agent.

A number of compounds have been made by direct combination of two halogens. Their formulas and melting points (° C.) are: IF_7 (5°), IF_5 (9.6°), ICl (two forms α 27.2°, β 13.9°), ICl_3 (101°), IBr (36°), BrF_5 (−61.3°), BrF_3 (9°), BrF (−33°), BrCl (−66°), ClF_3 (−83°) and ClF (−156°).

Element 85, or astatine (At), is a member of the halogen family but only short-lived radioactive isotopes are known. For additional information about astatine as well as other members of the halogen family *see* individual articles on each element.

See also references under "Halogens" in the Index volume. (R. P. S.)

HALOGETON, the generic and common name for a poisonous annual weed belonging to the goosefoot family (Chenopodiaceae), native to southwestern Siberia and northwestern China. *Halogeton glomeratus,* introduced into Nevada about 1930, has since spread widely in the northwestern U.S. It is confined to semidesert, salty lands, primarily in disturbed areas such as abandoned fields, abused ranges and roadsides.

Halogeton, with reddish stems, varies from a few inches to two feet tall. The bluish-green leaves, sausage-shaped and bearing a hairlike spine at the tip, are very high in water content. The true flowers are inconspicuous, but the very abundant seeds bear five winglike, whitish bracts; after midsummer the plant is a mass of these showy flowerlike seeds.

The high oxalate content of halogeton (the dried plants have 5%–25% of the salt) makes it poisonous to sheep and cattle. The lethal dose for a hungry sheep is two thirds of a pound of plants containing 10% oxalates, consumed at one time. Fortunately, animals do not eat the plant in quantity when other forage is available, so poisoning has been less frequent than might be expected. A few sensational losses of sheep have been recorded, however.

Ranges with large amounts of halogeton ordinarily can be safely grazed if herders avoid concentrating their livestock on pure stands. The halogeton problem can be solved by good range management and by preventing too-heavy grazing. If grazing is kept light, native perennial plants tend to crowd out most of the invading halogeton. Elimination of the weed by spraying is feasible only in small areas.

See L. M. Burge and J. L. O'Harra, "Halogeton in Nevada—Animal Poisoning and Control Studies," *Nev. St. Dept. Agric. Bull.* 4 (1952); H. L. Morton and others, "Halogeton and its Control," *Idaho Agric. Exp. Sta. Bull.* 307 (1959). (L. A. St.)

HALOPHYTES, a general name used in botany to denote plants growing in alkali soils, salt marshes and similar environments with a high salt content; examples are greasewood and saltbush. Such plants often show adaptations for conservation of water. *See* PLANTS AND PLANT SCIENCE: *Plant Ecology.*

HALS, FRANS (*c.* 1580–1666), celebrated Dutch painter of portraits and groups, to whom, of all the Dutch school, only Rembrandt unquestionably and Vermeer more doubtfully may be considered superior by reason of their profounder spiritual or intellectual qualities. The originality of Hals rests largely in technique, and as a manipulator of oil paint he has few rivals in his own or any other age. Belonging to the first generation of the great era

of Dutch art, he lived into the period when symptoms of decline were beginning to appear among the most literally "popular" painters in the form of glossy finish and laboured, imitative technique. Hals was not a successful artist in the material sense, but he remained true to his instincts and, contrary to the wide current of Dutch painting, his style grew steadily looser, fresher and more spontaneous.

Hals's place of birth is credibly supposed to have been Antwerp, but the date is not certain. According to A. Houbraken, he was 85 or 86 when he died, which places his birth in 1580 or 1581; another early source states that he died aged "ninety, or not much less," while N. S. Trivas in the best modern monograph on the painter suggests that he was born "about 1585." The family moved to Haarlem while Frans was still a child, and it was in Haarlem that he lived and worked throughout his recorded life, but the question of where and under what masters he received his early training remains open. One tradition says that he studied in Haarlem under Karel van Mander, another that he was a pupil of Adam van Noort in Antwerp. Both may be true. His known work shows no trace of Van Mander, but it does show marks of Flemish style, in particular of the bravura of Rubens, whom he could conceivably have met in Van Noort's studio.

About 1608 Hals married Annetje Harmensdr, who died in 1615, and in 1617 he took as his second wife Lysbeth Reyniers, who outlived him. The number of his children varies in the accounts of different authorities, but it was certainly very large. Seven sons followed him in the career of painting, though not all of them are now known by identifiable works. The expense of supporting a huge family, aggravated by his own habits, which were irregular to say the least, can explain in part the poverty in which much of his long life was spent, but the fact remains that, in spite of occasional commissions for civic portraits, he was never a fashionable or highly paid artist, and his patronage was virtually confined to Haarlem. The records of his name in the city archives are mainly concerned with the succession of financial difficulties and disasters that beset him, and with measures taken to relieve or redeem his erring children. In 1662 he was granted a small pension, and in the winter of 1663–64 he was further provided by the city with three cartloads of fuel. He died on Aug. 29, 1666, and was buried in the Groote Kerk.

No work of Hals's youth has been identified. The earliest dated picture is the "Banquet of Officers of the St. Joris-Doelen" ("Civic Guard of St. George") of 1616, and on evidence of style a few portraits can be assigned to about the same date, such as "Nurse and Child" (Berlin) and "Man Holding a Skull" (Barber institute, Birmingham, Eng.). These are mature works, confident and crisp in handling, and in the "Banquet" Hals displays already his astonishing ability to give his heads the animation of fleeting yet characteristic expressions. His faces are never masks. By a swift collaboration of eye and hand he captures the momentary movements of expression about the eyes and mouth as his sitters smile or turn to speak to each other or to the spectator. Though his portraits seldom display the deep human understanding of Rembrandt, there are none that "live" more vividly on the canvas than his. There are no landscapes, still lifes, genre or historical subjects in Hals's work. His lifelong preoccupation was with living humanity. Burgher or beggar, his subject is set before us in the fullness of life, with no overtone of social or moral comment, no philosophy beyond the simple one that life is good. The painter's own zest for life is evident in the freedom and audacity of his brushwork, while the typical mood of his sitters ranges from confident good humour to downright merriment. Most of his pictures are single portraits of respectable Haarlem citizens, but there are also character studies of laughing children (his own) and of ragged but exuberant tavern society.

His most solid achievements are the eight large group portraits which hang in the Frans Halsmuseum, and no true idea of Hals's stature as a painter can be formed without seeing them. The first of these, the "Banquet" already referred to, shows understanding of contemporary baroque composition in its swinging diagonals through the rows of heads and the banner. Its colour is fresh and masterly, a harmony of black and white, enlivened by the red and orange of sashes and banner. Similar, but less interesting in design, is the "Banquet of Officers of the Cluveniers-Doelen" ("Civic Guard of St. Andrew") of 1623–24. In 1627 Hals painted a second "Banquet of Officers of the St. Joris-Doelen," in which one may admire an increasing freedom and vivacity of brushstroke while regretting an increasing carelessness in formal design. More thought is apparent in the composition of the "Meeting of Officers of the Cluveniers-Doelen" (1633), in which the open-air background was possibly painted by another hand.

The last and most formal of the civic guard groups is again of "Officers of the St. Joris-Doelen" (1639), and includes a self-portrait of Hals, who is to be seen second from the left in the rear rank. The fine seated group of "Governors of the St. Elisabeth Hospital" (1641) shows Hals at the height of his powers and is only excelled in its kind by Rembrandt's "Syndics," which it may have influenced. A gradual progression from bright colour to a more monochrome treatment can be traced in these pictures, culminating in the last two groups that Hals painted. These, both of 1664, are respectively of the "Men Governors" and the "Lady-Governors of the Old Men's Home at Haarlem." In both there is a moving quality in the presentation of character that the earlier pictures lacked, and the technique also attains a peak in which passion mingles with dexterity to move the spectator. The "Men Governors" suffers like many an earlier work from slipshod composition, but the "Lady-Governors" has no such fault. Firmly designed and marvelously handled, it is the crowning masterpiece of Hals's erratic career.

The single portraits show a parallel development toward more monochrome colouring and looser handling. Their quality becomes uneven in the later years, looseness sometimes degenerating into incoherence. Good examples are: the inaptly nicknamed "Laughing Cavalier" (1624, Wallace collection, London); "Portrait of a Man" (dated 1633, National gallery, London); "Man holding a Watch" (1643, Barnes foundation, Merion, Pa.); the portraits in Antwerp of "Stephanus Geraerdts" and his wife "Isabella Coymans" (about 1650–52); and the "Man in a Big Hat" (about 1661–64, Cassel). Of the character pieces, most of which belong to his earlier period, one may pick out "Malle Babbe, the Haarlem Witch" (Berlin) and the so-called "Gipsy Girl" (Louvre, Paris), both of about 1628.

Of Hals's pupils and followers in Haarlem the most talented was Judith Leyster, whose pictures are often confused with his.

Dirck Hals (1591–1656), younger brother of Frans Hals the elder, was born in Haarlem. He was principally a painter of festive genre scenes, of which the earlier examples, such as "Cavaliers and Ladies at Table" (1626, National gallery), have the naïve elegance seen also in W. Buytewech and W. C. Duyster. Some of the later ones aspire (less successfully) to the more polished grace of G. Terborch.

Of the sons of Frans Hals: Harmen Hals (1611–1669) was a genre painter of the school of A. Brouwer and A. van Ostade;

BY COURTESY OF FRANS HALSMUSEUM

"LADY-GOVERNORS OF THE OLD MEN'S HOME AT HAARLEM" BY FRANS HALS. IN THE FRANS HALSMUSEUM, HAARLEM, THE NETHERLANDS

FRANS HALS, THE YOUNGER (*c.* 1620–1669), imitated his father and others with little subtlety (in "Malle Babbe and the Smoker," at Dresden, one figure is borrowed from Frans the elder, the other from Brouwer); REYNIER HALS (1627?–1671) is represented by genre pictures of moderate quality in the Frans Halsmuseum; CLAES HALS (1628–1686) was a more varied artist, and his few known landscapes in the Ruisdael manner, such as "Village Street" (Ashmolean museum, Oxford), show considerable talent.

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(R. E. W. J.)

HALSBURY, HARDINGE STANLEY GIFFARD, 1ST EARL OF (1823–1921), English lord chancellor remarkable for his grasp of legal principles and for his mastery in applying them, was born in London on Sept. 3, 1823. Educated at Merton college, Oxford, he was called to the bar at the Inner Temple in 1850, subsequently working at the central criminal court and at the Middlesex sessions. He became queen's counsel and a bencher of the Inner Temple in 1865. Giffard had twice unsuccessfully contested Cardiff as a Conservative candidate for parliament when he was appointed solicitor general by Disraeli in 1875 and knighted. From 1877, however, he represented Launceston, until he was created Baron Halsbury and appointed lord chancellor in 1885. Halsbury held this post continuously from 1886 to 1892, and again from 1895 to 1905. In 1898 he was created earl of Halsbury and Viscount Tiverton and became the leader of the group of Conservative "die-hard" peers who resisted to the end the abridgement of the powers of the house of lords embodied in the Parliament act of 1911. The digest famous as *Halsbury's Laws of England* was produced under his direction between 1905 and 1916. Halsbury died in London on Dec. 11, 1921. (W. T. Ws.)

HALSEY, WILLIAM FREDERICK (1882–1959), U.S. naval officer and commander of the 3rd fleet, operating in the Pacific area, during World War II, was born in Elizabeth, N.J., Oct. 30, 1882, the son of a naval officer, and graduated from the United States Naval academy in 1904. He became a naval aviator May 15, 1935, was promoted to rear admiral in 1938, to vice-admiral in 1940 and to admiral in 1942. After commanding aircraft of the Pacific fleet, Halsey became commander of the South Pacific force and the South Pacific area on Oct. 19, 1942. Naval task groups under his command defeated the Japanese in the battle of Santa Cruz Islands, Oct. 26, 1942; the naval battle of Guadalcanal, Nov. 12–15, 1942; and in a series of lesser fights. He became commander of the 3rd fleet on June 15, 1944, and led his carrier task forces in brilliant air strikes. In the battle for Leyte gulf his fleet sank four Japanese carriers and a battleship. He led the U.S. forces in the final naval operations of the war around Okinawa, from May 28 to the Japanese surrender on Sept. 2, 1945. Halsey was promoted to the rank of fleet admiral on Dec. 12, 1945, and retired in 1947. He died on Aug. 16, 1959. (J. B. Hn.)

HÄLSINGBORG (HELSINGBORG), a seaport of southern Sweden in the *län* (county) of Malmöhus at the narrowest part of the Sound opposite the Danish town Elsinore. Pop. (1960) 76,504. The town's picturesque situation has given it the name "the Pearl of the Sound." Opposite the central harbour lie the North German Gothic town hall (1897) and the main square with the equestrian statue of Magnus Stenbock, the famous Swedish field marshal (*c.* 1665–1717). On a hill above the town is the keep (kärnan) of the medieval castle. The principal thoroughfare, Drottninggatan, contains the concert hall, built (1931) in strikingly modern style, and in the town centre is St. Mary's church, a Gothic brick building with traces of an older sandstone church. There are also a theatre, a museum, an art gallery (Vikingsberg) and an open-air museum (Fredriksdal), as well as several parks and salt-water baths. The royal summer residence (Soñero castle) is situated to the north of the town. The modern indoor sports centre is one of the biggest stadiums of Sweden. Railways run to Stockholm, Göteborg and Malmö. The town is the most convenient crossing place for motor traffic to enter Sweden, Norway and Finland, the ferry across the Sound taking only 20 min. Hälsingborg is a major manufacturing town of Sweden. It has copper, india-rubber and superphosphate works, a pharmaceutical industry, factories for electric motors, generators and transformers, chemical industries and a shipyard with two dry docks. The depth of the new harbour is 37 ft.

The town occupies the third position among the shipping centres of Sweden, with exports of wood, paper, iron ore, briquettes, chemical products and minerals. Imports include coal, coke, mineral oils, sulfur ore, machines and automobiles. Hälsingborg was first mentioned as a town in 1085. With its strong fortress, it was of great military and political importance during the middle ages. All fortifications, except the castle keep, were dismantled in 1680. In 1658 the town passed with the rest of the Scanian province from Denmark to Sweden, and in the subsequent war it was several times occupied by the Danes and laid waste. After the battle of Hälsingborg (1710) it passed finally into Swedish hands. The abolition of the "Sound toll" in 1857 marked the beginning of the town's commercial prosperity.

(H. Bu.; To. M.)

HALSTED, WILLIAM STEWART (1852–1922), U.S. surgeon, who developed original operations for hernia, carcinoma of breast, goitre, intestinal and gall bladder diseases and aneurysms, was born in New York city on Sept. 23, 1852. He studied at Andover and Yale and took his medical degree from the College of Physicians and Surgeons, New York, in 1877, later studying in the European clinics of E. T. Kocher, Theodor Billroth, Richard von Volkmann and Ernst von Bergmann. Halsted was visiting surgeon at Bellevue, Presbyterian, New York and Roosevelt hospitals from 1880 to 1886. During this period he investigated the anesthetic properties of injected cocaine, to which in the course of his investigations he became addicted, recovering after two years of treatment. From 1886 to 1889 he worked in the laboratory of William H. Welch, and in 1890 was appointed professor of surgery at Johns Hopkins university, which position he held until his death on Sept. 7, 1922.

A surgical philosopher, Halsted established at Johns Hopkins the first school of surgery in the United States. He emphasized the concepts of complete hemostasis, absolute asepsis, gentleness in the handling of tissues and accurate reapproximation of divided tissues, concepts that are accepted as fundamental in all techniques of surgery. In 1890 he introduced the wearing of rubber gloves by all members of the surgical team during an operation. He was author of numerous surgical papers and of several monographs, published in two volumes in 1924 and reprinted in 1951.

(EE. F. H.)

HALTEMPRICE, an urban district (1935) and parliamentary division of the East Riding of Yorkshire, Eng., on the Humber immediately west of Hull, for which it is a residential district. Pop. (1961) 42,388. It includes the old villages of Hessle, Anlaby, Cottingham, Kirk Ella, Willerby—all mentioned in Domesday—West Ella and Dunswell. Haltemprice (old French "high enterprise") was originally the name of an Augustinian canonry at Cottingham. A small Elizabethan manor house in Cottingham was built on the site of Baynard castle. Among the industries are horticulture under glass, agricultural products, shipbuilding at Hessle, precision engineering, mink farming and the making of trailers, carpets and essences.

HAM (in the Douai version of the Bible, CHAM) is the name of Noah's second son. (Though he appears in Gen. ix, 24 as the youngest of Noah's three sons, close examination of this story makes it clear that the name Ham has replaced an original Canaan.) The table of nations in Gen. x represents Ham as the ancestor of Cush (= Ethiopia), Egypt, Put and Canaan; that is, of the original inhabitants of Palestine and the peoples to the southwest. Ham appears also as a place name in Gen. xiv, 5, and as the designation of a people or place in I Chron. iv, 40; both references are obscure.

HAM, a small town in the Somme *département*, Picardy, northern France, lies 20 km. (12½ mi.) S.W. of St. Quentin by road. Pop. (1962) 4,193. It is situated in the upper valley of the Somme river, dominated by a ruined castle that occupies a chalk spur almost surrounded by water and marsh. During the Franco-German War (1870–71) Ham, commanding an important crossing of

the Somme, changed hands several times. It was again important during World War I and suffered severe damage. In its vicinity tanks were first used. The town was rebuilt after the war, but the town hall and church were again damaged in World War II and the Germans left the medieval château in ruins. The château had frequently been used as a state prison, and among the notable prisoners held there were Joan of Arc and Louis Napoleon. There are sugar factories, dealing with the beet that is extensively grown on the surrounding farms. (AR. E. S.)

HAM, a rear leg of the hog, is one of the most desirable cuts of pork (*q.v.*) because of its flavour, palatability and nutritional characteristics. Shoulder portions of pork carcasses are frequently processed and marketed as shoulder hams, picnic hams, Calis and Californias but such products are inferior to true ham. Most ground ham spreads, sold under a variety of trade names, are processed from pork shoulders and ham trimmings.

A compact source of high-grade animal protein, ham compares favourably with good beef in this respect and has available energy ranging from 1,200 to 2,600 calories per lb., depending on fatness. It is an outstanding source of thiamine (B_1), iron, riboflavin, niacin, phosphorus and calcium, all readily digestible. Ham was one of the most ancient meats of civilized man and was common throughout Europe and Asia except where forbidden by religious edict. Introduced to the American continents by the first white settlers, it became a favoured food on the farms of the U.S., where home-curing of hams became an elaborate tradition of the late fall and winter months. Losses through putrefaction were high, however, and product quality varied greatly.

Processing.—Curing ham is essentially a process of checking the growth of spoilage bacteria by the application of curing agents, and until they are sufficiently concentrated to protect the centre of the ham the meat must be kept at a low temperature. In addition to preserving the meat, curing gives it additional flavour, depending upon the ingredients in the cure, the length of time they are applied, etc. In modern meat packing most hams receive a mild cure, giving a mild flavour, and require continuous refrigeration, but others that do not require refrigeration after processing, known as country hams, are produced on farms and in some plants having a specialty trade.

Salt preserves the meat but in excessive quantities impairs the flavour and makes the lean muscles undesirably hard. These disadvantages can be offset by the addition of sugar to the curing mixture, which also improves the flavour and texture of the meat; the result is called a sugar-cured ham, which most consumers prefer to the plain salt-cured product. Saltpetre, which fixes the colour of the meat, is also used in curing. Honey may be used to give a distinctive flavour, with sugar or replacing it, and various condiments may be added for aroma and flavour.

Basic methods of curing are dry curing, in which the cure is rubbed into the meat by hand, and brine curing, in which the meat is soaked in a mixture of water and the curing agents. Brine curing requires about four days per pound of ham; dry curing is faster (two to three days per pound). Curing may be accelerated by injecting the pickle (curing mixture) into the ham by means of a pump fitted with a perforated needle. Many mild-flavoured retail hams are processed rapidly by being pumped arterially to 110% of their raw weight with a pickle containing a high proportion of sugar. In conventional curing, which tends to dry the meat, alkaline phosphates are commonly used to increase moisture retention. Combination cures—for example, pumping with pickle, followed by dry curing—are also used.

Heat processing is determined by the type of finished product desired. Fully cooked hams for retail sale are processed to an internal temperature of 155° F. (68.33° C.) and are therefore acceptable as food without further cooking. (A processing temperature of 137° F. [58.33° C.] is adequate to destroy trichina.)

After curing hams may be smoked, which gives the meat a rich mahogany colour, helps in preservation and helps develop a mellow flavour. Green hickory wood and sawdust are considered desirable fuels, but there are many variations in materials and methods of smoking. Some hams are aged after smoking.

Ham Production.—The two hams constitute on the average 13% of the weight of a pork carcass. For figures on world hog populations and a discussion of the quality of meat produced by different breeds, *see* PIG. Generally speaking, the heaviest concentrations occur in the corn belt of the midwestern U.S. and in the potato and grain regions of Europe and China. Danes, Germans and Americans remain the heaviest per capita consumers of ham.

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(R. W. HD.; G. D. W.; F. GE.)

HAMADAN, a city in west central Iran, is the seat of the Hamadan governor-generalship. Situated 175 mi. S.W. of Teheran at the northeastern foot of Mt. Alwand (Kuh-e Alvand), whose granite peak reaches 11,641 ft., at an elevation of over 6,000 ft., it dominates the wide, well-watered and fertile plain of the upper Qareh Su. Its population (100,029 in 1956) has remained stable since World War II. About one-fourth are of Turkish origin; the remainder are Iranians with a few Jews (5,000) and Armenians. The narrow and tortuous streets of the old city have been cut by six tree-lined avenues which meet in a central circular space. Modern development is modest. A little way to the east of the city is the Musallah, a natural mound covered with debris of ancient and modern buildings.

The summer climate is pleasant and has made Hamadan a much favoured summer resort not only for Iran but also for Iraq. The winters are long and severe, with heavy falls of snow. Cultivation in the district is mainly irrigated but also benefits from rainfall in the more elevated parts. Grain and fruits are grown in abundance. Hamadan is one of the principal trade and marketing centres of western Iran, on the main highway from Teheran through Kasvin (Qasvin) and Kermanshah to Baghdad, and connected by minor roads with neighbouring districts and centres such as Sanandaj, Saveh, Malayer, Arak, and with Borujerd by the highway to Khuzistan. In the rug trade it is second only to Kerman. There is some manufacturing of tobacco, leather, wool and ceramics, but modern industrialization has been slow. (H. Bo.)

History.—Known to the Assyrians as Bit Daiukki, to the Medes as Agbatana and to the Greeks as Ecbatana (*q.v.*), Hamadan (identified as the biblical Achmetha) owed its importance to its situation on the ancient highway from Mesopotamia to the Persian plateau. Agbatana means place of assembly and the ancient city, according to the Greeks, was founded by the Medes to check Assyrian attacks, although the legendary founder was said to be Jamshid. The modern town is built on the mounds of the earlier city, which have never been investigated. Rock carvings of the Akkadian period have been found nearby and suggest that there was probably an earlier settlement than the Median one. Agbatana gained prominence when the Achaemenian kings made it their summer palace. In 1923 two small foundation tablets of silver and gold, inscribed with the name of Darius I (reigned 522–486 B.C.) and recording the building of several palaces in the city were discovered there. Herodotus' description of the town appears not to have been based upon personal observation. Polybius (2nd century B.C.) indicates that Agbatana greatly exceeded the other Median cities in wealth and magnificence, but the actual city he described appears to have been that of Antiochus the Great (built *c.* 209 B.C.). The latter is said to have coined about 4,000 talents out of the silver roof tiles and silver and gold decoration of the palace and the temple to Anahita.

Under the Parthians and Sasanians, Hamadan remained a place of some importance. At the beginning of the 4th century A.D. Queen Shushandukht or Suzan, wife of King Yazdegerd I (*q.v.*) and mother of Bahram V, herself a Jewess, established a Jewish colony in the town. The tomb, reputed to be that of Esther (Edissa), is in reality that of this queen and remains to this day a place of pilgrimage. Another tomb is traditionally that of Esther's cousin Mordecai (Mardochai).

In 644 Hamadan fell to the Arab invaders, and for the next 600 years it was a provincial city. In the second half of the 12th century the Seljuk sultans made it their capital, and so it remained for the next 60 years. It was during this period that the magnificent Gunbad-i-Alaviyan, the mausoleum of the Alavi family, was built; it is now partially destroyed. The Mongol invasions of A.D. 1220 laid the town in ruins but it was rebuilt by the end of the century. In 1386 Timur (Tamerlane) again destroyed the city and massacred the inhabitants but it was repopulated soon after this. In the 17th century the city was beautified by Shah Abbas I but during the 18th century it fell upon evil times and frequently changed hands in the wars between Iraq and Persia. The city suffered severely and became largely depopulated. By 1850 it had again to a large extent recovered and became an important centre of trade and industry.

The town was the burial place of Avicenna (*q.v.*). His grave, restored in 1877, is still extant as is that of the poet Baba Tahir, a grandson of Omar Khayyam. (M. V. S.-W.)

HAMADHANI, AL- (ABU AL-FADL AHMAD IBN AL-HUSAIN AL-HAMADHANI) (967–1007), Arab poet and writer known as Badi'-al-Zaman ("the wonder of the age") whose reputation is based on his letters and *maqamat* (romances and anecdotes) in rhymed prose. He was born and educated at Hamadan in west Persia in 967. He traveled, after 990, in Khorasan and Sijistan, finally settling in Herat (northwest Afghanistan) under the protection of the vizier of Mahmud, the Ghaznevid sultan. He was renowned for a remarkable memory and for fluency of speech, as well as for the purity of his language, and was one of the first to use rhymed prose in letters, *maqamat* and dialogues (of which he claimed to have composed 400), as well as in theological discussions, sermons and poetical puzzles.

His letters were edited by Ibrahim al-Ahdab (1890). The *maqamat* were edited by Mohammed 'Abduh (2nd ed. 1908) and translated into English by W. J. Prendergast (1915).

See Zaki Mubarak, *La Prose Arabe* (1931); C. Brockelmann, *Geschichte der arabischen Litteratur,* vol. i (1898) and Suppl., vol. i (1937).

HAMAH (HAMA), a city and administrative centre of the *muhafaza* (governorate) of Hamah in Syria, is situated on the Asi (Orontes) river, 75 mi. S.S.W. of Aleppo. Pop. (1960) 110,809. It is famous for its huge water wheels, used for irrigation since the middle ages, and is attractively set among resultant gardens. Dominated by a tell, crowned by an ancient citadel, it has many new buildings and some fine mosques, the oldest of which dates from the 12th century. It is a market town specializing in the weaving of textiles and woolens, underclothes and cloaks. Hamah is linked by road with Aleppo, Homs and Damascus, and with the coastal road by a branch road to Baniyas; and is on the Damascus-Aleppo railway. There is an airport near the town.

Hamah has been an important settlement since prehistoric times. A Danish expedition led by Harald Ingholt conducted excavations there between 1931 and 1938 and uncovered 12 levels extending throughout the Bronze Age. There is also a large Iron Age cemetery with cremated burials. A Hittite hieroglyphic inscription was found built into the wall of a house toward the end of the 19th century. In the 1st millennium B.C. it was the capital of an Aramaean kingdom and opposed the Assyrians in the 9th century B.C. Known as Hamath during the second and first millenniums B.C., the city was renamed Epiphania by the Seleucid rulers in honour of Antiochus IV Epiphanes (175–163 B.C.). During the Christian period it reverted to Emath, a form of its old name. In A.D. 638 the town was taken by the Muslims and the principal Christian church, already built on a temple site, was transformed into the Great mosque. Captured by the crusaders in 1108, and devastated by an earthquake 49 years later, Hamah was occupied by Saladin in 1188, and two years later given to his nephew Taki ud-Din Omar, by whose family it was held until 1299. Under the Egyptian Mameluke sultans it was the seat of the governor, and when Sultan Selim I (1512–1520) added Syria to the Ottoman empire after the battle of Marj Dabiq, Hamah was made part of the sanjak of Tripoli. It has remained an important provincial city.

The *muhafaza* of Hamah is mainly a desert plain except in the areas which are irrigated by the Asi river. The area is 3,213 sq.mi. and the population in 1960 was 325,076. A large dam for storage purposes was constructed in the 1960s to increase the area under irrigation. The main products are cotton, cereals, millet and fruits. (M. V. S.-W.)

HAMAMATSU, Japanese city (1960 pop. 333,009), is located on the Pacific coast of Honshu in Shizuoka prefecture, midway between Tokyo and Kyōto. A leading industrial centre with strong Nagoya ties, it is noted for cotton weaving and dyeing, high quality musical instruments (pianos, violins, harmonicas and organs), hats, cellophane and other consumer goods. Hamamatsu is the regional marketing centre for western Shizuoka, serving the Lake Hamana and lower Tenryū river areas. Long a transportation hub, it is served by the Tōkaidō railway line and the Shinano and Tōkaidō highways. (J. D. EE.)

HAMANN, JOHANN GEORG (1730–1788), German philosopher known as the "Magus of the North" because of his cryptic and paradoxical style of utterance, was born at Königsberg in Prussia on Aug. 27, 1730. After miscellaneous studies he worked intermittently as a tutor at Riga and in Courland from 1752 to 1759 (apart from a journey to London with a merchant in 1757–58) and then returned to Königsberg. Having secured a post in the excise office in 1767, he was appointed administrator of the customshouse in 1777 but fell into financial difficulties in 1784 and was pensioned off. Thereafter he lived mainly with friends, in particular with F. H. Jacobi at Pempelfort and with F. K. Buchholtz at Wellbergen near Münster. He died in Münster on June 21, 1788.

Hamann's principal works were *Biblische Betrachtungen eines Christen* (1758); *Sokratische Denkwürdigkeiten* (1759); *Kreuzzüge eines Philologen* (1762), in which he makes the much-quoted remark that poetry is the mother tongue of mankind; *Golgatha und Scheblimini* (1784), against Moses Mendelssohn; and *Metakritik über den Purismus der Vernunft* (written 1780; published 1800). Temperamentally rather unstable, Hamann was radically opposed both to the rationalism of the Enlightenment and to the systematic idealism of Kant (with whom he nevertheless maintained friendly relations). He contended that truth was a matter of subjective belief, which the individual must attain for himself through experience or intuition. Against the prevalent tendency toward abstraction and distinction he upheld Giordano Bruno's doctrine of the identity of opposites. Everything, moreover, is a revelation of God and serves to convince us of his benevolence.

Hailed as a seer by the writers of the *Sturm und Drang* movement in German literature, Hamann was despised for his irrationalism by the academic philosophers of the 19th century but came to command more respect with the development of Christian existentialism.

The best edition of Hamann's works is by J. Nadler (1949–).

See J. Nadler, *Johann Georg Hamann* (1949).

HAMASAH, the name of a famous Arabic anthology compiled by Habib ibn Aws, surnamed Abu Tammam (*q.v.*). The collection is so called from the title of its first book, containing poems descriptive of constancy and valour in battle, patient endurance of calamity, steadfastness in seeking vengeance, and under reproach and in temptation, all which qualities make up the attribute called by the Arabs *hamasah* and best rendered into English by the word "fortitude."

The *Hamasah* consists of ten books or parts, containing in all 884 poems or fragments of poems, and named respectively—(1) *al-Hamasah,* 261 pieces; (2) *al-Marathi,* "Dirges," 169 pieces; (3) *al-Adab,* "Manners," 54 pieces; (4) *al-Nasib,* "The Beauty and Love of Women," 139 pieces; (5) *al-Hija,* "Satires," 80 pieces; (6) *al-Adyaf wa-l-Madih,* "Hospitality and Panegyric," 143 pieces; (7) *al-Sifat,* "Miscellaneous Descriptions," 3 pieces; (8) *al-Sair wa-l-Nu'as,* "Journeying and Drowsiness," 9 pieces; (9) *al-Mulah,* "Pleasantries," 38 pieces; and (10) *Madhammat al-nisa,* "Dispraise of Women," 18 pieces. The poems are for the most part fragments selected from longer compositions. They are taken from the works of Arab poets of all periods down to that of Abu Tammam himself (the latest ascertainable date being A.D.

832), but chiefly of the pre-Islamic period (*Jahiliyyun*), of the early days of Islam (*Mukhadrimun*) and of the reigns of the Umayyad caliphs, A.D. 660–750 (*Islamiyyun*). Perhaps the oldest pieces in the collection are those relating to the war of Basus, which ended with the peace of Dhu-al-Majaz, about A.D. 534.

Most of the poems belong to the class of extempore or occasional utterances, as distinguished from *qasidahs*, or elaborately finished odes. While the *qasidahs* abound with comparisons and long descriptions, the poems of the *Hamasah* are short, direct and for the most part free from comparisons. Abu Tammam in compiling his collection chose hardly anything from the works of the most famous poets of antiquity. Not a single piece from Imru'-al-Qays occurs in the *Hamasah*, nor are there any from 'Alqamah, Zuhayr or A'sha; Nabighah is represented only by two pieces of four and three verses respectively; 'Antarah by two pieces; Tarafah by one piece; Labid by one piece; and 'Amr ibn Kulthum by one piece.

The book entitled *al-Nasib* is, however, an important exception, and contains verses relating to women and love. In the classical age of Arabic poetry it was the established rule that all *qasidahs* must begin with the mention of women and their charms, in order that the hearts of the hearers might be softened. These fragments are therefore generally taken from the opening verses of *qasidahs;* where this is not the case, they are chiefly compositions of the early Islamic period.

About A.D. 935 Abu Tammam, the compiler, visited Khurasan, then ruled by 'Abdallah ibn Tahir, whom he praised and by whom he was rewarded; on his journey home to Iraq he passed through Hamadan, and was there detained as a guest of Abu al-Wafa, son of Salama. During his stay at Hamadan, Abu Tammam is said to have compiled or composed five poetical works, of which one was the *Hamasah*. This collection remained as a precious heirloom in the family of Abu al-Wafa until it fell into the hands of Abu l-'Awadhil, who carried it to Isfahan and made it known to the learned of that city.

The worth of the *Hamasah* as a storehouse of ancient legend can hardly be exaggerated. The high level of excellence which is found in its selections caused it to be said that Abu Tammam displayed higher qualities in his choice of extracts than in his own compositions. The class of poetry of which the *Hamasah* is a specimen is remarkable for the evident firsthand experience which the poets possessed of all about which they wrote. For historical purposes the value of the collection is considerable; but most of all there shines forth from it a complete picture of the strenuous life of passion and battle, which marked the valiant stock who bore Islam abroad over the outworn civilizations of Persia, Egypt and Byzantium.

The importance of the *Hamasah* in the history of Arabic literature is indicated by the fact that no fewer than 20 commentaries on it by medieval Arab scholars are enumerated by Hajji Khalfah, the historian and bibliographer. Of these the most famous are those of Abu Riyash, Abu al-Fath ibn al-Jinni, Shihab-al-Din Ahmad al-Marzuqi of Isfahan and Abu Zakariya Yahya al-Tibrizi (1030–1109). This last is a mine of information regarding the classical age of Arabic literature.

When the *Hamasah* is spoken of, that of Abu Tammam, as the first and most famous of the name, is meant; but several collections of a similar kind, also called *Hamasah*, exist. The best-known and earliest of these is the *Hamasah* of Buhturi (*q.v.*). Four other works of the same name, formed on the model of Abu Tammam's compilation, are mentioned by Hajji Khalfah. Besides these, a work entitled *Hamasat al-Rah* ("the Hamasah of wine") was composed by Abu-al-'Ala al-Ma'arri.

BIBLIOGRAPHY.—Editions of the *Hamasah* include those by G. W. Freytag, with Latin trans. and al-Tibrizi's commentary (1828–1851); and by Mohammed Sa'id al-Rafi'i, with notes from al-Tibrizi's commentary, 2nd ed. (1913). The text was published by A. Amin and A. S. Harun with al-Marzuqi's commentary (1951). There is a German verse trans. by F. Rückert (1846) and an English trans. of some excerpts by Sir Charles Lyall (1885). *See* also the bibliography to ARABIC LITERATURE. (C. J. L.; X.)

HAMBURG, a city-state and *Land* (state) of Germany, which after partition of the nation following World War II became part of the Federal Republic of Germany, is situated on the Elbe, 109 km. (68 mi.) from its mouth at Cuxhaven. It is the largest seaport on the continent of Europe and has an area of 288 sq.mi. Pop. (1961) 1,832,374. The city proper lies on both sides of the little Alster river, which, dammed up a short distance from its mouth, forms a lake, of which the southern portion within the line of the former fortifications bears the name of the Inner Alster (Binnen Alster), and the other and larger portion, that of the Outer Alster (Aussen Alster).

To the west lies the new town (Neustadt), incorporated in 1678; beyond this is St. Pauli, incorporated in 1876, with its pleasure district, the Reeperbahn, and toward the northeast St. Georg, which grew up in the 13th century, but was not incorporated till 1868. During the following centuries numerous rural communities were incorporated. On April 1, 1938, the former Prussian towns of Altona, Harburg and Wandsbek as well as several rural communities were united with Hamburg (Gross Hamburg).

The old town lies low, and it is traversed by a great number of narrow canals or "fleets" (*Fleeten*). The Binnen and Aussen Alster are separated by the Lombardsbrücke (a second bridge over the Alster was completed in 1953) and surrounded by newer buildings. Shallow-draft screw steamers provide means of communication between the business centre of the city and the outlying suburbs. The largest of the public squares in Hamburg is the Hopfenmarkt, which contains the church of St. Nicholas (Nikolaikirche). Others of importance are the Rathausmarkt, the Gänsemarkt, the Zeughausmarkt and the Grossneumarkt. The St. Petrikirche, St. Nikolaikirche, St. Katharinenkirche, St. Jakobikirche and St. Michaeliskirche give their names to the five old city parishes. The old Nikolaikirche was destroyed in the great fire of 1842, which destroyed a great part of the Altstadt, and the new building, designed in Gothic style by Sir George Gilbert Scott, was opened in 1863. Except for the steeple, it was destroyed in World War II and now serves as a war memorial. The Michaeliskirche, on the highest point in the city, is remarkable for its bold construction, there being no pillars. The St. Petrikirche, originally consecrated in the 12th century and rebuilt in the 14th, was the oldest church in Hamburg; it was burned in 1842 and rebuilt in its old form in 1844–49. The St. Katharinenkirche and the St. Jakobikirche are the only surviving medieval churches. Both were seriously damaged by bombing during World War II but have been restored.

The new *Rathaus*, a German Renaissance-style building, constructed of sandstone in 1886–97, is the seat of the city and *Land* governments. Immediately adjoining it and connected with it is the exchange, erected in 1839–41 on the site of the convent of St. Mary Magdalen. Along the line of the former town wall are the criminal law courts (1879–82, enlarged 1893), the civil law courts (finished in 1901) and the Oberlandesgericht (finished in 1912). The picture gallery (Kunsthalle) contains works by old and modern masters, and the museum for art and industry, founded in 1874–76, is one of the most important institutions of its kind in Germany. Hagenbeck's zoological gardens are in Stellingen; and there are schools of music, arts, fashion, navigation, engineering, commerce and other technical schools. In 1901 an institute for seamen's and tropical diseases, with a laboratory for their physiological study, was opened.

Hamburg university was founded in 1919 as a development of the Colonial institute (1908); it has six faculties. In the mid-1960s there were more than 14,000 students, and a new university centre was constructed.

From the Reformation to the French occupation in the beginning of the 19th century, Hamburg was a purely Lutheran state; according to the Great Recess of 1529, re-enacted in 1603, non-Lutherans were subject to punishment and expulsion from the country. Exceptions were gradually made in favour of foreign residents, but it was not till 1785 that regular inhabitants were allowed some religious freedom. In 1860 full religious liberty was guaranteed, and the identification of church and state abolished. After 1887 a church rate was levied on the Evangelical Lutheran communities, and after 1904 upon the Roman Catholics also. Civil marriages were permissible after 1866.

Trade, Shipping and Industry.—Hamburg, the "gateway to

the world" and an important traffic centre, is one of the largest trade and shipping places of the European continent and the most important industrial town of the Federal Republic of Germany. A dense network of shipping lines connects the port with all parts of the world. A lively inland traffic by rail and road, waterways and canals, passes through Hamburg because of its nearness to the estuary of the Elbe. The division of Germany after World War II, however, caused heavy loss to Hamburg by separating it from its hinterland in central and eastern Germany and thus reducing east-west traffic. The effects of German division were so serious that they could not even be compensated by increased industrialization.

HANS HARTZ, HAMBURG

VIEW OF HAMBURG LOOKING TOWARD THE BINNEN AND AUSSEN ALSTER (LAKES) WITH THE RATHAUS (CITY HALL) AND ITS TALL CLOCK TOWER IN THE FOREGROUND

The port is the centre of Hamburg's economy. To a large extent commerce and industry receive their impetus from shipping. Shipbuilding and its manifold auxiliary industries, factories manufacturing import and export goods, and consumer-goods industries for the city's own population have been developed. By the 1960s there were over 3,000 industrial enterprises with more than 270,000 employees. Hamburg's shipyards are among the busiest in western Europe and were producing annually more than one-quarter of all the ships built in West Germany including a large proportion for foreign customers.

Hamburg is the port of registry of 55% of the merchant marine of the Federal Republic, which comprises about 2,500,000 tons gross. More than 300,000,000 marks (RM./D.M.) were spent during the first ten years after World War II for the reconstruction of the port. As much as 80% of copper production, 40% of oil extraction, 35% each of shipbuilding and mineral-oil refining, 32% of fish curing and processing and 25% each of the margarine and cigarette industries of the Federal Republic of Germany were by 1955 established in Hamburg. Many of the goods coming in by sea, such as mineral oil, coal, iron ore, copper, wheat, feedstuff, fruit and tropical fruits, coffee, tea, cocoa, fish, meat, oilseeds, animal and vegetable oils and fats, timber and wood manufactures, wool, cotton and skins and hides, are processed in Hamburg. Most of its exports consist of the finished products of West German industries, such as machinery and industrial equipment, metal goods, glass and glassware, vehicles, timber and wooden articles, and also cement, mineral-oil derivatives, fertilizers and sugar. In the early 1960s the number of ships entering the port exceeded 20,000 annually. Hamburg has the oldest airport in Europe, now called the "Northern Aircross," at Fuhlsbüttel. It is serviced by more than 20 airlines; regular flights on 50 different routes connect this airport with all the major countries of the world and there are many direct flights to New York. Hamburg's leading position in foreign trade is also shown by the large number of consulates located there.

History.—Hamburg probably had its origin in a fortress erected by Charlemagne, on an elevation between the Elbe and Alster, as a defense against the Slavs, and called Hammaburg because of the surrounding forest (*Hamme*). In 811 Charlemagne founded a church there, perhaps on the site of a Saxon place of sacrifice, and this became a great centre for the evangelization of the north of Europe, missionaries from Hamburg introducing Christianity into Jutland and the Danish islands and even into Sweden and Norway. In 834 Hamburg became an archbishopric. In 845 church, monastery and town were burned down by the Norsemen, and two years later the see of Hamburg was united with that of Bremen (*q.v.*) and its seat transferred to the latter city. The town, rebuilt after this disaster, was again more than once devastated by invading Danes and Slavs. In 1110 Hamburg, with Holstein, passed into the hands of Adolph I, count of Schauenburg, and it is with the building of the Neustadt (the present parish of St. Nicholas) by his grandson, Adolph III of Holstein (1188), that the history of the commercial city actually begins. In return for a contribution to the costs of a crusade, he obtained from the emperor Frederick I in 1189 a charter granting Hamburg considerable franchises, including exemption from tolls, a separate court and jurisdiction and the rights of fishery on the Elbe from the city to the sea. The city council (*Rat*), first mentioned in 1190, had jurisdiction over both the episcopal and the new town. Craft guilds were already in existence, but these had no share in the government. The defensive alliance of the city with Lübeck in 1241, extended for other purposes by the treaty of 1255, practically laid the foundations of the Hanseatic league, of which Hamburg continued to be one of the principal members. The internal organization of the city, too, was rendered more stable by the new constitution of 1270 and the recognition in 1292 of the complete internal autonomy of the city by the count of Schauenburg. The exclusion of the craftsmen from the *Rat* led, early in the 15th century, to a rising of the craft guilds against the patrician merchants, and in 1410 they forced the latter to recognize the authority of a committee of 48 burghers, which concluded with the senate the so-called First Recess; there were, however, fresh outbursts in 1458 and 1483, which were settled by further compromises. During the 16th century Hamburg became a free imperial city.

The Great Recess of 1529 which established the Reformation in Hamburg at the same time vested the government of the city in the *Rat*, together with the three colleges of the *Oberalten*, the Forty-eight (increased to 60 in 1685) and the Hundred and Forty-four (increased to 180). The ordinary burgesses consisted of the freeholders and the master workmen of the guilds.

The 17th century saw notable developments. Hamburg had established, as early as the 16th century, a regular postal service with certain cities in the interior of Germany; *e.g.*, Leipzig and Breslau; in 1615 it was included in the postal system of Turn and Taxis. In 1603 Hamburg received a code of laws regulating exchange, and in 1619 the bank was established. In 1615 the Neustadt was included within the city walls. During the Thirty Years' War the city received no direct harm, but the ruin of Germany reacted upon its prosperity, and the misery of the lower orders led to an agitation against the *Rat*, culminating in 1708 in the victory of the democratic factions. The imperial government, however,

intervened, and in 1712 the Great Recess established durable good relations between the *Rat* and the commonalty.

The trade of Hamburg received its first great impulse in 1783, when the United States, by the treaty of Paris, became an independent power. From that time dates its first direct maritime communication with America. Its commerce was further extended and developed by the French occupation of Holland in 1795, when the Dutch trade was largely directed to its port. The French Revolution and the later occupation of the city by Napoleon (1811–14), however, exercised a depressing and retarding effect. Under the long peace which followed the close of the Napoleonic Wars, its trade gradually revived, fostered by the introduction of steam navigation and the declarations of independence of South and Central America, with both of which it opened close commercial relations. In 1866 Hamburg joined the North German confederation, and in 1871 became a constituent state of the German empire, retaining its own constitution which had become liberalized after 1848. In 1921 a democratic *Bürgerschaft* (parliament) was set up.

The jurisdiction of the free port was, on Jan. 1, 1882, restricted to the city and port by the extension of the *Zollverein* to the lower Elbe, and in 1888 the whole of the state of Hamburg, with the exception of the so-called free harbour (comprising the port proper and some large warehouses, set apart for goods in bond), was taken into the *Zollverein*.

The *Land* of Hamburg was re-established by the constitution of 1952. Its parliament consists of 120 deputies elected for four years who in their turn elect a senate of a maximum of 15, from which the first and second *Bürgermeister* are chosen.

Effects of World Wars and Reconstruction.—Hamburg's commercial prosperity was seriously affected by World Wars I and II. In Nov. 1918 the Council of Workmen and Soldiers assumed political power in the city, and endeavoured to form a state of Great Hamburg; but in the following February, after a conflict with the soldiers of the German *Reich*, the movement was suppressed. (*See* H. Ströbel, *The German Revolution and After;* Eng. trans. 1923.)

During World War II, Hamburg was of vital importance because of its large trade, great railway yards and warehouses, numerous industries and especially its shipyards, where large naval vessels were built and repaired and submarines were fitted out. It was therefore subjected to severe bombing; seven big air raids during July and Aug. 1943 killed more than 50,000 persons and destroyed more than half of the city's dwellings, many port installations and much of its business and industrial premises. Of 470 schools 250 remained at the end of the war. Of these, only 60 could be used for teaching; the others served as residential quarters, hospitals, offices or had been requisitioned by the occupation forces. In addition 70 road and railway bridges had been destroyed. By the early 1960s thousands of flats had been built, many of which were financed out of public funds. Many modern business buildings and more than 100 schools were also built. In the harbour 30 transit sheds covering nearly 120 ac. were built or repaired, 900 modern cranes were put into operation, about 9,700 yd. of quay walls were constructed and 215 mi. of harbour railways were relaid.

See also references under "Hamburg" in the Index volume.

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HAMDANI (ABU MOHAMMED AL-HASAN IBN AHMAD IBN YA'KUB AL-HAMDANI) (d. 945), Arabian geographer, belonged to a family of Yemen. Held in repute as a grammarian and poet, he compiled astronomical tables and studied the history and geography of Arabia. He died in prison at San'a' in 945.

His *Geography of the Arabian Peninsula* (*Kitab Jazirat al-'Arab*), by far the most important work on the subject, was edited by D. H. Müller (1884). His other important work is the *Iklil* ("Crown"), concerning the genealogies of the Himyarites and the wars of their kings, in ten volumes. Of the surviving parts of this work, volumes 1, 2, 8 and 10 were published, and volume 8 was translated into English by N. A. Faris as *The Antiquities of South Arabia*.

See the introduction to *The Antiquities of South Arabia*, trans. by N. A. Faris (1938); also C. Brockelmann, *Geschichte der arabischen Litteratur*, 1st supplementary volume, p. 409 (1937).

HAMDI BEY, OSMAN (1842–1910), Turkish statesman and art expert, son of Hilmi Pasha, one of the last of the grand viziers of the old regime, was born at Istanbul. Hamdi Bey's great service to his country was the assertion of the right of Istanbul to receive the finds made by various archaeological enterprises in the Turkish empire. He founded the museum of antiquities at Istanbul and became its director in 1881; it owes much to his enlightened taste and to his energy.

Hamdi Bey secured for Turkey the famous Greek sarcophagi found in Sidon in 1887, which are among the treasures of the museum of antiquities. These are not only magnificent examples of Greek art of the 5th and 4th centuries B.C., but are in perfect preservation, and the magnificent "Alexander" sarcophagus even retains traces of its original colouring (*see* SIDON). In 1888 Hamdi Bey founded the School (later, Academy) of Fine Arts in Istanbul. He died on Feb. 23, 1910.

His brother, HALIL EDHEM BEY (b. 1860), was also a distinguished archaeologist. He held various ministerial posts and eventually became director of the Turkish museums in Istanbul.

HÄME (TAVASTEHUS), a county (Hämeen *lääni*) of southwest Finland, is the home district of the Tavastians or Tavastlanders (*Hämäläiset*), one of the original groups of Finnish people. Pop. (1960) 580,765. Area 7,499 sq.mi. (19,422 sq.km.). Hämeenlinna (*q.v.*) with its garrison fortress and county administration, is the historical centre of the *lääni;* Tampere (*q.v.*) is the industrial centre; Lahti (*q.v.*) is the newest city in Finland. These towns are connected with the great lakes of western Finland which drain principally by way of the Kokemäki (Kumo) river. Riihimäki, Nokia, Valkeakoski, Forssa, Mänttä and Toijala are other manufacturing towns in the *lääni*. (W. R. ME.)

HÄMEENLINNA (Swed. TAVASTEHUS), capital of Hämeen *lääni* (Häme county), southwest Finland, is situated on the shores of Lake Vanajavesi, about 105 km. (65 mi.) N.N.W. of Helsinki by road. Pop. (1960) 28,298. The main features of interest are the medieval castle, the church (1798), the Renaissance-style town hall and the birthplace of Jean Sibelius. There are several educational institutions and important industrial establishments. The nearby glacial formations of the ridges of Hattelmala and Ahvenisto, as well as the Aulanko park with its tourist hotel, are scenically interesting. Hämeenlinna is on the main railway from Helsinki to Tampere (Tammerfors) and northern Finland. A waterbus route runs from Hämeenlinna to Tampere and the Kaivanto canal. The original town was a fortified village which was granted staple rights in 1638. It was moved to its present site in 1779. (E.-S. KU.)

HAMEG (HAMAG), a name shared by the Kanembu of the Lake Chad area and the Negroid subjects of the Fung to the south of Sennar (*q.v.*) in the Republic of the Sudan. It implies a servile position as used in the 1960s.

In the Sudan the Hameg are the descendants of the aboriginal inhabitants of the southern Gezira before the coming of the Fung, who probably gave them the name of Hameg. In the 20th century they were particularly centred on Jebel Guli (between Renk and Roseires) and Keili, farther south on the borders of Beni Shangul.

About the middle of the 18th century, Mohammed Abu el Kaylak or Abulikeilik, a famous Hameg (really the son of a Ja'ali by a Hameg mother), became commander of the Fung army and governor of Kordofan; from that date the real power belonged to him and his descendants rather than to the Fung kings. On the Egyptian occupation, his grandson Idris Adlan retired to Guli and was recognized as chief of all the area south, including Sillok, Kurmuk, Ulu, the Burun and Fadasi. His descendant was still nazir of Dar Fung in modern times, although he would resent being called a Hameg because of the servile association of the name. *See* also SUDAN, REPUBLIC OF THE. (A. J. AL.)

HAMELIN, FERDINAND ALPHONSE (1796–1864), French naval officer, an early advocate of armour for naval vessels, was born at Pont l'Évêque on Sept. 2, 1796. He took part in the expedition to Spain in 1823 and distinguished himself in the action at Algiers in 1830. In the later years of Louis Philippe's monarchy he held a command in the Pacific. Having become vice-admiral in 1848, he led the Black sea squadron in the Crimean War, collaborating with the English admiral J. W. D. Dundas in the bombardment of Sevastopol. He became an admiral in 1854 and was minister of marine from 1855 to 1860. Hamelin was an able administrator and took a notable part in developing the use of armour; the "Gloire," launched in 1859, set the model for seagoing ironclads. When Napoleon III made his first concession to the Liberal opposition, Admiral Hamelin was among the first ministers to be dismissed. He held no further command, and died in Paris on Jan. 10, 1864.

HAMELN, a town of Germany, *Land* (state) of Lower Saxony, which after partition of the nation following World War II became part of the Federal Republic of Germany, lies on the Weser 46 km. (28½ mi.) S.W. of Hanover by road. Pop. (1961) 50,436. Situated in the hill district around the middle Weser, the town is rich in stone and half-timbered houses, especially of the Renaissance period. Chief of these are the Stiftsherrnhaus (1558), Rattenkrug (1568–69), the local history museum (1585–89), Rattenfängerhaus (1602), Dempterhaus (1607) and the Hochzeitshaus (1610–17). There are a law court, technical schools and the Weserbergland-Festhalle (a theatre opened in 1953). Hameln is on the railway from Hanover to the Ruhr and to Frankfurt am Main; its industries include the manufacture of carpets, chemical products, electric motors, baking powder, textiles and ceramics. There is an iron foundry and a large flour mill, the Wesermühlen.

Hameln originated near the village and monastery or collegiate church of St. Boniface, founded before A.D. 800 by monks from Fulda (*q.v.*); it was a market centre dependent on the abbey of Fulda until 1259. It was ruled by the Guelphs from about 1270 until 1866, when it passed to Prussia.

The legend of the pied piper of Hamelin is well known, although apart from the ratcatcher collection in the local history museum the only two reminders of it are inscriptions on the Rattenfängerhaus and the Hochzeitshaus. The historical basis for the legendary departure and fate of the children of Hameln in 1284, with which the traditional story of the ratcatcher came to be associated during the 16th century, has not been completely verified or adequately explained even after 300 years. The most widely discussed theory supposes an exodus of the young men of the town in connection with the German colonization of the east. (R. Fe.)

HAMERLING, ROBERT (1830–1889), Austrian poet, whose real name was Rupert Johann Hammerling, is now chiefly remembered for his epics. Born at Kirchberg am Wald, Lower Austria, March 24, 1830, he studied in Vienna, sharing in its defense against the troops of Prince Alfred von Windischgrätz in 1849. From 1855 to 1866 he was a teacher in Trieste. He spent his last years in Stiftingstal, near Graz, where he died on July 13, 1889. His popular epics *Ahasver in Rom* (1866, 28th ed. 1916) and *Der König von Sion* (1869, 17th ed. 1910) reveal both classical and romantic tendencies. Other works include dramas, a novel and autobiographical writings such as *Stationen meiner Lebenspilgerschaft* (1889). Hamerling's collected works were edited by M. M. Rabenlechner, four volumes (1900). His letters were published in four volumes (1897–1901).

See also Franz Koch, *Idee und Wirklichkeit*, vol. 1, pp. 271–284 (1956); and (for biographies) Wilhelm Kosch, *Deutsches Literatur-Lexikon*, vol. 1, pp. 815–816 (1949). (L. H. C. T.)

HAMHUNG (Japanese Kankō), a city of North Korea, about 115 mi. N.E. of Pyongyang, was the commercial and governmental centre of northeastern Korea during the Yi dynasty (1392–1910) and was further developed by the Japanese (1910–45). Even greater transformation took place in Hungnam, a nearby fishing village which became a major industrial centre and port. Chemical and other industries depended largely upon the large scale hydroelectric power projects developed inland from Hamhŭng.

During the Korean War, UN troops captured Hamhŭng and the reservoir areas, but were forced to retreat by massive numbers of Chinese Communist troops. The hydroelectric power facilities and many industrial plants in the Hungnam area were destroyed. The population of the Hamhŭng-Hungnam area in 1958 was estimated at 400,000. (S. McC.)

HAMILCAR BARCA or Barcas (d. winter 229/228 B.C.), Carthaginian general and statesman. Nothing is known of him before he was given command of the Carthaginian forces in Sicily in 247 when Carthaginian resources were at their lowest during the First Punic War. Hamilcar was a common Punic name; another general of the same name preceded Hamilcar Barca in command. Barca was perhaps a family name, though more probably a nickname meaning "lightning."

He was indeed a general of outstanding speed and ability. The course of the war had robbed Carthage of all Sicilian possessions save Lilybaeum (Marsala) and Drepanum (Trapani) when Hamilcar Barca took command. While harassing the Roman troops with guerrilla tactics in western Sicily he staged a landing on the north coast, captured Mt. Ercte (probably Monte Pellegrino near Palermo) and held it for three years in face of desperate Roman attempts to dislodge him (246–244). From this mountain and Palermo bay he mounted piratical expeditions against the Sicilian and south Italian shores. Suddenly he quitted Ercte for Mt. Eryx (mod. Erice near Trapani) which he held until 241. After the total defeat of the Carthaginian fleet in that year by Gaius Lutatius Catulus, it was left to Hamilcar to make treaty with the Romans and return to Africa.

In Africa his mercenary troops revolted and until 238 Hamilcar was engaged, first in substitute for and later in association with the rival general Hanno (*q.v.*), in a series of campaigns which narrowly averted the capture of Carthage and reconquered the north African provinces. Hence his popularity as leader of Carthage's popular party grew and led him, without sanction, to occupy Spain as a compensation for the loss of Sicily and Sardinia. There he founded the city of Akra Leuke ("white point"; perhaps Alicante) and made extensive conquests (237–228) before his death in battle. He had several children, the most famous being Hannibal (*q.v.*).

See Cornelius Nepos, *Hamilcar;* O. Meltzer, *Geschichte der Karthager,* vol. ii, book 3 (1896). (Wm. C.)

HAMILTON, the name of a famous Scottish family whose first authentic ancestor, Sir Walter FitzGilbert de Hameldone (d. *c.* 1346), was witness to a charter to Paisley abbey given by James, high steward of Scotland, in 1295. He was also among the Lanarkshire and Renfrewshire lairds who gave homage in 1296. It is assumed he was the son of Gilbert de Hameldone and apparently held lands from the high steward. In the Anglo-Scottish wars he first joined the English, but after the battle of Bannockburn (1314) went over to Robert Bruce, was knighted, obtained the barony of Cadzow and was justiciar of Lanarkshire by 1321. From his younger son John sprang the Hamiltons of Innerwick and from the Priestfield branch of this house derived Thomas, who was created earl of Haddington in 1627. (*See* Haddington, Earls of).

Sir "David FitzWalter FitzGilbert" Hamilton (d. 1375), baron of Cadzow, who carried on the main line, was captured at Neville's Cross (1346). Of his sons, David succeeded to Cadzow, Sir John of Fingaltoun was ancestor of Hamilton of Preston and Walter of the Hamiltons was ancestor of Cambuskeith and Sanquhar. David, the first to describe himself lord of Cadzow, died by 1392, leaving several sons, from whom were descended the Hamiltons of Bathgate, Bardowie, and Udstown (from which branch came the lords Belhaven (*see* Belhaven and Stenton, John Hamilton, 2nd Baron). Sir John of Cadzow (d. *c.* 1402), David's eldest son, had two younger sons from whom are derived the Dalserf and Raploch branches. Sir John's eldest son, James of Cadzow (d. *c.* 1440), was one of the hostages for James I's ransom (1424–26). From him the Hamiltons of Silvertonhill and lords Hamilton of Dalzell claim descent.

Sir James Hamilton (*c.* 1415–79) of Cadzow was made a hereditary lord of parliament in 1445; his second marriage in 1474 was to Mary, sister of James III, widow of Thomas Boyd, earl

of Arran. Their son James (*c.* 1475–1529), 2nd Lord Hamilton was created earl of Arran in 1503 (*see* ARRAN, EARLS OF). Among his illegitimate children were Sir James Hamilton (d. 1540) of Finnart, ancestor of Gilkerscleugh, and John (d. 1571), archbishop of St. Andrews, ancestor of the Hamiltons of Blair and also, it is said, of Hamilton of London, baronet. The second son of James (d. 1575), 2nd earl of Arran, John (*c.* 1535–1604), was created marquess of Hamilton in 1599 (*see* HAMILTON, MARQUESSES AND DUKES OF); the chiefship passed to this branch of the family, which took the name and arms. Another son Claud, created Lord Paisley (1587), was the ancestor of the dukes of Abercorn (*see* ABERCORN, EARLS AND DUKES OF), heirs male of the house of Hamilton. The estates of this branch came to be mainly in Ireland.

See G. Hamilton, *History of the House of Hamilton* (1933).

(T. I.)

HAMILTON, MARQUESSES AND DUKES OF. The holders of these titles descended from Sir James Hamilton of Cadzow (*see* HAMILTON). JOHN (*c.* 1535–1604), 1st marquess of Hamilton, third son of James Hamilton, 2nd earl of Arran, was given the abbey of Arbroath in 1551. In politics he was largely under the influence of his unscrupulous younger brother Claud, afterward Lord Paisley. At first hostile to Mary Stuart, they later became her devoted partisans. Claud met Mary on her escape from Lochleven and escorted her to Hamilton palace. John appears to have been in France in 1568 when the battle of Langside was fought and it was probably Claud who commanded Mary's vanguard in the battle. With others of the queen's party they were forfeited by the parliament and sought their revenge on the regent Moray. Although the Hamiltons disavowed all connection with Moray's murderer, James Hamilton of Bothwellhaugh, he had been provided with horse and weapons by the abbot of Arbroath and it was at Hamilton that he sought refuge after the deed. Their uncle, Archbishop John Hamilton, was hanged at Stirling in 1571 for alleged complicity in the murder of Lord Darnley, and is said to have admitted that he was a party to the murder of Moray. At the pacification of Perth in 1573 the Hamiltons abandoned Mary's cause. On the uncertain evidence extracted from the assassin by torture, the Hamiltons had been credited with a share in the murder of the regent Lennox in 1571. In 1579 proceedings against them for these two crimes were resumed and when they escaped to England their lands and titles were seized by their enemies. John Hamilton soon dissociated himself from the policy of his brother Claud, who continued to plot for Spanish intervention on behalf of Mary. With other Scottish exiles, John crossed the border in 1585 and marched on Stirling; he was admitted on Nov. 4, and formally reconciled with James VI, with whom he was thenceforward on the friendliest terms. He was created marquess of Hamilton, earl of Arran and Lord Aven in 1599 and died on April 6, 1604.

His eldest surviving son, JAMES (*c.* 1589–1625), 2nd marquess of Hamilton, was created earl of Cambridge and baron of Innerdale in the peerage of England in 1619 and these honours descended to his son JAMES (1606–49), who in 1643 was created duke of Hamilton (*see* HAMILTON, JAMES HAMILTON 1st Duke of). WILLIAM (1616–1651), 2nd duke, succeeded to the dukedom on his brother's execution in 1649. He was created earl of Lanark in 1639 and in the next year became secretary of state for Scotland. Arrested at Oxford by the king's orders in 1643 for "concurrence" with Hamilton, he escaped and was temporarily reconciled with the Presbyterian party. Sent by the Scottish committee of estates to treat with Charles I at Newcastle upon Tyne in 1646, he sought in vain to persuade the king to consent to the establishment of Presbyterianism in England. In Dec. 1647 he was one of the Scots who signed the treaty with Charles known as the "Engagement" and thereafter he helped to organize the second phase of the Civil War. He fled abroad in 1649 returning to Scotland with the future Charles II in 1650, and the next year joined in the Scottish invasion of England. He died on Sept. 12, 1651, from wounds received at the battle of Worcester. He left no male heirs and the title devolved on the 1st duke's elder surviving daughter ANNE (*c.* 1631–1716), duchess of Hamilton in her own right.

Anne married in 1656 WILLIAM DOUGLAS (1635–1694), earl of Selkirk, who was created duke of Hamilton in 1660 on his wife's petition, receiving also several of the other Hamilton peerages, but for his life only. He resisted the duke of Lauderdale's measures in Scotland and was dismissed from the privy council in 1676. He presided over the convention of estates which offered the Scottish crown to William and Mary in March 1689. He died at Holyrood abbey on April 18, 1694. Anne's eldest son JAMES DOUGLAS (1658–1712), 4th duke of Hamilton and duke of Brandon (created 1711), succeeded his mother, who resigned the dukedom to him in 1698. He opposed the Union (1701), though capriciously and ineffectively. On Nov. 15, 1712, he fought the duel with Charles, Lord Mohun, narrated in Thackeray's *Henry Esmond*, in which both the principals were killed.

ALEXANDER (1767–1852), 11th duke, was ambassador to Russia from 1806 to 1807 and bore the crown at the coronations of William IV and Victoria. DOUGLAS (1903–), 14th duke, succeeded to the title in 1940. In the spring of 1941, Rudolf Hess made his spectacular and deluded flight to Scotland to see the duke in order to arrange peace between England and Nazi Germany.

The title of Viscount Hamilton, in the peerage of Great Britain conferred on Charles Hamilton (1712–89), 8th earl of Abercorn, in 1786, is borne by the dukes of Abercorn, whose eldest son is usually styled by courtesy, marquess of Hamilton, a title which was added to the other family honours when the 2nd marquess of Abercorn was raised to the dukedom in 1868.

See George Hamilton, *A History of the House of Hamilton* (1933).

(G. S. P.)

HAMILTON, ALEXANDER (1755–1804), American statesman and founding father, was born on the island of Nevis in the British West Indies, probably on Jan. 11, 1755, and not in 1757 as he himself claimed. His father was James Hamilton, a drifting trader and the fourth son of Alexander Hamilton, the Laird of Cambuskeith, Ayrshire, Scotland; his mother was Rachel Fawcett Lavien, the daughter of a French Huguenot physician and the wife of John Michael Lavien, a German or Danish merchant who had settled on the island of St. Croix in the Danish West Indies. Rachel probably began living with James Hamilton in 1752 but Lavien did not divorce her until 1758. Although he came of good stock, Alexander Hamilton from his earliest years was sensitive to his stained origin. "My blood," he once said, "is as good as that of those who plume themselves upon their ancestry."

In 1765, after having brought his family to St. Croix, James Hamilton abandoned it. Destitute, Rachel set up a small shop and at the age of 11 Alexander became a clerk in the counting-house of Nicholas Cruger and David Beekman, New York merchants who had recently established themselves at St. Croix. Rachel died in Feb. 1768. Alexander became a ward of his mother's relatives and continued to work for Cruger and Beekman. From Nov. 1771 to March 1772, when Cruger left the island, young Hamilton's ability, industry and engaging manners won him advancement from bookkeeper to manager. Several months later friends who were impressed by Hamilton's talents sent him to the North American mainland to further his education. For a year he studied at a preparatory school in Elizabethtown, N.J., and in the autumn of 1773 entered King's college (later Columbia) in New York. Fired by a fierce ambition, he became a serious and successful student, but his studies were interrupted by the brewing revolt against Great Britain. Throwing himself behind the colonial cause, he publicly defended the Boston Tea Party. In 1774–75 he wrote three influential pamphlets, *A Full Vindication of the Measures of the Congress*, *The Farmer Refuted*, and *Remarks on the Quebec Act*, that upheld the nonimportation, nonconsumption and nonexportation agreements of the continental congress and attacked British policy in Quebec. Those anonymous publications, the first of which had been attributed to John Jay and John Adams, two of the ablest of American propagandists, gave the first solid evidence of Hamilton's precocity that astonished his contemporaries.

Service in Revolutionary War.—In March 1776, through the influence of friends in the New York legislature, Hamilton was commissioned a captain in the provincial artillery. He organ-

ized his own company and at the second battle of Trenton, when he and his men prevented the British under Lord Cornwallis from crossing the Raritan river and attacking George Washington's main army, showed conspicuous bravery. Thereafter Hamilton's star rose. In Feb. 1777 Gen. Washington invited him to become an aide-de-camp with the rank of lieutenant colonel. In his four years on Washington's staff he grew close to the general and was entrusted with his correspondence. He was sent on important military missions and, thanks to his fluent command of French, he became liaison officer between Washington and the French generals and admirals. During that time he formed some of the friendships he was to retain for the rest of his life. He also attracted the attention of political leaders in New York. During the inactive periods of the winter campaigns he continued his studies, reading deeply in the classics and particularly in the literature of economics and public finance.

Eager to connect himself with wealth and influence, Hamilton married Elizabeth, the daughter of Gen. Philip Schuyler, the head of one of New York's most distinguished families, in Dec. 1780. Meantime, having grown tired of the routine duties at headquarters and yearning for military glory, he pressed Washington for an active command in the field. Washington refused and in Feb. 1781 Hamilton impetuously seized upon a trivial quarrel to break with the general and leave his staff position. Fortunately he had not forfeited the general's friendship, for in July Washington gave him command of a battalion. At the siege of Cornwallis' army at Yorktown in October, Hamilton gained a moment of glory in an assault on a British redoubt.

Early Political Activities.—Meanwhile, in letters to a member of congress and to Robert Morris, the superintendent of finance, in 1780 and 1781, Hamilton had analyzed what he considered the financial and political weaknesses of the general government. In Nov. 1781, with the war virtually over, he moved to Albany where he studied law and was admitted to practice in July 1782. That same month he became receiver of continental taxes for the state of New York, a post he gave up a few months later after the New York legislature had elected him to the continental congress. Between July 1781 and July 1782 he wrote six essays for a newspaper, the *New York Packet*, under the pen name of "The Continentalist," in which he argued for a strong central government. In congress from Nov. 1782 to July 1783 he worked for the same end, being convinced that the Articles of Confederation, the nation's first constitution, were the source of weakness and disunion.

In Nov. 1783 Hamilton began to practise law in New York city. He defended unpopular Loyalists in suits brought against them under a state law of that year called the Trespass act. Using the pseudonym "Phocion," he published two pamphlets in 1784 pleading for moderation and justice in the treatment of Loyalists and in 1786, partly as a result of his efforts, state acts disbarring Loyalist lawyers and disfranchising Loyalist voters were repealed. In that year he also won election to the lower house of the New York legislature, taking his seat in Jan. 1787. Meantime, the legislature had appointed him a delegate to the convention in Annapolis, Md., that met in Sept. 1786 to consider the commercial plight of the union. Hamilton suggested that the convention exceed its delegated powers and call for another meeting of representatives from all the states to discuss various problems confronting the nation. He drew up the draft of the address to the states from which emerged the Constitutional Convention that met in Philadelphia in May 1787. After persuading New York to send a delegation, Hamilton, through the influence of General Schuyler, obtained a place for himself on the delegation. (*See* ANNAPOLIS CONVENTION; CONSTITUTIONAL CONVENTION [U.S.].)

Hamilton went to Philadelphia as an uncompromising nationalist who wished to replace the Articles of Confederation with a strong centralized government, but he did not take much part in the debates and his attendance was irregular. He served on two important committees, that on rules in the beginning and that on style at the end of the convention. In one long speech on June 18 he presented his own idea of what the national government should be. His model was the England of George III. "I have no scruple in declaring . . . that the British government is the best in the world," he said, "and that I doubt much whether anything short of it will do in America." He suggested a government of three departments—legislative, executive and judicial. The legislature would consist of an assembly or lower house elected for three years by free male citizens and a senate chosen indirectly by electors for life. The president, who also would hold office for life and was to be selected by a double set of electors, would have an absolute veto over the legislature. The central government would appoint the state governors who would have an absolute veto over state legislation. The judiciary would consist of a supreme court whose justices would have life tenure. Although the states were to be preserved, they would have virtually no power. The most significant feature of the plan, which was essentially monarchical, was that the national government would have unlimited sovereignty. Other than to reveal his own conservative ideas, Hamilton's plan had little impact on the convention; the delegates went ahead to frame a constitution that stood some chance of acceptance by the people. Since the other two delegates from New York had withdrawn from the convention, New York was not officially represented and Hamilton had no power to sign for his state. Nonetheless, even though he knew that his state wished to go no further than a revision of the Articles of Confederation, he signed as an individual.

The Federalist Papers.—Opponents in New York quickly attacked the new constitution and Hamilton answered them in the newspapers under the signature "Caesar." Since the Caesar letters did not win the influence he desired, Hamilton turned to another classical pseudonym, "Publius," and to two collaborators, James Madison and John Jay, to write *The Federalist*, a series of 85 essays in defense of the constitution and republican government that appeared in the New York newspapers between Oct. 1787 and Aug. 1788. Hamilton wrote at least two-thirds of the essays, including some of the most important ones that interpreted the constitution, explained the powers of the executive, the senate and the judiciary, and expounded the theory of judicial review. Although written and published in haste, *The Federalist* was widely read, had a great influence on contemporaries, became one of the classics of political literature, and helped shape American political institutions. In Jan. 1788 Hamilton was reappointed a delegate to the continental congress from New York. At New York's ratifying convention in Poughkeepsie in June, where he was a delegate, he became the chief champion of the constitution and, against strong antifederalist opposition, won approval for it.

Hamilton's Financial Program.—President Washington launched the new federal government in April 1789 and in September appointed Hamilton the first secretary of the treasury. Congress quickly asked Hamilton to draw up a plan for the "adequate support of the public credit." This was all he needed. Envisaging himself as something of a prime minister in Washington's official family, Hamilton from this point on developed and carried out a bold and masterly program designed to build a strong union, one that would weave his political philosophy into the government. His immediate objectives were to establish the nation's credit at home and abroad and to strengthen the national government at the expense of the states. He outlined his program in four notable reports to congress. In the first two, *The Reports on the Public Credit*, which he submitted on Jan. 14, 1790, and Dec. 13, 1790, he urged the funding of the national debt at full value, the assumption in full by the federal government of debts incurred by the states during the Revolution, and a system of taxation to pay for the assumed debts. His motive was as much political as economic. By paying the debts he hoped to bind the men of wealth and influence, who had acquired most of the domestically held bonds, to the national government. Such powerful opposition arose to the funding and assumption scheme that Hamilton was able to push it through congress only after he had made a bargain with Thomas Jefferson in July whereby he gained southern votes in congress for it in exchange for his own support in locating the future national capital on the banks of the Potomac.

Hamilton's third report, the *Report on a National Bank*, which he submitted on Dec. 14, 1790, advocated a national bank called

the Bank of the United States and modeled after the Bank of England. With the bank he wished to solidify the partnership between the government and the business classes who would benefit most from it and further advance his program to strengthen the national government. After congress passed the bank charter, Hamilton persuaded Washington to sign it into law. He advanced the argument that the constitution was the source of implied as well as enumerated powers and that through implication the government had the right to charter a national bank as a "proper" means of regulating the currency. This doctrine of implied powers became the basis for interpreting and expanding the constitution in later years. In the *Report on Manufactures*, the fourth, the longest, the most complex and the most farsighted of his reports, submitted on Dec. 5, 1791, he proposed to aid the growth of infant industries through various protective laws. Basic in it was his idea that the general welfare required the encouragement of manufactures and that the federal government was obligated to direct the economy to that end. In writing his report, Hamilton had leaned heavily on Adam Smith's *The Wealth of Nations*, but he revolted against Smith's laissez-faire idea that the state must keep hands off the economic processes, meaning no bounties, tariffs or other aid. The report had greater appeal to posterity than to Hamilton's contemporaries, for congress did nothing with it.

Political Parties.—One of the results of the struggle over Hamilton's program and over issues of foreign policy was the emergence of national political parties. Like Washington, Hamilton had been one of the foremost among the founding fathers who had deplored parties, equating them with disorder and instability. He had hoped to establish a government of superior persons who would be above party. Yet he became the leader of the Federalist party, a political organization in large part dedicated to the support of his policies. Hamilton placed himself at the head of that party because he needed organized political support and strong leadership in the executive branch to get his program through congress. Washington usually supported Hamilton's policies and in effect became a Federalist. The political organization that challenged the Hamiltonians was the Republican party, created by James Madison and Thomas Jefferson. In foreign affairs Hamilton and the Federalists favoured close ties with England whereas Secretary of State Jefferson and his followers preferred to strengthen the old attachment to France. In attempting to carry out his program, Hamilton frequently interfered in Jefferson's domain of foreign affairs. Detesting the French Revolution and the equalitarian doctrines it spawned, he tried to thwart Jefferson's policies that might aid France or injure England and to induce Washington to follow his own ideas in foreign policy. Hamilton went so far as to warn British officials of Jefferson's attachment to France and to suggest that they bypass the secretary of state and instead work through himself and the president in matters of foreign policy. This and other parts of Hamilton's program led to a feud with Jefferson from 1791 to 1793 in which the two men attempted to drive each other from the cabinet. They even used party newspapers to attack each other and the policies each espoused, and each tried to turn Washington against the other.

Neutrality Controversy.—When war broke out between France and England in Feb. 1793, Washington asked his cabinet's advice in formulating American policy toward the conflict. Hamilton wished to use the war as an excuse for jettisoning the French alliance of 1778 and steering the United States closer to England, whereas Jefferson insisted that the alliance was still binding. While not challenging the validity of the alliance, Washington essentially accepted Hamilton's advice and in April issued a proclamation of neutrality that Republicans said favoured England. In that month an emissary from republican France, Edmond C. Genet, reached the United States and proceeded to violate American neutrality in trying to advance the cause of his own country. Infuriated by Genet's activities, Hamilton in June began a series of articles under the name "Pacificus" in defense of the neutrality proclamation and in August another series under the title "No Jacobin" that condemned Genet's activities. He also took the lead in demanding Genet's recall, which, despite Jefferson's initial opposition, was consummated early in 1794.

Jay Treaty.—At the same time British violations of American neutrality and other grievances led to strident popular demands for war against Britain, a clamour that Hamilton steadfastly opposed. He believed that war with England would be national suicide, for his program was anchored on trade with Britain and on the import duties that supported his funding system. To save his program, Hamilton persuaded the president to send John Jay to London to negotiate American grievances. Hamilton wrote Jay's instructions, manipulated the negotiations, and helped defend the unpopular treaty Jay brought back in 1795, notably in a series of essays he wrote for the New York newspapers beginning in July 1795 and continuing in 1796 under the signature "Camillus." Jay's treaty as a consequence has often been called Hamilton's treaty. As Hamilton planned it, the treaty kept the peace and saved his system.

Whisky Rebellion.—The Republicans in congress, meantime, had tried to destroy Hamilton. In Jan. 1793 they had demanded a full accounting of treasury operations from the beginning until the end of 1792. Hamilton promptly offered the information. A month later William Branch Giles of Virginia introduced a number of resolutions in the house of representatives charging Hamilton with dereliction of duty and irregularities in the management of the treasury. Hamilton's friends defended him so well that when the resolutions came to a vote, he was vindicated on every count. In 1794 his program was also challenged from another direction, by farmers in western Pennsylvania who rose against an excise tax he had been instrumental in placing on distilled liquors, an important source of income for the frontiersmen. He had advanced the tax to raise money and to strengthen the power of the federal government at the expense of the states in an area of taxation that they had considered as theirs exclusively. To Hamilton, who urged Washington to use every means to suppress the resistance, the Whisky rebellion presented an opportunity he had long desired, a chance for the first time to test the power of the federal government, as opposed to local defiance, by a showdown of arms. Congress authorized the president to call out the militia, and Hamilton in September took a leading part in the expedition sent to chastise the rebels, who melted away before the overwhelming federal force. Hamilton looked upon the suppression as a triumph for law and order that added immeasurably to the prestige of the federal government.

Out of the Cabinet.—Lashed by criticism, tired and anxious to repair his private fortune, Hamilton left the cabinet on Jan. 31, 1795. He did not, however, sever his connection with the government; his influence, as an unofficial adviser, continued as strong as ever. Washington and his cabinet consulted him on almost all matters of policy. When Washington decided to retire, he turned as usual to Hamilton, asking his opinion as to the best time to publish a farewell to the nation. With his eye on the coming presidential election, Hamilton advised withholding the announcement until a few months before the meeting of the presidential electors. Following that advice, Washington gave his *Farewell Address* to the nation in Sept. 1796. Hamilton drafted most of the address, one of the great documents of American history, and some of his ideas were prominent in it. In the election Federalist leaders passed over Hamilton's claims and nominated John Adams for the presidency and Thomas Pinckney for the vice-presidency. Since Adams did not appear devoted to Hamiltonian principles, Hamilton tried to manipulate the electoral college so as to make Pinckney president. Adams won the election and Hamilton's intrigue succeeded only in sowing distrust within his own party. Nonetheless Hamilton's influence in the government continued, for Adams retained Washington's cabinet and its members consulted Hamilton on all matters of policy, gave him confidential information, and in effect urged his policies on the president.

Early in 1797 James T. Callender, a Republican hack, published a *History of the United States for the Year 1796* in which he accused Hamilton of corruption in connection with an affair Hamilton had had six years earlier with a physically attractive adventuress, Mrs. Maria Reynolds. Hamilton met the attack by writing a pamphlet in which he confessed the "irregular and indelicate

amour," and printed the blackmailing letters that the woman's husband, a confidence man, had sent to him, but denied any corrupt dealings with him. Although Hamilton successfully defended his integrity as a public man, he subjected his private life to a bitter humiliation.

Threatened War with France.—In retaliation against Jay's treaty, France meantime had broken relations with the United States. Although he stood for firmness, Hamilton agreed with the president's policy of trying to re-establish friendly relations. After the failure of a peace mission Adams had sent to Paris in 1798, followed by the publication of certain dispatches insulting to American sovereignty, Hamilton wanted to place the country under arms immediately. He even believed that the French, who had embarked on an undeclared naval war against the United States, might attempt to invade the country. Still eager for military glory, Hamilton sought command of the new army, though Washington would be its titular head. Adams resisted Hamilton's desires, but in Sept. 1798 Washington forced him to make Hamilton second in command of the army, the inspector general with the rank of major general. Adams never forgave Hamilton for this humiliation. Hamilton wanted to lead his army into Spain's Louisiana and the Floridas and other points south, but never did. Through independent diplomacy, Adams kept the quasi war from spreading into a full-scale conflict and at the order of congress disbanded the provisional army. With his dream of military glory faded, Hamilton resigned his commission in June 1800. Meantime Adams had purged his cabinet of those he regarded as "Hamilton's spies."

Election of 1800.—In retaliation, Hamilton tried to prevent Adams' re-election to the presidency. In Oct. 1800 he privately circulated a bitter personal attack on Adams, entitled *Letter from Alexander Hamilton Concerning the Public Conduct and Character of John Adams.* Aaron Burr, Hamilton's political enemy in New York, obtained a copy and had it published. Hamilton was then compelled to acknowledge his authorship and to bring his feud with Adams into the open, a feud that revealed an irreparable schism in the Federalist party. Thomas Jefferson and Aaron Burr won the election but because both had received the same number of electoral votes, the choice of president was thrown into the house of representatives. Hating Jefferson, the Federalists wanted to throw the election to Burr. Hamilton tried to persuade them, not too successfully, to select Jefferson instead. By supporting his old Republican enemy, who won the presidency, Hamilton lost prestige within his own party and virtually ended his public career.

The Burr Quarrel.—Hamilton then concentrated on his law practice and his family. In 1801 he built a country house on Manhattan Island called "The Grange," and helped found a Federalist newspaper, the New York *Evening Post.* Although Hamilton did not write for it under his own name, its policies reflected his ideas. Through the *Post* he hailed the purchase of Louisiana in 1803, even though New England Federalists had opposed it. Some of them talked of secession and in 1804 began to negotiate with Aaron Burr for his support. Almost all the Federalists but Hamilton favoured Burr's candidacy for the governorship of New York in that year. Hamilton urged the election of Burr's Republican opponent, who won by a close margin, but it is doubtful that Hamilton's influence decided the outcome. In any event, Hamilton and Burr had long been enemies and Hamilton had several times thwarted Burr's ambitions. In June 1804, after the election, Burr demanded satisfaction for remarks Hamilton had allegedly made at a dinner party in April in which he said he held a "despicable opinion" of Burr. Although Hamilton held an aversion to the practice of dueling, as a man of honour he felt himself compelled to accept Burr's challenge. If he declined, his reputation as a gentleman would be lost, as would whatever political influence he still retained. The two antagonists met early in the morning of July 11 on the heights of Weehawken in New Jersey where Hamilton's eldest son, Philip, a boy of 20, had died in a duel three years before. Burr's bullet found its mark and Hamilton fell. "This is a mortal wound, Doctor," he said, and became unconscious. He died the following day. A poor man, Hamilton left his wife and seven children heavily in debt, but friends paid off the debts.

Hamilton was a small, slender man, about five feet seven inches tall, with a fair complexion, light hair, strong features and deep-set eyes. He had an erect, dignified bearing, made striking by elegant clothes and fine manners. Some people found him stiff and formal, even vain and arrogant, but friends saw him as witty, warm, benevolent and loyal. Although a fine orator, he was more persuasive as an essayist. He was both a man of action and of ideas, but all of his ideas involved action and were directed toward some specific goal in statecraft. Unlike Benjamin Franklin or Thomas Jefferson, he did not have a broad inquisitive mind, nor was he speculative in his thinking in the philosophical sense of seeking intangible truths. He was ambitious, purposeful, a hard worker and one of America's administrative geniuses. In foreign policy he was a realist, believing that self-interest should be the nation's polestar; questions of gratitude, benevolence and moral principle, he held, were irrelevant.

Most of all, Hamilton was one of America's first great nationalists. He believed in an indivisible nation where the people would give their loyalty not to any state but to the nation. Although a conservative, he did not fear change or experimentation. The conservatism that led him to denounce democracy as hostile to liberty stemmed from his fear that democracy tended to invade the rights of property, which he held sacred. His concern for property was a means to an end. He wished to make private property sacred because upon it he planned to build a strong central government, one capable of suppressing internal disorders and assuring tranquility. His economic, political, military and diplomatic schemes were all directed toward making the union strong. Hamilton's most enduring monument was the union, for much of it rested on his ideas.

See also references under "Hamilton, Alexander," in the Index volume.

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HAMILTON, ANTHONY (*c.* 1645–1719), French writer, author of the *Mémoires* of his brother-in-law Philibert, comte de Gramont (*q.v.*), was an Irishman of Scottish extraction. His father, the fourth son of James Hamilton, 1st earl of Abercorn, moved his family from Ireland to France in 1651 but settled then in England in 1661 and took a house near Whitehall. Anthony's sister Elizabeth was married to Gramont in 1663. When Roman Catholics were expelled from the English army, Anthony's brother George went to France in 1658 with a body of troops that he had raised for Louis XIV, the *régiment d'Hamilton.* Serving with this regiment, Anthony was wounded at Entzheim in Alsace (1674). After George's death (1676), the fortunes of the regiment declined, and Anthony returned to Ireland, where in 1687 he was given a colonelcy by James II. After the siege of Limerick (Aug. 1690), he joined James II in France and shared in the general poverty of the Jacobite court at St. Germain. He died on April 21, 1719.

The *Mémoires du comte de Grammont,* theoretically dictated

by the aged Gramont, were written at Sceaux in 1704 and published in Holland, under the false imprint of "Cologne," in 1713. Weak in chronology but generally accurate in substance, they are most valuable for their pictures of the English court. Their success is due to a fortunate resemblance in style and in wit between author and subject. Hamilton can describe Tunbridge Wells as neatly as Versailles. His characters, small and great, are mordantly sketched; the innkeeper Cerise, "Swiss by nationality, poisoner by trade and thief by force of habit"; or the maid of honour, Miss Price, who "was round and stocky and accordingly did not dance." Macaulay was persuaded that this of all books was the most exquisitely French in spirit and manner. As well as some light verse, Hamilton also wrote satirical tales: *Zeneyde* (*c.* 1696; publ. 1731), which Macaulay used as a historical source on the court of St. Germain, *Le Bélier* (1705; publ. 1730), *Les Quatre Facardins* and *Histoire de Fleur d'Épine* (both probably between 1710 and 1715; publ. 1730).

BIBLIOGRAPHY.—There are collected editions of Hamilton's works by A. A. Renouard, 3 vol. (1812) and J. B. J. Champagnac, 2 vol. (1825). Of the *Mémoires* more than 40 editions include one by Horace Walpole (1772). Walter Scott edited an English translation with extensive notes (1811 and later editions); and there is a modern translation by G. Goodwin, 2 vol. (1908). *See* also Ruth Clark, *Anthony Hamilton, . . . His Life and Work and His Family* (1921).

(W. G. ME.)

HAMILTON, EMMA, LADY (*c.* 1765–1815), wife of Sir William Hamilton (*q.v.*), the British envoy at Naples, and famous as the mistress of Nelson, was the daughter of Henry Lyon, a blacksmith of Great Neston, Cheshire, where she was christened on May 12, 1765. When she went to live with Charles Greville in 1781 she called herself Emily Hart. Under the protection of Greville, whose means were narrowed by debt, she was taught to sing, dance and act with professional skill. In 1782 he introduced her to his friend Romney, whose portraits of her may have somewhat idealized her apparently robust and brilliantly coloured beauty, but her vivacity and powers of fascination cannot be doubted. She seems to have been sincerely attached to Greville. In 1784 his uncle, Sir William Hamilton, saw—and admired—her. Two years later she was sent on a visit to him at Naples, as the result of an understanding between Hamilton and Greville—the uncle paying his nephew's debts and the nephew ceding his mistress. Emma at first resented the exchange, but submitted. Her beauty, her artistic capacity, and her high spirits made her a great favourite in Neapolitan society, and Queen Maria Carolina became closely attached to her. She became famous for her "attitudes," a series of *poses plastiques* in which she represented classical and other figures. On Sept. 6, 1791, during a visit to England, Hamilton married her, in order to justify her public reception at the court of Naples, where she was the channel of communication between the queen and the British minister—sometimes in opposition to the policy of the king. It was claimed that she secured valuable information in 1796, and was of essential service to the British fleet in 1798 during the Nile campaign, by enabling it to obtain stores and water in Sicily. When Nelson returned from the Nile in Sept. 1798 Lady Hamilton subjugated him, and drew him into a most unhappy participation in the domestic troubles of Naples, and when Sir W. Hamilton was recalled in 1800 she traveled with him and Nelson across Europe. In England Lady Hamilton paraded her hold over Nelson. Their child, Horatia Nelson Thompson, was born on Jan. 30, 1801. On her husband's death in 1803 she received by his will a liferent of £800, and the furniture of his house in Piccadilly. She then lived with Nelson at his house at Merton. On his death she received Merton, and an annuity of £500, as well as the control of the interest of the £4,000 he left to his daughter. But gambling and extravagance kept her poor, and in 1813 she was put in prison for debt and remained there for a year. She died at Calais in distress if not in want on Jan. 15, 1815. *See* also NELSON, HORATIO NELSON, Viscount.

See O. Warner, *Emma Hamilton and Sir William* (1960).

HAMILTON, LORD GEORGE FRANCIS (1845–1927), English statesman, was born on Dec. 17, 1845, third son of the 1st duke of Abercorn. He was educated at Harrow and entered the house of commons in 1868 as Conservative member for Middlesex. He sat for the Ealing division from 1885 until his retirement in 1906. Lord George took a keen interest in education throughout his life. He was vice-president of the committee of council on education from 1878 to 1880 and chairman of the London School board from 1894 to 1895. He was a well-known economist and statistician and rendered signal service to social science as chairman of the Poor Law commission, 1905–09. Perhaps his greatest work was done as first lord of the admiralty (1885–1886 and 1886–1892). He carried through the Naval Defence act of 1889, which formed the framework for the development of the navy up to the beginning of World War I. He secured the transfer of the control of naval ordnance from the war office to the admiralty, created the naval intelligence department and "discovered" John Arbuthnot Fisher (afterward Lord Fisher).

His long service with Unionist governments ended in 1903, when he and C. T. Ritchie resigned on the fiscal question. Lord George Hamilton became secretary of state for India in 1895 under Lord Salisbury and held this office until 1903. This important period in Indian affairs covered the viceroyalties of Lord Elgin and Lord Curzon. At the outset he laid down a moderate frontier policy which secured the Indian government from much fruitless border warfare. His last public service was as chairman of the Mesopotamia commission (1916–17). He died in London on Sept. 22, 1927.

Lord George married in 1871 Lady Maud Lascelles, daughter of the 3rd Earl Harewood. He wrote *Parliamentary Reminiscences and Reflections* (1916–22).

HAMILTON, SIR IAN STANDISH MONTEITH (1853–1947), British general who was in charge of the Gallipoli campaign in World War I, was born in Corfu on Jan. 16, 1853. He joined the army in 1872, transferring to the 92nd Highlanders and serving with them in the Second Afghan War (1878–80), where he caught the eye of Gen. F. S. Roberts with whom he was to be associated for many years. He later served in the South African campaign (1881), Nile expedition (1884–85), Burma (1886–87), Chitral relief force (1895) and Tirah (1897–98). In the South African War (1899–1902) he commanded a brigade and division and was later chief of staff to Lord Kitchener. Hamilton headed a military mission (1904–05) with the Japanese armies in the Russo-Japanese War. He was later commander of the southern command and adjutant general at the war office (1909–10) where he took a leading part in opposing Lord Roberts' campaign for compulsory service. He became commander in chief in the Mediterranean in 1910. His appointment in 1915 to command the Mediterranean expeditionary force was the greatest test of his career and as a commander he failed. The operations in Gallipoli (*see* DARDANELLES CAMPAIGN) never reached full success for several reasons—faults in command, Hamilton's overoptimism, heavy casualties, and Hamilton's opposition to suggestions for withdrawal. All of these developments resulted in his recall.

Hamilton was an exceptionally gifted officer of great personal courage, but after Gallipoli he was given no further command. He took a great interest in the British Legion and its work. He died in London on Oct. 12, 1947. He was an accomplished writer with original ideas. His publications included *A Staff Officer's Scrap Book*, two volumes (1905–07); *Compulsory Service* (1910); *Gallipoli Diary*, two volumes (1920); *When I was a Boy* (1939); *Jean* (1942) and *Listening for the Drums* (1944).

See C. F. Aspinall-Oglander, *Official History of the Great War: Gallipoli*, 2 vol. (1929–32).

(R. G. TH.)

HAMILTON, JAMES (1769–1829), English teacher and originator of the Hamiltonian system of language instruction. He was for some years a merchant in France and at Hamburg where he learned German from a French *émigré*, General D'Angeli. In 1815 he sailed to New York with the intention of becoming a farmer and manufacturer of potash, but changed his mind during the voyage and decided to teach languages on D'Angeli's plan. In 1816 he gave his first lecture on the Hamiltonian system at Philadelphia. After visiting other cities in the United States and Canada, he returned to England in 1823 and taught languages to adults in towns throughout the country. He wrote his own textbooks in

which he discarded grammar for a literal word-for-word translation below each line of the original text. Among the interlinear translations were the Gospel of St. John, Aesop's *Fables* and Eutropius. He was a very successful teacher and some of his pupils mastered a new language in an incredibly short time. His method, which he described in *The History, Principles, Practice and Results of the Hamiltonian System* (1829), was criticized by many teachers, but was defended by Sydney Smith in the *Edinburgh Review*. He died in Dublin on Sept. 16, 1829. (S. J. C.)

HAMILTON, JAMES HAMILTON, 1ST DUKE OF (1606–1649), Scottish royal favourite whose rash advice and ineffectual actions did much damage to the royalist cause during the English Civil War, was born on June 19, 1606. He was the son of James, 2nd marquess of Hamilton, and of Anne Cunningham, daughter of the earl of Glencairn. As the direct descendant of James Hamilton, 1st earl of Arran, he was heir to the throne of Scotland failing descendants of James VI. He married in his 14th year Margaret Feilding, aged seven, daughter of Lord Feilding (afterward 1st earl of Denbigh), brother-in-law of George Villiers, duke of Buckingham. He was educated at Exeter college, Oxford, succeeded his father as 3rd marquess in 1625 and in 1628 was made master of the horse, gentleman of the bedchamber and privy councilor. In 1631 he led several thousand men to assist Gustavus Adolphus in Germany. He guarded the fortresses on the Oder while Gustavus fought Graf von Tilly at Breitenfeld. Hamilton later occupied Magdeburg, but his army was destroyed by disease and starvation and he was back in England by May 1633.

After the Scots had drawn up the national covenant in protest against the new prayer book, Hamilton, who had previously played little part in Scottish affairs, was appointed king's commissioner to the general assembly which met on Nov. 21, 1638, in Glasgow cathedral. He dissolved the assembly on Nov. 28, when it decided to exclude the bishops from membership and to pass judgment upon them, but the assembly continued to sit and Hamilton returned to England. When the covenanters prepared for war, Hamilton was chosen to command an expedition to the Forth to menace their rear. He found the opposition too strong and resigned the commissionership in July 1639. In England, he supported the earl of Strafford's proposal to call the Short parliament, but otherwise opposed him as the author of friction between king and people, and in Feb. 1641 he persuaded Charles to admit some of the parliamentary leaders to the council.

Hamilton accompanied Charles I on his second and last visit to Scotland in Aug. 1641. He found he had an antagonist in the earl of Montrose, who detested both his shifty irresolution and his attempt to make terms with the more extreme covenanters under the earl of Argyll. When no reconciliation proved possible between Charles and Argyll, Hamilton sided with the latter. In consequence he received a challenge from Lord Ker, informed Charles of this and obtained an apology. Montrose wrote to Charles declaring that he could prove Hamilton to be a traitor. Shortly after, on the discovery of a plot, known as the "incident," to seize Argyll, Hamilton and the earl of Lanark (Hamilton's brother), the three fled from Edinburgh (Oct. 12, 1641). In spite of his intrigues Hamilton retained Charles's confidence and went to Scotland in July 1642 to try to prevent the participation of the Scots in the English Civil War. A breach then opened between him and Argyll. In Feb. 1643 Hamilton instigated the "cross petition" in opposition to Scottish intervention in England and also tried to strike at the earl of Loudoun, who was chancellor of Scotland and a supporter of the policy of intervention. When this failed Hamilton promoted a scheme for outvoting Argyll in the Scottish parliament by sending to Scotland all the Scottish peers then with the king, while Charles was to guarantee the establishment of Presbyterianism in Scotland though not, as the Scots demanded, in England. He won over the queen to his project and was created duke of Hamilton on April 12, 1643. Montrose, who was eager for military action to anticipate the plans of the covenanters, was thus condemned to inaction. Hamilton's scheme failed. On refusing to sign the Solemn League and Covenant, he and his brother were obliged to leave Scotland. They arrived at Oxford on Dec. 16, 1643. Hamilton's conduct had at last incurred Charles's resentment and he was imprisoned in Pendennis castle (Jan. 1644). Removed to St. Michael's mount in 1645, he was liberated by Gen. Sir Thomas Fairfax's troops on April 23, 1646.

After taking part in the negotiations between the Scots and Charles at Newcastle, Hamilton returned to his policy of outvoting Argyll in the Scottish parliament, this time successfully, and he was able to raise a large army in favour of the "Engagement" between the Scots and Charles I. Leading the army into England on July 8, 1648, Hamilton showed complete incapacity; he was kept in check for some time by John Lambert and, though outnumbering the enemy by 24,000 to about 9,000, allowed his troops, dispersed over the country, to be defeated (in detail) by Oliver Cromwell at the so-called battle of Preston. Taken prisoner on Aug. 25, Hamilton was condemned to death on March 6, 1649, and executed three days later. (GN. D.)

HAMILTON, JOHN (1512–1571), Scottish prelate and statesman, illegitimate son of James, 1st earl of Arran, obtained the abbacy of Paisley at an early age in 1525. He became bishop of Dunkeld in 1546 and was translated to St. Andrews in 1547, also holding the offices of keeper of the privy seal (1543–46) and lord treasurer (1543–54). As archbishop of St. Andrews he held provincial councils in 1549, 1552 and 1559, which promulgated reforming statutes, but he was unable to avert the Scottish reformation in 1560. Protestant hostility led to his imprisonment in 1563 and when released he became an active partisan of Mary Stuart. Tried on a charge of complicity in the murders of Lord Darnley and the regent Moray, he was hanged on April 7, 1571.

See Sir J. Herkless and R. K. Hannay, *The Archbishops of St. Andrews*, vol. v (1915). (A. L. MU.)

HAMILTON, SIR WILLIAM (1730–1803), British diplomat and archaeologist, was the husband of Lady Emma Hamilton, Nelson's mistress. Hamilton was the son of Lord Archibald Hamilton, governor of Greenwich hospital and of Jamaica, and was born in Scotland on Dec. 13, 1730. He served in the 3rd regiment of foot guards from 1747 to 1758, but left the army after his marriage to a Welsh heiress, and inherited an estate in Swansea upon her death in 1782. From 1764 until his recall in 1800 he was British envoy to the court of Naples. Hamilton made or caused to be made, at Vesuvius and Etna, a series of observations on the action of volcanoes and published several treatises on earthquakes and volcanoes between 1772 and 1783. He was a notable collector and many of his treasures went to enrich the British museum. He married Emma in 1791. The outbreak of the French Revolution and the rapid extension of the revolutionary movement in western Europe soon overwhelmed Naples, a situation with which he was incapable of dealing. He died on April 6, 1803. *See* HAMILTON, EMMA.

HAMILTON, SIR WILLIAM, BART. (1788–1856), Scottish metaphysician, who as a teacher exerted a remarkable influence over the thought of the younger generation in Scotland, was born in Glasgow on March 8, 1788, the son of William Hamilton, professor of anatomy and botany there. Educated at Glasgow, Edinburgh and Balliol college, Oxford, he took his B.A. in 1811 and became a member of the Scottish bar two years later. Hamilton was an unsuccessful candidate for the chair of moral philosophy at Edinburgh university in 1820 but was appointed professor of civil history there in 1821. His essay in the *Edinburgh Review*, on the "Philosophy of the Unconditioned" (1829), a critique of Victor Cousin's *Cours de philosophie*, led to a long and friendly correspondence between him and Cousin. His subsequent articles on German philosophy (he had taken up the study of the German language as a result of visits to Germany in 1817 and in 1820) established his reputation as a philosopher; and in 1836 he was elected to the chair of logic and metaphysics at Edinburgh. His knowledge embraced anatomy, physiology, literature and theological lore as well as his professed subjects.

Hamilton published a pamphlet on Presbyterian church affairs, *Be Not Schismatics, Be Not Martyrs by Mistake*, in 1843. In the following year he was stricken with paralysis. His edition of Thomas Reid's works appeared in incomplete form in 1846. Later publications were *A Letter to Augustus De Morgan* (1847), part

of a controversy on the principles of logic; *Discussions on Philosophy, Literature and Education* (1852), a collection of articles reprinted from the *Edinburgh Review;* and 9 vol. (1854–56) of an edition of the works of Dugald Stewart. He died in Edinburgh on May 6, 1856.

Hamilton was not a great originator, and his attempt to combine the Scottish "philosophy of common sense" with elements of Kantianism was not successful. He was, however, influential both in stimulating a taste for metaphysics in his students and in introducing some of Kant's ideas to the British public. At the lowest estimate, he made British philosophy less narrow and one-sided than it was. In the history of logic he has a place for his doctrine of the "quantification of the predicate" (an attempt to elaborate the traditional classification of propositions by expanding "All *A* is *B*" into the two forms "All *A* is all *B*" and "All *A* is some *B*"; and so on); but its radical implications in leading to an extensional conception of logic were not perceived by him. In the field of education Hamilton's *Edinburgh Review* articles on "The State of the English Universities" (1831) and "The Right of Dissenters to Admission Into the English Universities" (1834) were among the factors which led to the royal commission of 1850 and the subsequent reforms.

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HAMILTON, WILLIAM, OF GILBERTFIELD (*c.* 1665–1751), Scottish poet whose vernacular poetry (*e.g.*, "The Last Dying Words of Bonnie Heck," printed in James Watson's *Choice Collection,* 1706) is among the earliest in the 18th-century revival. He was born at Ladyland, Ayrshire. He exchanged with Allan Ramsay "Familiar Epistles" in verse, which are usually included in editions of Ramsay; and his modernized version of Blind Harry's *Wallace* (1722) influenced Burns. He died at Latrick, Lanarkshire, May 24, 1751. (E. G. M.)

HAMILTON, WILLIAM GERARD (1729–1796), English politician, known as "Single Speech Hamilton," was born in London on Jan. 28, 1729, and educated at Winchester and at Oriel college, Oxford. His maiden speech in the house of commons (Nov. 13, 1755), a marathon effort lasting almost 15 hours, established his nickname (unjustifiably, since he made at least one other speech) and a reputation for brilliance. He was much admired by Horace Walpole, Samuel Johnson and Fanny Burney, although his onetime secretary, Edmund Burke, was not so effusive. Hamilton was made a commissioner for trade and plantations (1756). The rest of his career was spent largely in Ireland, graveyard of English political reputations, as chief secretary (1761) to Lord Halifax, lord lieutenant of Ireland, and as chancellor of the Irish exchequer (1763–84). He later returned to the house of commons but did not favour it with any further displays of oratory. He died in London on July 16, 1796.

HAMILTON, SIR WILLIAM ROWAN (1805–1865), Irish mathematician, whose works were of great value in mathematical physics, was born in Dublin on Aug. 4, 1805. His great mathematical intelligence was awakened by the reading of Newton's *Arithmetica universalis* when he was 12 years old. He went on to the *Principia,* and when he was 17 attacked Laplace's *Mécanique céleste.* In this he detected an error which was communicated to John Brinkley, then royal astronomer in Ireland, who at once recognized one of the first mathematical minds of the age. Hamilton had a brilliant career at Trinity college, Dublin, but before it was completed he was appointed, at the age of 22, to the Andrews chair of astronomy in succession to Brinkley. The rest of his life was spent at the observatory at Dunsink, near Dublin, in the close study of mathematics. He was knighted in 1835. At the time of his death, Sept. 2, 1865, Hamilton was working on his *Elements of Quaternions,* on which the last six years of his life had been spent.

His earliest papers were the "Theory of Systems of Rays" (*Trans. Roy. Irish Acad.,* 1828–32); in the last of these, by the aid of mathematics, he predicted conical refraction. These were followed by papers on "The Principle of Varying Action" and in 1834 and 1835 by two memoirs "On a General Method in Dynamics." The latter papers made a great addition to the methods of inquiry in dynamics, being of great value particularly in the quantum theory.

Hamilton's *Lectures on Quaternions* were published in 1853 and his great book, *The Elements of Quaternions,* posthumously in 1866. In the preface to the *Lectures* he describes the steps by which he reached his important conclusions which form the germ of the later basic theories of hypercomplex numbers.

The discoveries, papers and treatises mentioned might well have formed the whole work of a long and laborious life. But he left an enormous collection of manuscript books, full of original investigations, that were handed over to Trinity college. His paper on *Fluctuating Functions* and his extremely ingenious invention of the hodograph must be mentioned. Only a few items of his investigations into the solution (especially by numerical approximation) of certain classes of differential equations were published in the *Philosophical Magazine.* Hamilton was a neat, precise and fastidious writer; this may be the reason that he published so little compared with the extent of his investigations.

See R. P. Graves, *Life of Sir W. R. Hamilton* (1882–89); Royal Irish Academy, *Mathematical Papers of Sir W. R. Hamilton,* 2 vol. (1931–40). (O. OE.)

HAMILTON, a city in southwestern Victoria, Austr. Pop. (1961) 9,495. It lies 576 ft. above sea level on Grange Burn, a tributary of the Wannon river south of the Grampians, the most westerly of the plateaus forming the Great Divide. A noted sheep, pastoral and agricultural district, it has municipal saleyards, abattoirs and meat freezing. It has sawmilling and woodwork, and produces plaster sheet, tools and butter. Made a borough in 1863, a town in 1928 and a city in 1949, it has air, road and rail services, parks and recreational reserves.

HAMILTON, the capital of the British colony of Bermuda, is situated on the main island along the sloping northern shore of a deepwater, landlocked harbour. Pop. (1960) 2,763. Rectangular in shape, its streets are parallel and cross at right angles. An imposing neo-Gothic cathedral is centrally situated on Church street at the highest point in the city, which it dominates. Near the cathedral is the handsome Sessions house, accommodating the house of assembly, the supreme court and judicial offices. It is surrounded by government departments, including the Public building, containing the colonial secretariat and the council chamber, in which the executive and legislative councils meet and the colonial parliament is convened and prorogued. The city possesses the Bermuda historical museum and a public library, which stands in the Par la Ville gardens. In the northwest is Victoria park. Hamilton was founded in 1790, incorporated in 1793, succeeded historic St. George as capital in 1815 and was raised to city status in 1897. In 1956 it was made a free port to encourage business and employment. Cars were not permitted in the city until 1946 when a 15-m.p.h. speed limit was imposed. External communications are maintained by sea, and by air from the terminal 11 mi. N.E. of the city. The principal industry is the thriving tourist trade.

HAMILTON, one of the chief cities of Canada, the seat of Wentworth county, Ont., occupies a site upon the shore of a large landlocked harbour, Hamilton bay, at the western extremity of Lake Ontario. It covers a plain stretching between the water front and an escarpment called "the mountain," over 250 ft. high.

La Salle landed on the shore of Hamilton bay in Aug. 1669, but European settlement did not begin until 1778 with the arrival of Robert Land and Richard Beasley, United Empire loyalists. The actual founder of the city was George Hamilton who bought a farm between present James and Wellington streets and between the mountain and King street. In 1813 he laid out a town, naming the first streets after members of his family. Incorporated in 1816, the village became a town in 1833 and a city in 1846.

During the first decades, Hamilton was overshadowed by nearby Dundas which had important industries, was an early focal point for roads and in 1837 gained access to the bay with the opening of the Desjardins canal. Hamilton, however, was more important

in trade and finance. It benefited from the opening in 1830 of the Burlington canal, which linked the bay with Lake Ontario. After 1850 Hamilton became a railway centre and the real growth of the city began. Railway repair shops, bridge building and a variety of other metal-working industries were established. The basic iron and steel industry began in 1893. In its wake a large variety of metal-using industries followed: transportation equipment, structural steel shapes, building equipment, bolts, screws, wire, farm machinery, etc.

Called the "Pittsburgh of Canada," Hamilton is a leading industrial centre producing over 50% of the steel made in the country. The heavy industries are mainly concentrated on the water front, and the port handles over 8,000,000 tons of freight annually, including direct overseas trade. The harbour covers about 10 sq.mi. and is separated from Lake Ontario by a four-mile-long sand and gravel bar which carries a railway and highway. The approach to the harbour was greatly improved with the completion of a high-level bridge for the highway in 1958. The business district is centred around King and James streets as are the civic buildings such as the library, the city hall and the courthouse.

Hamilton is the centre of one of the finest fruit-growing districts on the continent, and behind the city hall is Canada's largest open-air market, held three days a week with fresh displays of fruits, vegetables and flowers. The better residential districts are toward the foot of the mountain, and residential development has spread to the top of the escarpment.

McMaster university, founded in Toronto in 1887 and moved to Hamilton in 1930, and its affiliate Hamilton college are on the western edge of the city. The university is known for nuclear research, having Canada's first privately owned nuclear reactor. Nearby is Hamilton's art gallery. The city has four high schools (one Roman Catholic) and several other educational institutions, four hospitals, a tuberculosis sanatorium and a mental hospital.

On the western fringes are the Royal Botanical gardens of 1,900 ac., established in 1941 by provincial legislation and including the famous rock gardens, an outstanding horticultural attraction. Well-known is the monument in the park at Stoney Creek, 5 mi. E. of the city, marking the site where in 1813 a British force of 700 men defeated an invading force of 2,000 Americans in a decisive battle of the War of 1812.

The population of Hamilton is largely of British, Polish, Italian and Hungarian descent. Pop. (1961) 273,991; greater Hamilton, 395,189. (JB. S.)

HAMILTON, a city in the land district of Auckland, N.Z., is situated on the Waikato river, 82 mi. S.S.E. of Auckland by road and 86 mi. by rail. Pop. (1961) 42,212. The principal business centre is on the west bank of the river and the main street is Victoria street. The largest public buildings are the hospital, founder's memorial theatre, a government building, the main post office and the courtrooms. Besides schools and colleges, there is a branch of Auckland university. Parks and playing fields in the city total 800 ac. Frankton junction (in the city) is one of the largest railway stations handling freight in the country, while 6 mi. S.E. of the city is Rukuhia airport. Hamilton is the centre of a large, fertile farming area. Its industries include timber, dairy, plastic and concrete products, engineering and brewing, and the manufacture of cardboard cartons and clothing.

HAMILTON, a large burgh of Lanarkshire, Scot., situated about 1 mi. from the junction of the Avon water with the Clyde and 11 mi. S.E. of Glasgow by road over Bothwell bridge. Pop. (1961) 41,928. Hamilton, which is crossed by many winding burns, is flanked on the east side by the Hamilton Low parks and by alluvial haughs. The area has been settled since prehistoric days, the original capital of the parish being Cadzow castle, now about 2 mi. S.E. on a precipitous rock, 200 ft. in height, washed by the Avon. After a charter of 1445 the town was renamed after the 1st Lord Hamilton, and became a burgh of barony in 1456 and a royal burgh in 1548, this last dignity being surrendered in 1670 when it was made the chief burgh of the regality and dukedom of Hamilton.

The discovery of coal caused great expansion of the town, and later iron foundries and engineering works were established, but by 1947 all the pits had closed down. Mainly a residential and shopping town, its industries include the production of metal castings and goods, electrical equipment, radio sets, carpets, knitwear and foodstuffs. In the district are orchards, market gardens and dairy farms.

The Mote hill in the Low parks is the site of the original village of Netherton whose 10th-century cross now stands in front of the parish church. In the churchyard is a monument to a group of covenanters executed at Edinburgh in 1600. The dukes of Hamilton had a palace on the part of their estate called the Low parks; the building was begun in 1591 and added to through the centuries, but because of subsidences caused by mining it was demolished in 1927. In the town is a domed mausoleum, 120 ft. high, erected by the 10th duke of Hamilton (d. 1852), and bought by the burgh in 1922. Near the mausoleum stood the tolbooth, built in 1642 and demolished in 1951, except for the clock steeple. The 16th-century grammar school, called the Academy, is housed in buildings dating from 1913. The municipal buildings were opened in 1914.

At Barncluith, 1 mi. S.E. of the town, are the Dutch gardens laid down in 1583 on the Avon terraces. Two mi. S.E. of Hamilton, near the ruined Cadzow castle, is the chase with its ancient oaks—remains of the great Caledonian forest; there is a herd of wild, white cattle in this estate of the High parks.

HAMILTON, a city of southwestern Ohio, U.S., the seat of Butler county, is located on the Great Miami river, 23 mi. N. of Cincinnati. The population of the city in 1960 was 72,354; the population of the Hamilton-Middletown standard metropolitan statistical area (comprising all of Butler county) was 199,076 according to the federal census. Fort Hamilton, the first of a chain of forts on the Miami and Maumee rivers, was built there in 1791 by Gen. Arthur St. Clair. A town called Fairfield was laid out adjoining the fort in 1794. The fort was abandoned in 1796 and about that time Fairfield was renamed Hamilton, for Alexander Hamilton. When Butler county was organized in 1803, Hamilton became the county seat. It was incorporated as a village in 1810 and as a city in 1857. Across the river was Rossville, a lusty rival until it united with Hamilton (1854).

Hamilton had the advantages of being in a fertile agriculturat district, at the centre of many turnpikes, on a useful river, on the Miami and Erie canal (from 1827 to 1913), and on the Baltimore and Ohio and the Pennsylvania railways. Abundant water power encouraged early industrial development, including the manufacture of farm machinery, paper, textiles and tools. Manufactures include paper, paper-mill felts, safes, vaults, automobile bodies, machinery, diesel engines, woolen blankets, machine tools, prefabricated houses and hydraulic and mechanical presses. The city has several parks and public buildings, and owns its public utilities (water since 1884; electricity since 1895). (W. E. SH.)

HAMILTON RIVER (GRAND or ASHUANIPI) is the principal river of Labrador, in northeastern Canada. It rises on the central plateau of Labrador-Ungava in a chain of lakes 1,750 ft. above sea level, and wanders aimlessly for 208 mi. until it falls precipitously into the Bowdoin canyon at Grand falls, 250 mi. from its mouth. The falls are 302 ft. high, and the river drops more than 800 ft. in 10 mi. Grand falls have a hydroelectric power potential estimated in excess of 4,000,000 h.p.; a program to harness them was begun in 1956. The upper stream, at the outfall from Menihek Lakes, was developed in 1953 to provide power for Schefferville. Below Grand falls the river flows in a deeply cut valley about 800 ft. below the plateau level, opening out only in the final six miles before discharging into Lake Melville and thence into the Atlantic ocean. Dense spruce forests vegetate the lower sections of the valley. Grand falls were discovered in 1839 by John McLean, Hudson's Bay company. (J. D. I.)

HAMIRPUR, a town and district in Uttar Pradesh, India. The town, headquarters of the district, is situated on the right bank of the Jumna (Yamuna) river near its confluence with the Betwa. Pop. (1961) 10,921. Kanpur (39 mi. N.) and Banda (37 mi. S.) are connected by road and railway.

HAMIRPUR DISTRICT (area 2,775 sq.mi.; pop. [1961] 794,449) forms part of the great plain of Bundelkhand, which stretches

from the Jumna to the central Vindhyan plateau and contains the famous artificial lakes of Mahoba. The old town of Mahoba (pop. [1961] 24,878) is known for the cultivation of betel nut. The northern part of the district is a flat plain overlaid with black cotton soil except where erosion has been severe, while the southern part is higher with gneissic outcrops jutting into low hills. The Jumna, Betwa, Dhasan and Barma rivers drain toward the east and southeast. Agriculture is the principal occupation. The main crops grown are rice, wheat, barley, millets, cotton and oil seeds. (M. N. K.)

HAMITE, a term applied to those peoples of Africa who speak Hamitic languages. Although there is some difference of thought as to the precise limits of this cluster of languages, they are generally considered to include the Berber languages (Berber, Rif, Kabyle and others of the Atlas mountain region, and Tuareg and others of the central Sahara); the Cushitic or Eastern Hamitic languages of northeastern Africa (including Somali, Afar, Beja, Galla and many others); Ancient Egyptian; and Hausa and some other languages of the Lake Chad area. These languages are closely related to Semitic languages, and the two main groups are usually considered to form a single Hamito-Semitic language family. In the past many scholars have included others, such as Hottentot and Fulani; this is certainly erroneous. Others have included the "Nilo-Hamitic" languages of east Africa; these, however, have not been finally classified, although it seems probable that they contain few Hamitic elements.

The inclusion of these various languages reflects an old ethnological assumption that all pale-skinned pastoralists of Negro Africa came from a Hamitic "race" which had also introduced sacral kingship and other features of "civilization" into Negro Africa from ancient Egypt. Although there is clearly considerable admixture of non-Negroid elements in the populations of east, central and south Africa, it is by no means certain that this strain is that of prehistoric Hamitic speakers. The extreme view of diffusionists such as William J. Perry has been exploded by anthropological observers. *See* also AFRICAN LANGUAGES; AFRICA: *Ethnography (Anthropology); Northeast Africa.*

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HAMITIC LANGUAGES: *see* AFRICAN LANGUAGES: *The Hamito-Semitic (Afro-Asiatic) Languages;* SEMITIC LANGUAGES.

HAMLET, the hero of Shakespeare's tragedy, corresponds to the figure Amleth or Amloði in books three and four of Saxo Grammaticus' Latin history of Denmark, written late in the 12th century. There Horvendill, Amleth's father, is murdered by his brother Feng, who later marries his victim's widow, Gerutha. Amleth feigns imbecility so that Feng will think him harmless and spare his life. He avoids entanglement with a girl sent by his enemies to entrap him and kills an eavesdropper in his mother's chamber. Ophelia and Polonius are thus faintly foreshadowed. When sent by Feng to England with two attendants who bear a letter instructing the king of England to assassinate him, Amleth manages to alter the letter so that the attendants are killed instead. He weds the king's daughter, returns to Denmark and slays Feng whom, however, his father-in-law is secretly pledged to avenge. To compass this the English king sends Amleth to the court of the dreaded Scottish queen, Hermuthruda, but she falls in love and marries him. He defeats the English king in battle and returns, with both wives, to Jutland.

It is possible that Saxo derived his story from the lost Icelandic saga of Amloði, mentioned by the 10th-century poet Snaebjörn. Certainly he introduced details from the classical tale of Lucius Junius Brutus. Kemp Malone has argued that the Amleth of Saxo was originally a product of Geatish tradition as developed in Jutland. He interprets the name Amloði as meaning "mad Onela" and suggests identification with the Swedish king Onela mentioned in *Beowulf*. Rudolf Zenker has suggested an oriental origin, basing his theory on the similarities between the Amleth story and that of Kei Chosro and Afrasiab in the *Shāh-Nāma* of the Persian poet Firdausi. Others posit a Celtic original, pointing to the warrior Amhlaidhe named as the slayer of king Niall Glundubh in the Irish annals under the year 917. Parallels to the Hamlet story occur in the legends which lie behind the English romances of Havelok, Horn and Bevis of Hampton, and also in the tale of Helgi and Hroar in the Scandinavian *Hrólfs Saga Kraka.*

The story of Hamlet is narrated in the fifth volume of François de Belleforest's *Histoires Tragiques* (1576), and an English version of this, *The Hystorie of Hamblet*, was published in London in 1608. Shakespeare's play may be dated between 1599 and 1602. It is clear, however, from a derogatory reference in Thomas Nashe's preface to Robert Greene's *Menaphon*, that a play of Hamlet had appeared on the English stage in or before 1589. Gregor Sarrazin and others have conjectured that Thomas Kyd was the author of this.

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HAMLIN, HANNIBAL (1809–1891), vice-president of the United States (1861–65), was born in Paris Hill, Me., Aug. 27, 1809. He was educated in the local school and at Hebron academy. Surveying, school teaching, farming and operating a weekly newspaper occupied him until he was able to study law. He was admitted to the bar in 1833 and practised successfully at Hampden near Bangor, Me. Entering politics as an antislavery Jacksonian Democrat, he was a member of the state house of representatives, 1836–40. He was defeated when he ran for congress in 1840 but was elected in 1842 and re-elected in 1844. From 1848 to 1856 he served in the U.S. senate. He took an antislavery position on sectional issues and left the Democratic party in 1856 because of its endorsement of the Kansas-Nebraska act. In the same year he was elected as Maine's first Republican governor but resigned in Feb. 1857, to return to the U.S. senate. The Republican national convention of 1860 nominated Hamlin for vice-president in the belief that as an easterner and former Democrat he would balance Lincoln's presidential nomination. As vice-president he favoured radical emancipation measures and the arming of Negroes.

After failing to secure renomination in 1864 he became collector of the port of Boston, but resigned in 1866 when he found himself out of sympathy with President Johnson's policies. Again in the senate, 1869–81, he upheld radical reconstruction, worked for postal reforms, and served as chairman of the foreign relations committee. After voluntary retirement from the senate he was U.S. minister to Spain, 1881–82. He died in Bangor, Me., on July 4, 1891.

See C. E. Hamlin, *Life and Times of Hannibal Hamlin* (1899). (E. H. Ro.)

HAMM, a town of Germany, *Land* (state) of North Rhine-Westphalia, which after partition of the nation following World War II became part of the Federal Republic of Germany, is on the Lippe and Ahse rivers about 40 km. (25 mi.) by road E.N.E. of Dortmund. Pop. (1961) 70,641. Hamm is on the eastern outskirts of the Ruhr, and more than half the buildings were destroyed in World War II. The new town is dominated by a 13-story skyscraper, completed in 1959, which houses the *Land* Supreme Court of Hamm. The main shopping streets have been rebuilt. There are a museum, music school and library, formal garden, a large wooded park and thermal springs.

Hamm is a key railway junction with lines radiating to all parts of Germany. Its freight station is one of the largest in western Europe. It is also connected to the *Autobahn* and canal systems. Wire and cable manufacture form the chief industries but machinery, stoves, beer, stockings, yeast and varnish are also made. There are coal mines in the neighbourhood.

Founded in 1226, Hamm was at its zenith at the end of the 17th century. The Industrial Revolution caused further expansion in the 19th century. In World War II Hamm was one of the most heavily bombed of all German cities.

HAMMAD AL-RAWIYAH (ABU AL-QASIM HAMMAD IBN ABI LAILA SABUR) (*c.* 694–*c.* 772), Arab scholar, famous for his

knowledge of pre-Islamic and early Islamic poetry and credited with the collecting of the early odes known as the *Mu'allaqat* (*q.v.*). He was born in Kufa, probably in 694, of the tribe of Dailam. Reputed to be the most learned man of his time in regard to the "days of the Arabs" (*i.e.*, their chief battles), their stories, poems, genealogies and dialects, he is said to have boasted that he could recite 100 long *qasidas* (odes) for each letter of the alphabet (*i.e.*, rhyming in each letter) and these chiefly from pre-Islamic times. Hence his name *al-Rawiyah* ("the reciter of verses from memory"). A favourite of the caliphs Yazid II and Hisham, he came to live in Damascus, where he died *c.* 772.

See Ibn Khallikan's biographical dictionary in French trans. by M'G. de Slane, vol. i (1842).

HAMMANN, OTTO (1852–1928), German journalist, who as director of the press section of the German foreign office from 1894 to 1916 exercised considerable influence, was born at Blankenhain, Jan. 23, 1852. He studied law and in the 1880s moved to Berlin where he became a journalist. He was appointed leader of the foreign office press section by the imperial chancellor, Count Leo von Caprivi, and played a leading part in Caprivi's defensive campaign against Bismarck's followers. Hammann maintained friendly relations with Caprivi's successor Prince Hohenlohe, and under the chancellorship of Prince von Bülow, who fully recognized the importance of the press, his influence increased, arousing, however, much hostility. Among his tasks was the preparation of the important declarations of policy which the chancellor made before the *Reichstag*. His works include *Der neue Kurs* (1918), *Zur Vorgeschichte des Weltkriegs* (1918) and *Um den Kaiser, Errinerungen . . .* 1906–09 (1919). He died in Berlin, June 18, 1928.

See *Deutsches Biographisches Jahrbuch*, vol. x, 1928 (1931).

HAMMARSKJÖLD, DAG (HJALMAR AGNE CARL) (1905–1961), Swedish statesman, economist and United Nations official who was posthumously awarded the 1961 Nobel peace prize, was born at Jonköping, Swed., on July 29, 1905. Son of a former Swedish prime minister, Hjalmar Hammarskjöld, he studied law and economics at the universities of Uppsala and Stockholm. At Stockholm he became an assistant professor of political economy in 1933. He joined the civil service in 1936 as permanent undersecretary in the ministry of finance. He was also for several years president of the board of the Bank of Sweden.

In 1947 Hammarskjöld was appointed to the ministry of foreign affairs and was made responsible for all international financial and economic questions. He served for two years as permanent secretary-general of that ministry and entered the cabinet in 1951 as minister of state with the functions of deputy foreign minister. In April 1953, he was elected secretary-general of the UN and was re-elected unanimously for another term of five years in Sept. 1957. In 1956–57 Hammarskjöld was deeply involved in the Suez canal crisis. Thereafter the middle east continued to occupy his attention, and he went there several times to confer with Israeli and Arab leaders. On March 27, 1959, he visited Soviet Premier N. S. Khrushchev at Sochi, U.S.S.R.

Civil strife broke out in the Belgian Congo after it gained independence in 1960 and Hammarskjöld dispatched UN troops to the area in an effort to reunite—by force if necessary—the warring factions. This action was denounced by the U.S.S.R., which demanded that Hammarskjöld resign and that a three-man board replace the office of secretary-general. The members of this *troika* (a Russian word meaning a three-horse team) would represent the western, neutralist and Communist nations, and each would exercise veto power over the other two and thus over the actions of the secretariat. Hammarskjöld refused to resign, but while on a peace mission to the Congo he was killed in a plane crash near Ndola, Northern Rhodesia, on Sept. 18, 1961, just one day before the scheduled opening of the 16th session of the UN general assembly. A month after his death Hammarskjöld was awarded the 1961 Nobel peace prize.

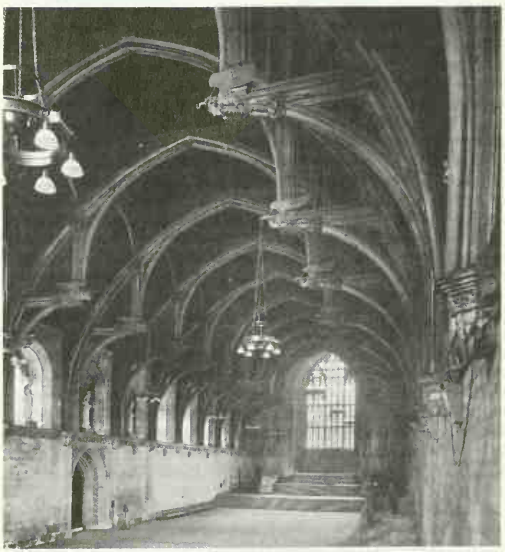
HAMMARSKJÖLD, HJALMAR (1862–1953), Swedish statesman, prime minister in World War I, was born at Tuna on Feb. 4, 1862. He studied at Uppsala, where in 1891 he was appointed professor of civil law. He became minister of justice in the Van Otter cabinet, holding this post from 1901 to 1902, when he was appointed president of the Göta high court. In 1905 he was minister of education in the Lundeburg cabinet and also a delegate to the conference with Norway at Karlstad at the time of the dissolution of the union. He was Swedish minister in Copenhagen from 1905 to 1907, when he became governor (*landshörding*) of the province of Uppsala.

He had been Swedish delegate at The Hague conferences on private international law in 1900 and 1904, and from 1904 he was Swedish member of The Hague international board of arbitration. In 1907 he was Sweden's leading delegate to the Hague peace conference and in 1909 acted as president of the Franco-German board of arbitration in regard to the Casablanca affair. He presided in 1913 over the Franco-Italian arbitration court regarding the seizure of vessels during the Tripoli war.

In Feb. 1914 he succeeded Karl Staaff as prime minister, retaining this post until 1917. Hammarskjöld became a curator of the Académie de Droit International at The Hague. He was president of the Institut de Droit International (1924–38) and chairman of the Nobel Prize foundation (1929–47). He died in Stockholm on Oct. 12, 1953.

HAMMER, commonly a hand tool consisting of a head at the end of a shaft. The implement is used in such operations as beating, crushing, flattening and driving. The head, usually of metal, may have two flat faces, or the ends may be shaped to serve various purposes. Peen ends function to crack or chip materials, to make indentations and so on. Devices resembling the common hammer in shape or function, including heavy power-driven equipment used in drop forging and some pneumatic tools are also called hammers. Hammerlike devices are employed for striking metal and wood elements in some musical instruments, for ringing bells and for discharging many types of firearms. The word hammer is used to describe an extremely wide variety of objects ranging from a tiny bone (the malleus) in the human ear to a weight thrown in athletic competition. Another hammer, usually known as *martel de fer*, was a medieval hand weapon. With a long shaft it was used by infantry, especially against mounted troops. With a short handle, and usually made entirely of metal, it was used by cavalry soldiers.

HAMMERBEAM ROOF, in architecture, a term for a type of truss used in an open timber roof. In this construction, the



A. F. KERSTING

HAMMERBEAM ROOF IN WESTMINSTER HALL, LONDON

ordinary tie beam, *i.e.*, the horizontal beam in a roof which ties together the feet of the rafters, is cut through, leaving a horizontal portion, the hammerbeam, which projects from the wall. The cutting of the tie beam allows a higher open space in the centre of the building.

The hammerbeam is supported by curved braces springing from wall posts which rest on corbels. A post usually rises vertically from the end of the hammerbeam to the intersection of the rafter and the cross tie. For greater strength a large arched piece of timber, rising from the wall post or from the hammerbeam, is often carried across the hall. The hammerbeam ends usually terminate in carved figures and all other parts are richly decorated with moldings. Two rows of hammerbeams are occasionally used, and the hammerbeam is also found in conjunction with other forms of trusses.

Although this principle of trussing was known in the 13th century, it received its most characteristic development in 14th-century England. The earliest extant example is the Great Hall, Palace of Westminster, London, begun 1394. Other important examples exist over the halls of the palaces of Hampton Court and Eltham, and many examples are to be found, especially in East Anglia, in parish churches of the 15th and 16th centuries.

(E. B. MacD.)

HAMMERFEST, the most northerly town in the world and therefore a great tourist attraction, is situated 60 mi. S. of Nordkapp on the barren island of Kvalöy off the northwest coast of Norway, in Finnmark *fylke* (county), at 70° 39′ N., 23° 43′ E., the latitude being that of the extreme north of Alaska. Pop. (1961 est.) 5,862. The January temperature is only a little below freezing point, because of the influence of the warm North Atlantic drift, and the harbour is ice-free. Between Nov. 21 and Jan. 21 the sun is not visible and from May 17 to July 29 it does not set. After World War II the town was rebuilt as the main centre of west Finnmark. There are schools, churches and hospitals. The town hall is surrounded by public parks, one of which was the gift of a former U.S. ambassador to Norway, Charles U. Bay. Every summer the surrounding country, including nearby islands, is visited for grazing by herds of partially domesticated reindeer belonging to nomad Lapps. The town was a base for trapper pioneers in the arctic region and its coat of arms depicts a polar bear on a red background.

Hammerfest is a busy port. In summer there is a road connection with the national highway and with Finland, and air services. Industrial undertakings include modern fish-filleting and freezing, ship repairing and carpentry. Main exports are cod liver oil, fish and fish products. Coal and salt for curing are imported. Hammerfest's town charter was granted in 1789. The town was bombarded and pillaged by two English brigs in 1809. The meridian stone, commemorating the conclusion of the international scientific survey of a meridian arc between Hammerfest and the Black sea, was established in 1852. Eighty per cent of the town was destroyed by fire in 1891. Hammerfest had the first municipal hydroelectric power station of its kind the same year. The town was occupied in 1940 by the Germans who blew up all installations in 1944 and forcibly evacuated the population. Rebuilding started in 1945. Mine-sweeping of the harbour was completed in 1947. The majority of the population returned 1946–49. (R. Ja.)

HAMMERHEAD, any of several species of sharks of the genus *Sphyrna*, characterized by the unique configuration of the head, the anterior portion of which resembles a double-headed hammer with an eye on the end of each stalk. They are formidable and ferocious and occur in all tropical and subtropical seas, particularly in the Indian ocean. The common or smooth hammerhead (*Sphyrna zygaena*), which attains a length of about 12 ft., is world wide in temperate and tropical coastal waters; the scalloped hammerhead (*S. lewini*) has the same range. The great hammerhead (*S. mokarran*), of warm Atlantic waters, may attain 15 ft. in length. *See* Shark.

HAMMER-PURGSTALL, JOSEPH, Freiherr von (1774–1856), Austrian diplomat and author, the pioneer of Islamic studies in Germany, was born at Graz, June 9, 1774. In 1799 he was appointed to a post in the Austrian embassy in Constantinople and subsequently took part in an English campaign against the French in the eastern Mediterranean. He returned to Austria in 1807, and on inheriting estates in Syria in 1835 he was ennobled and retired from the diplomatic service. He died in Vienna, Nov. 23, 1856.

Hammer-Purgstall's services to oriental studies in Germany resembled those of Sir William Jones in England and Silvestre de Sacy in France. For 50 years he wrote incessantly on many subjects, but more important than his scholarly works were his texts and translations of Arabic, Persian and Turkish authors, which made their work known to a public outside narrow academic circles and opened the way for later studies. His principal historical work is his *Geschichte des Osmanischen Reiches*, 10 volumes (1827–35). He also wrote poems, plays and novels, now forgotten. He was largely responsible for the foundation of the Akademie der Wissenschaften at Vienna. Despite faults, Hammer-Purgstall did more for oriental studies than those who criticized his inaccuracies.

For a full list of Hammer-Purgstall's works, see *Comptes rendus* of the Académie des Inscriptions et des Belles Lettres (1857). *See* also C. Schlottmann, *Joseph von Hammer-Purgstall* (1857).

HAMMERSCHMIDT, ANDREAS (1612–1675), Austro-Bohemian composer known for his sacred music, was born at Brüx, Bohemia. Nothing is known of his youth or education. He was in the service of Count Rudolf von Bünau in 1633, in 1635 he was organist at the Peterskirche, Freiberg and about 1639 he became organist at the Johanneskirche, Zittau, where he remained until his death at Zittau on Nov. 8, 1675. His considerable output is important in the history of Lutheran music and most of the chorale tunes in the Lutheran service are taken from his work. In form his cantatas foreshadow those of the 18th century, though they have little variety in mood or treatment. Hammerschmidt's sources are mainly the chorales and the German Bible and his style is a simple one. His works include 17 short Lutheran Masses (Kyrie and Gloria only), unaccompanied sacred madrigals (*Geistliche Madrigalien*), a set of sacred symphonies (*Geistliche Symphonien*) for one or two voices with strings and continuo, and a book of secular songs (*Weltliche Oden*). (C. P. Co.)

HAMMERSMITH, a metropolitan borough of London, Eng., which under the London Government Act 1963 was to be amalgamated on April 1, 1965, with Fulham to form the new London borough of Hammersmith (*see* London). The metropolitan borough of Hammersmith is bounded by Willesden, Acton, Brentford and Chiswick, the Thames, Fulham, Kensington. Pop. (1961) 110,333. Area 3.6 sq.mi. It was mentioned with Fulham as a camp of Danish invaders in 879 when they occupied the island of Hame (now Chiswick Eyot). Hammersmith is residential with big industrial concerns (chiefly in Shepherd's Bush in the north) such as electrical and light engineering, sugar refining and the manufacture of foodstuffs. Old Hammersmith bridge, designed by W. Tierney Clark (1824), was the first suspension bridge near London; in 1884–87 another suspension bridge, designed by Sir Joseph Bazalgette, replaced it.

Until 1834 Hammersmith formed part of Fulham parish. Its church of St. Paul was built as a chapel of ease to Fulham and consecrated by Archbishop William Laud in 1631. The modern building dates from 1890. St. Paul's school was founded in or about 1509 by John Colet, dean of St. Paul's. But it appears that Colet actually refounded and reorganized a school which had been attached to the cathedral from at least the early 12th century. The school was attended by Milton and Pepys; it was moved to its site in Hammersmith road in 1883. The number of foundation scholars was set at 153, according to the number of fishes taken in the miraculous draught (John xxi. 11). The school governors are appointed by the Mercers' company (by which body the new site was acquired) and Oxford, Cambridge and London universities. There are also the Latymer Upper school for boys (1624); the Godolphin school, founded in the 16th century and remodeled as a grammar school in 1861; St. Paul's school for girls, in Brook Green; Nazareth House of Little Sisters of the Poor; and other institutions. By Shepherd's Bush green is the White City stadium, first occupied by the Franco-British exhibition of 1908. A television centre and film studios are nearby. The new town hall

(1939) faces Furnivall gardens which are crossed by the Cromwell road extension to the west completed in 1956 to relieve congestion in King street. Other buildings include the Olympia exhibition centre, built in 1884 and refaced in 1930, and Wormwood Scrubs prison, built in 1874 by convicts. In the neighbourhood of the Mall, bordering the river, are the Doves inn, where James Thomson is said to have written part of "The Seasons," and Kelmscott house, residence successively of Sir Francis Ronalds, who there invented a telegraph in 1816, George Macdonald and William Morris. Hammersmith returns two members to parliament, for North Hammersmith and, with part of Fulham, for Baron's Court.

HAMMERSTEIN, OSCAR, II (1895–1960), U.S. lyricist, musical comedy author and theatrical producer, who helped reshape American musical comedy, was born in New York city on July 12, 1895. He was graduated from Columbia university in 1916 and studied law there prior to entering upon a career in the theatre. Hammerstein wrote all or part of approximately 45 musical dramas for stage, film or television between 1920 and 1959. His collaborators included Otto Harbach, Frank Mandel, Guy Bolton and Laurence Schwab. He wrote lyrics for such composers as Herbert Stothart, Vincent Youmans, Rudolf Friml, Jerome Kern, Sigmund Romberg, Arthur Schwartz and Richard Rodgers. Among his best-known early works are *Rose Marie* (1924), *Sunny* (1925), *Desert Song* (1926) and *Show Boat* (1927). After 1943 he worked exclusively with Rodgers. Their musical dramas, including *Oklahoma!* (1943), *Carousel* (1945) and *South Pacific* (1949), did much to develop musical comedy into an integrated dramatic form instead of the conventionalized "boy-meets-girl" revue. After 1949 Rodgers and Hammerstein became theatrical producers for their own works as well as for those of many others. Hammerstein died at Doylestown, Pa., on Aug. 23, 1960. (O. G. B.)

HAMMER THROWING is the name given the 16-lb. weight-throwing event of the Olympic games track-and-field program that was developed into a sport centuries ago in Ireland, Scotland and England.

The earliest authentic date for a hammer-throwing contest outside the British Isles was Sept. 4, 1838, at Hoboken, N.J. On Sept. 11, 1839, there was a similar competition near Toronto, Ont. In 1900 the event was placed on the Olympic games program. It was made popular in the United States by a group of Ireland-born U.S. citizens, who raised the world record to 189 ft. 6½ in. in 1913—an increase in distance of 111 ft. 1½ in. over the winning performance at the first English amateur championships, March 23, 1866. (For hammer throwing in the Olympic Games, *see* OLYMPIC GAMES.)

The principal reason for the increase in record distances was the improvement in equipment and technique. In the early years of the sport, which goes back at least to 1154, a blacksmith's sledge hammer with a stiff wooden handle was used, and it was from the employment of that implement that the event originally derived its name.

The modern implement bears little resemblance to that used by the early Irish, Scottish and English hammer throwers. In its specifications of the implement to be used in its hammer-throwing event, the Amateur Athletic Union of the United States stated that the head should be of lead or a brass shell filled with lead or cast gray iron and spherical in shape. The handle must be a single unbroken and straight length of spring steel wire not less than ⅛ in. (3.175 mm.) in diameter, or no. 36 piano wire .102 in. (2.591 mm.) in diameter. The handle may be looped at one or both ends as a means of attachment. The grip may be either of single or double loop construction, but must be rigid and without hinging joints of any kind. The handle must be connected to the head by means of a swivel which may be either plain or ball bearing. The grip must be connected to the handle by means of a loop. A swivel may not be used. The weight must be not less than 16 lb. (7.257 kg.) complete as thrown. The length must not be more than 4 ft. (1.219 m.) complete as thrown.

There was also a diversity of rules governing the event prior to 1900. In Ireland, the thrower was permitted to make one or more turns before releasing the hammer. In Scotland, the throw was made from a stand. A 30-ft. circle was used in Oxford and Cambridge university competition from 1866 to 1881. The English Amateur Athletic association used a seven-foot circle from 1866 to 1887, changed that year to a nine-foot circle and a few years later returned to the seven-foot circle, which became the standard in Olympic games competition. In the United States, from 1876 to 1886, rules of the national championship specified that the throw was to be made from a stand without follow. After 1887, turns were permitted in national A.A.U. competitions. The throw is made from a seven-foot circle, the thrower must not touch the circle or the area outside the circle, and the hammer must fall within a 90° sector marked on the ground. These also became the rules governing the event in Olympic games competition.

Method of Throwing.—All successful hammer throwers use the same basic technique. The effort is begun at the rear of the circle with the thrower's back toward the intended direction of flight. The athlete swings the hammer several times about his head and then begins the first of three full turns of the body. Upon the completion of the third turn the hammer is released. It is important that each turn be faster than the preceding one. The first half of each turn is usually made on the heel of the left foot and completed on the ball of the left foot. During the throw, the left foot should always maintain contact with the ground.

Hammer-throwing performance depends upon the efficiency with which centrifugal force is developed. Thus, the orbit of the hammer must be circular until its release. An athlete best develops centrifugal force by twisting his body from right to left about a perpendicular axis. In this way the body is twisted from a position of nonalignment to and past a position of alignment. The fundamental principle employed in hammer throwing is similar to that used in swinging a bat or golf club. However, the use of body turns permits repetitions of the twisting motions with a consequent increase in centrifugal force. In the 1950s there was remarkable improvement in hammer-throwing performance throughout the world. In 1952 at Oslo, Nor., Sverre Strandli first threw a 16-lb. hammer more than 200 ft. officially, the distance being 200 ft. 11⅜ in. Throws of better than 200 ft. became common, and in the 1960s throws of more than 230 ft. were recorded. Advances in the style of throwing did not involve a new principle of centrifugal force development; instead, changes were designed to obtain a fuller and faster twisting movement of the body.

See Jacob Weber and Frank Rasky, *Training Olympic Champions in Track and Field* (1951). (H. AR. RN.; F. J. RN.)

HAMMERTOE, a painful condition in which a toe, commonly the second toe, is rigidly bent due to pressure from short shoes. The salient angle on its upper aspect is constantly irritated by the shoe and develops a corn (*see* SKIN, DISEASES OF). It is treated surgically by the excision of the small digital joint, causing the toe to lie flat.

HAMMETT, (SAMUEL) DASHIELL (1894–1961), U.S. writer whose works may be considered the first and best attempt to depict realistically the world of American crime, was born in St. Mary's county, Md., on May 27, 1894. His writings stem from his eight years' experience, as a young man, with Pinkerton's Detective agency. Hammett's countless short stories and novelettes in the magazine *Black Mask,* starting in 1923, and his first two novels—*Red Harvest* (1929) and *The Dain Curse* (1929)—are about the Continental Op, an anonymous agency operative modeled on Jimmy Wright of Pinkerton's Baltimore office. *The Maltese Falcon* (1930) introduces the more complex Sam Spade, in a work which many critics rank not only as a great detective story but as an important American novel. *The Glass Key* (1931) is a subtle study in loyalties. *The Thin Man* (1934) is his least typical book—a poor detective story but a bright comedy, featuring Nick and Nora Charles. After 1934 Hammett stopped writing for publication. In only a decade of creative activity, he exerted an influence on the American detective story greater than that of any other author since Poe, and no small influence upon the American novel. His gifts of characterization and dialogue have been compared, notably by André Gide, to those of Ernest Hemingway. Hammett died in New York city Jan. 10, 1961. (AY. B.)

HAMMOND, EDMUND HAMMOND, 1ST BARON (1802–1890), British civil servant, who, as head of the foreign office for

nearly 20 years, exercised considerable influence behind the scenes on late 19th-century diplomacy. He was a son of George Hammond (1763–1853), the first British minister to the United States (1791–95) and permanent undersecretary for foreign affairs (1795–1806 and 1807–09). Edmund Hammond was born in London on June 25, 1802, and was educated at Eton, Harrow and University college, Oxford. He began his official career in the privy council office in Oct. 1823 but was transferred to the diplomatic service early in 1824. Apart from four special missions abroad, he passed the rest of his working life in the foreign office. Lord Palmerston made him head of the Turkish department. In 1854 Hammond was permanent head of the office as undersecretary for foreign affairs, a post he retained until 1873. He was distinguished by an exceptional capacity for work, coupled with an exceptional grasp of detail; though always subordinate, he often influenced foreign secretaries. He inexpediently assured Lord Granville, then foreign secretary, on July 5, 1870, ten days before the Franco-German War began, that he had never known "so great a lull in foreign affairs," an opinion also expressed by a French prime minister five days earlier. On retirement, Hammond was raised to a barony Feb. 22, 1874, almost an unprecedented honour for a civil servant. He died at Menton, France, on April 29, 1890; as he had no male heir the peerage became extinct. (M. R. D. F.)

HAMMOND, JOHN HAYS (1855–1936), U.S. mining engineer, was born in San Francisco, Calif., on March 31, 1855. He studied at the Sheffield scientific school, Yale university, until 1876, and later at the Royal School of Mines, Freiburg, Saxony. In 1880 he was engaged by the U.S. geological survey for a study of the California gold fields; afterward, as consulting engineer, he visited most of the countries of North and South America. In 1893 he became associated with Barnato Bros. and Cecil Rhodes in South Africa, acting as consulting engineer for the Consolidated Gold Fields Company of South Africa, the British South Africa company and the Randfontein Estates Gold Mining company. As a leader of the Rand faction, he was, in Jan. 1896, after the Jameson raid, arrested and condemned to death but was released on payment of a $125,000 fine. In 1900 he became interested in mining properties and irrigation projects in the United States and Mexico. He was chairman of the World Court commission, 1914–15, and chairman of the U.S. coal commission, 1922–23. In 1903 he became general manager and consulting engineer of the Guggenheim Exploration company. In 1911 he was special U.S. ambassador at the coronation of King George V.

He died at Gloucester, Mass., on June 8, 1936.

His son, JOHN HAYS HAMMOND, JR. (1888–1965), was in 1959 awarded the Edward Cresson medal by the Franklin institute for inventions and developments in radio and electronics, particularly for remote radio control of marine and submarine vehicles. He also received the medal of honour of the Institute of Electrical and Electronic Engineers in 1963. (S. C. HR.)

HAMMOND, an industrial city of Lake county, Ind., U.S., adjacent to Chicago and Calumet City, Ill., a part of the Gary-Hammond-East Chicago standard metropolitan statistical area. The city had its beginning in 1869 when George H. Hammond, a Detroit butcher and pioneer in shipping refrigerated beef by rail, established with Marcus M. Towle the State Line Slaughter house, ultimately the G. H. Hammond company, on the Grand Calumet river. This site was selected because the ice used for refrigeration could be readily obtained from the river and inland lakes, and it was far more economical to ship dressed beef than live cattle from the Chicago stockyards to distant markets. Until it was destroyed by fire in 1901, the packing house, which at that time employed 1,500 workers, was Hammond's largest industry.

It was originally called Hohman's Inn, then State Line because of its location on the Illinois-Indiana boundary. The name was changed in 1873 to Hammond, in honour of the meat packer. The city was incorporated in 1883. It was heavily populated by Germans in the earlier years, manifested by the many streets that bear German names. In 1910 the census showed that almost 30% of its people were born in Germany and Austria or their parents were natives of those countries.

While Hammond was served by numerous railroads and had a frontage on Lake Michigan, heavy industrial development was initially handicapped by the lack of a harbour. Consequently, it failed to secure the heavier basic industries such as steel mills and oil refineries as did its neighbours, East Chicago, Whiting and Gary. The city attracted smaller industries which included iron and brass foundries, steel fabricators, and those manufacturing railroad equipment, surgical instruments and metal toys; other products include soaps, corn products, chemicals, gasoline and motor oils, clothing and stock feeds. There is also a large printing industry.

Hammond is the site of a Purdue university extension centre which includes a technical institute for the advanced training of industrial employees. The Calumet centre of Indiana university presents a regular schedule of classes.

The population increased from 5,428 in 1890 to 20,925 in 1910 and soared to 55,378 in 1920. It was 87,594 in 1950 and 111,698 in 1960. (For the standard metropolitan statistical area *see* GARY.) For comparative population figures *see* table in INDIANA: *Population.* (P. ME.)

HAMMURABI (*c.* 18th century B.C.), the sixth and greatest king of the 1st ("Amorite") dynasty of Babylon. Year formulas on contracts dated in his reign confirm that he reigned 42 years but the exact chronology is disputed. Since the discovery of the Mari (*q.v.*) documents, his rule is variously assigned by scholars to 1792–50, 1729–1686 B.C. or to other, less likely, years between 1856 and 1662 B.C. The principal events of Hammurabi's life can be reconstructed from the date formulas, a few historical and building inscriptions, the prologue to his laws and from the many letters he wrote to subordinate officials.

Hammurabi, about 25 years of age, succeeded his father, Sinmuballit, when Babylon was but the centre of a small city-state surrounded by powerful neighbours in Assyria (Shamshi-Adad I), Mari on the Euphrates river, Eshnunna to the east and Larsa (Rim-Sin) in southern Babylonia. For the first six years he devoted his energies to the re-establishment of religion, law and order, activities which were to mark his whole reign. Then, with Semitic allies, he began military operations to take control of the principal Sumerian cities, capturing Uruk (Erech) from Rim-Sin and Isin in his seventh year. Emutbal, to the east, was won over in the following year, and soon his expeditions brought him into close contact with the powerful rulers of Mari and Yamhad (Aleppo). At first he intrigued with Assyria against Zimri-Lim of Mari but then took the opportunity afforded by Zimri-Lim's campaigns to

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LIMESTONE RELIEF SHOWING HAMMURABI, KING OF BABYLON. IN THE BRITISH MUSEUM

help him drive out Ishme-Dagan of Assyria. In return Zimri-Lim assisted him against Eshnunna and Elam. One Mari letter shows Hammurabi's relative strength at this time, for he is said to have had 10 to 15 kings allied with him, the same number as supported Ibalpi 'el of Eshnunna and the king of Qatna but only about half of the support given Yarim-lim of Aleppo, a state with which Hammurabi never dared to clash.

By his 30th year, relations with Mari had deteriorated and Hammurabi faced the hostility of Mari, Elam, Eshnunna, Malgum, Gutium and the Subarean nomads. A coalition of these peoples was defeated in battle, and in the following year Hammurabi conquered his oldest rival Rim-Sin of Larsa. Having gained control of all Babylonia, he intensified his military expeditions defeating Eshnunna and Gutium, the Subartu and Sutu tribes and, to the west, again attacked Malgum. His next move was to defeat Zimri-Lim, capture Mari and level its defense walls to restrict its military value. The date of his conquest of Nineveh and Ashur is uncertain but in his 37th and 38th regnal years Hammurabi had to make further raids against the tribes to the north and east of Assyria.

In a short time Hammurabi had thus established the most extensive Babylonian empire since Sargon of Akkad (died *c.* 2300 B.C.) and ruled a confederation of city-states in an area not to be enlarged until the successes of Nebuchadrezzar II (605–562 B.C.). In all the subjugated capitals Hammurabi paid respect to the leading deities, and there is little evidence of the religious reforms involving the definition of Marduk as head of the pantheon for which he has been credited. He settled his war veterans on lands recently acquired on the more disputed borders and in many ways sought to integrate his Sumerian and Semitic subjects. One aspect of this policy was his erection, in Babylon toward the end of his reign, of an eight-foot-high diorite stele on which he is portrayed receiving the insignia of kingship and justice from the seated deity Marduk. Below this he had inscribed in 21 columns 282 clauses or case laws, sometimes called a code of laws. These are, in effect, a series of amendments to the common law of Babylon to accommodate the new political situation. Some provisions can be traced back to the earlier legislation enacted by Uru-ka-gina of Lagash in the 3rd millennium B.C., Lipit-Ishtar of Isin (*c.* 1870 B.C.) and the laws of Eshnunna. The clauses include those directed against offenses against the administration of justice, tenure of property, trade and commerce, marriage and the family, slaves, assaults, professional conduct, agriculture and wages. The penalties vary according to the social status of the offenders. Seven columns were partially erased when the stele was carried off to Susa, where it was discovered in 1901 and brought to the Louvre, Paris. The influence of these laws can be judged by the fragmentary copies found at other sites, among them Assyrian copies made for the library at Nineveh in the 7th century B.C. and in later Neo-Babylonian times at Babylon. Since both the Hammurabi and later Mosaic legislations include provisions common throughout the ancient near east it is not possible to judge how much, if at all, the latter was dependent on the former. (*See* HAMMURABI, CODE OF.)

The name Hammurabi, the etymology of which is disputed, was also borne, about this time, by at least three Syrians, kings of Kurda, Yamhad and Hana. *See* also BABYLONIA AND ASSYRIA.

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HAMMURABI, CODE OF. The great code of Hammurabi is the completest and most perfect monument of Babylonian law. The Sumerians, the earliest inhabitants of Babylonia, dwelt in cities and developed a rule of law partly determined by the idea of a hierarchy under a city god and his temporal representative. One of the earliest Sumerian rulers, Uru-ka-gina of Lagash (*c.* 2370 B.C.), has left inscriptions describing his efforts to impose respect for customs which had been perverted and to curb the oppression of the poor by officials and priests. About two centuries later Gudea, a city governor, refers to the suspension of proceedings in court and of distraint during a solemn observance; and not long afterward appears the first known "code of laws" (a fragment only) issued by Ur-Nammu, a king of the 3rd dynasty of Ur (*c.* 2130 B.C. or, according to some authorities, 2113–2096 B.C.). From that time onward there are other extant remains or evidences of the legislative acts of different Babylonian kings in their respective lands or cities, as well as an increasing number of private documents concerned with contract and litigation. These legislative acts or "codes," as they are too ambitiously named, had from Uru-ka-gina onward the character of reforms and the style of royal inscriptions. But other kinds of legislative acts are also known, such as the laws of the kingdom of Eshnunna, of the Assyrians and of the Hittites, royal edicts and price lists; and it is through a fuller understanding of the nature and purpose of these enactments that an explanation must be sought of their common features, particularly their very incomplete coverage of the realm of law and the absence of evidence from contemporary documents that their provisions necessarily governed the practice of the law courts.

The principal (and only considerable) source of the code of Hammurabi is the imposing stone monument discovered at Susa in 1901 by the French Assyriologist Jean Vincent Scheil and preserved in the Louvre, Paris. The nearest comparisons to it are the relatively extensive laws of Eshnunna. Its background is a body of Sumerian law (some specimens of which survive) under which civilized communities had lived for many centuries. The existing text is in the Akkadian (Semitic) language; and although there has not yet appeared any fragment of a Sumerian version, the code was meant to be applied to a wider realm than any single country; *i.e.,* to "establish justice in Sumer and Akkad." Despite a few primitive remains relating to family solidarity, district responsibility, trial by ordeal and the *lex talionis,* or law of retaliation, the code has advanced far beyond tribal custom and recognizes no blood feud, private retribution or marriage by capture.

Social Classes.—Many of the code's provisions contemplate a division of the king's subjects into three classes, called *awelum, mushkenum* and *wardum.* The first of these words, meaning simply "man," is nowhere defined, but from the laws themselves it is clear that "man" (or, more definitely, "son of a man") was the designation of the highest class, a freeman in the full sense. Freemen could exact more severe retaliation and higher compensation for injuries, but they also bore, on the principle of *noblesse oblige,* the burden of heavier punishment for offenses, with greater fees and fines to pay. From want of definition, however, *awelum* tended to become a mere courtesy title, with as much or as little significance as "gentleman." Next below these persons of quality stood the *mushkenum,* in a status which has proved very difficult to comprehend. It is at least clear that this class occupied a middle rank: the word is best translated as "citizen," although its tendency to connote inferiority is marked by its history and by its survival in the sense of the French derivative *mesquin.* According to the code, persons of this class were free but they had to accept monetary compensation for corporal injuries, paid smaller fees and fines and owed less valuable offerings to the gods. The *wardum* was a slave and a chattel but could own property, even including other slaves. His master fed and clothed him and paid his medical charges but took all compensation owed to him. The master usually gave him a slave girl as wife (the children were then born slaves), sometimes set him up in business and took a yearly rent from his industry. Or the slave might marry a free woman (the children being then free); a free wife might bring him a dower which his master could not appropriate; but at his death one-half of his property passed to his master. Slaves were indicated outwardly by a physical mark, and it was a grave offense to obliterate this or to harbour a runaway.

Property.—Much of the land was certainly in royal possession, but despite this the code recognized private ownership, all sales of land being subject to the discharge of fixed liabilities. The most important of these was the duty of providing men for the army and for public works. Most of the required hands were supplied by the king's own estates, which were of vast extent. Upon these was settled a population of officials and soldiers occupying small holdings granted for their maintenance. Such fiefs were usually hereditary and, in the case of soldiers, inalienable. When

the tenant was called up he could nominate a son (if of age) to carry on his cultivation; or the king would put in a substitute tenant, allowing one-third of the produce to the tenant's wife. Among public works the most urgent was the clearance of canals for traffic and irrigation; this was done by local governors who enlisted the necessary workmen.

Land might be farmed by the owner, by an employee or by a tenant. Every cultivator was obliged to raise an average crop, for if he failed the code prescribed a statutory return in any case. If the land was let at a fixed rent any such deficiency fell upon the tenant; if it was let on a share-profit basis the parties divided the loss in the proportions agreed between them. This system was much in vogue, especially upon temple lands; the landlord found labour, animals, implements and seed, and the returns were shared as contracted. Irrigation was regulated with a care befitting its importance, especially with a view to preventing flood damage due to negligence. Houses were let usually for the year, and the tenant was bound to keep his house in repair. Land for building was let on lease for eight or ten years rent free, but after that period the building devolved to the landlord.

Hired labour was often needed, especially at harvest time, and boys were sometimes sent out to this work by their parents. The term of hiring might be for a year or for a few days only, the rates of wages being fixed. Cattle were hired for various agricultural needs. They were otherwise entrusted to herdsmen, who gave receipts and took a share in the profits of exploitation and breeding, but had to replace losses and were liable to pay heavy compensation for damage caused by their charges.

Property could be transferred in many ways—by sale, lease, barter, gift, dedication, deposit, loan or pledge—all of which were matters of contract. No claim was admitted without evidence of documents or the oath of witnesses. A buyer had to satisfy himself of the seller's title to dispose, for he might be liable to the death penalty if he incautiously purchased stolen property or property offered for sale by one who had no right to it. If he could prove that he had bought in good faith, however, he need only restore; and could claim fivefold restitution from the fraudulent seller. Payment in kind was more usual than payment in cash (the usual cash medium for commerce was silver). A debtor must be allowed to pay in produce according to an official scale; but debts could be secured upon his person. A man arrested for debt could nominate his wife, child or slave to work off the liability, but the wife or child could not be detained for more than three years. If their death occurred through the creditor's misuse he became liable to pay full compensation.

Many of the code's provisions at once regulate and incidentally describe the processes of trade both inside the country and with foreign lands. The traveling merchant is a prominent figure in these clauses, which combine with many private documents of the period to illustrate his journeys with caravans of pack-asses over all the highways of the near east. He was generally the agent of a principal in one of the great cities, with whom the laws regulate his relations. He had to give a detailed receipt for all goods, and nothing could be claimed which was not on the list. If no profit accrued from his journey he still had to return double the value of the stock entrusted to him; if the profit were only small he had to make up the deficiency but could plead loss by robbery or extortion. When successful he took a share, usually half, of the proceeds. Water transport, of great importance in a land of rivers and canals, is the subject of several laws. Boats were hired at a tariff based upon their capacity, inclusive of the crew's wages; prices of boatbuilding were fixed, giving one year's guarantee of soundness; and other laws dealt with rules of navigation and liability for damages incurred afloat.

The Family.—Marriages were arranged by parents, the bridegroom's father providing the bride price, and the bride's father her dowry. The latter generally consisted of personal effects or household furniture and remained the wife's property for life. Every lawful marriage had to be sanctioned by a contract, which usually stated the consequences to either party of repudiating the other. The couple then formed a legal unit, especially for debt, and several laws concern the respective liabilities of the parties.

A man might divorce his wife at will, but must restore her dowry and provide for her maintenance and that of any children; if there were no children, he both returned the dowry and paid her a sum equal to the bride price. But in order to receive these benefits the wife must establish that she had not failed in her duties, for in this case she might be divorced without compensation and even lose her children. For her own part a wife could obtain judicial separation for cruelty or neglect; but she sued at her peril, for if the fault was found to be on her side she might incur the penalty of death by drowning. A widow brought up her family and subsequently took a child's share in the estate, which she must not dissipate in the meanwhile.

A barren wife might give her husband a handmaid to bear him children, who were then considered to be of the family. Such a concubine was free, ranked as an inferior wife and could be divorced only upon the same conditions as the principal wife. The offspring of a slave girl were born free, their mother could not be sold, and the children could be legitimized and share the family estate if the father acknowledged them before witnesses. Should a freewoman marry a slave the children were free, and at the father's death the widow took back her dowry with one half of their joint savings, the other half going to the slave's master.

The control of a father over his children was unlimited until their marriage; he could dispose of their labour and even of their persons for his profit. Daughters could be freely given either in marriage or as religious votaries or as concubines. They had only a life interest in their dowries, which went afterward to their children (or back to their family if they had no children). It appears that sons received their share of the family estate upon marriage, but sometimes continued to reside in the paternal house.

Adoption, which was regulated by several laws, was common, for the purpose either of perpetuating a family or of securing the continuance of a business. An adopted son could not be reclaimed by his natural parents at maturity, and could not be discarded by his adopter if he afterward obtained children of his own. The adopted son had in that case a right to a defined portion of the inheritance. Those adopted by special classes of persons, particularly by temple votaries, were bound to them by absolute ties, and repudiation was punished by severe physical penalties. A craftsman too had an absolute right to retain the services of an adopted son; the latter's parents could reclaim him only if it could be proved that he had not been taught the trade. All legitimate children shared their father's estate at his death and also the possessions of their mother (but not of their stepmother). Disinheritance of a son required judicial consent, which was granted only upon proof of repeated unfilial conduct. For adultery both guilty parties were liable to drowning, but if the wronged husband pardoned his wife the king might do the like for her paramour. Incest was punished by death or exile according to its heinousness; seduction was punished by fines; sodomy is not mentioned.

Criminal Law.—The ruling principle of punishment was the *lex talionis*, and the death penalty was freely awarded. Loss or mutilation of an offending member was inflicted according to the nature of the offense; *e.g.*, the hand that struck a father was cut off; the eye that pried into secrets was put out. Death was the fate of the false accuser on a capital count, as also of those condemned for various forms of theft, brigandage, disorder, shirking of state service and criminal negligence. Specified forms of execution such as gibbeting, burning, impalement or drowning were inflicted upon the perpetrators of particular crimes. The notion of "a life for a life" extended to such correspondences as the execution of a creditor's son for having caused the death of a debtor's son while holding him as a pledge; that of a builder's son for negligence in construction causing the death of a purchaser's son; that of the daughter of a man guilty of the manslaughter of another's daughter.

A strange omission from the code is that of willful murder, and there is uncertainty as to how it was punished or by whom the retribution was inflicted. The corrupt judge was permanently deprived of office; the extravagant wife and undutiful children could be enslaved. Imprisonment is not used in the code, nor is forced labour. Monetary compensation, on the principle of restitution, is prescribed often and is sometimes multiple, but these

"fines" were not paid to the state. Accidents, or any injuries beyond reasonable possibility of prevention, were not generally imputed as offenses. Thus a defendant guilty of manslaughter was simply fined if he could swear that the act was unintentional; the owner of an ox that gored a passer-by was responsible only if it was known to be a vicious beast; poverty excused bigamy on the part of a deserted wife. On the other hand, carelessness and neglect were severely punished. A clumsy surgeon might lose his hands as the penalty for a maiming operation; a veterinary had to repay part of the value of a beast that died through his treatment. In general it may be said that the penalties inflicted under the code of Hammurabi stand midway between the brutal excesses of corporal punishment so shocking in the Assyrian laws and the comparative leniency of those of the Hittites.

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HAMPDEN, HENRY BOUVERIE WILLIAM BRAND, 1st VISCOUNT (1814–1892), 23rd Baron Dacre, was speaker of the house of commons and, earlier, a prominent member of the English Liberal party. Born on Dec. 24, 1814, Brand was elected to parliament for Lewes in 1852 and retained the seat until 1868, sitting for Cambridgeshire from 1868 to 1884. He was parliamentary secretary to the treasury between 1859 and 1866 and was chief whip during the last ministries of Lord Palmerston and Lord (John) Russell. Brand was speaker of the house of commons from 1872 until 1884, when he retired and was raised to the peerage. He died at Pau, France, on March 14, 1892.

Brand was a greatly respected political manager in a difficult period for the Liberal party and laid the foundations of the party's later organization. His success as whip led to criticism of his election as speaker. However, Brand proved an excellent choice. His tenure of the chair was memorable for the part he played in reforming parliamentary procedure in 1882, having taken the initiative in meeting Irish obstruction in 1881; and for his dignified conduct during the disputes caused by Charles Bradlaugh's election to the commons. (A. F. T.)

HAMPDEN, JOHN (1594–1643), English parliamentary leader, famous for his opposition to Charles I over ship money, is believed to have been born in London in 1594. He was the eldest son of William Hampden, a wealthy Buckinghamshire country gentleman, and of Elizabeth, daughter of Sir Henry Cromwell of Hinchingbrooke in Huntingdonshire. He was thus a first cousin of Oliver Cromwell. He was educated at the grammar school at Thame, at Magdalen college, Oxford, and at the Inner Temple. In 1619 he married Elizabeth Symeon (d. 1634), by whom he had three sons and six daughters; his second wife was Lady Letitia Vachell, widow of Sir Thomas Vachell.

Hampden had a reputation for good temper and modesty; he was a popular figure in the house of commons and an astute debater. He first entered parliament in 1621 as member for Grampound. He was not in the parliament of 1624, but the next year he represented Wendover. During his early years he showed himself litigious and managed to have his share of the subsidy (or property tax), for the war against Spain, reduced from £13 6*s* 8*d* to £10. A close friend of Sir John Eliot, the opposition leader, he was consulted by him about the proposed impeachment of the duke of Buckingham. Hampden refused in Jan. 1627 to contribute to a "forced loan" demanded by the king and was imprisoned. He was released with 75 others before parliament met again in 1628. In this parliament he was extremely active, again specializing in questions of taxation. He was also a member of a group, including Lord Saye, Lord Brooke and John Pym, who were prominent in advocating and financing colonial ventures for the settlement of Puritans in the Caribbean and North America. When after the dissolution of parliament in 1629 Eliot was imprisoned, Hampden took care of his children, corresponded with him in the Tower of London and discussed his political and religious writings with him. Hampden never forgave Charles I for Eliot's death in prison.

In the mid-1630s part of the parliamentary opposition decided that it was right in principle to resist the levying of ship money, Charles's latest expedient for raising money without parliamentary consent (*see* SHIP MONEY). The first demand was made on coastal counties in 1634, but in 1635 the levy was extended to inland counties. A third levy was imposed in 1636 after the judges had been consulted by Charles I and had given their opinion that it was legal. In spite of this decision Hampden deliberately refused to pay the sum of 20*s*. for his property at Stoke Mandeville in Buckinghamshire. The case was argued in the exchequer chamber before 12 judges. Hampden was represented by his friend and relative by marriage, Oliver St. John, and by Robert Holborne. Their argument was that although the king might, in a genuine national emergency, require the furnishing of ships, if the danger to the nation were merely "apprehended," then the matter must be discussed in parliament. If the king alone could define an "apprehended danger," then he might always exact taxation without parliamentary consent and everyone's liberty and property would be in peril. The judgments were given over a long period: although seven judges found for the king, five found for Hampden, even if two of them did so on purely technical grounds. This test case became famous, since the majority for the king was so narrow, and the yield of subsequent payments of ship money declined. When parliament met in April 1640 the king was obliged to offer to waive his right to levy ship money if the commons would grant him sufficient taxes for his purposes.

In the Long parliament Hampden, now member for Buckinghamshire, was hailed as father of his country, and "the pilot that must steer their vessel through the tempests and rocks that threatened it." Now that Eliot was dead, he became John Pym's principal lieutenant in his outright attack on royal policies. He was one of the managers of the impeachment of Thomas Wentworth, earl of Strafford, the king's chief adviser (who had earlier said that Hampden ought to have been whipped into his right senses). Ship money was declared illegal. Parliament no longer trusted the king: when Charles visited Scotland in 1641 to try to raise support there, Hampden was nominated to a parliamentary committee also sent up to Scotland—ostensibly to negotiate, but in reality to watch the king's movements. Hampden took a leading part in the debates on the Grand Remonstrance and was one of five members whom the king vainly tried to arrest for treason in Jan. 1642. Hampden earned the reputation of being a clever debater rather than a studious orator. He was courteous and attractive even to his enemies and carried weight behind the political scenes. Honest, brave and incorruptible, he was the soul of the opposition to the king as his friend, Pym, was its sword.

Throughout 1642 Hampden was busy preparing for civil war. He was appointed a member of the committee of safety in July; he also became a deputy lord lieutenant of Buckinghamshire and later arrested the lord lieutenant, who was a royalist. Hampden raised a foot regiment in Buckinghamshire, served as its colonel and fought at the battles of Edgehill and Brentford once the Civil War had begun. He was strongly opposed to peace negotiations with the king and discussed the reform of the army with Cromwell. When the earl of Essex's army moved on Oxford in June 1643, Hampden, who served with it, was wounded by musketry fire in a skirmish with Prince Rupert's cavalry at Chalgrove field near Thame. He died of his wounds on June 24, 1643, and was buried in the church at Great Hampden. The loss of this popular leader depressed his friends and pleased the king. He was revered by later generations as the noblest type of parliamentary statesman and soldier.

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HAMPDEN, WALTER (WALTER HAMPDEN DOUGHERTY) (1879–1955), U.S. actor, was born in Brooklyn, N.Y., June 30,

1879. After a year at Harvard, he graduated from Brooklyn Polytechnic institute. Following a year's study of singing, dancing, speech and the cello in France, he joined Sir Frank Benson's company in England, where he played over 70 classical roles in three years. In 1905 he married Mabel Moore, an actress in the troupe, and the following year he played Hamlet in London to great applause. After his return to the U.S. in 1907 he appeared in several modern dramas with Nazimova, but his *Hamlet* was so successful that when he formed his own repertory company that play became its foundation. In 1923 Hampden revived Edmond Rostand's *Cyrano de Bergerac*, a play that will forever be associated with his name. He opened his own theatre (1925), with Ethel Barrymore as his leading lady, and among his outstanding performances in the ensuing years were *Hamlet* and *The Merchant of Venice* (1925–26), *The Immortal Thief* and *Caponsacchi* (1926–27) and *An Enemy of the People* (1927–28). In 1939 Hampden appeared in his first motion picture, *The Hunchback of Notre Dame*, and later played the part of an aging actor in *All About Eve*. He made his television debut as Macbeth in 1949. Hampden was the fourth president of the Players' club, succeeding John Drew, Edwin Booth and Joseph Jefferson. He died in Los Angeles, Calif., June 11, 1955. (S. W. H.)

HAMPSHIRE (abbr. HANTS) is a county of southern England bounded west by Dorsetshire and Wiltshire, north by Berkshire, east by Surrey and Sussex and south by the English channel. Area of the geographical county is 1,651 sq.mi., including the Isle of Wight (147.1 sq.mi.), which formed part of ancient Hampshire but became a separate administrative county in 1890 (*see* WIGHT, ISLE OF). Hampshire was styled the County of Southampton for legal purposes until April 1, 1959, when its name was officially changed to Hampshire.

Physical Features.—The county falls physiographically into four areas. A broad belt of rolling chalk downland, at times more than 800 ft. high, runs across the middle from west to east. To the north and south lie mixed Tertiary clays, sands and gravels, often covered by heath and woodland. In the east the western extremity of the Weald, with its typical scarps and vales, crosses the county border. The oldest rocks occur in this Wealden area—the Lower Greensand (Hythe, Sandgate and Folkstone Beds) and the Gault and Upper Greensand. The Upper Cretaceous beds are, for the most part, flint-bearing Upper Chalk, although the Middle and Lower Chalk strata are exposed toward the Surrey-Sussex border. Scattered over the chalk are small Tertiary outliers. The Tertiary rocks of the north, about Aldershot, Farnborough and Kingsclere, comprise the Reading Beds and London Clay, often covered by the more sandy Bagshot Beds. The Tertiaries, south of the chalk boundary by Romsey and Bishops Waltham to Havant, include the Eocene Reading Beds, London Clay and Bagshot, Bracklesham and Barton Beds and, at Brockenhurst, Hordle and Lyndhurst, the Oligocene Headon Beds. The Barton and Headon strata are rich in fossils.

The narrow strait called The Solent and known at its eastern end as Spithead, which divides the Isle of Wight from the mainland, marks the lower course of the ancient Frome or Solent river. Submergence, further evidence of which can be seen in the drowned valleys and estuaries of the Hampshire coast line, converted it into an arm of the sea, and rivers which were formerly tributaries in that greater system are now independent streams. These streams, flowing southward through rich alluvial valleys, drain nearly the whole of the chalk and southern Tertiary areas. The Avon, in the southwest, rises in Wiltshire and is joined by the Dorset Stour near its mouth at Christchurch. The Test, with its tributary the Anton, and the Itchen rise in the chalk downs near Ashe and Hinton Ampner respectively and flow into the head of Southampton water. The Lymington or Boldre, the Beaulieu, Hamble, Meon and Wallington also drain southward. The Wey, Loddon and Blackwater, rising in the northeastern part of the county, flow northward into the Thames basin. The clear, swift chalk streams, especially the Test and Avon, are famous for their trout and salmon fishing.

Climatically the county has little to distinguish it from other parts of southern England. Interesting minor contrasts occur between conditions inland and on the coast. The numerous varieties of vegetation and animal life likewise vary from place to place, the New forest (*q.v.*), with its rare butterflies, deer and ponies, being especially attractive to the naturalist. Old Winchester hill near West Meon is a national nature reserve, and there are three forest nature reserves in the New forest. The National trust owns more than 6,000 ac. and protects 30 ac.

History, Antiquities and Architecture.—There is considerable evidence of prehistoric settlement in Hampshire, particularly on the chalk downs and heathlands. Paleolithic tools have been found in the river gravels and Mesolithic implements near Petersfield and elsewhere, and there are Neolithic long barrows, *e.g.*, near Bournemouth, Danebury, Meonstoke and Rockbourne. Bronze Age settlement is represented by round barrows of different types and by the remains of small farmsteads, as at Quarley. Most notable among Iron Age remains are the hill forts, *e.g.*, Danebury, Hengistbury, Ladle, Old Winchester, Quarley and St. Catherine's.

Hampshire was conquered within a few years of the Roman invasion in A.D. 43. During the occupation, urban settlements developed at Silchester (Calleva Atrebatum) and Winchester (Venta Belgarum), the focal points of the Roman road system in the area. There was a small settlement at Southampton (Clausentum). Villa sites are especially numerous in the northwest of the county. There were potteries in the New forest and an imperial weaving works at Winchester. The most substantial Roman remains are the town walls of Silchester (*q.v.*) and the outer wall at Portchester castle which formed part of the defenses of what was probably the most westerly of the forts of the Saxon shore. Reading museum houses a large collection of objects from Silchester.

The progress of the early English settlement of Hampshire is obscure and the contributions of the Jutes, along the coast and in the Hamble and Meon valleys, the followers of Cerdic and Cynric, the Gewisse and the peoples moving in from the northeast, are uncertain. The county, first mentioned by name in the Anglo-Saxon Chronicle in 755, became the cradle of Wessex (*q.v.*) and the English kingdom, with Winchester the capital. It suffered severely from the attacks of the Norsemen. During the middle ages, apart from coastal raids during the Hundred Years' War, the county enjoyed a comparatively peaceful existence and the influence of the church and such men as William of Wykeham (*q.v.*) was of major importance. Few castles were built and only at Christchurch, Odiham, Portchester and Winchester are there substantial remains. At Winchester and, more especially, Southampton, town walls and gates still survive. Later 16th-century coastal defenses exist in Calshot and Hurst castles. During the Civil War, battles were fought at Alton (1643) and Cheriton (1644), Portsmouth and Basing house suffered notable sieges, and Charles I stayed at Hurst castle and Titchfield. Some postmedieval fortifications can be seen in and near Portsmouth.

The conversion of Hampshire to Christianity was begun by Birinus (634) and Wilfrid (687). At first the county formed part of the West Saxon bishopric of Dorchester-on-Thames, but on the transference of the episcopal seat in 676 it was included in the diocese of Winchester. The whole of the county remained in this diocese until the creation of the sees of Guildford and Portsmouth in 1927. Medieval Hampshire had many religious houses. There

EDWIN SMITH

REMAINS OF THE BASTIONED ROMAN WALL THAT SURROUNDS THE OUTER COURT OF THE RUINED PORTCHESTER CASTLE 4 MI. N.W. OF PORTSMOUTH, HAMPSHIRE; IT ALSO ENCLOSES THE CHURCH OF ST. MARY

were pre-Conquest Benedictine foundations at Romsey and Wherwell besides three in Winchester—St. Swithun's, New Minster and St. Mary's. After the Conquest, houses of Augustinian canons were established at Breamore, Christchurch, Mottisfont, Portchester (later moved to Southwick), Selborne and Southampton (St. Denys); of Cistercians at Beaulieu, Hartley Wintney and Netley; and of Premonstratensians at Titchfield. Alien priories existed at Andover, Andwell, Ellingham, Hamble, Hayling and Monk Sherborne. There were houses of Franciscan friars at Southampton and Winchester, and of Austins, Carmelites and Dominicans at the latter. Substantial monastic remains can still be seen at Beaulieu and Netley, in the great churches of Christchurch and Romsey and in the cathedral at Winchester. Although not renowned for its parish churches, Hampshire can show interesting Saxon work, *e.g.*, at Boarhunt, Breamore, Corhampton and Headbourne Worthy; Norman work, *e.g.*, at East Meon, Hambledon and Portchester; and early English, *e.g.*, at Cheriton, Grateley, Hound and Sopley. Decorated and Perpendicular work are represented in a number of places, but only by details. Eighteenth-century churches can be seen at Avington, Wolverton and St. George's, Portsmouth and good examples of 19th-century Gothic at St. Michael's and St. Peter's, Bournemouth and St. Mary's, Portsea.

Interesting domestic architecture includes Norman houses at Southampton and Christchurch; the medieval palace at Bishops Waltham; 16th-century and later work in The Vyne at Sherborne St. John; the Jacobean Bramshill, the work of Henry Holland at Broadlands; and Charles Barry's 19th-century restoration of Highclere. The homes of Jane Austen at Chawton, Charles Dickens at Portsmouth, and Gilbert White at Selborne are museums.

Hampshire has always been essentially agricultural, but its history shows some evidence of industrial activity. Woolen manufactures were formerly widespread throughout the county, *e.g.*, in the Alresford, Andover, Romsey and Winchester areas, and survived in some places until the early 19th century. Iron was smelted at Sowley in the New forest and near Bramshott until the 18th century. Salt manufacture was carried on at a number of places along the coast, particularly at Lymington, where the last saltworks disappeared as late as 1865. Among the many ships built in Hampshire yards, the men-of-war launched at Bucklers Hard in the late 18th and early 19th centuries are perhaps the most famous. Other industries practised at different times include malting, brewing and tanning, and silk weaving and papermaking which were introduced into the county by Huguenot refugees. Winchester (St. Giles) and Weyhill had nationally important fairs. Southampton, since the Conquest, has been pre-eminent in overseas and coastal trade. There the medieval wine and wool trade and the business with northern Italian merchants in rich Levantine commodities were followed by a period of decline until the railway and dock development of the mid-19th century. From early in the 18th century, Portsmouth grew rapidly as a naval dockyard town. During World War II Portsmouth and Southampton were heavily damaged by German air raids.

Famous figures connected with Hampshire include Jane Austen, William Cobbett, Charles Dickens, John Keble, Charles Kingsley, George Meredith, Mary Mitford, Florence Nightingale, Izaak Walton, Isaac Watts, Gilbert White and Charlotte M. Yonge.

Population and Administration.—In 1961 the population of Hampshire, excluding the administrative county of the Isle of Wight (94,141), was 1,336,794, which represents a growth of 11.6% since 1951. There are 3 county boroughs, Bournemouth (pop. [1961] 154,296), Portsmouth (215,077) and Southampton (204,822); 9 municipal boroughs, Aldershot (31,225), Andover (16,985), Basingstoke (25,980), Christchurch (26,336), Eastleigh (36,642), Gosport (62,457), Lymington (28,721), Romsey (6,350), Winchester (28,770); 6 urban and 11 rural districts. Bournemouth and Southampton each return two members to parliament, Portsmouth returns three and Gosport and Fareham one. The administrative county is divided into six parliamentary divisions each of which returns one member. The urbanized, heavily populated coastal strip contrasts strongly with the agricultural, inland area. The Castle, Winchester, is the administrative headquarters.

Industries and Communications.—Great changes took place in Hampshire farming after 1939. The old system of folded sheep and barley on the chalkland, the extensive water meadows and much formerly semiderelict farmland disappeared. Hampshire agriculture is almost equally concerned with corn production and dairying. Just over one-half the area of the county is under crops and grass; about one-third of this is devoted to grain and one-half to permanent and temporary grass. On the Tertiaries, particularly in the south, farms are generally smaller, and between Southampton and Portsmouth market gardening, with strawberries and potatoes, is especially important. In the Greensand area, in addition to grain and dairy produce, hops are grown near Alton. There is still a high proportion of woodland in the county. In the New forest, once a royal hunting ground, the rights of the Forestry commission, commoners and general public are carefully defined by the New Forest act (1949). There has been a marked increase in cattle rearing and milk production in this area. In the vicinity of Aldershot, Blackmoor and Bordon large tracts of wasteland are used by the army for military training.

Portsmouth and Gosport form one of the principal naval centres of Great Britain. The great port of Southampton is especially concerned with passenger traffic. Eastleigh has important railway works. Two modern industries which are of particular importance are petroleum refining at Fawley on the western side of Southampton water, and aircraft engineering at Christchurch, Farnborough and near Southampton. The tourist industry affords much employment, particularly at Bournemouth (which since the beginning of the 19th century has grown from a few scattered houses into a county borough), and at Southsea. Smaller resorts along the coasts include Highcliffe, Barton, Milford-on-Sea, Lee-on-the-Solent and Hayling Island. Bursledon, Christchurch, Hamble and Lymington are well-known yachting centres. Shipyards of varying size and character are to be found at a number of places. Most market towns have light industries; engineering, *e.g.*, at Andover, Basingstoke, Lymington and Ringwood, and brewing, *e.g.*, at Alton and Romsey, are two of the major ones.

The county is served by three main lines of the Southern region of British railways which also owns the docks at Southampton. A main route from London to the southwest crosses the county from Farnborough to Andover. From it the Southampton-Bournemouth line branches south at Basingstoke. Portsmouth is linked with London via Petersfield. Some of the secondary lines were closed after World War II. There are civil airports at Hurn, Portsmouth and Southampton.

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(A. G. G.; R. DE.)

HAMPSTEAD, a metropolitan borough of London, Eng., which under the London Government Act 1963 was to be amalgamated on April 1, 1965, with Holborn and St. Pancras to form the new London borough of Camden (*see* LONDON). Hampstead is a parliamentary constituency. The metropolitan borough of Hampstead (1900) is bounded by Finchley, Hendon, Willesden, St. Marylebone, St. Pancras. Pop. (1961) 98,844. Area 3.5 sq.mi. It is built up the steep southern slopes of a hill from the top of which the Spaniards road leads across the heath to Highgate hill. From between the rather sterile Bagshot Sands of Hampstead heath and the London Clay flowed chalybeate springs, one of which in the early 18th century caused a fashionable spa to grow up by Well walk near the heart of the old village—still a complexity of streets, alleys, flats, mansions and cottages. Down the hill are the late 19th-century residential accretions of Belsize Park, Chalk Farm, Swiss Cottage, the Finchley road area and Kilburn near the Edgware road. Hampstead, almost entirely residential, has long been the home of lawyers, artists, writers and politicians; the few industries include the making of Christmas cards. In Hampstead are two colleges of London university, several big schools, hospitals and medical research centres. Samuel Johnson, Sir Richard Steele, Sir Rowland Hill, Kate Greenaway, John Galsworthy and H. G. Wells are among the well-known people once resident there.

Hampstead was settled in Anglo-Saxon times; a Roman burial and a barrow on Parliament hill are the only antiquities. The manor, which included Kilburn priory, belonged to Westminster abbey until the Reformation. In St. John's parish church (rebuilt 1744–47) and its churchyard lie buried many famous men including John Constable, George du Maurier and Sir Herbert Beerbohm Tree. Old houses include Fenton house (*c.* 1693), George Romney's house (1797) and the Keats Memorial house. The Spaniards, Jack Straw's Castle and the Bull and Bush near Pitt house, home of the first earl of Chatham, are well-known local inns. At Wyldes farm, near North End, William Blake was a frequent guest of John Linnell. Ken Wood house (reconstructed *c.* 1767 by Robert Adam, gardens by Humphrey Repton) with its paintings and other works of art, was given to the nation by Lord Iveagh in 1927.

The heath, consisting of 793 ac. (rising to 443 ft.) of woods, grassland and ponds includes Golders Hill park, Parliament hill and Ken wood, all largely outside the borough; it is administered by London County Council. On bank holidays two fun fairs are held.

HAMPTON, WADE (1818–1902), U.S. statesman and Confederate general during the American Civil War, was born on March 28, 1818, at Charleston, S.C. He was the son of Wade Hampton (1791–1858), planter and politician, and grandson of Wade Hampton (1754–1835), who served as a colonel in the American Revolution and as a brigadier general in the War of 1812. He graduated from South Carolina college in 1836 and inherited vast estates. As a South Carolina legislator he opposed secession but nevertheless raised "Hampton's Legion" for Confederate service when war came. He was an infantry colonel at the first battle of Bull Run and a brigadier general at the battle of Seven Pines. Transferring to Gen. J. E. B. Stuart's cavalry of the army of northern Virginia in 1862, he won praise and promotion and was wounded five times. After Stuart's death Hampton became a lieutenant general and served as chief of General Lee's cavalry during the defense of Petersburg. In 1865 he assisted Gen. Joseph E. Johnston's effort to oppose Gen. W. T. Sherman's march through the Carolinas and attempted to save Pres. Jefferson Davis from capture after Johnston's surrender.

During the reconstruction period Hampton worked for conciliation and the restoration of southern home rule. He was governor of South Carolina, 1877–79, U.S. senator, 1879–91, and U.S. commissioner of Pacific railways, 1893–97. He died at Columbia, S.C., on April 11, 1902. (M. W. We.)

HAMPTON, a city in southeastern Virginia, U.S., on the north side of the harbour of Hampton Roads and the James river. Pop. (1960) 89,258; for the Newport News–Hampton standard metropolitan statistical area *see* Newport News. (For comparative population figures *see* table in Virginia: *Population.*)

Permanent English settlement of the site began in May 1611, when Sir Thomas Dale caused two small forts, built the previous year, to be reoccupied. Known at first by the Indian name, Kecoughtan, the area became Elizabeth City county in 1620, and the settlement near the forts was called Hampton after the Earl of Southampton. A thriving port during colonial times, Hampton was eclipsed by Norfolk after the American Revolution. In 1861 it was burned by Confederate troops to prevent its use by Union forces at nearby Ft. Monroe. Hampton was incorporated as a town in 1849 and as a city in 1908. In 1952 it assumed its present form with the merger of Hampton, Phoebus and Elizabeth City county to form the city of Hampton. Hampton is the home of the Kecoughtan veterans administration centre and of Hampton institute, a four-year college for Negroes founded in 1868 under the leadership of Samuel Chapman Armstrong (*q.v.*). The principal industry is sea-food packing. (M. Br.)

HAMPTON COURT, a Tudor palace in Twickenham (*q.v.*), Greater London, Eng., on the Thames 15 mi. S.W. of St. Paul's cathedral. It was built by Cardinal Wolsey who in 1526 presented it to Henry VIII whose favourite residence it became. Jane Seymour died there after giving birth to Edward VI in 1537, and Catherine Howard and Catherine Parr were privately married in Henry VIII's Holyday closet. George II was the last reigning sovereign to occupy it, and Queen Victoria opened the state rooms to the public. Later, nearly 1,000 rooms were assigned by the sovereign as "grace and favour" apartments for the widows or children of distinguished servants of the crown.

Henry VIII enlarged the palace, building wings on either side of the Great gatehouse behind which is the Base court and Anne Boleyn's gateway leading to the Clock court. This contains Henry VIII's Great hall and the colonnade and King's staircase built by Sir Christopher Wren. Over the gateway is the astronomical clock made by N. Oursian for the king in 1540; the George II gateway opposite leads to Fountain court rebuilt by Wren for William III with the state apartments on the south side. Beyond are the Broad walk and the Great Fountain garden.

The Chapel Royal, built by Wolsey, was embellished by Henry VIII, and by Grinling Gibbons according to designs by Wren for Queen Anne. Charles II filled in the moat which was dug out again in 1910 when Henry VIII's bridge was uncovered. The tennis court, built for Henry VIII, is the oldest in the world where the game is still played.

The gardens, laid out in the Dutch style for William III, contain a vine planted in 1768, two orangeries along the south side of the palace, a wilderness and a maze.

See G. H Chettle, *Hampton Court Palace,* reprinted (H.M.S.O., 1954).

HAMPTON INSTITUTE, a privately controlled, nonsectarian coeducational college located in Hampton, Va., founded in 1868 by Samuel Chapman Armstrong with the aid of the American Missionary association as an agricultural, normal and industrial school for Negroes. Armstrong's most noted student was Booker T. Washington (*q.v.*). The school was chartered (1870) as Hampton Normal and Agricultural institute; the present name was adopted in 1930. *See* Virginia: *Education.* *See* also Armstrong, Samuel Chapman.

HAMPTON ROADS, a natural roadstead or harbour of Virginia, U.S., formed by the confluence of the James, Nansemond and Elizabeth rivers. It lies to the west of Chesapeake bay, with which it is connected by Thimble Shoal channel (1,000 ft. wide, 40 ft. deep and 11 mi. long); two deepwater channels branch out from the harbour. The southern channel is linked with the sounds of North Carolina through the Intracoastal waterway. The port of Hampton Roads, administered by a state port authority, includes the port cities of Norfolk, Newport News and Chesapeake (*qq.v.*), which connect with nine trunk railroads and which have a combined water frontage of about 50 mi. (80 km.). The Hampton Roads tunnel bridge (4½ mi. [7 km.]) spans the James river between Norfolk and Newport News.

An important naval base since colonial days, Hampton Roads embraces the most significant concentration of naval establishments in the U.S., including the headquarters of the Atlantic fleet (at Norfolk) and the Norfolk naval shipyard (at Portsmouth). Army and air force installations are also located in the vicinity. The Civil War naval engagement between the "Monitor" and "Virginia" ("Merrimack") was fought in Hampton Roads (*see* "Monitor" and "Merrimack," Battle of). The abortive peace conference between President Lincoln and Confederate representatives was held there aboard the "River Queen," Feb. 3, 1865.

In the second half of the 20th century waterborne commerce exceeded 80,000,000 tons annually. Foreign commerce (mainly exports, comprising about 75% of total tonnage) increased considerably after World War II. Coal is the principal export, but tobacco, grain, scrap metal, fertilizer and cotton are also important. Crude-oil residues, oils, ores and crude gypsum are leading imports. (G. M. Be.)

HAMSTER, a burrowing, stout-bodied, short-tailed nocturnal rodent with large cheek pouches and thick soft fur. Hamsters belong to the superfamily Muroidea, in which they typify the family Cricetidae. There are many species representing several genera, of which three are well known. *Cricetus,* the European genus, ranges throughout Europe and into Asia; *Cricetulus,* commonly known as the Chinese hamster, is a larger genus and its distribution extends throughout Asia and into southern parts of Europe; *Mesocricetus,* the Syrian hamster, is limited to Asia Minor and the Balkans. The European hamsters are the largest in size, with a body

length of more than eight inches. The most common species, *Cricetus cricetus*, is light brown above and mainly black underneath. The Chinese hamsters are small and gray, and one species (*Cricetulus barabensis*) has a mid-dorsal black stripe. *Mesocricetus auratus*, the most common species of the Syrian genus, is medium in size with reddish brown above and gray underneath, and is commonly known as the golden hamster.

JOHN MARKHAM

GOLDEN HAMSTER (MESOCRICETUS AURATUS)

Species of these three genera have been introduced into the laboratory for research purposes, but the most successful in captivity by far is *Mesocricetus auratus*. It has been extensively used since 1930, when one litter was captured in Aleppo, Syr., and brought to the laboratory at the Hebrew university, Israel (then Palestine). All golden hamsters in laboratories in Europe and America derive from this original litter raised in captivity. The golden hamster is very easily tamed and has become a popular pet. It is clean and attractive, requires little care and can be fed common foodstuffs. On the average a golden hamster lives about a year, but some individuals may attain almost two years.

Cricetus cricetus inhabits cultivated lands of central Europe, where it constitutes a pest to agriculture because of the enormous quantities of grain and vegetables which it ransacks from the field. It digs elaborate burrows consisting of galleries and chambers; in the summer these are short and shallow with one central chamber for grain, while in the winter they are one or two yards deep with several storage places. Provisions are stored in great quantities for the winter, and the animals, having fattened themselves during the previous season, retire to their burrows to spend the cold months in a state of inactivity.

All hamsters are very prolific, the female producing several litters in one year. Birth occurs two to three weeks after mating. The young are born blind and naked, but they mature fast and by three weeks set forth on their own. Hamsters are usually pugnacious and attack other rodents, lizards and small birds, which they consume as part of their diet, although their chief food consists of fruits, vegetables and grain. They are preyed upon by carnivores and killed by man but nevertheless remain abundant. The skin of the hamster is of some value (*e.g.*, as a lining for coats) and its flesh is used in some localities for food. *See* also RODENT.

(E. O.; X.)

HAMSUN, KNUT (1859–1952), Norwegian novelist, dramatist and poet, winner of the Nobel prize for literature in 1920, was born on Aug. 4, 1859, at Lom in the Gudbrandsdal valley, of poor parents. He started to write at the age of 19 when he was a shoemaker's apprentice at Bodö in north Norway, and for the next ten years earned his livelihood in various ways; *e.g.*, as coal trimmer and country schoolmaster. During this period he went twice to the U.S., where he worked for a time as a streetcar conductor in Chicago and a farm labourer on the prairies. Eventually he returned to Norway, where the publication of his first novel, *Sult* (1890; Eng. trans., *Hunger*, 1899), established him as a writer. To the English-speaking world he is chiefly known by this novel and by *Markens Gröde* (1917; Eng. trans., *Growth of the Soil*, 1920) and *Konerne ved Vandposten* (1920; Eng. trans., *The Women at the Pump*, 1928). But three other novels—*Pan* (1894), *Börn av Tiden* (1913; Eng. trans., *Children of the Age*, 1924) and *Landstrykere* (1927; Eng. trans., *Vagabonds*, 1930)—are perhaps of greater literary value. The influence of Nietzsche and Strindberg was apparent in Hamsun's impatience with contemporary emphasis on man's social problems: his talents were long centred more directly on the psychological analysis of the individual at grips with a simpler reality (hunger, physical labour, etc.). After World War II Hamsun was charged with treasonable behaviour during the German occupation, but charges were dropped in view of his advanced age. He died near Grimstad on Feb. 19, 1952. (D. A. H.)

HAMTRAMCK, a city of Wayne county, Mich., U.S., is completely surrounded by Detroit. Named for Col. John F. Hamtramck, the first American commander at Detroit (1796), the area was originally settled by French and later by German farmers. After 1910, stimulated by the growth of the automobile industry, a great migration of Poles to this area began. In that decade Hamtramck's population increased from about 3,500 to more than 45,500. After World War II the city was a haven for refugees from central Europe and the Balkans. The Hamtramck public school code, fostered by Maurice R. Keyworth in the 1920s, was a notable plan for educating children of foreign-born parents for American democracy, and its principles were widely adopted by educators in other cities. Hamtramck was incorporated as a village in 1901 and as a city in 1922. The automobile industry is the most important; other industrial products include paints, varnishes, automobile radiators, wire, electrical supplies, dishes and metal products. For comparative population figures *see* table in MICHIGAN: *Population.* (P. P. M.)

HAN, the name of a dynasty that ruled China for over 400 years from 202 B.C. to A.D. 221 with a short interruption during the early part of the first century A.D. The period before the interruption, when the dynasty had its capital at Ch'ang-an, is known as the Former or Western Han; that after the interruption, when the capital was moved east to Loyang, is called the Latter or Eastern Han.

The dynasty encompassed the reigns of the following emperors during the periods indicated:

1. Kao-tsu, 202–195 B.C.
2. Hui, 195–188 B.C.
3. Wen, 180–157 B.C.
4. Ching, 157–141 B.C.
5. Wu (or Han Wu Ti), 141–87 B.C.
6. Chao, 87–74 B.C.
7. Hsüan, 74–48 B.C.
8. Yüan, 48–33 B.C.
9. Ch'eng, 33–7 B.C.
10. Ai, 7–1 B.C.
11. P'ing, 1 B.C.–A.D. 6
    (interruption of Han dynasty by Wang Mang)
12. Kuang-wu, 23–57
13. Ming, 57–75
14. Chang, 75–88
    (succession of weak emperors preceding end of dynasty in 221)

Former or Western Han.—The founder of the dynasty, Liu Pang, posthumously known as Kao-tsu, was born in northeastern China, the son of a peasant family, though later in the dynasty he was fitted with a genealogy relating him to the legendary sage of antiquity, Emperor Yao. He joined the revolt against the tottering Ch'in dynasty and eventually won mastery of the empire. In 206 B.C. he became king of Han, a region in western Shensi, and dated his reign from this year, though he did not assume the title of emperor until 202 B.C. Until his death in 195 B.C. he devoted his energies to consolidating the power of the dynasty and combatting disaffected followers.

He was succeeded by his son Liu Ying, known as Emperor Hui the Filial. (The title of "Filial" was, with one exception, added to the posthumous names of all succeeding Han emperors.) The real power, however, was wielded by Kao-tsu's widow, a cruel and ambitious woman who worked to strengthen the position of her own clan, the Lü, by appointing her male relatives to important posts. When Emperor Hui died in 188 B.C. she placed two infant rulers in succession on the throne, while continuing to advance the interests of the Lü clan. After her death in 180 B.C. a coalition of high ministers and disgruntled princes of the imperial family managed to overthrow and massacre the Lü clan and restore power to the Liu family.

The statesmen and elders of the imperial family debated the selection of a new emperor. The choice lay between Liu Hsiang, the oldest son of Kao-tsu's oldest son, and Liu Heng, Kao-tsu's

oldest living son. Disregarding primogeniture, they chose the latter, principally because his mother's clan had a reputation for good conduct. Already it was recognized that ambitious empress dowagers and their male relatives could pose a grave threat to the security of the dynasty.

Liu Heng, known as Emperor Wen, reigned until 157 B.C. and was praised in later ages as one of the most virtuous of Chinese sovereigns. Frugal in his private life, he exercised economy in government and worked to improve the lot of the people by reducing taxes and lessening the harshness of punishments. He encouraged local officials to recommend capable men for government office and was noted for his willingness to listen to frank criticism, a trait shared by few of his successors. During his reign the princes of the imperial family, who were enfeoffed as semiautonomous "kings" in various crucial areas of the empire, began to threaten the authority of the central government, but Emperor Wen attempted to restrain them by moral suasion and reprimand. The barbarians on the northwest, the Hsiung-nu (or Hiung-nu), made several devastating raids into China, at one time riding to within sight of the capital. Emperor Wen repulsed them but made no effort to carry the warfare beyond the frontier, preferring to conclude a peace alliance. A deeply religious man, he was frequently preyed upon by charlatans and wonderworkers who attracted his attention with reports of supernatural happenings.

Emperor Wen was succeeded in 157 B.C. by his son Liu Ch'i, known as Emperor Ching. His short reign, which ended with his death in 141 B.C., was marked by prosperity and peace, broken only by a brief but serious uprising in 154 B.C., the Revolt of the Seven Kingdoms. It was led by princes of the imperial family, notably the kings of Wu and Ch'u in the south, who had grown powerful and restive under the lenient rule of Emperor Wen and were angered by the attempts of Emperor Ching to curb them by deprivations of territory. Though the revolt was quickly put down, it showed how dangerous the feudal princes could be if allowed to accumulate wealth and power too freely. To prevent a recurrence, Emperor Ching and his successor Emperor Wu took steps to cripple the feudal lords by depriving them of the right to appoint their own ministers, forcing them to divide their domains among their sons and gradually whittling away their wealth and resources.

In 141 B.C. Emperor Ching's son Liu Ch'e, known as Emperor Wu or Han Wu Ti took the throne. His long reign, lasting until 87 B.C., was marked by furious government activity, large scale attacks on the Hsiung-nu, and expansion into southeast and central Asia and into Korea. These undertakings and the luxury of Emperor Wu's court exhausted the funds accumulated during the preceding era of prosperity. For all the glory of his foreign conquests, Emperor Wu left the empire in a state of poverty and unrest.

His son Liu Fu-ling, known as Emperor Chao, came to the throne in 87 B.C. at the age of eight and died in 74 B.C. During his reign the actual power was exercised by Ho Kuang, an able statesman who laboured to repair the damage done by Emperor Wu's extravagance. He practised economy, reduced taxes, granted loans to the poor and confined military activity to the defense of the borders.

On the death of Emperor Chao a grandson of Emperor Wu was summoned to the throne, but when he failed to observe the proper decorum during the period of mourning for his predecessor, he was speedily stripped of his position by Ho Kuang and the other ministers and replaced by Liu Ping-i, known as Emperor Hsüan, a great-grandson of Emperor Wu. He proved a wise and kindly ruler who worked to suppress the harshness and corruption among officials that had marred the administrations of Emperor Wu and Emperor Chao. His frugal ways, combined with a succession of good harvests, brought the empire to the highest peak of prosperity it was to know under the dynasty. During his reign a leader of a large section of the Hsiung-nu people was persuaded to acknowledge Han sovereignty, and the Hsiung-nu for a time ceased to trouble China.

Emperor Hsüan was succeeded in 48 B.C. by his son Liu Shih, known as Emperor Yüan. Emperor Wu and his successors, while establishing Confucianism as the official creed, had often disregarded its teachings in actual practice, but Emperor Yüan wholeheartedly supported Confucian doctrine and promoted Confucians to high posts, where they did much to lessen the expenses of government and improve the welfare of the people. At the same time Emperor Yüan, believing that he was conforming to Confucian teachings, unwisely granted great power to his maternal relatives, setting a precedent that was to bring about the downfall of the dynasty. His reign also saw the appearance of another evil that eventually contributed much to the ruin of the Han, namely the domination of the ruler by eunuch secretaries.

In 33 B.C. Emperor Yüan's son Liu Ao, known as Emperor Ch'eng, succeeded to the throne. A weak ruler like his father, he awarded high posts to his mother's brothers of the Wang clan and allowed them to control the government. The Wangs soon acquired great affluence and continued to exercise *de facto* rule during the reigns of Emperor Ch'eng's two short-lived successors, Emperor Ai (7 B.C.–1 B.C.) and Emperor P'ing (1 B.C.–A.D. 6). In A.D. 6 Wang Mang, the most powerful member of the clan, declared himself regent for a child he had set on the throne, and in A.D. 9 he openly assumed the title of emperor and proclaimed the termination of the Han and the establishment of a new dynasty, the Hsin.

Latter or Eastern Han.—Because of widespread unrest and the drastic reforms that Wang Mang attempted, however, he soon found himself in serious difficulty. In A.D. 22 a descendant of Emperor Ching named Liu Hsiu raised an army in the area of Hupeh and, with the aid of other princes of the Liu family, defeated Wang Mang's armies and put an end to the usurper's reign in A.D. 23, proclaiming the restoration of the Han. In 25 Liu Hsiu took the title of emperor and moved the capital to Loyang. The following ten years he devoted to defeating rivals, suppressing bandit groups and securing control of the empire. He died in 57 and is posthumously known as Emperor Kuang-wu of the Latter or Eastern Han.

Emperor Kuang-wu, unlike Kao-tsu, was an educated man and a patron of Confucianism who won the throne through the support of the Liu clan and other powerful aristocratic families which possessed enormous wealth and influence in the provinces. These great families dominated the society of the Latter Han, accumulating large estates which were worked by tenant farmers, securing posts in the bureaucracy for their members and clients, and, as the central government grew weaker, relying more and more upon their private military forces for protection. The Latter Han resembled less an empire ruled by an absolute monarch than a federation of great clans.

Kuang-wu was succeeded by his son Liu Chuang, known as Emperor Ming, under whose reign we find the first official mention of Buddhism in China. This period also saw a burst of military activity against the Hsiung-nu and other peoples to the west which reasserted Han influence in central Asia.

In 75 Emperor Ming's son Liu Ta, known as Emperor Chang, took the throne and ruled until 88. He was a kind and lenient ruler and his reign was relatively peaceful, but the dynasty by this time was sinking rapidly. Of the nine rulers who followed him, the oldest was 14 at the time of his succession and several were mere infants who occupied the throne for no more than a year. All were puppets in the hands of their maternal relatives and the palace eunuchs. Intrigues raged at court, bands of rebels appeared in the countryside, and the government's grip on the empire grew increasingly feeble.

In 190 a military dictator, Tung Cho, set up a boy of eight, Liu Hsieh, known as Emperor Hsien, and the dynasty lost the last remnants of actual power. Though Tung Cho was assassinated two years later, he was replaced by another military leader, Ts'ao Ts'ao, whose party completely dominated the government. Ts'ao Ts'ao was opposed by two rivals who controlled the western and southern areas of the empire. After suffering a severe defeat when he attempted to break their power, he died in 220. His son Ts'ao P'i forced Emperor Hsien to cede the imperial title to him and set himself up as emperor of a new dynasty, the Wei, ruling northern China. His rivals followed suit, establishing their own dynasties in the west and south. China became divided into three parts, the Three Kingdoms of the succeeding era, and the Latter Han officially came to an end. *See* CHINA: *History: Middle Period; see* also references under "Han" in the Index volume.

See Homer H. Dubs, *The History of the Former Han Dynasty by*

Pan Ku, 3 vol. (1938–55); Hans Bielenstein, "The Restoration of the Han Dynasty," *Bulletin of the Museum of Far Eastern Antiquities 26*, pp. 1–209 (1954), vol. ii, *Bulletin of the Museum of Far Eastern Antiquities 31*, pp. 1–287 (1959). (B. D. W.)

HANAU, a town of Germany, *Land* (state) of Hesse, which after partition of the country following World War II became part of the Federal Republic of Germany, is on the right bank of the Main, 20 km. (12.5 mi.) E. of Frankfurt by road. Pop. (1961) 47,207. Much of the town is new, 87% having been destroyed by air raids in World War II, but the new buildings were erected on the same general plan as that of the older town. The old part of the town has narrow and crooked streets; in the newer part they are built at right angles to one another. The chief buildings of interest are the 14th-century St. Mary's church, the Dutch-Walloon church built 1600–08 in the form of two intersecting circles, the church of St. John (1658) and two town halls. In front of the town hall in new Hanau is the memorial to the brothers Grimm, born in Hanau. Philippsruhe castle (1701–12), modeled on Versailles, and Wilhelmsbad spa (1776–84) are nearby.

Railways run to Frankfurt, Nürnberg and Hanover, and there is an important harbour on the Main. These, together with the roads, handle much goods. The chief industries are diamond cutting, foundry work and the production of chemicals, rubber, gold, silver and platinum articles, ultraviolet and operating theatre lamps, and beer. The jewelry trade has a strong tradition. The district was settled in late Paleolithic times. Hanau received civic rights in 1303, the local seigniory became a countship of the Holy Roman empire in 1429, and in 1597 the count Philipp Ludwig II founded the new town of Hanau beside the old town. Hanau was the site of an important battle on Oct. 30, 1813, when Napoleon, retreating from the battle of Leipzig with 100,000 men, defeated 50,000 Bavarians under General Karl Wrede and so was able to withdraw the French forces from Germany unmolested.

HANCOCK, JOHN (1737–1793), American Revolutionary leader, was born on Jan. 12, 1737, in the part of Braintree, Mass., that is now known as Quincy. After graduating from Harvard in 1754 he entered a mercantile house in Boston that was owned by his uncle, who had adopted him. Upon the death of his uncle in 1764 he fell heir to a large fortune and a prosperous business. In 1765 he became a selectman of Boston, and from 1769 to 1774 was a member of the Massachusetts general court. He was chairman of the committee appointed in a Boston town meeting immediately after the "Boston massacre" in 1770 to demand removal of the British troops from the city. Not averse to smuggling to avoid paying import duties, he became popular with the radicals although he was not a brilliant or inspiring leader.

In 1774 and 1775 he was president of the first and second provincial congresses and he shared with Samuel Adams the leadership of the Massachusetts patriots in all their irregular measures. The famous expedition sent by Gen. Thomas Gage from Boston to Lexington and Concord on April 18, 1775, had for its object, besides the destruction of war supplies at Concord, the capture of Hancock and Adams, then temporarily staying at Lexington. Warned, Hancock and Adams escaped and proceeded to Philadelphia. Hancock was a member of the continental congress from 1775 to 1780; he served as its president from May 1775 to October 1777 and was the first to sign the Declaration of Independence. He aspired to be commander in chief of the continental army but George Washington was selected instead.

Hancock was a member of the Massachusetts constitutional convention of 1780 and in the same year was elected governor of the state. He served in the congress under the Articles of Confederation in 1785–86 and then returned to the governorship. Although at first unfriendly to the new federal constitution drafted in 1787 he was won over to its support and presided over the Massachusetts convention of 1788 that ratified it. Hancock wielded great influence primarily because of his wealth and social position, but he was liberal, courageous and public-spirited. While serving his ninth term as governor he died at Quincy, Mass., Oct. 8, 1793.

See H. S. Allan, *John Hancock* (1948). (H. H. P.)

HANCOCK, WINFIELD SCOTT (1824–1886), Union general during the American Civil War and later a presidential candidate, was born in Montgomery county, Pa., Feb. 14, 1824. He graduated from West Point in 1844 and served with distinction in the Mexican War. From 1848 to 1861, in various peacetime posts, he showed a conscientious mastery of detail and organization. Appointed a brigadier general of volunteers on the outbreak of the Civil War, he soon demonstrated high qualities as a combat leader as well. The performance of his brigade in the Peninsular campaign of 1862 against Richmond earned him the commendation of "superb" from Gen. George B. McClellan. Given a division at Antietam, he led it through action at Fredericksburg and Chancellorsville, and in May 1863 he was promoted to the command of the II corps, Army of the Potomac, which he led for most of the war's duration.

After part of the Union army was defeated on the first day of the battle of Gettysburg, Hancock helped to select and prepare the Union defensive position on Cemetery ridge that successfully defied Confederate attack for the next two days. On July 3, 1863, the II corps took most of the shock of Pickett's charge. Hancock was badly wounded in the thigh and was out of action for nearly six months. The spring of 1864 saw his corps in the full fury of the drive on Richmond. Renewed trouble with his old wound kept him inactive during the war's final months. Though he never received an independent army command, the war department recognized his services by making his wartime rank of major general permanent in 1866.

After postwar service "pacifying" Indians in the west, Hancock was thrown into the caldron of Reconstruction, when he was assigned to command the military division comprising Louisiana and Texas. Rejecting the great discretionary powers conferred on him, Hancock declared that he would insist on the maintenance of the civil authorities in their "natural and rightful dominion." This policy enraged some Radical Republicans, who were counting on a liberal use of military power to protect Negro and white Republicans and sustain "carpetbag" government in the south. Hancock was made so uncomfortable in his command that he requested relief in 1868.

This stand endeared Hancock to the Democrats, who nominated him for the presidency in 1880. Political innocence, which had been an asset to Grant in 1868, was by now a drawback for Hancock. With the depression of 1873 and the worst corruptions of the Reconstruction all somewhat abated, there were few real issues. After losing by a narrow margin to James A. Garfield, also a Civil War general, Hancock returned to military life, and died at Governor's Island, N.Y., on Feb. 9, 1886. (B. A. W.)

HAND, (BILLINGS) LEARNED (1872–1961), U.S. jurist, whose more than 2,000 opinions ranged virtually through all fields of law, was born in Albany, N.Y., on Jan. 27, 1872. Both his grandfather, Augustus Hand (1803–78), and his father, Samuel Hand (1833–86), were judges; the former, justice of the New York supreme court and the latter, judge of the New York court of appeals, New York's highest state bench. With his cousin and boyhood companion, Augustus Noble Hand (1869–1954), also an outstanding U.S. judge in New York, Learned Hand attended Harvard, where he studied philosophy under William James, Josiah Royce and George Santayana, graduating in 1893. He received an M.A. degree (1894) and an LL.B. (1896) from Harvard. For 12 years he practised law in Albany and New York city.

In 1909 he was appointed United States district judge in New York. In 1913 he ran unsuccessfully on the Progressive ticket for chief judge of the New York state court of appeals. In 1924 he was elevated to the federal court of appeals for the second circuit (New York, Connecticut and Vermont), where he became chief judge in 1939 through seniority. Augustus N. Hand reached the same bench in 1927.

His notable cases included the celebrated antitrust suit against the Aluminum Company of America (1945) in which his court acted for the supreme court where a quorum, because of disqualifications, was impossible. Summarizing his view of 40,000 pages of testimony, taken over four years, Hand said in characteristic epigram: "Congress did not condone 'good trusts' and condemn 'bad ones'; it forbade all." He upheld in 1950 the conviction of the top 11 Communist party members on Smith-act charges of

conspiracy to teach and advocate overthrow of the government. His opinion (183 F. 2d 201) was adopted by Chief Justice Frederick M. Vinson in 1951 when the supreme court also sustained the convictions (*Dennis* v. *U.S.*, 341 U.S. 494). But in 1957, under Chief Justice Earl Warren and with other changes in the justices, the supreme court substantially altered the application of the Smith act and with it the Hand and Vinson decisions. "Advocacy or teaching of abstract doctrine," the court said (*Yates* v. *U.S.*, 354 U.S. 298), was not punishable "even though uttered with the hope that it may ultimately lead to violent revolution."

In delivering the Holmes lectures at Harvard in 1958, Hand cautioned strongly against judge-made law by "a third legislative chamber," with the result that his views were claimed as support for the Jenner-Butler bill (then before Congress) to limit severely the supreme court's jurisdiction. Asked to clarify this, Hand wrote to Sen. Thomas C. Hennings, Jr., that he believed enactment of the bill "would be detrimental to the best interests of the United States" inasmuch as the supreme court "should have the last word on the questions of the character involved." Describing the highest tribunal as "the least contentious organ of government generally," he said that while he did not think it always right, "some final authority is better than unsettled conflict."

Hand's Harvard lectures appeared as *The Bill of Rights* (1958). A collection of his papers and addresses, *The Spirit of Liberty* (1952; reissued with new material, 1960), appeared in his 81st year. The combination of faith and skepticism that distinguishes his thought was movingly presented in his "I Am an American" day address in New York city, May 21, 1944. This brief definition of the spirit of a free people had an impact so immediate and profound that it was likened to Lincoln's "Gettysburg Address." Hand retired officially in 1951, but continued to sit in many cases.

On April 10, 1959, Judge Hand, then 87 years old, set a record of 50 years of service in the United States judiciary, an occasion marked by a special session of his court at which Chief Justice Warren led the national bench and bar in paying him warm and admiring tribute. He died in New York city on Aug. 18, 1961.

See citations in *The Spirit of Liberty: Papers and Addresses of Learned Hand,* collected and with an introduction and notes by Irving Dilliard, 3rd. ed. (1960). (I. Dd.)

HAND. That man has a hand, rather than a paw, hoof, fin or wing, has set him above all other animals and has enabled him to develop a culture based on toolmaking and tool using. It is quite possible that the emergence of a culture in turn accelerated the pace of hominid evolution to hasten the appearance of modern man, *Homo sapiens* (*see* Man, Evolution of). It is thought that the hand has evolved from the five-rayed forepaw of early vertebrates. Occasionally, however, a child is born with an extra rudimentary thumb (prepollex) and an extra rudimentary little finger (postminimi) which has led some to speculate that the hand was originally seven-rayed.

In the human hand there are 8 small bones (carpals), 5 longer tubular bones (metacarpals) and 14 shorter tubular bones (phalanges). The phalanges compose what are called fingers; the thumb contains two phalanges, the other four fingers, three each.

Scientifically the thumb is numbered finger I; index finger, II; middle, III; ring, IV; and little finger, V.

The thumb is the outstanding part of the human hand. Although the anthropoid apes can flex and extend their thumb (bend it, straighten it) and can abduct it and adduct it (move it away from and return it to the midline), only man has true opposability (*i.e.*, he can rotate it inwardly so that very precise pincerlike movements are possible).

From anthropoid to man the thumb has increased in relative and absolute length. For example, the pollicial index (total phalangeal length of finger I × 100/total phalangeal length of finger III) may be noted: gibbon 35.2%, orangutan 30.2%, chimpanzee 35.4%, gorilla 37.3%, man 56.9%. In man the total absolute finger length is, in descending order, most often III, IV, II, V, I, though frequently IV equals II.

Anthropoids tend to be ambidextrous. But man is predominantly right-handed; only about 8% favour their left hand. (*See* Handedness.) A man-made flint implement possibly 1,000,000 years old appears to have been beveled to be held between the right thumb and forefinger. In prehistoric Europe a cave painting shows a man throwing a spear with his right hand.

The hand is very important in the study of the growth and development of the child. In carpals, metacarpals and phalanges centres of ossification appear in a time-sequence that (via X-ray film) gives a biological growth-age of the child.

As an important cultural symbol the hand is used in gestures that impart meaning; the hand is also important medico-legally; *i.e.*, fingerprints (*q.v.*) serve to identify; and other marks, calluses, worn areas, etc., give clues to the possesser's occupation.

For a discussion of the anatomy of the hand *see* Skeleton, Vertebrate: *Appendicular Skeleton;* Muscle and Muscular System; Nervous System. *See* also Hand, Diseases and Disabilities of.

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HAND, DISEASES AND DISABILITIES OF. The hand is composed of skin, fatty tissue, tendons, nerves, muscles, bones and joints. Disease may affect each tissue separately or the whole hand.

Abnormality of the hand may occur as an anomaly of development. Two or more fingers may be conjoined (syndactyly). A finger or thumb may be duplicated, presenting a hand with six or more digits. Conversely, the hand may be formed with absence of part of a finger or an entire finger or fingers. One such deformity is seen in the hand that has only a thumb and little finger and resembles a lobster claw; although unsightly, such hands may be very agile. A less severe but commoner developmental abnormality is the thumb that cannot be completely straightened due to constriction of a tendon by adjacent tissues, a condition known as a trigger thumb.

The hand is subject to frequent and severe injuries. Lacerations of the skin of the hand are more serious than such lacerations in most other parts of the body, because in the hand there is little fatty tissue protecting the vital nerves and tendons. Should a nerve be severed the finger will lose sensation and therefore most of its function. A severed tendon leaves the finger as useless as a marionette without strings. Fingertips are prone to crushing injuries in doors and under ill-aimed tools. Should such an injury result in loss of the tip of the finger, the tip is frequently replaced by tender scar, greatly reducing the effectiveness of the digit. Tendons may be severed without an exterior wound, as when a baseball is caught on the end of an outstretched finger; the tendon near the base of the nail is pulled loose and the end of the finger cannot be straightened. Drummers may wear out the tendon that straightens the thumb on the left hand. Other tendons break spontaneously in arthritic hands. Fractures of the bones of the hand result from direct blows or when the hand is used as a striking instrument, as in boxing. Most fractures in these bones heal readily. Serious injuries may occur to the hands when they are caught in machines, as washing-machine wringers.

Diseases affecting other parts of the body may show evidence in the fingers. Swelling of finger joints may indicate arthritis (rheumatoid), and enlarging prominences near joints may indicate osteoarthritis or gout.

Infections may occur as a result of minor cuts and scratches, "hangnails" (causing infection in the base of the nail called runaround), pin pricks into finger tips (abscess in the pulp). The most serious infections of the hand are those occurring in the tendons and deep in the palm.

Function of the hand is of paramount importance, and this is most severely impaired when one of the three major nerves to the hand is damaged. Such damage may take place as a result of fractures of the arm, birth injury to the neck, lacerations of the wrist or poliomyelitis. Should the nerve to the small muscles of

the thumb be destroyed, almost 80% of the function of the hand is lost. Damage to one of the major nerves results in loss of sensation to the skin, and this impairs the ability of the hand to feel objects.

Tumours (*q.v.*) may be found in all the composite tissues of the hand. Within the bones occur benign tumours of cartilage; along the tendons occur tumours of fatty tissue; tumours of a gelatinous substance occur in joints.

Disability of the hand arises from a loss of one or both of its functions, feeling and grasping. Feeling is lost when a nerve is severed. Grasp is lost when motor power in the muscles is lost or when stiffness of the fingers robs them of their flexibility. Such stiffness may be due to arthritis, too long immobilization for treatment of a fractured finger, swelling of the hand due to injury of the arm, infection in the tendons or scarring of the skin and fatty tissue after an extensive burn.

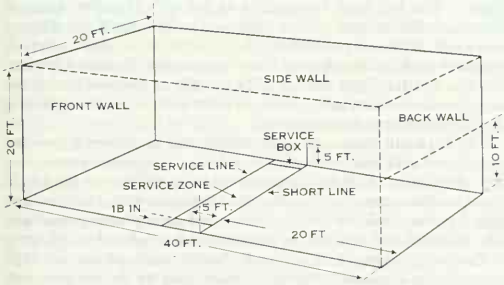
For the anatomy of the hand, *see* SKELETON, VERTEBRATE; MUSCLE AND MUSCULAR SYSTEM; NERVE. (T. D. B.)

HANDBALL, an active game that is popular in the United States, Canada and in various forms in other countries, is played with a small rubber ball that is struck with a gloved hand against a wall or walls. (For English versions of the game, *see* FIVES.) Two or four persons play at a time. When two play, the game is called singles and when four play, doubles. The object is to strike the ball in such a manner that the opponent or opposing team has difficulty in returning it or is unable legally to keep the ball in play.

The game is played on a court, either indoors or outdoors. The court usually has one wall or four walls (*see* below for variations). Three organizations in the United States formerly issued playing rules; co-operation among the three—the Amateur Athletic union (A.A.U.), the United States Handball association (U.S.H.A.) and the Young Men's Christian association (Y.M.C.A.)—resulted in the publication in 1959 of one set of official unified handball rules.

The game involves strenuous physical activity, and persons of all ages and both sexes enjoy it. It helps develop speed, skill and endurance, and has been used by athletes as a conditioner for other sports.

History.—The Irish hard handball is often considered one of the national games of Ireland (*see* below). In the late 19th century, the game was introduced to the United States, and thereafter it grew rapidly in popularity There were more players in



FOUR-WALL HANDBALL COURT ACCORDING TO OFFICIAL UNIFIED RULES

the United States, it was believed, than in any other country of the world in the second half of the 20th century.

The first international match was the Lawlor-Casey series played in 1887 with a prize of $1,000 for the best of 21 games, 10 to be played in Cork, Ire., and 11 in the U.S. John Lawlor won six games to four in Cork; Phil Casey, the U.S. champion, won seven straight in New York city, winning the match. Casey, who retained his title against all challengers until he retired in 1900, was spoken of as "the father of handball in the U.S." Bernard McQuade, Drew Cashman and Michael Eagan were other outstanding stars of former days.

After 1900 handball developed into three separate games (covered separately below): a four-wall game called soft handball; the one-wall game; and the Irish four-wall, hard-ball game. National hard-ball championships were discontinued in the U.S. after 1938.

In the United States national A.A.U. championships were started in 1919 and national Y.M.C.A. championships in 1925, and the United States Handball association began conducting national championships in the early 1950s. The three organizations sponsored one combined national tournament in 1958. In 1959, the Y.M.C.A. and the A.A.U. again conducted a combined national tournament, but the U.S.H.A. sponsored a separate tournament. In 1961 the U.S.H.A. severed its working agreement with the A.A.U. in order to open its amateur tournaments to athletes who compete professionally in other sports.

When the first Helms Hall of Fame handball selections were made in 1954, Joe Platak, who died in that year, was chosen along with Al Banuet. Banuet was the leading player for three years, 1929–31, but was disqualified as an amateur after a brief professional boxing career. Platak dominated singles championship play from 1935 to 1941 and returned in 1943 and 1945 to bring his total to nine national championships. Victor Hershkowitz of Brooklyn, N.Y., dominated modern tournament play. He had captured more than 20 national championships in one-wall, three-wall and four-wall play when he won another title in the national Y.M.C.A. championships in 1957. Other outstanding players included Robert Brady of San Francisco, Calif., Philip Collins and John Sloan of Chicago, Ill., and Jimmy Jacobs of Los Angeles, Calif., and New York.

Four-Wall Game.—This is the most popular version of the game in the United States. The approved court should measure 20 ft. wide, 40 ft. long and 20 ft. high with the back wall 10 ft. high, under official unified handball rules (*see* diagram).

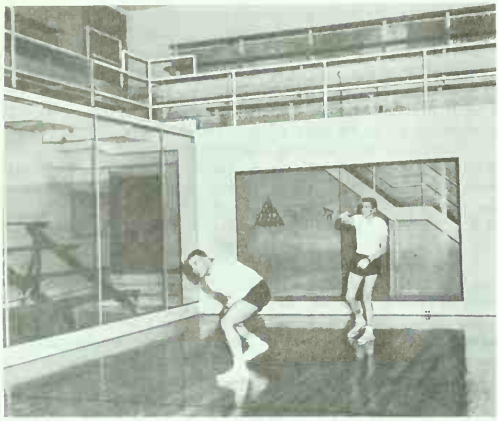
A game consists of 21 points. A match is the best two out of three games.

The ball is made of black rubber; it is $1\frac{7}{8}$ in. in diameter with not more than $\frac{1}{32}$ in. variation; it should weigh 2.3 oz. with not more than .2 oz. variation; when dropped from a height of 70 in. the ball must rebound not less than 42 nor more than 48 in. at a room-and-ball temperature of 68° F. Only one hand may be used in striking the ball; no other part of the body may be used. When attempting to return the ball, the player cannot strike it more than once. Gloves made of soft cloth or leather must be worn during all matches (to prevent moisture from the hands making the ball wet and slippery).

A service zone five feet wide is marked across the court; the back edge (called the short line) is exactly in the middle of the court (*e.g.*, in a court 20 ft. wide and 40 ft. long, the 20 ft. back edge of the zone, the short line, is parallel with and 20 ft. from the front wall; the front edge of the service zone, called the service line, is parallel with and 15 ft. from the front wall. To put the ball in play the server stands anywhere he chooses within the service zone, drops the ball to the floor and on the rebound strikes it with one hand so it travels directly to the front wall and rebounds in such a manner that it travels beyond the short line before striking the floor. A legally served ball that fails to rebound beyond the short line before it touches the floor, or one that hits two side walls before touching the floor is called a short serve. Two short serves retire the server. If the server steps outside the service zone, while in the act of serving, this is called a foot fault and is considered the same as a short service. Two foot faults retire the server.

After the ball is served the server's opponent (or one of the opponents in a doubles game) known as the receiver, must play the ball before it touches the floor twice, hitting it in such a manner that it travels from the striker's hand to the front wall without touching the floor. First the receiver then the server play the ball in alternate fashion until one or the other makes an error. If the receiver fails to return the ball legally a point is scored for the server. If the server makes an error, no point is scored, but he is "out" and the receiver comes "in" and has his opportunity to serve and while doing so may score points. A server continues to serve as long as he makes points.

In singles the receiver stations himself anywhere in the back



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HANDBALL COURT WITH GLASS WALLS THAT PERMIT SPECTATORS TO VIEW THE PLAY

court (but at least five feet behind the short line), where he waits for the service. In doubles the two receivers may stand anywhere in the back court (at least five feet behind the short line), but the server's partner must stand in the service box with his back to the side wall, both feet on the floor, and remain there until the ball passes the short line. If a served ball strikes the server's partner while he is in the back-to-wall position, it is called a dead ball (the ball is out of play) and the serve is made over. If the server's partner leaves the service box position before the served ball crosses the short line, this is a short service and must be repeated.

Because of the many angle shots (side wall to front wall, ceiling to front wall, recoveries from the back wall, and so on) many players and spectators consider the four-wall game more scientific and interesting than the one-wall game. The one-wall game supporters say their game requires more speed, stamina and control. It is generally conceded that a person who learns the one-wall game and then changes to the four-wall game adapts more quickly than does a four-wall starter who goes to the one-wall game.

One-Wall Game.—The one-wall game is played in several sections of the United States, but it achieved its greatest popularity in the New York city area, where an estimated 2,500 one-wall courts were built in parks and playgrounds, at beaches and elsewhere. The one-wall game is played with the ball described above for the four-wall game and is scored the same as the four-wall game. The court dimensions differ; as specified by the Amateur Athletic union, they are length, 34 ft.; width, 20 ft.; and front wall, 16 ft. high. The short line is 16 ft. from and parallel to the front wall. A "receiver restraining" line called the service line is indicated 9 ft. behind the short line (25 ft. from and parallel to the front wall). In doubles the server's partner steps outside the court but in the space represented by a slight extension of the serving zone beyond the side line of the court.

Definitions.—A hinder is an accidental interference with or obstruction of flight of the ball; no penalty is involved. Fault refers to an infraction of the rules which involves a penalty. A ball returned to the front wall in such manner that it rebounds so close to the floor that it is impossible to get has been "killed." An ace is a service which completely eludes the receiver.

Other Versions.—Standard versions of the game in the United States have been described, but various adaptations have been introduced. Instead of two or four players, for example, three participants may engage in "cut-throat" handball. One player, while serving, engages the other two. He continues to serve as long as he makes points. When he is put "out," a move clockwise is made, the server pairs off with another, and a new server comes "in." The person scoring 21 points first is the game winner.

Sometimes a one-wall court laid out on a gymnasium floor where the back line of the court is parallel to and near a gymnasium wall can be adapted for two-wall play. By agreement players are allowed to play legal balls off the wall, thus keeping in play balls that would not otherwise be returnable.

Some one-wall courts are laid out in the corner of a gymnasium, permitting corner shots and play on a side wall as well as the front wall. There are also courts with two folding triangular "wings" that swing out from the front wall of a one-wall court and fit into place on the side lines. The wings thus provide two front corners for angle corner shots. A further modification of this idea is a three-wall court (front, side and back wall), with one side open to accommodate a large group of spectators when contest matches are played. Two such courts were built by the New York department of parks and opened in Nov. 1959 with special exhibition matches. One is in Lincoln Terrace park, Brooklyn; the other is at Forrest park playground in Queens.

Glass-wall handball courts permit as many as 200 or 300 spectators to see tournament matches, but problems of materials, lighting, glare, variation in bounce and expense delayed development of such courts. The St. Louis Downtown Branch Y.M.C.A. built one of the first partial glass-wall courts. In 1958 the principal and final contests of the combined national four-wall handball tournament were played in a glass-enclosed court at the Y.M.C.A. in Aurora, Ill. (H. T. Fd.)

Irish Handball.—The game of Irish handball originated about 1,000 years ago and was played on a hard clay floor, with one wall, of stone, at the front of the court, against which the ball was struck. In the modern form of the game the court dimensions and rules are almost identical with those laid down in the 1880s, when the first Irish championships were played; the ball and the system of scoring go back to the 18th century, when handball was a popular pastime in many parts of Ireland.

The standard ball court is a four-wall structure, with concrete walls and floor. The playing floor is 60 ft. long and 30 ft. wide; the front wall is 30 ft. high and the back wall, 9 ft. high. The side walls are higher at the front than at the back. The walls must be perpendicular and smooth. The short line, from which the ball is tossed (served), is drawn at or near halfway down the court. In the toss the ball must be hit against the front wall on the first bounce and must come out beyond the short line to be accepted. Returns count, as in all ball games; the game proceeds with return and counterreturn—the ball is "up" when it hits the front wall direct. The ball may be punched or hit with the open palm or kicked. Ambidexterity is most important in Irish handball. Players toss a coin for inside position which is held until the tosser (server) is beaten in the rally. A good tosser can score a considerable number of aces direct from service. The game is 21 aces and the rubber of games varies from five to seven or more games. Both single- and double-handed games are general.

The Irish ball has a cork or greenhart centre covered by woolen thread and thin pieces of cork or rubber. The outer cover is of thin sheepskin. This ball is called an alley cracker or hard ball. Some tournaments or championships are played with a soft, rubber ball, but the Irish ball is the recognized championship medium. The standard ball is $1\frac{7}{8}$ in. in diameter and weighs $1\frac{1}{2}$ to $1\frac{3}{4}$ oz.

For many years challenge and championship games for high wagers were common. Side bets amounting to £1,000 were not unusual. Many matches for big wagers were played between Ireland and the United States between 1895 and 1910. Then the Gaelic Athletic association took handball under its wing; wager matches were abolished in 1924 and handball became a truly amateur game in Ireland. Separate boards of handball control were subsidized by the Gaelic Athletic association, and regular county, provincial and all-Ireland championships were organized. There are many standard courts throughout Ireland and innumerable ball alleys, and every secondary school and college has its first-class handball court. The soft ball is generally used in schools.

(P. D. M.)

Bibliography.—*Ace* (monthly, 1951 *et seq.*). *See* Unified Rules Committee of the Amateur Athletic Union, U.S. Handball Association and Y.M.C.A., *Unified Handball Rules (Four-Wall Handball)*; Na-

tional Amateur Athletic Union, *Official One-Wall Handball Rules;* Bernath E. Phillips, *Handball* (1957); John R. Tunis, *Sports for the Fun of It*, rev. ed., pp. 98–111 (1950).

HANDCUFFS AND FETTERS are instruments for securing the hands and feet of prisoners under arrest, or as a means of punishment. The old names were manacles, shackbolts or shackles, gyves and swivels. Until modern times handcuffs were of two kinds, (1) the figure eight, which confined the hands close together either in front of or behind the prisoner; and (2) rings which fitted around the wrists and were connected by a short chain, the latter being somewhat like those used by the modern police forces. Handcuffs are made of steel, adjustable to the wrist size and equipped with an automatic locking device.

Thumb cuffs, made of lightweight, stainless steel also are used; these cuffs may be employed by juvenile officers and as an auxiliary restraining device by police officers and detectives. For transferring gangs of convicts an arrangement of handcuffs connected by a light chain has been used, the chain running through a ring on each fetter and made fast at both ends by what are known as endlocks.

Several appliances have been used as handcuffs; *e.g.*, snaps, nippers, twisters. They differ from handcuffs in being intended for one wrist only, the other portion being held by the captor. In the snap the smaller circlet is snapped onto the prisoner's wrist. The nippers can be instantly fastened on the wrist. The twister, which is liable to injure prisoners seriously, is a chain attached to two handles; the chain is put round the wrist and the two handles twisted until the chain is tight enough.

Leg irons are anklets of steel connected by light chains long enough to permit the wearer to walk with short steps. Modern leg irons are adjustable to the size of the leg or ankle and lock automatically when they are applied to the prisoner. Sometimes leg irons are combined with handcuffs, being attached to the latter by a chain.

An obsolete form of leg iron was an anklet and chain to the end of which was attached a heavy weight, usually a round shot. The Spanish used to secure prisoners in bilboes, shackles around the ankles secured by a long bar of iron. This form of leg iron was adopted by the English and was much employed by them during the 17th and 18th centuries. (R. G. CL.)

HANDEDNESS. It is the usual practice to classify persons as right-handed, left-handed or ambidextrous. People differ considerably in the range of activities for which they prefer a given hand as well as in the degree of disparity in skill between their two hands. Probably no one favours his right or left hand exclusively.

Origin and Development of Handedness.—There is no extensive agreement on the question of the origin of the manual preferences people show. Some authors believe laterality is inherited; others, that the child is trained to it; and still others, that some organization of intrauterine forces, such as those producing twinning, or some extrauterine environmental influences initiate biases. It is possible all three hypotheses are, in a measure, correct. It does seem clear that left-handed parents more frequently have left-handed offspring than do right-handed parents; that even at birth most babies tend to move one arm—usually the right—more than the other; and that, if a systematic effort is made to keep infants from developing a preference, they still come to favour one hand. It is equally apparent that most babies, if the hand used the more frequently in reaching or grasping is taken as the clue to handedness, shift their preference once or twice during their first year. The consistency with which children use one hand in preference to the other increases with age, at least through the preschool years and probably longer. Although the incidence of left-handedness seems to vary with the way it is measured and with the population studied, it is probably not too far wrong to say that in the United States 18 to 24 children become right-handed for every one who persists in left-handed tendencies.

Effects of Interference with Handedness.—Most children can be trained to use and to prefer the right hand in any given operation, and many have been so trained without obvious harmful effects. How wise it is to interfere with a child's spontaneous preference is, however, a question. There does seem to be some sort of relationship between left-handedness and stuttering. Some hold the view that a left-handed person in a right-handed society, by virtue of being disapproved, interfered with and inconvenienced, is under more emotional strain, on the average, than is a right-handed person, and this stress causes stuttering. Others believe that if a left-handed person has his hand preference changed, he does not develop the clear-cut dominance of one cerebral hemisphere over the other which is necessary for co-ordinated functioning. His speech is an indicator of this lack of co-ordination in neurological activity. Some workers maintain, on the other hand, that the cerebral organization that makes for a lack of consistent unilateral dominance is inherited.

Laterality in the Body.—There is evidence that the brain speech centre tends to be located in the hemisphere contralateral to the side of the dominant hand and that brain waves from corresponding parts of the two cerebral hemispheres are more conspicuous on the nondominant side. Neither of these bits of evidence shows conclusively, however, that the cortical organization a person inherits is responsible for his hand preference. There is little support for the view, as the theory of a dominant cerebral hemisphere might lead one to expect, that the body structures under the control of one hemisphere are uniformly more efficient than those under control of the other. The dominant hand is not always on the side of the dominant foot. About three-fourths of dextrals and one-third of sinistrals are right-eyed in sighting.

It is probable that a person's preference for a given hand is an expression of many influences. Since it is not a matter of great importance which hand a person uses, as long as he performs well, it seems wiser to allow choice as to hand if a strong preference is indicated. Whatever the choice, however, there is evidence that it is desirable to work for a clear-cut dominance of one hand.

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(H. L. K.)

HANDEL, GEORGE FREDERICK (HÄNDEL, GEORG FRIEDRICH) (1685–1759), Anglo-German composer of the oratorio *Messiah* and other important vocal and instrumental works, the greatest English composer of the late baroque era.

His Life.—Handel was born at Halle in Saxony on Feb. 23, 1685. His father was a barber-surgeon of some eminence. At the age of seven the composer already showed signs of musical talent, and it is said that he practised the clavichord secretly at night, as his father was opposed to the idea of his son's following music as a profession. But when his father took him on a visit to the court of Saxe-Weissenfels, the duke was impressed with the boy's talent and he persuaded Händel senior to allow his son to study music seriously; he was then placed with F. W. Zachau, organist of the Liebfrauenkirche in Halle, but at the same time the boy was required to pursue a general education at the Lutheran *Gymnasium*. After his father's death in 1697 young Handel entered Halle university as a law student, although he had already begun to earn a living as an organist at Halle cathedral. Among the friends that Handel made at this time was G. P. Telemann (1681–1767), soon to be regarded as the leading composer in north Germany.

Handel decided to make music his career and, having finished his legal studies in accordance with his father's wishes, he left Halle about 1703 and went to Hamburg, at that time a notable centre for German opera. The Hamburg opera was under the direction of R. Keiser (1674–1739), one of the most gifted opera composers of the day, and Handel found a position as violinist and later harpsichordist in the opera orchestra. He made friends with Johann Mattheson (1681–1764), a young singer and composer who later became well known as a writer on music. The two young men went on an expedition to Lübeck in the hope that one or the other might succeed the celebrated but aged D. Buxtehude (*c.* 1637–1707) as town organist; however, the appointment also en-

tailed marriage with Buxtehude's daughter and as neither wished to undertake this responsibility they returned to Hamburg. Handel composed a St. John Passion that was performed in Holy Week, 1705. In the same year he produced his first opera, *Almira*, in which he showed a gift for writing memorable tunes. It was a success, and he soon followed it with another, *Nerone*.

He then made a journey to Italy, where he met many of the greatest Italian musicians of the day, including Corelli and A. and D. Scarlatti. Among the works he composed there were *La resurrezione; Il trionfo del tempo; Aci, Galatea e Polifemo;* the operas *Rodrigo* and *Agrippina;* and a large number of chamber cantatas. His fame spread throughout Italy and from there to Germany and in 1710 he was appointed *Kapellmeister* to the elector of Hanover, the future King George I of England. Soon after his appointment he applied for leave of absence and went to England, where he found favour with Queen Anne and soon his Italian opera *Rinaldo* was produced. Attempts had already been made to found an Italian opera in London, with scores and singers brought over from Italy, but it was only with the production of *Rinaldo* in Feb. 1711 that Italian opera became firmly established in England. *Rinaldo* was a work full of youthful fire and energy and it created for Handel an immense reputation in England. Although it became necessary for him to return to Hanover he soon was back again in England, where he produced further Italian operas: *Il pastor fido* (1712) and *Teseo* (1713), as well as a *Te Deum* to celebrate the peace of Utrecht and a birthday ode for Queen Anne, who granted him an annual pension of £200. A year later the queen died, and his neglected master, the elector, succeeded her on the English throne. It has been said that Handel composed *The Water Music* to win his way back to royal favour, but this has been rejected by modern scholars although part, at least, of *The Water Music* seems to date from the early years of the king's reign and it is known that Handel directed music for a royal water party on the Thames in 1717. As the new king confirmed Handel's pension, it seems that they must have soon been reconciled. Meanwhile Handel was composing and directing his operas, a task that was to absorb the greater part of his energies for the next 20 years or so. Eighteenth-century *opera seria* was to be aptly defined by Dr. Johnson as an "exotic and irrational entertainment," for the texts were in Italian, a language understood by only a very few of the audience; the plots were incredibly involved, full of disguisings and counterdisguisings; and the librettos were as often as not written in great haste by hack writers employed by the theatrical managers. The composers were concerned not so much with dramatic effectiveness as with showing off the phenomenal accomplishments of the singers, chief of whom were the *castrati*. Both male and female singers were notoriously vain, and Handel frequently found himself at variance with them over the presentation of his music.

Handel was more independent than many of his contemporaries, but he was not above accepting a certain measure of patronage; he lived at Burlington house for a time as the guest of Lord Burlington and there met many famous wits, authors and fellow artists. From 1718 to 1720 he was composer to the Duke of Chandos at the duke's famous mansion of Cannons near Edgeware in Middlesex. It was for Chandos that Handel composed the magnificent series of *Chandos Anthems*, which were sung by the musicians of the duke's private chapel. Other works that Handel wrote for Chandos include the English masques *Esther* and *Acis and Galatea;* the latter was akin to, but by no means the same as, his Italian serenata *Aci, Galatea e Polifemo*. The English *Acis* is one of Handel's most delightful works. Handel soon became involved once again in operatic rivalries; feuds sprang up not only between the singers but also between the partisans of the several composers, such as Bononcini, Ariosti, Porpora and Hasse, who were at one time or another all advanced as Handel's rivals. But Handel, in spite of all difficulties, artistic or financial, continued to compose and direct opera after opera. Among those of the 1720s were *Floridante* (1721), *Ottone* (1723), *Giulio Cesare* (1724), *Rodelinda* (1725) and *Scipione* (1726). Handel's first London operas were written for Aaron Hill, manager of the King's theatre in the Haymarket.

He became a naturalized British subject in 1726, and in the next year was commissioned to compose four of the anthems sung at the coronation of the new king, George II. He was already music master to the royal family and this appointment was confirmed in the new reign with his pension increased to £400 a year. The year 1727 also saw his *Admeto* and *Riccardo I* produced, and in 1728 *Siroe* and *Tolomeo* were performed. But the opera establishment was now in serious financial difficulties, partly due to the immense success of the *Beggar's Opera* by John Gay and J. C. Pepusch, which was produced at the theatre in Lincoln's Inn Fields on Jan. 29, 1728. However, a new Italian opera company was formed and Handel went to Italy in search of fresh talent. On his return journey he revisited Halle and saw his aged mother and married sister. Back again in London he produced *Lotario* (1729), the first of a new series of brilliant Italian operas. Of more importance, however, was a pirated performance of *Acis and Galatea* that brought home to Handel the fact that there was profit to be made out of his compositions set to English words. After producing several new operas (*Ezio, Sosarme, Orlando*), he composed the English oratorio *Deborah*, to a poor libretto, but when it was performed in conjunction with revivals of his earlier pieces such as *Esther* it had sufficient success to warrant his considering other works in the same genre. In 1733 he was invited to make a professional visit to Oxford, where he produced *Esther* and *Deborah* and a new oratorio, *Athalia*. Handel was still busy with Italian operas and early in 1734 London saw *Arianna* (or *Ariadne*). This work is chiefly remembered for the minuet in its overture, which was one of the most popular of all 18th-century tunes.

The marriage of the princess royal and the prince of Orange on March 14, 1734, gave Handel the opportunity of putting on the serenata *Parnasso in festa*, which was largely a *pasticcio* from the music to *Athalia*. He also composed a wedding anthem for the royal pair and performed some of the *concerti grossi* that were published as his Opus 3. He revived *Sosarme*, and *Il pastor fido* in a new version was performed at the King's theatre in the Haymarket. During the summer of 1734 he was engaged to write operas for John Rich, the prosperous producer of pantomimes and ballad operas, who had founded and was running Covent Garden theatre, and so began Handel's long association with the theatre that was to become London's chief opera house. A third version of *Il pastor fido*, preceded by *Terpsicore*, was produced at Covent Garden theatre in the autumn. Handel now found himself composing not only operas but also ballet music for Rich's French protégée, the ballerina Mlle Sallé. Accordingly, Handel's new operas, *Ariodante* and *Alcina*, although still primarily Italian in character, have a certain amount of dance music in the French style and of a quality superior to that of much of the music in his *opera seria*. He set to music John Dryden's ode, *Alexander's Feast*, which was produced with much success in 1736; he produced *Atalanta* in Italian during the same year, and *Arminio* and *Giustino* in 1737.

The opera was again in serious difficulties. Throughout his London career Handel had suffered competition not only from rival composers but also from rival opera houses in a London that could barely support even one Italian opera in addition to its English theatres. Moreover, the opera was supported by the world of fashion and when fashion changed even the finest singers and the best music might lose its audience and as a result Handel often played to empty houses. In 1719 a Royal Academy of Music had been formed in imitation of the French Académie Royale de Musique (both institutions were founded to perform operas, not to teach music). In 1733 an "opera of the nobility" had been formed to perform at the theatre in Lincoln's Inn Fields, but about 1738 both this and Handel's company went bankrupt. Handel became seriously ill. After a course of treatment at the baths at Aachen, he was restored to health and was soon at work again, composing, among other things, the *Funeral Anthem* for the obsequies of Queen Caroline. Handel became composer to a new operatic venture, in which the remnants of the two old companies were united. For this new company he set *Faramondo* and *Serse*, his one attempt at comic opera, and compiled a *pasticcio, Ales-*

sandro Severo, all performed early in 1738. He also wrote two of his most celebrated English oratorios, *Saul* and *Israel in Egypt,* in that year; these were performed early in 1739. He was now at the height of his powers and, whatever his personal fortunes, his reputation as a composer was immense. In recognition of his popularity, Jonathan Tyers, the proprietor of Vauxhall gardens, had his statue, by the French sculptor L. F. Roubillac, erected there.

The year 1739 saw the composition of his finest set of orchestral concertos, the *Twelve Grand Concertos,* Opus 6. Handel also produced a setting of Dryden's *Ode for St. Cecilia's Day,* performed on Nov. 22, 1739. Yet he was still setting and producing Italian operas, with *Imeneo* appearing in 1740 and *Deidamia* in 1741; they were lighter in character than some of their predecessors, but they had little success and again Handel was overtaken by serious finanical difficulties. Even his oratorios were not paying. Yet, in spite of his troubles, the year 1741 also saw the composition of his greatest masterpiece, *Messiah,* and its scarcely less inspired successor, *Samson,* composed in a matter of weeks. About this time he received an invitation to go to Dublin, and it was in that city that *Messiah* was first heard on April 13, 1742. It was received with tremendous enthusiasm, but when Handel produced it a little later in London it was somewhat coldly received and only gradually won its way to popularity, and then largely because of its identification with charitable causes, in particular with its annual performance at the Foundling hospital. At this time Handel finally abandoned opera, but he still had a liking for classical subjects and his search for suitable texts for music led him to W. Congreve's *Semele,* written years before as an English opera. Handel set it as a masque but produced it in 1744 without dramatic action "after the fashion of an oratorio." It contains some of his most charming music, including the famous aria "Where'er you walk," but it had little success in his lifetime. His next true oratorio was *Joseph* (1744). It suffers from an unusually banal libretto and has rarely been revived. He also composed a fine *Te Deum* (1743) for the peace of Dettingen. He then returned to classical mythology for subject matter and composed the secular oratorio *Hercules;* this and another fine work, the biblical drama *Belshazzar,* were produced in 1745 with little response from the public. In spite of his prodigious efforts, Handel was again in serious financial difficulty and to add to his troubles his health broke down once more. Early in 1746 Handel produced the successful *Occasional Oratorio* to celebrate the duke of Cumberland's victories over Prince Charles Stuart. More successful still was the bellicose *Judas Maccabaeus,* produced 1747. *Judas Maccabaeus* was the turning point in Handel's fortunes; he had begun to create for himself a new public among the people of the rising middle classes, who would have turned away in moral indignation from the Italian opera but who were quite ready to be edified by a moral tale from scripture, set to suitably dignified and, by now, rather old-fashioned music.

Gradually his financial position improved. He had found a new librettist in the clergyman Thomas Morell, who, though not perhaps a very good poet, could tell a semidramatic tale in sufficiently smooth verse to please Handel's new audiences. Handel composed *Alexander Balus* and *Joshua* in 1747 and produced them during the Lenten season of 1748; *Solomon* and *Susanna,* composed during 1748, were produced in 1749. The latter year was made even more memorable by the composition and performance of his instrumental *Fireworks Music,* commissioned by the king for the celebration of the peace of Aix-la-Chapelle. It was performed by a large band of musicians as a musical accompaniment for Signor Servandoni's display of fireworks in the Green park and, although the fireworks were not a complete success, Handel's music was enthusiastically received. In July of that year (1749) he finished his oratorio *Theodora,* a work that he valued highly but one that, from its first production in 1750, never won popular fancy. In gratitude for his work for the Foundling hospital, he was elected a governor and continued to give a performance of *Messiah* in the chapel every year. In his will he left the Foundling hospital a complete set of parts for the performance of *Messiah.*

Handel now began to experience trouble with his sight. He managed, with much difficulty, to finish his last great oratorio, *Jephtha,* and produced it in 1752, but blindness was fast descending upon him. At first he handed over the direction of his oratorio seasons to others, but later on he again took part in the performances with the assistance of his faithful friend and amanuensis, J. C. Smith the younger. Although in failing health he participated in a performance of *Messiah* during the Lenten season of 1759. A week later, on April 14, 1759, he died in his house on Brook street, London, esteemed and respected in England as the greatest composer of his age. After all the financial straits of earlier years, he died a rich man. He was buried in Westminster abbey, where his monument, again by Roubillac, still stands.

Handel's Character.—Handel had a dry sense of humour and a way of expressing himself in a mixture of several languages at once, retaining a strong German accent to the end of his life. He was impatient and peremptory, and his temper was quickly lost, but he rarely bore malice and would apologize quickly if he felt he was in the wrong. He was generous and charitable, even when in financial trouble himself, and was one of the founder-members of the Fund for Decayed Musicians (now the Royal Society of Musicians). He was a warmhearted and kindly man, although perhaps a rather solitary one. Although a lifelong bachelor, Handel was by no means averse to female company but of his emotional life nothing is known. In all business matters he was scrupulously honest, but he seems to have seen nothing wrong in adopting other composers' material and incorporating it in his own compositions. This habit of plagiarizing has been excused as a mere extension of the easygoing artistic habits of an age of *pasticcio* makers, but it is more noticeable in Handel than in other composers of the time.

Handel the Composer.—The first basis of Handel's style was the north German music of his childhood, but it was soon completely overlaid by the Italian style that he acquired in his early manhood during his travels in Italy. The influences of Corelli and A. Scarlatti, both of whom he greatly admired, can be detected in his work to the end of his long life; the French style of Lully and his followers also influenced him, especially in his overtures and dance music; finally, in England he came under the influence of Henry Purcell. There is a robustness in his later music that gives it a very English quality and 18th-century English critics recognized it as such, welcoming what they called "the manly style of Handel." Above all, his music is eminently vocal and his directness of style makes him one of the great masters of choral music. His choruses have a power and effectiveness that have never been surpassed, and in these his writing is remarkable for the manner in which he interweaves massive but simple harmonic passages with contrapuntal sections of great ingenuity, the whole most effectively illustrating his text. His writing for the solo voice, whether male or female, was outstanding in its suitability for the medium and its unerring melodic line. Handel was also able to depict character in music in a single scene or even aria. The scene in which the giant Polypheme enters, in *Acis and Galatea,* is perhaps Handel's most obvious example of graphic character drawing in music, but there are many other such examples to be found in his works, both in the Italian operas and in the English oratorios.

Although the bulk of his music was vocal, Handel was nevertheless one of the greatest instrumental composers of the late baroque era. His long series of overtures, mostly in the French style; his orchestral concertos (Opus 3 and Opus 6); his large-scale concerted music for strings and wind (such as the *Water Music* and the *Fireworks Music*), the massive double concertos and organ concertos all show him to have been a complete master of the orchestral means at his command. Indeed, the present revival of interest in early methods of performance has vindicated Handel as one of the surest of orchestral composers.

Operas, Cantatas and Other Vocal Music With Italian Words.—As can be seen from his biography, Handel had a lifelong attachment to the theatre—even his oratorios were usually performed on the stage and not in church or even in the concert room. Until almost the end of his life he loved Italian opera, and only after it involved him in ever-increasing financial losses did

he abandon it for English oratorio. Like other composers of his time he accepted the conventions of Italian opera with its employment of male sopranos and contraltos and the formalized sequences of stylized recitatives and arias upon which *opera seria* was constructed; using these conventions, he produced many masterpieces among his Italian operas. Such works as *Sosarme*, *Giulio Cesare* and *Alcina* still make impressive stage spectacles, with some scenes of great dramatic power bursting through the stiff baroque grandeur. To dismiss the Italian operas as mere steppingstones toward the English oratorio is a mistake; many of Handel's Italian operas have been revived in the 20th century and some can still thrill a modern audience. Handel's Italian vocal works also comprise many cantatas to Italian words, some with simple *basso continuo* accompaniment, others with orchestra; some of these are remarkably fine.

There are also a number of "chamber duets," some of which he reworked as choruses for *Messiah*; a well-known example is "No, di voi non vo fidarmi," which is better known as "For unto us a child is born." Finally there are some serenatas and oratorios, mostly dating from the time of his Italian travels, that he later adapted to English words with varying success.

Vocal Music With English Words.—It was circumstance rather than choice that turned Handel into a composer of English oratorios, but, having finally made his choice, he devoted his final years to the form that he himself had practically created. Paradoxically enough, his oratorios now seem much more dramatic than his operas, and they can mostly be performed on the stage with remarkably little alteration. The great exceptions are *Messiah* and *Israel in Egypt*, neither of which is characteristic of Handelian oratorio in general. Most of the others, from the earliest attempts like *Esther* to the consummate mastery of the later works such as *Saul*, *Samson*, *Belshazzar* and *Jephtha*, can all be presented as stage spectacles and rank among the great dramatic masterpieces of the 18th century. With *Israel* and *Messiah* the emphasis is quite different, *Israel* because of its uninterrupted chain of massive choruses, which do not lend themselves to stage presentation, and *Messiah* because it is a meditation on the life of the Saviour rather than a dramatic narration of his Passion. Yet although *Messiah* is unique in Handel's output, it is commonly regarded as his most typical oratorio, just as it is still his most popular work. Handel also used the dramatic oratorio form for a number of secular works; chief among these were *Semele* and *Hercules*, both based on stories from Greek mythology and both splendid works that are eminently suitable for modern dramatic production. But his greatest work in this genre is *Acis and Galatea*, composed originally for private performance at Cannons. There is a youthful magic about it that he never quite recaptured, even in *Semele*. One of the most English of all Handel's larger vocal works is *L'Allegro, il penseroso* after the poems by John Milton, which in spite of its Italian title is a haunting evocation of the English countryside. In common with other composers of English and foreign birth then resident in London, Handel set various odes for St. Cecilia's day, which was long celebrated with special musical events throughout Britain; chief of these was his setting of Dryden's *Alexander's Feast*, a brilliant work although perhaps lacking in depth and feeling. Finally, special mention must be accorded to one delightful work that has been called "a comic oratorio"; this is *Susanna*, a highly enjoyable piece that has been revived with much success in recent years. All these, like the Italian operas that preceded them, contain innumerable arias that exhibit Handel's outstanding gift of writing easy natural melodies for the solo voice, as well as numerous choral numbers that display his genius in writing for massed voices.

Church Music.—Handel's most notable contribution to church music is his series of large-scale anthems. Foremost among these are the *Chandos Anthems*. They are 12 in number and, although written for a small group of singers and instrumentalists, are conceived on a grand scale. Closely following these works were the four anthems written for the coronation of King George II; of these the most celebrated is *Zadok the Priest*, which is a striking example of Handel's achievement of massive grandeur with the simplest means. Other occasional vocal works are the Utrecht and Dettingen *Te Deums*, the *Funeral Anthem* for Queen Caroline and the wedding anthems for the princess royal (1734) and the prince of Wales (1736). He also set two German Passions: one to the text of the Gospel according to St. John (1704); the other to a text by B. H. Brockes (*c.* 1716). There are also several Latin works written mostly in his early years and during the Italian tour. Finally there are the *Foundling Hospital Anthem* and three hymns to words by Charles Wesley, the best known of which is "Rejoice, the Lord is King."

Instrumental Music.—Handel wrote much instrumental music, some in connection with his operas and oratorios and some for concert use. By far the greater part of his orchestral music consists of the overtures, usually in the French style of Lully, that commence with his earliest operas and go on to his latest oratorios; they total about 80 and (published separately from the vocal works from which they originally came) were still a major feature of English concerts long after Handel's death. There were also various sinfonie that originated as act tunes; these, however, mostly fell into disuse with the operas for which they were intended, although one or two were published, together with dances from the operas, in the form of chamber trios as his Opus 5.

Handel was equally at home in the larger orchestral forms of his day, especially the *concerto grosso*, in which he generally followed the pattern set by Corelli; *i.e.*, with four or more movements. There are a few solo oboe concertos, mostly early works. Then come the six concertos published in 1734 as his Opus 3 and generally called the *Hautboy Concertos* because of the inclusion of oboes and other wind instruments in the score. His next purely orchestral collection was the set of *Twelve Grand Concertos*, published in 1739. These represent not only Handel's own noblest contribution to orchestral music but also the peak of the baroque *concerto grosso* for stringed instruments. A further type of Handelian concerto is the large-scale concerto for wind and string bands, which seems to have originated in his *Fireworks Music* of 1749. The group of concertos published in the Händelgesellschaft edition (volume 47) is not large, but the over-all concept of the music is on the grandest scale. Finally there are the *Water Music* and *Fireworks Music* suites themselves; these are sometimes thought of as *concerti grossi*, but in fact they are much more closely related to the suites of *Tafelmusik*, such as were composed by Handel's friend Telemann. However one may classify them, they stand in a special class, not only in Handel's own music but also in the whole history of late baroque music; there is nothing quite like them for tunefulness and grandeur successfully combined in a way that was peculiar to Handel, and they are still among the most popular of Handel's works, whether played according to his own orchestration or in arrangements for modern orchestra.

Handel was a notable organist and a great exponent of the art of keyboard improvisation. He composed something closely approaching an organ concerto movement as early as 1708 for his Italian oratorio *Il trionfo del tempo*. He then seems to have forgotten the form until the 1730s, when he realized the joint possibilities of the organ concerto and his own prowess as an organist. Accordingly he took some of his own earlier trio sonatas and expanded them into organ concertos, which he then played between the acts of his English oratorios. This was so successful that the practice was continued long after Handel's death. Handel published, in 1738, a set of organ concertos as his Opus 4. John Walsh issued a second set about 1740, but only two of these were true organ concertos, the others being arrangements of some of his grand concertos. Finally, a third set was published posthumously in about 1760 as his Opus 7; these were in many places scarcely more than outline sketches with many gaps left marked *ad libitum* at the points where Handel himself would have improvised solo passages. One or two other examples of organ concertos (some plagiarized from Telemann's music) are printed in volume 48 of the Händelgesellschaft edition, and there remains also a fragment of a concerto for two organs and orchestra. It must be remembered that in general Handel's concertos were written for a comparatively small organ, more like a chamber organ than a modern church or cathedral instrument, and that very few English organs

of the time had pedal boards. His instrumental treatment is consequently more akin to harpsichord technique than to that of the grand organ style of Bach and the other north Germans.

Handel left very little solo organ music, apart from a set of fugues, which were equally suitable for the harpsichord. He published a certain amount of harpsichord music, however, commencing with the first set of *Suites de Pièces pour le Clavecin* in 1720, followed by a second set in 1733. These two sets of suites, 17 in all, represent his finest contribution to the harpsichord repertory. His third collection of harpsichord music was the set of six fugues mentioned above, and finally a fourth collection of miscellaneous pieces from various sources was published by Chrysander in volume 2 of the Händelgesellschaft edition. Much later, a selection of the harpsichord music found in the collection of Handel manuscripts formerly owned by the Aylesford family, and now in the Royal Music library in the British museum, was published under the title of *The Aylesford Music,* edited by J. A. Fuller-Maitland and W. Barclay Squire in 1928. Various minuets and dance tunes were published, in harpsichord arrangements, with or without his consent, during his own lifetime.

Chamber Music.—In common with most of his contemporaries, Handel wrote sonatas for one or more solo instruments with *basso continuo* accompaniment for harpsichord and optional viola da gamba. Some of these were published in his own lifetime; his *opera prima*, for example, was the set of *Twelve Solos for a German Flute, Hautboy or Violin,* published in both London and Amsterdam. Three others were added to these in a later publication, and the resulting 15 were gathered together and printed by Chrysander in volume 27 of the Händelgesellschaft edition, and a further three appeared in the Händelgesellschaft volume 48. Several other sonatas for flute, violin, etc., remain in manuscript in the Fitzwilliam museum, Cambridge, and elsewhere. There is also a sonata for viola da gamba and *basso continuo,* printed in the Händelgesellschaft volume 48. The favourite chamber music form of the baroque era, however, was the trio sonata for two solo instruments, violins, oboes or flutes with *basso continuo.* Handel began to write such trio sonatas very early in his career, his first large set being a group of six sonatas for two oboes and continuo, which were written when he was still in Germany and which display an astonishing mastery of counterpoint. He continued to write trio sonatas, some of which are known from editions printed during his lifetime; the chief of these is his Opus 2, which consisted originally of six sonatas for two violins, oboes or flutes, first published in Amsterdam about 1722. Three others are added to these in various editions and are often loosely referred to as belonging to the Opus 2 set, although this is not strictly correct. These trio sonatas are mostly four-movement works, majestic and dignified in character, more akin to the *sonata da chiesa* than to the chamber sonata, the latter being recognizable by the inclusion of dance movements. Handel's last set of trio sonatas, *Seven Trios for Two Violins, Hautboys or German Flutes,* published by Walsh in 1739 as Handel's Opus 5, definitely belongs to the *sonata da camera* class, however; they are much lighter than his Opus 2 and contain many dance movements, chiefly taken from his stage works such as *Alcina* and *Ariodante.* It is obvious that Handel wrote a number of other trio sonatas from the fact that many of the overtures to his *Chandos Anthems,* to say nothing of the well-known overtures to *Saul* and *Esther,* were obviously derived from trio sonatas, sometimes with very little alteration. There are also several rather doubtful works discovered during the 20th century, including the two so-called *Concerti a quattro,* which may or may not have been by Handel. Most of the genuine trio sonatas are published in volume 27 of the Händelgesellschaft edition.

Handel's Influence.—Although Handel was highly regarded in his own day, his influence was by no means as paralyzing to British music as some historians believe. During his own lifetime, many highly competent English composers (Arne, Boyce, Avison, Stanley and many others) wrote in their own version of the late baroque style, sometimes closely akin to Handel's own, sometimes more closely related to that of the new school of the younger Italian composers—Arne, for example, was a much more "modern" composer than Handel himself. Handel's own style was becoming old-fashioned by the time of his death and about 1760 an immense change took place in the music played and composed in London, coinciding with the return of Lord Kellie from Mannheim and the advent of J. C. Bach and his friend K. F. Abel, who set the pattern for the more up-to-date of the younger English musicians with the new manner of the Mannheim and galant composers. Handel's influence dwindled in all fields but that of the oratorio, church music and the organ voluntary. Even the organ concerto, Handel's own special contribution to instrumental music, took on a galant air after about 1765 in keeping with the times and in open imitation of J. C. Bach's style. It was the Handel commemoration of 1784 (erroneously supposed to be the centenary of his birth) that turned Handel into the semiecclesiastical lay figure of later legend. Even so, the only field in which his influence was really marked was that of the oratorio. True, there was a brief interest just after the commemoration in what was called "the ancient style" and composers wrote a few works, usually overtures, in a late baroque idiom, often apologizing for doing so. However, this interest in a bygone style was only superficial and was similar to the interest displayed by Mozart and other continental composers in what they called the "learned style" of J. S. Bach and of Handel. In England, Handel's influence was largely superseded by that of Haydn in the latter part of the 18th century and by Mozart in the early 19th. The most obvious sign of Handelian influence was the festival movement, which grew out of the Handel commemoration of 1784 and into the mammoth Handel festivals given in the Crystal palace in the late 19th century. The "additional accompaniments" (which began with Mozart's extra wind parts written for Baron von Swieten's concerts in Vienna) were absolutely imperative when orchestras tried to struggle with such vast choral bodies as those that took part in the Crystal Palace festivals, and Handel's scores were subjected to gross indignities in the name of musical progress. With the publication of Handel's original scores as edited by Chrysander for the Händelgesellschaft, which, for all their faults, represented Handel's original intentions more closely than those in general use at the time, a movement was set afoot that eventually led to the reinstatement of Handel's position as a completely competent orchestrator of his own music. His works are now usually performed with respect for the original text and with Handel's own instrumentation. In some fields Handel's reputation is higher than ever; his *concerti grossi,* for example, have never been more admired than they are at the present day, while his operas are frequently revived. One interesting development of modern times is the stage presentation of his oratorios, with dramatic action and scenery, an experiment that is sometimes highly successful.

Editions of Handel's Works.—Most of Handel's works were printed, although often in wretchedly incomplete editions, in his own lifetime or soon afterward. In the 1790s, Samuel Arnold began the preparation of a complete edition, the first complete edition of any composer's works to be published. It was full of errors and misprints, but it was a remarkable achievement and opened the way for the *opera omnia* editions of the major composers published in the following century. An abortive attempt at another complete edition of Handel's works was made by the London Handel society, formed in 1843; about a dozen works were printed before publication ceased in 1855. By then Chrysander had begun his monumental work on Handel. The first prospectus of his German Händelgesellschaft was published in 1856, and eventually he saw through the press the greater part of Handel's works in a much more correct and complete edition than those of the earlier editors. Since this edition was defective by modern standards of musicology and had long been out of print, a new complete edition was proposed after World War II. This publication, by Bärenreiter (1955–), incorporates much new material from sources unknown to, or unused by, Chrysander. *See* also references under "Handel, George Frederick" in the Index volume.

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HANDEL-MAZZETTI, ENRICA, Freiin von (1871–1955), Austrian writer, was born in Vienna on Jan. 10, 1871. She is known primarily as the author of many historical novels markedly Roman Catholic in outlook. Her manner of depicting the customs and modes of thought of earlier times first aroused notice because her direct realism was unfamiliar to Austrian Roman Catholic circles.

Meinrad Helmpergers denkwürdiges Jahr (1900) treats the theme of an English boy's conversion to Roman Catholicism in 18th-century Austria after his father has been tortured and killed as a freethinker by Berlin Protestants. Clashes between Protestant and Catholic are central issues in *Jesse und Maria* (1906) and *Die arme Margaret* (1910). *Der deutsche Held* (1920) and the Karl Sand trilogy *Das Rosenwunder* (1924), *Deutsche Passion* (1925) and *Das Blutzeugnis* (1926) have a 19th-century setting, while *Frau Maria* (1929–31) is a trilogy centring upon the 18th-century poet Johann Christian Günther. She died on April 8, 1955, at Linz.

See *Enrica von Handel-Mazzetti zur 75. Jahrfeier*, ed. by F. Berger and K. Vancsa (1946). (H. M. Wa.)

HANDICRAFTS are manual skills for making usable products graced with intentional visual appeal. Handicrafts include needlework, lace, weaving, printed textile decoration, basketry, pottery, ornamental metalwork, jewelry, leatherwork, woodworking, etc., and such crafts as glass blowing and stained glass which require complex facilities. Articles in *Encyclopaedia Britannica* on these subjects are for the most part historical surveys; readers interested in the practice of handicrafts will find them valuable, particularly the introductory sections which usually include information about techniques and processes. Needlework describes various stitches; the craft history is found under Embroidery. There is a separate article Weaving, Hand.

Embellishing the useful is one of the oldest human activities; throughout thousands of years until the Industrial Revolution, handicrafts along with more strictly utilitarian manual skills supplied the whole of human productivity. Handicrafts were originally based on home production for home needs, but soon surplus items were traded, and more elaborate production and distribution processes influenced the goods made. Over the centuries, formidable traditions were built up in the crafts, culminating in guilds in European society, and in similar systems elsewhere. Training for handicrafts became formalized into steps, culminating in the rank of master, whence such words as masterpiece and maestro. Few human institutions, few systems of thought, remained uninfluenced by the work or the example of handicrafts.

The Industrial Revolution incurred the violent displacement of the deeply rooted handicrafts. With mass production many goods became less expensive, and new distribution facilities allowed them to reach fast-expanding populations in the western world and its colonies. New and improved products were also made by machine. The vast new markets invited exploitation in all senses of the word, and reactions against the early abuses of industrial production were inevitable. The arts and crafts movement (*q.v.*) arose as one such reaction, inaugurating the present-day role of handicrafts in limited production for special uses. Handicrafts are also used for self-expression and for occupational therapy. Furthermore, handicrafts supply models for many industries, such as power weaving and automobile-body building.

When in the mid-20th century the less industrialized and colonial areas of the world began to grow and become independent, handicrafts were recognized as one of their distinctions, not to be discarded thoughtlessly. Here the work and doctrine of M. K. Gandhi were outstanding.

HANDL, JAKOB (1550–1591), Austrian composer of Slovenian origin, also known as Jacobus Gallus, celebrated for his sacred music, was born in 1550 at Reifnitz, now Ribnica, Yugos. He traveled in Bohemia, Moravia and Silesia; was a member of the Viennese court chapel in 1574; and choirmaster to the bishop of Olmütz (Olomouc) from 1579 to 1585. He died in Prague on July 18, 1591, just after publishing his *Opus musicum* (1586–91).

This famous collection of motets for the entire year shows Handl breaking away from the traditional primacy of Mass composition: even his 19 Masses are largely based on material from his own motets. Handl's wide-ranging, eclectic style blends archaism and modernity. He rarely used *cantus firmus* and reveled in the new Venetian polychoral manner, yet he was equally conversant with the earlier imitative techniques. Some of his harmonic progressions seem old-fashioned, yet his daring chromatic transitions foreshadowed the breakup of modality. He enjoyed word painting in the style of the madrigal, yet he could write the simple *Ecce quomodo moritur justus* later employed by G. F. Handel in his funeral anthem, "The Ways of Zion Do Mourn."

A modern edition of the *Opus musicum*, edited by E. Bezecny and J. Mantuani, was published in *Denkmäler der Tonkunst in Österreich* between 1899 and 1919. Six Masses, edited by P. A. Pisk, were published in the same collection in 1935. (B. L. Tr.)

HAND TOOLS, HISTORY OF. Hand tools are devices used in manual work. While this article is limited to a discussion of the history of craft tools, it should be recognized that devices of all kinds that help the hand to fashion, manipulate, measure and mark are properly considered hand tools. Although hand tools have yielded many of their functions to machines, they are necessary somewhere in the planning and production of every machine-made object. The tools of the diemaker and maintenance tools for machines are but two examples. Hand tools are indispensable in the building trades, in the repair of vehicles and appliances, and in dozens of other skilled occupations. A world without hand tools would be unthinkable, and there is overwhelming evidence to show that basic hand tools are far from becoming obsolete.

The most striking characteristic of hand tools is the persistence of their forms. The antiquity of the essential form of modern tools is often difficult to believe. The tools of the carpenter, for example, were approaching their final forms by the time of Christ. The hammer, saw, adz, chisel, file, drill, plumb line, level, rule and tongs of various kinds already were widely distributed. The carpenter's plane as it is now known is nearly as old. Certain regional preferences may emerge as modifications (the English carpenter's plane as compared with one in the U.S., for example) but the essential form persists. Apparently there are right ways to do many things. Once a design has been found and agreed upon by many thousands of independent artisans, only the acute insight of an extremely rare genius can be expected to make an essential improvement. The patent offices of the western world are littered with modifications of basic tools, made by ingenious but ill-informed individuals. Changes that offer no improvement are quickly forgotten and serve only to illustrate a propensity to tinker with basic ideas without troubling to understand them.

Hand tools can be classified as (1) tools that fashion or shape materials (including the chisel, plane, drill, file, saw and blacksmith's hammer); (2) manipulators (including the carpenter's hammer, tongs, pliers, wrench, crowbar and mason's maul); and (3) tools that measure and mark. Examples are the rule, scale, marking gauge, square, plumb line, level, dividers and calipers.

In this article only selected examples of the tools of the carpenter, mason and blacksmith will be featured; however, the same general pattern of development of basic tools of the trade can be found in nearly every tool-using occupation, ranging from surgery and dentistry through engraving and sculpturing to seafaring and agriculture.

Prehistoric Tools.—The name Stone Age comes from the surviving tools of that very early period. Among the earliest tools recognized by archaeologists are the pebble tools. The more sophisticated bifacial tool was a natural stone fragment, small enough to be grasped in the palm of the hand, with a broken edge or face that could be used for scraping and, in a rudimentary way, for chopping. The development of techniques for shaping tools by flaking (*see* FLINT AND OTHER STONE TOOLS) probably occupied many thousands of years and enormously increased the range of shape and function of stone tools. Scrapers, knives, spearheads, and eventually ax and adz blades were thus produced.

The ideas of smoothing the flaked tool by abrasion or polishing, and attaching a handle (hafting) to the smoothly sharpened stone head further increased the usefulness of stone tools. The development of barbed spears and the long-bladed knife or sickle, made by embedding a series of small flaked or sharpened stone fragments in a wooden or bone matrix, came near the end of the Stone Age. The refinement and versatility of cutting tools had then reached a point where increasing familiarity with metals (which could be more easily wrought to a desired shape) effectively ushered in the Copper Age (*c.* 4000 B.C.). The Bronze Age followed without any distinct separation. Before the Bronze Age gave way to the Iron Age (*c.* 1000 B.C.) the precursors of most basic modern hand tools were in existence.

Egyptian Tools.—Copper tools used in Egypt from about 4000 B.C. were much softer than their stone counterparts, but copper could be wrought into much thinner sections, which are desirable for ax heads, adz blades, saw blades and chisels. Thus the tool could remove chips without cramping or shattering, more than offsetting the disadvantage of softness. Bronze tools, which overcame some of the objections to copper tools, were used in Egypt by about 2000 B.C. The general characteristics of Egyptian tools can be observed in those employed in stonemasonry and woodworking. Egyptian pyramids and temples become especially impressive when it is realized that there were no iron tools for quarrying or dressing the individual blocks of stone, or such rigging tools as jacks and pulley blocks. The works testify that patient persistence is a real, if not economical, substitute for sophistication in tools. In quarrying large blocks from solid rock, a groove was formed around the block by literally pulverizing the rock with hammerstones, each weighing about 12 lb. Wedges, probably of wood, were inserted in the grooves to crack the blocks loose. Once free of the original bed, the blocks are believed to have been cut into smaller pieces with a toothless copper saw that used sand as an abrasive. (Blocks of marble and granite are sawed today in much the same way, except that iron saw blades and harder abrasives are used.) The Egyptian mason had at his disposal a square with which to mark and check a right angle, and a string coated with pigment and snapped to mark outlines for cutting and dressing. For laying up blocks there was a horizontal level, consisting of a plumb line hung from the apex of an A-shaped assembly of dressed wooden members. Vertical lines were established either directly by plumb line or by placing against the surface a vertical board upon which a plumb line was fastened. The requirement for a standard unit of measurement was met by the cubit, about 20.7 in. long. A number of primary stone standards for the cubit have been recovered, as well as a few secondary standards of wood. Working measures of wood have not survived in sufficient quantity to permit the conclusion that they were common tools.

Surviving Egyptian works in wood are also impressive. In the tombs great wooden boxes were used to contain the mummy cases. These boxes, about 7 ft. long inside, 2½ ft. wide and 2 ft. deep, were made of planks 2½ to 3 in. thick. Because wood was scarce, many curious and ingenious joints had to be made in building up available pieces of wood to the sizes required. These boxes are smooth, outside and inside; the sides are parallel, and the surface onto which the top was laid is a plane, without winding or twisting. A wider variety of tools was in the carpenter's chest than in the mason's. Saws were used, with the work held vertically, and there is no evidence to suggest two-man saws. Saw teeth were formed by irregular notches in a curved bronze blade. The adz, consisting of a flat and sharp copper or bronze blade, attached to a wooden handle with rope or leather lacing, was used for truing a flat surface, just as the adz is used by the modern shipwright. Copper axes, generally light and flimsy as compared to the adz, were probably employed in preliminary dressing. Chisels of copper or bronze, secured in wooden handles and urged by wooden beetles (similar to a mason's mallet), were used for cutting grooves and mortises for joints. Bow drills were used for piercing, but only for holes of small diameter. The plane was conspicuously lacking, and smoothing of the members is thought to have been done by means of rubbing stones which applied sand as an abrasive.

The tomb of Meket-Re', near Thebes, yielded in 1920 an undisturbed cache of miniature models of craft shops, dating from *c.* 2000 B.C., in which craftsmen are shown at work. In a Cairo, Egy., museum model tools are shown in use in the carpenter shop, where a partially sawed timber is lashed to a post; adz and chisel techniques are clearly shown; and the finishers patiently wield their rubbing stones.

Iron Age Tools.—From 1000 to 500 B.C. the range and capacity of hand tools was greatly extended by the introduction of iron. Chisels, hinged tongs, blacksmith's hammers and anvils, all of iron, were in common use at the height of Greek civilization.

As the Roman empire developed, with its emphasis upon material works, a few new types were added to the tools of the craftsmen, and tools generally moved much closer to modern forms. A surviving frame saw has an iron blade whose tooth points were set (slightly bent alternately to right and left) to produce a cut wider than the saw blade in order to avoid cramping. An iron-soled carpenter's plane, found on the site of a Roman town near Silchester, Eng., and dating from before A.D. 400, is a remarkable example of the high state of development of Roman tools. Several iron twist drill bits have been found, and many variations of the hammer, ax and adz of this period are known. A nail-heading tool, pierced to receive the shank of a nail rod, and usually with a small depression for forming the nail head at the upper end of the pierced hole, was used by the Romans to produce nails of surprising uniformity. This type of tool was used in the U.S. until the latter part of the 19th century.

Notable contributions during Roman times to the advance of measuring tools include hinged dividers, plain and folding foot rules, and a water level, which employed a shallow water-filled trough in the upper face of a long straight edge. Except for the

FROM THE DUKE OF WELLINGTON'S COLLECTION IN THE READING MUSEUM

ANCIENT ROMAN CARPENTER'S TOOLS, LARGELY OF IRON: (TOP LEFT) CHISELS; (TOP RIGHT) AX-HAMMER HEAD; (TOP CENTRE) AX HEAD; (BOTTOM CENTRE) HAMMER HEAD; (BOTTOM LEFT) IRON-CASED JACK PLANE; (BOTTOM RIGHT) FARRIER'S RASP. SCALE OF PLANE APPROXIMATELY ⅛; OTHERS ¼

COURTESY, BOSTON MUSEUM OF FINE ARTS

BLACK-FIGURE PAINTING ON A 6TH CENTURY B.C. VASE SHOWING A GREEK SMITHY AND SELECTION OF GREEK TOOLS. THE HINGED TONGS ARE OF PARTICULAR INTEREST

double-cranked bitstock (carpenter's brace) nearly all of the basic woodworking and metalworking hand tools by the end of the Roman era had been brought to a form instantly recognizable by modern artisans.

Medieval and Renaissance Tools.—From about A.D. 1200 to 1500, when many of the great European cathedrals were raised, techniques for working and fashioning metals kept pace with the demand for fittings and embellishments of the many noble stone structures. A tradition of fine craftsmanship was brought to a brilliant climax in the 16th and 17th centuries, and tools that had been spare and plain developed during the later Renaissance period (1500–1700) into exquisitely wrought works of art in their own right. The pride of craftsmanship, which has always been a part of the work of a craftsman, came to be lavished upon the tools themselves. The rise of the guilds, which tended to preserve traditional ways of doing things, encouraged at the same time the creation of painstakingly embellished tools of all kinds. Many were produced for the personal or palace workshops of royal patrons. The guilds encouraged specialization of the craftsmen, and the number of specific trades with their distinct tools increased greatly.

Modern Hand Tools.—The period from about 1800 through the 1960s has been marked by the proliferation of minor variations in design and by the introduction of machine-made hand tools.

Hand tools in the U.S., for example, nearly all have their counterparts in western Europe. American colonists brought with them the tools of their country of origin. Also, there developed in the years from 1750 to 1850, particularly in the woodworking crafts, a distinctively American tool. In general, the tools were spare as well as economical to manufacture and use. The result was, to many observers, a particularly graceful and unembellished character. It is difficult to find a handmade hand tool of this period that is not pleasant to look at.

Factory-made tools were introduced at about the same time as machine-made products of all kinds. Machine-made axes appeared in quantity in Connecticut around 1820. For about a generation after 1830 very large quantities of Sheffield tools (wooden bitstocks with brass fittings, edge tools, files and screw plates, among others) were imported from England into the U.S. In the 1840s molding planes began to be produced in the U.S., particularly in Ohio, and by the 1880s, when machine-made wood moldings made the molding planes obsolescent, every joiner's tool chest contained dozens of varieties of this highly specialized tool. With the development of machine-forging in the 1860s, a wide assortment of metal wrenches, pliers, bitstocks and planes became available. The introduction after 1900 of power-driven hand tools increased the rapidity with which work could be done.

The positive gain from machine-made and power-driven hand tools was partly offset by the loss of identification of the craftsman with his tools. The tools became merely means to an end that often depends less upon a craftsman's skill and versatility than upon his ability to compete with factory-made products.

Historical Collections of Hand Tools.—Hand tools have survived in relatively large quantities. An active interest on the part of individual collectors and museums in collecting and preserving this facet of our technical heritage has brought thousands of old tools out of attics, barns and sheds.

Fortunately, the integrity of early toolmakers usually insured a rugged, high-quality, long-lasting tool. When a tool was laid aside, it was not the sort of thing that would be discarded. The customary tool chest was also a factor in the survival of tools, for the chest made it possible to keep collections intact and to move them without excessive preparation.

Interesting tools from the modern period may be found in a number of museum collections. Some of these have assumed value as collector's items, and include:

1. Molding Planes.—These planes, made in large quantities in the U.S. from about 1840 to 1900, have a wooden body; a wooden wedge holds the "iron," or blade, in place. They are stamped with the maker's name, such as Sandusky, Ohio Tool, Auburn or Chapin.

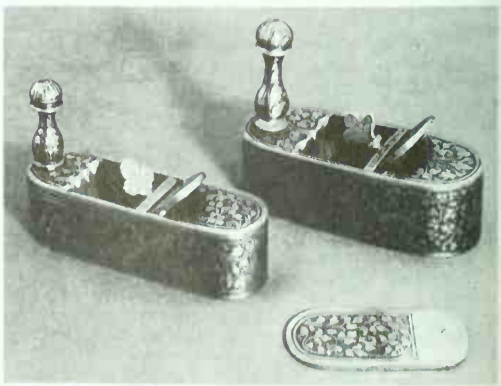
2. Other Wooden Planes.—Wooden carpenter's planes were used in the U.S. until after 1900, and are still being made in some European countries. A horn, or handle, at the front end, is typical of German planes. Many others have only a flat strike button ahead of the throat. A sharp blow on the button will dislodge the wedge and iron for readjustment.

3. Pipe-Boring Tools.—Water pipes and well-pump barrels were made of logs, bored out by hand, throughout the 19th century. Long T-handled twist-augers or spoon-shaped bits are sometimes encountered, along with special reamers for preparing compression joints.

4. Measuring Tools.—Boxwood carpenter's rules, substantially like those in use today, were machine-divided in England before 1830, in the U.S. by 1850. Accurate steel machinist's scales were being made in the 1850s. The pocket-size micrometer caliper originated in France in 1848; the first U.S.-made instrument was sold in 1868; the standard modern pattern was shown in a patent of 1878. Cast-iron spirit levels were widely used in the 1850s.

Outstanding collections of 18th- and 19th-century hand tools are in colonial Williamsburg, Va., where appropriate tools are distributed among restorations of craft shops; Bucks County Historical Society museum, Doylestown, Pa.; Shelburne (Vt.) museum; and the Pennsylvania Farm museum of Landis Valley, Pa. Egyptian tools and tomb models are in the Metropolitan Museum of Art, New York city. Roman tools are in the Reading Museum and Art gallery, England.

Descriptions and illustrations of specific hand tools may be found in numerous articles including MASONRY: *Mason's Tools;*



DEUTSCHE FOTOTHEK DRESDEN

DECORATIVE MEDIEVAL GERMAN PLANES

SCULPTURE TECHNIQUES; WOODCUT AND WOOD ENGRAVING; PNEUMATIC TOOLS; IRONWORK; BOOKBINDING; ENGRAVING, LINE; ANVIL; HAMMER; BRUSH; MICROMETER.

BIBLIOGRAPHY.—Prehistoric tool development is outlined in Kenneth P. Oakley, *Man the Tool-Maker* (1957). Egyptian tomb models are described and illustrated in H. E. Winlock, *Models of Daily Life in Ancient Egypt* (1955). For modern tools (after 1750) see Henry C. Mercer, *Ancient Carpenters' Tools* (1951) and Frank H. Wildung, *Woodworking Tools at Shelburne Museum* (1957). Tools of all ages are described in Charles Singer *et al.* (eds.), *A History of Technology* (1954–58), particularly vol. i, ch. 5, "Tradesmen's Tools *c.* 1500–1800." *The Chronicle* of the Early American Industries Association is concerned chiefly with craftsmen's tools. For example, see articles on molding planes in issues of July 1950 and April and July 1955. (E. S. FE.)

HAND TREE (*Chiranthodendron pentadactylon*), a tree of the family Sterculiaceae, native to Mexico, which takes its name from the peculiar formation of the flowers, the five bright red stamens of the calyx projecting in such a way as to resemble somewhat the fingers of a human hand—the corolla being absent. It is related to the baobab (*q.v.*) of west Africa.

HANDWRITING, or chirography, writing with the hand as distinguished from print, as a term has come to be more or less restricted to mean the form of writing peculiar to each person. Thus, in addition to the actual motor act and the resulting script, "handwriting" includes also handwriting identification and graphology. These are the aspects of the subject discussed in this article, along with the teaching of handwriting. Other related aspects are discussed in the separate articles on CALLIGRAPHY; PALEOGRAPHY; and WRITING.

Before the introduction of the typewriter for general use, when handwriting had a greater utilitarian value, schools stressed handwriting instruction. In the United States scales were developed by E. L. Thorndike, L. Ayers and others for gauging the quality of the script from grade to grade in the elementary schools, and a series of careful investigations of the handwriting movements were undertaken. Studies showed that the pressure on the penholder (grip pressure) as well as the pressure of the pen point on the paper (point pressure) varies continuously during writing, and the speed of writing is not uniform but depends upon the type of stroke being made. For example, speed of movement usually rises slowly as the stroke begins, comes to a maximum in the middle and drops off toward the end. The direction of the stroke, turns and loops, complexity of stroke and the type of stroke that preceded will alter the speed of a given writing movement. Speed is affected also by length of letter elements, since it usually takes more time to make long strokes than to make short ones. By comparing the handwriting movements of good and poor writers, F. N. Freeman found that these two groups differ in position of writing hand, speed and types of movements in fingers and hand. Considerable relationship was found to exist between the changes in speed and the form of letters, and good writers showed greater uniformity in the speed of formation of similar strokes. Later, other educators, experimenting with manuscript writing and printed script, maintained that the latter type of handwriting is learned and executed more speedily because it resembles printed type more. Scales were developed for evaluating quality of manuscript writing, which is taught increasingly in modern schools in the U.S.

The handwriting of adults is so individual that it is considered unlikely that any two people could really write identical hands. This high degree of individualization occurs even among those who learned to write from the same school copy under the same teacher. Investigations into the handwriting characteristics of children have indicated that individualization in graphomotor development begins very early in life. The scribblings of the preschool child as well as the early versions of the child's copy work are often found to show individual characteristics sufficient to identify the author of a handwriting specimen. Among the anomalies of early writing development is mirror writing, that is, reversed script which reads from right to left and is seen as ordinary writing only when reflected from a mirror. Reversal of individual letters to some degree is part of normal spatial and motor development in children, but students of the subject disagree on the physiological processes involved in mirror writing. Most agree that it is the left-handed child's natural form of writing; these children however, tend to conform to the school standard as they gradually assimilate the conventional left-right direction. Brain injuries may result in partial or total mirror writing, which in these instances is considered a regression to the earlier reversal state. The most famous instance of mirror writing is that of Leonardo da Vinci who allegedly did it to keep his scientific work secret.

Despite the highly individualized character of mature writing, it is not always possible to determine age, sex and intelligence from the script itself, although expert estimates are better than chance. Alfred Binet, the first to investigate graphological claims scientifically, carried out a series of experiments in which two graphologists, one the talented Crepieux-Jamin, and 15 untrained judges participated. Binet found that in estimating the sex of the writer of 180 envelopes, the graphologists scored higher than the untrained judges. However, the highest score, 79%, made by Crepieux-Jamin, left too wide a margin for error for practical application when certainty of sex is crucial, as in court proceedings. Similar experiments were made for evaluation of age and intelligence, and again, though the graphologists were consistently better than the untrained judges, the percentage of error was too high for certainty of evaluation. Nevertheless, Binet considered these results promising for the future of graphology. Investigations of resemblances in handwriting of blood relatives have indicated that similarity in handwriting is not so great as in other characteristics such as height, weight and intelligence.

Handwriting Identification.—Identification of handwriting assumes great importance in courts of law when the authenticity of signature is contested. Even when the handwriting itself is not to be doubted, the conditions under which it was written sometimes become of great moment. Such questions as whether the writer's hand was forced or guided and whether alterations were introduced after the completion of the document often have to be answered by the expert. One of the first steps in the investigation of a suspected or disputed writing is to find some genuine writing of the disputed author with which to make a comparison. The writing characteristics which experts use in determining authenticity presuppose that each handwriting has certain permanent characteristic features from which the available handwriting sample may vary, and the question is whether the observed variation is within expected limits or beyond them. Many ingenious methods have been developed to determine the authenticity of a given piece of writing: comparison of dates with age of paper, determining whether writing at the creases preceded or followed the creasing, and chemical and physical examination of the paper and the ink to determine its origin, date of manufacture, date of writing, etc. The presence of tremors, types of final strokes for ending words, and other characteristics of handwriting which graphologists utilize in personality evaluations are also utilized by handwriting experts for identification purposes. However, handwriting experts usually limit themselves to problems of identification only.

Graphology.—Handwriting in its relation to personality has interested observers for many centuries. Peculiarities in the handwriting of Octavius Augustus were noted by G. Suetonius Tranquillus as early as the 2nd century. The Chinese called attention to the relationship between handwriting and personality as early as the 11th century. In Europe in 1622 Camillo Baldi observed that all persons have a recognizably characteristic way of writing. Baldi began the analysis of handwriting into its elements, which later gave impetus to the French school of Abbé Hippolyte Michon (originator of the term graphology) and Crepieux-Jamin, sometimes known as the founders of the school of "isolated signs." Their purpose was to relate specific elements in the handwriting to specific personality traits. In contrast, the intuitive graphologists evaluated handwriting by the total impression it made on them, without always being able to indicate the exact basis of their evaluation. The Chinese philosopher of the 11th century and the European poets, artists and philosophers of the 18th–19th century, among them Goethe, Poe, Madame de Staël, Leibniz and Gainsborough, who were amateur graphologists may be classed with the intuitive graphologists. It was not until the close of the 19th century that an attempt at a unified approach to graphological theory was provided by a study of the handwriting movement itself

—the graphomotor process rather than the end product. In this way handwriting joined speech, gait and facial expression as an expressive movement. The features of these expressive movements were assumed to be determined internally, reflecting the stresses and strains, rhythms and inhibitions which the individual characteristically experiences in his everyday life.

In attempting to assess personality from handwriting many investigations have been conducted in which the script is analyzed into its component elements. Factors such as size of letters, width, slant, spacing between letters, degree of connectedness of strokes and letters and many other measurable aspects of writing have been studied. Other aspects of handwriting which do not lend themselves to geometrical measurement can also be rated. Among these are the form level (over-all evaluation of the character and type of form used in writing), degree of ornamentation or simplification of the basic form of the school copy, degree of angularity *v.* curvature, and types of connecting forms between strokes and letters. There are definite indicators in the handwriting from which the pressure of writing and its speed can be estimated. For example, pressure can be gauged by comparing the width and degree of darkness of the upstrokes, which usually bear little pressure, with the width and degree of darkness of the downstrokes, in which pressure is usually more pronounced. Similarly, increased speed of writing may be gauged from the smoothness of the writing, trimness of the strokes, "i" dots and periods that assume the form of commas as speed increases, increase in right-tending forms, increasing left-hand margins, prolonged lively finishing strokes and infrequency of changes in direction after breaks or pauses.

One of the most fundamental problems in graphology is that of finding an underlying dimension for evaluating all handwriting elements in measurable or ratable scales. With the provision of such a dimension, size of letters, a measurable element, and form level, a ratable one, could be evaluated on the same continuum as could all the other characteristics which graphologists consider important. Though a start in this direction was made by L. Klages, who regarded handwriting as an expressive movement and who tried to provide a systematic procedure for analyzing this movement along a specified continuum, many graphologists continued to be either atomistically analytic or intuitive. The analytic graphologists have claimed that each of the handwriting elements has specific meaning. Thus, unusually large handwriting is said to characterize the ambitious, imaginative person; very small writing, the pedantic person. However, it is recognized that there may be more than one cause for the same effect. Minute writing may be due to myopia; magnification of script may mask loss of motor control. Empirical studies in which attempts are made to relate individual handwriting elements to personality traits in an atomistic fashion rarely yield positive results. Many graphologists claim that only when the isolated elements are integrated into patterns is it possible to find significant relationship with personality.

Klages, maintaining that healthy people express themselves rhythmically in all expressive movements and especially in writing, suggested that the degree of rhythm exhibited by handwriting is a good measure of the wholesomeness of the personality. However, he gave no specific system for classifying degrees of rhythm. T. S. Lewinson and J. Zubin tried to correct this deficiency by providing scales in which the degree of rhythm present in each writing element can be judged. These scales have two opposite poles, extreme contraction and extreme release, with rhythmic balance centred between them. Writing which lacks rhythm as a result of inhibited movement is placed at the contraction end of the scale, while that which lacks rhythm as a result of deficient control is placed at the release end of the scale. The intermediate steps in the scale show an increasing degree of rhythm (or a decreasing degree of contraction or release) up to the point of rhythmic balance in the centre. Each handwriting element is classified on the seven-point scale, and the handwriting of well-adjusted normal persons is expected to vary in a bell-shaped curve of distribution about the point of rhythmic balance. Standards for classifying a given handwriting element on the contraction-release scale have been developed. Rose Wolfson applied these scales to the writings of delinquent and nondelinquent boys. She found that the scales differentiated significantly between the two groups, reflecting less rhythm and more release for the delinquent than for the nondelinquent subjects. Moreover, statistical analysis revealed a cluster of handwriting elements, consisting of size of letter, spacing and curvature, etc., which seem to be the most important elements in the handwritings of delinquents and may also prove to be the most important in all handwriting.

Another development in graphology was Max Pulver's interpretation of the symbolic in handwriting. Following Klages, Pulver studied the entire writing, but he interpreted its symbolic character according to dream symbolism and the relations between symbols and personality according to psychoanalytic theory.

Some broad claims have been made for graphology in predicting and diagnosing various physical and mental ailments—liver, heart and gastrointestinal disease, cancer, accident proneness, numerous psychiatric diagnostic categories and tuberculosis. It is difficult to evaluate the validity of many of these claims because too often the data on which they are based lack sufficient control, but studies in which scientific controls are utilized do not invariably disprove the claims of graphology. Careful comparisons of group data on epileptics, schizophrenics and manic-depressives with data obtained from comparable normal persons have shown significant differences, but such group differences are not suitable for the diagnosis of individuals. Similarly, differences have been noted between the premorbid and morbid handwriting of patients. Other investigators, however, have shown that there are no observable differences between the premorbid handwriting of schizophrenics and suicides and the handwriting of comparable normal persons. Group differences have been reported for stutterers and for criminals, and the handwriting of mental patients has been found to be more variable in its rhythmic qualities on the contraction-release continuum proposed by Lewinson and Zubin. A study of neurotic patients was conducted in which the answers of each patient to a personality questionnaire were compared with the answers to the same questions given to him by a graphologist based on an analysis of the patient's writing. This study indicated that the graphologist was right significantly more often than she was wrong.

The specific basis for the graphological judgment, however, rather than the accuracy or validity of an interpretation, is the issue in the development of graphology as a scientific method. Methods which match graphological interpretations with different indices (such as personality test scores, self-appraisal estimates and friends' opinions) may show that graphologists can evaluate personality with better than chance success, but the exact method of analysis is left undefined. Moreover, judges' opinions as to the validity of an analysis are not always conclusive. F. E. Krueger and Karl Ziets obtained handwritings from 80 individuals, then, without referring to the handwriting specimens, concocted a universal personality sketch of the type that astrologists use; each of the 80 subjects accepted this sketch uncritically as applying to himself.

The question of the ultimate scientific value of graphology is unanswered. The answer will depend largely on the development of more adequate laboratory techniques and preparation of more objective rating scales, but also on deeper insight into the factors underlying personality so that graphological results can be related to stable criteria of personality measurement. (J. Z.; R. W.)

Teaching Handwriting.—Teaching handwriting is one of the basic tasks of the elementary grades in all school systems. The form of instruction differs according to the nature of language script, the system of instruction and the availability of writing materials and instruments. Where Roman-type letters are in use, instruction tends toward the use of whole words. Many countries have adopted simplified forms of writing to help children overcome difficulties in beginning instruction. In countries using an alphabetic language, the simplified form is called variously script, printscript or manuscript writing. Most children are expected to have some skill in handwriting by the age of eight or nine, at which time, in the United States, they change from manuscript to cursive (slanted, connected, with special letter forms) writing. The hands

commonly taught to British children, after the initial experience with manuscript writing, include that recommended for use in the civil service, Marion Richardson's script and the so-called italic script.

Teachers generally emphasize correctness of letter formation, neatness of writing, uniformity of letters, spacing of letters and words, alignment of words and sentences, and speed of writing. Instruction begins with drawing or tracing of letter forms or words and moves to more rapid writing of words as skill is gained. Speed is not emphasized early in instruction, however. Greatest attention is paid to proper body and paper position, less attention to wrist and least to proper arm movements. Many devices are used in teaching handwriting—copying from letter form models, exercises and drills in drawing lines or circles, tracing of letter forms with stylus or pencil—as well as procedures that emphasize rhythm (counting, music). Ordinarily lower case letters are introduced first, then upper case and then numerals. Seven letters—*r, u, e, a, o, s* and *t*—account for more than half the illegibilities in handwriting, and *r, e* and *a* are the most difficult to master. Failure to close letters, closing looped strokes, looping nonlooped strokes and straight rather than rounded strokes are the major causes for poor letter forms.

Beginners generally start with large pencils and paper ruled with $\frac{1}{2}$ in. or 1 in. spacing; sometimes unlined paper is used to encourage them to concentrate on the shape and content of what they write. There is an increasing tendency, however, to have the child use in writing instruction the same kind of writing instrument that he uses in general writing and will use later as an adult. Greater use thus is being made of well-designed adult pencils and ball-point and fountain pens.

The majority of apparently left-handed children can be taught to write with the right hand, but the desirability of interfering with the child's spontaneous preference is highly questionable (*see* HANDEDNESS). Increasing use is being made of handwriting scales for the evaluation of writing. (V. E. H.)

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HANDY, WILLIAM CHRISTOPHER (1873–1958), U.S. Negro composer who established the popularity of the blues. The son of a minister, he was born at Florence, Ala., on Nov. 16, 1873. He was a schoolteacher in his youth and later was a bandmaster. Though he became blind at the age of 30 he conducted his own orchestra from 1903 to 1921. With his "Memphis Blues" (1911), an election campaign song for the mayor (Edward H. "Boss" Crump) of Memphis, and especially his "St. Louis Blues" (1914), he introduced a nostalgic element into the prevalent ragtime, chiefly by means of the "blue" lowered seventh, which became a characteristic feature of this music. He published anthologies of Negro spirituals and blues and also studies of Negro musicians in the U.S. He died in New York city on March 28, 1958. *See* also JAZZ. For a portrait *see* NEGRO, AMERICAN.

See W. C. Handy, *Father of the Blues* (1941).

HANGAR: *see* AIRPORT.

HANGCHOW (HANG-CHOU), one of the notable historic cities of China and capital of Chekiang province. Pop. (1953) 696,600; (1957 est.) 784,000. Its importance is largely the product of its position. It lies at the mouth of the basin of the Ch'ien-T'ang river, which drains west Chekiang, and at the head of Hangchow bay. It is the natural link between the thickly peopled plains on either side of the bay and is the outlet of west Chekiang. Hangchow has a wider significance through its position on the south margin of the Yangtze delta and through its participation in the cultural development of the deltaic cities. It is the focal point for the southern ends of the waterways of the delta and is the southern terminus of the Grand canal (Yün Ho), which was from the time of the Mongols to the mid-19th century the main avenue of communication between the Yangtze delta and Peking. Yet the greatest days of Hangchow were before the completion of the Grand canal as a route between north and south. It was during the later Sung dynasty (A.D. 1127–1280), when the Chinese had retreated before the Mongols south of the Yangtze and had established their capital at Hangchow that the city reached the height of its importance, becoming the scene of intense literary activity of the period. Hangchow was then called Linan but popularly known as King-shih (the capital), from a corruption of which Marco Polo's *Kinsai* was derived.

Hangchow has been a commercial centre of great importance from the T'ang period onward. Although one of the points where the system of inland waterways which thread the Yangtze delta reaches the sea, Hangchow itself has never been a port for seagoing vessels, its port functions being restricted to inland navigational shipping. From the T'ang to the Yüan periods it utilized Kan-p'u farther down Hangchow bay, and with the continued silting of the bay, its seagoing trade has had to pass through Shanghai. The total trade of the port before World War II was slightly less than that of Soochow or Chen-chiang, which are also within the delta and on the Grand canal. Hangchow is of some importance industrially, the most important industry being silk manufacture, based on the famous sericultural region of northwest Chekiang. Like Nanking, Hangchow is a silk-weaving rather than a silk-reeling centre. After 1949, a jute-sack industry developed in Hangchow. A considerable number of rice-hulling and cleaning mills reflected the rice culture of the surrounding plains.

The city is built at the foot of a beautiful range of hills, the Hsi-t'ien-mu shan, or Eye of Heaven mountains, and by the shores of the famous Hsi Hu, the Western lake. The beauty of its buildings and gardens equals the charm of its situation among hills and valleys studded with some of the most famous monasteries in China. Hence the Chinese proverb: "There is Heaven above and Soochow and Hangchow below."

To Marco Polo it was incomparably the finest city in the world. This beauty was sadly tarnished in 1861 by terrible devastations during the Tai P'ing rebellion, but the city, in a somewhat modernized form, largely recovered its prestige and still ranked as one of the leading cities of China.

After 1928, with the establishment of the national government at Nanking, Hangchow gained new importance as the capital of the native province of Chiang Kai-shek. Emphasis on cleanliness of streets and buildings, and a model police force, were some of the accomplishments. No foreign treaty port rights were recognized in Hangchow itself where only foreigners in Chinese service or missionaries were permitted to reside.

The city became the home of the National Chekiang university and the Hangchow Christian college, which continued its work until 1941 in Shanghai.

Hangchow is linked by rail with Shanghai, Ningpo and Nanchang. The city was held by the Japanese from 1937 until the end of World War II in 1945. In 1949 it was captured by Communist forces. (T. SD.)

HANGING is one of five methods used in the western world for executing persons sentenced to death for crime, the others being electrocution, guillotining, gassing and shooting. Hanging is the method used in some U.S. states, in England, Scotland and the commonwealth countries.

United States.—Execution by hanging was introduced early in colonial America by the English settlers. In 1630, according to Joseph Dillaway Sawyer in *History of Pilgrims and Puritans,* a John Billington was hanged at Plymouth in "ye first execution amongst them" for his murder of "one John New-comin" whom he "shote . . . with a gune, whereof he dyed."

Before the wide acceptance in the 19th century of the scaffold and the hangman's knot, which made possible a quick snapping of the spinal column, the victim often suffered slow strangulation before death.

In the United States the last public execution, a hanging, occurred in Kentucky in Aug. 1936. The number and type of witnesses attending executions are now highly restricted by law and administrative regulations. By the second half of the 20th century the laws of only six states (New Hampshire, Iowa, Kansas, Montana, Idaho and Washington) still prescribed hanging as the method of execution. One other state, Utah, gave the prisoner the right to choose between hanging and shooting. The tendency in the United States to replace hanging with some other method of execution is reflected in the fact that of the 48 executions that took place during 1958, only one was by hanging.

England and Scotland.—The procedure of an execution in England and Scotland is similar. The executioner and his assistant travel to the prison the day before that fixed for the execution. They observe the prisoner and are told his height and weight. They then go through the procedure of the execution using a sack of the same weight as the prisoner. The proper drop is calculated with regard to the physical characteristics of the prisoner. The trap upon which the condemned person stands is formed of two hinged leaves held in position from below by bolts which are withdrawn when a lever is pulled. Above the trap a rope is attached to an overhead beam in such a way that it can be adjusted to the proper height.

The execution is carried out in the presence of the sheriff or undersheriff. At the time appointed the executioner enters the condemned "cell," pinions the prisoner's arms behind his back and leads him to the appropriate spot on the trap of the gallows. The assistant executioner then pinions the prisoner's legs, while the executioner puts a white cap over his head and the noose around his neck.

The knot of the noose is drawn tight on the left jaw where it is held in position by a sliding ring. The executioner then pulls the lever and the prisoner falls through the trap thereby suffering fracture or dislocation of the first three cervical vertebrae and so damaging the vital centres of the spinal cord. It is said that the dislocation of the vertebrae causes immediate unconsciousness and there is no chance of a later recovery since breathing is no longer possible.

Apart from the sheriff the persons required to be present are the jailer, chaplain and prison surgeon and such other officers of the prison as the sheriff requires. Relatives and some other persons may be permitted to attend.

Hanging was derived by the Anglo-Saxons from their German ancestors (Tacitus, *Germ.,* 12). In England hanging was established as a punishment for homicide by the time of Henry II, and in the middle ages every town, abbey and nearly all important manorial lords had the right of hanging. From the 12th century the jurisdiction of the royal courts became exclusive. Until 1868 hangings took place in public. During the early years of the modern period, the corpse was gibbeted (*i.e.,* hung in chains) and allowed to remain in a public place as a warning to evildoers.

See also CAPITAL PUNISHMENT.

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HANK: *see* YARN.

HANKEY, MAURICE PASCAL ALERS HANKEY, 1ST BARON (1877–1963), British soldier and politician, the first holder of the office of secretary to the British cabinet, was born at Biarritz, Fr., on April 1, 1877. Educated at Rugby, Eng., and at the Royal Naval college, Greenwich, he served in the Royal Marine artillery (1895–1901) and in the naval intelligence department (1902–06). He became secretary to the committee of imperial defense in 1912 and when Lloyd George became prime minister (Dec. 1916), Hankey was given, in addition, the new appointment of secretary to the war cabinet. After World War I he continued as secretary to the cabinet and to the committee of imperial defense, posts that he occupied until 1938. He was raised to the peerage in 1939. At the outbreak of World War II he was recalled to service, and was a cabinet minister until 1942.

His knowledge, wisdom and experience were used by a succession of prime ministers, and he was British secretary at several international conferences, notably at Versailles (1919), Washington (1921), Genoa (1922), London (1924), The Hague (1929–30) and Lausanne (1932). His retirement from public service was the prelude to an independent and very full life as a regular speaker in the house of lords, as chairman of several scientific and technical committees and as British representative on the Suez Canal company. In his *Politics, Trials and Errors* (1949) he strongly opposed the war crimes trials after World War II, especially those in Tokyo. In 1951 he delivered the Romanes lecture at Oxford. He died at Redhill, Surrey, on Jan. 26, 1963. (F. S. G. P.)

HANKOW (HAN-K'OU), a member city of the tri-city conurbation of Wu-han on the left bank of the Han river where it joins the Yangtze in Hupeh province, China. Hankow was merged in 1950 with the adjacent cities of Han-yang and Wu-ch'ang to form the single metropolis of Wu-han. *See* WU-HAN.

HANN, JULIUS (1839–1921), Austrian meteorologist and climatologist, acquired a world-wide reputation for his works on atmospheric dynamics and thermodynamics, the "atmospheric pulse," cyclones and climatology. He was born near Linz, Upper Austria, on March 23, 1839. In 1865 he became editor of the *Zeitschrift der Oesterreichischen Gesellschaft für Meteorologie,* and from 1877 was occupied in the Central Meteorological institute at Vienna. In 1873 he was appointed professor of physics at the University of Vienna.

He died in Vienna on Oct. 1, 1921.

Hann's principal works are *Die Erde als Ganzes; Die Atmosphäre und Hydrosphäre* (1872); *Handbuch der Klimatologie,* 3 vol. (1908; rev. ed. by Karl Knoch, 1932); *Lehrbuch der Meteorologie,* 3d ed. (1914) and many papers in his own *Zeitschrift* and the reports of the Akademie der Wissenschaften.

HANNA, MARCUS ALONZO (1837–1904), U.S. industrialist and politician, was born at New Lisbon (now Lisbon), Columbiana county, O., on Sept. 24, 1837. He came to the forefront of the American political scene in the year 1896 when he successfully engineered the nomination and election to the presidency of William McKinley. He personified the political strength of industrialism in the United States.

In 1852 his family moved to Cleveland. After completing a public school education he attended Western Reserve college for a few months, then joined his father in a wholesale grocery business. In 1864 he married Charlotte Augusta Rhodes, and her father, Daniel P. Rhodes, made Hanna a partner in his coal and iron business. He devoted himself to this firm and became its dominant member; in 1885 the business was reorganized as M. A. Hanna & Company. In time his various other enterprises included shipping and shipbuilding, banking, street railways, the *Cleveland Herald* and the Cleveland opera house.

Hanna was also active in politics. He believed that the welfare of all business (and, consequently, of the country) was dependent upon the success of the Republican party. He worked for a sustained national effort among businessmen to ensure that success, and took it upon himself to find men who would best serve the party in the highest office, the presidency. After supporting James Garfield and John Sherman, he put his strength behind William McKinley.

When McKinley was re-elected governor of Ohio in 1893, Hanna withdrew from his own personal business affairs and devoted himself to preparing the way for McKinley's nomination as president. At his own expense, and with the help of paid assistants, he campaigned to persuade party leaders that McKinley was the ideal candidate. He succeeded brilliantly, was chosen national chairman

of the Republican party in 1896 and, after raising an unprecedented fund from wealthy individuals and corporations, he managed the victory of McKinley over William Jennings Bryan.

Hanna was appointed to the U.S. senate in 1897 and served there as one of the Republican inner circle until his death in Washington, D.C., on Feb. 15, 1904.

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HANNIBAL. Many Carthaginian generals bore this name, but the absence of Carthaginian patronymics sometimes makes it difficult to distinguish them.

HANNIBAL (d. 406 B.C.), son of Gisco, was outstanding among them. He was general in Sicily when the Segestans, after the defeat of the Athenian expedition to Sicily in 413 (they had appealed to the Athenians in 416 against Selinus; *see* PELOPONNESIAN WAR), requested the Carthaginians to help them in an attack on Selinus (mod. Selinunte), which was supported by pro-Spartan Syracuse. Hannibal landed at Lilybaeum (mod. Marsala) in 409 B.C., sacked Selinus after a siege of nine days' duration and proceeded to lay siege to Himera, which was defended by an army under Diocles of Syracuse. Fearing for the safety of their own city, the Syracusans withdrew and exposed Himera to the savage plundering of Hannibal and his troops, who razed the city and executed 3,000 of its male inhabitants. He returned in triumph to Carthage, but in 406 B.C. was prevailed upon to lead another expedition to Sicily in association with his cousin Himilco. This great expedition aimed to overthrow Agrigentum (mod. Agrigento), but during the siege of that city a pestilence, to which Hannibal fell victim, overtook the army.

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HANNIBAL (247–183 or 182 B.C.), son of Hamilcar Barca, was the most famous of the bearers of this name and is generally recognized as one of the greatest military leaders of antiquity. According to Polybius and Livy, the main Latin sources for his life, he was taken to Spain by his father and at an early age was made to swear eternal hostility to Rome. As it turned out, from the death of his father in 229/228, Hannibal's life was one of constant struggle against Rome.

Early Career.—His earliest commands were given to him in the Carthaginian province of Spain by Hasdrubal, son-in-law and successor of Hamilcar, and although nothing is known of the details of his earliest campaigns, he clearly emerged as a successful officer, for, on the assassination of Hasdrubal in 221 B.C., the army proclaimed him, at the age of 26, its commander in chief and the Carthaginian government hastened to ratify his field appointment.

Hannibal immediately turned himself to the consolidation of the Punic hold on Spain. He fought against the Olcades and captured their capital, Althaea; quelled the Vaccaei in the northwest; and in 221, making Cartagena (*q.v.*) his base, won a resounding victory over the Carpetani in the region of the Tagus river.

In the spring of 219 B.C. Hannibal made an attack on Saguntum, an independent Iberian city south of the Ebro river. In the treaty between Rome and Carthage subsequent to the First Punic War (*see* CARTHAGE; PUNIC WARS) the Ebro had been set as the northern limit of Carthaginian influence in the Iberian peninsula. Saguntum was indeed south of the Ebro, but the Romans had "friendship" (though perhaps not an actual treaty) with the city and regarded the Carthaginian attack on it as an act of war. The siege of Saguntum was a protracted one (eight months) and in it Hannibal was severely wounded. The Romans, who had sent envoys in protest (though they did not send an army to help Saguntum), after its fall demanded the surrender of Hannibal, though under what terms it is difficult to see, since Carthage had not violated the letter of the treaty. Thus began the Second Punic War, declared by Rome and conducted, on the Carthaginian side, almost entirely by Hannibal.

The March Into Gaul.—Hannibal spent the winter of 219/218 B.C. at Cartagena (Carthago Nova, the capital of Carthaginian Spain) in active preparations for carrying the war into Italy. Leaving his brother Hasdrubal in command of a considerable army for the defense of Spain and north Africa he crossed the Ebro in April or May of 218 and marched into the Pyrenees (the Romans, shortly before they heard of this, decided on war). There his army—which consisted, according to Polybius, of 90,000 infantry, 12,000 cavalry (Polybius' figures are probably exaggerated; a total force of about 40,000 is more likely) and a number of elephants—met with stiff resistance from the Pyrenean tribes. This and the desertion of some of his Spanish troops greatly diminished his numbers, but he was able to reach the Rhône river with but little resistance from the tribes of southern Gaul. Meanwhile Publius Cornelius Scipio transported his army, which had been detained in north Italy by a rebellion of the Boii, by sea to Massilia (Marseilles). As Scipio moved northward along the right bank of the Rhône he learned that Hannibal, anxious to avoid battle, had already crossed the river and was marching northward on the left bank.

The Roman general, realizing now that it was Hannibal's intention to cross the Alps and being uncertain by which Alpine pass the enemy would descend into the north Italian plain, himself embarked for north Italy to take command of the two legions stationed there, while he sent his brother Gnaeus, in command of the two legions on the Rhône, to campaign against the Carthaginian forces which still remained in Spain.

A great deal of controversy has surrounded the details of Hannibal's movements after the crossing of the Rhône. Polybius states that it was crossed while the river was still in one stream at a distance of four days' march from the sea. Fourques, opposite Arles, is thought by these calculations to be the most likely place. Hannibal used coracles and boats locally commandeered; for the elephants he made jetties out into the river and floated the elephants from these on earth-covered rafts. Horses were embarked on large boats or made to swim. During this operation hostile Gauls appeared on the opposite bank, and Hannibal dispatched a force under Hanno to cross farther upstream and attack the Gauls in the rear.

After this successful operation and after receiving a deputation of friendly Gaulish leaders headed by those of the north Italian Boii, whose superior knowledge of the Alpine passes must have been of the greatest value to Hannibal's plans, the Carthaginians crossed the Durance river (or more probably an ancient branch of it that flowed into the Rhône near Avignon) and passed into an area which both Polybius and Livy call "the island." This area, the identification of which is the key to Hannibal's subsequent movements on land, was, according to Polybius, a fertile, densely populated triangle bounded on one side by hills, on the second by the Rhône and on the third by a river which Polybius called Skaras and Livy Arar. Much controversy and textual emendation have surrounded these two names, but the most convincing proposal is that both are variant names for the Aygues river, which arises in the Alps of Dauphiné and flows in a southwesterly direction to meet the Rhône near Orange at an angle of about 60°, thus cutting off a triangle of land whose third side is bounded by a range of mountains called Les Baronnies. This river fits the descriptions both of Livy (that it rose in the Alps and flowed near the territory of the Allobroges) and of Polybius.

Here on the "island" a civil war was being fought between two brothers (of what tribe it is not clear). Brancus, the elder of these, in return for Hannibal's help, provided new equipment for the Carthaginian army, which after marching about 750 mi. in four months from Cartagena was in sore need of new supplies.

The Alpine Crossing.—Passing, according to Livy, through the territory of the Celtic Tricastini, along the far edge of the territory of the Vocontii and through the territory of the Tricorii, Hannibal's army approached the Alps by either the Col de Grimone or the Col de Cabre, through the basin of the Durance and out of this by either the Pass of Mont-Genèvre or, more likely, the Col de la Traversette, descending into the territory of the Taurini, who, unlike the Insubres beyond them, were ill disposed to the Carthaginians. Hannibal's first action therefore was to storm their chief town, the modern Turin.

A number of details have been preserved about this great feat

of military enterprise. It is not known whether there were Punic accounts of the march; none is referred to by classical authors, but two Greeks, Sosilos, teacher and biographer of Hannibal, and Silenos, a war commentator, are mentioned as sources by Cornelius Nepos. Silenos' work was translated by Lucius Coelius Antipater and was known to Livy. It is Polybius however who gives the fullest account; he himself traversed Hannibal's route more than 60 years later, lived in the household of Aemilius Paulus (Paullus), was tutor to Publius Scipio Aemilianus and was present at the fall of Carthage. He provides details for each of the 15 days of the Alpine crossing.

In the initial days of the Alpine crossing the danger came from the Allobroges, who attacked the rear of Hannibal's column. (Along the middle stages of the route other Celtic groups attacked the baggage animals and rolled heavy stones down from the heights on the enfilade below, thus causing both men and animals to panic and lose their footings on the precipitous paths. Hannibal took countermeasures, but these involved him in heavy losses in men.) He was able on the third day to capture a Gaulish town, perhaps near Aspres-sur-Buech, and to provide the army from its stores with rations for two or three days. Harassed by the daytime attentions of the Gauls from the heights and mistrusting the loyalty of his Gaulish guides, Hannibal on the seventh day bivouacked on a large bare rock to cover the passage by night of his horses and pack animals in the gorge below. It was already October and snow was falling on the summit of the pass, making the descent even more treacherous. Upon the hardened ice of the previous year's fall the soldiers and animals alike slid and foundered in the fresh snow. On the 12th day a landslide had blocked the narrow track and the army was held up for one day while it was cleared. Finally on the 15th day, after a journey of five months from Cartagena, with 20,000 infantry and 6,000 cavalry intact, Hannibal descended into Italy, having surmounted the difficulties of climate and terrain, the guerrilla tactics of inaccessible tribes and the major difficulty of commanding a body of men diverse in race and language under conditions to which they were ill fitted.

Few of Hannibal's 38 elephants survived this ordeal. An Etruscan coin of the 3rd century B.C. is stamped on the obverse with a Negro head and on the reverse with an Indian elephant, perhaps one of Hannibal's surviving beasts. Carthaginian coins of Cartagena picture on their reverse sides elephants and their riders. These are African elephants, which were still found in numbers in the foothills of the Atlas mountains in Hannibal's time. Some authorities think that Hannibal might also have used Indian elephants since these were used in the army of Alexander the Great. The Ptolemies of Egypt captured Indian elephants from Seleucid princes, and Ptolemy II perhaps lent these as well as the large sum of money he is known to have lent to Carthage in the First Punic War.

The War in Italy.—Hannibal's forces were now totally inadequate to match against the proconsular army of Scipio, who had rushed to the Po river to protect the recently founded Roman colonies of Placentia and Cremona. The first action between the two armies took place on the plains west of the Ticino river in conditions which turned the battle favourably for Hannibal's Numidian cavalry. The Romans withdrew to Placentia. Scipio had been severely wounded. After a number of maneuvers which failed to lead to a second engagement, the consular army of Sempronius Longus joined forces with that of Scipio at the Trebia river just south of Placentia, and although greatly superior in numbers were decisively defeated by Hannibal on its left bank (Dec. 218 B.C.). This victory brought both Gauls and Ligurians to Hannibal's side and his army was considerably augmented by Celtic recruits. After a severe winter (in which he contracted an eye infection) he was able to advance in the spring of 217 B.C. as far as the Arno river. Although two Roman armies were now in the field against him, he was able to outmaneuver that of Gaius Flaminius at Arretium and reached Faesulae (mod. Fiesole) and Perugia. By design this move led Flaminius' army into open combat, and as it passed between the northern shore of Lake Trasimeno and the opposite hills, Hannibal's troops from their prepared positions all but annihilated it, killing thousands and driving others to drown in the lake. Reinforcements of about 4,000 cavalry under Gaius Centenius were intercepted before they arrived on the battlefield and were destroyed.

This was one of the greatest defeats suffered by Rome, but the Carthaginian troops were too worn to clinch their victories and march on Rome. Hannibal, furthermore, nurtured the vain hope that the Italian allies of Rome, whose attachments he always underestimated, would defect and cause civil war.

The summer of 217 was spent resting at Picenum, but toward the autumn and during the winter he ravaged Apulia and Campania; during this time the famous delaying tactics of the army under Q. Fabius Maximus Cunctator (*see* FABIUS) prevented anything but skirmishes between the two armies. Suddenly in late winter 216 Hannibal moved southward and seized the large army supply depot at Cannae on the Aufidus river. There early in August was fought, against an army of 50,000–55,000 (according to Livy; *see* CANNAE) under the command of L. Aemilius Paulus and Gaius Terentius Varro, the famous battle of Cannae, in which, while the Gauls and Iberian infantry of Hannibal's centre line yielded (without breaking) before the drive of the numerically superior Roman infantry, the Libyan infantry and cavalry of Hannibal's flanks stood fast, overlapped the Roman line and in a rear encircling movement turned to pursue the victorious legionaries in the rear.

This third of Hannibal's great land victories in Italy brought the desired effect: Apulia, Lucania, Bruttium and the city of Capua were among the places which defected from the Italic confederacy. But even with this victory behind him Hannibal did not march on Rome but spent the winter of 216–215 in Capua. Gradually the Carthaginian fighting strength weakened. The strategy suggested by Fabius was put into operation: to defend the cities loyal to Rome; to try to recover, where opportunity offered, those cities which had fallen to Hannibal; never to enter battle when the enemy offered it but rather to keep the Carthaginians alert in every theatre of war. Thus Hannibal, unable because of inferior numbers to spread his forces to match the Romans and unable to employ this concentrated strength in a decisive battle, passed from the offensive to a cautious and not always successful defensive in Italy, inadequately supported by the home government at Carthage and, because of the Roman command of the sea, forced to obtain local provisions for protracted and ineffectual operations.

Between 215 and 213 Hannibal, except for the capture of Tarentum (mod. Taranto), gained only minor victories; neither Philip V of Macedonia nor the Syracusans in Sicily (who had alike risen against Roman domination on the inspiration of the Carthaginian victories) were able to render direct aid. Reinforcements from Carthage were few. In 213 Casilinum and Arpi (captured by Hannibal in winter 216–215) were recovered by the Romans, and in 211 Hannibal was obliged to march to relieve the Roman siege of Capua. Despite Hannibal's countermeasure of a quick march to within three miles of the strongly fortified walls of Rome, Capua fell. In the same year in Sicily (211) Syracuse fell and by 209 Tarentum in south Italy had also been recaptured by the Romans.

The War in Spain.—Meanwhile after years of indecisive warfare in Spain the successes of Publius Cornelius Scipio (Africanus) dealt severe blows to Carthaginian power in the peninsula. In 208 Hasdrubal, detaching a force from the main Carthaginian army, crossed the Alps (probably by his brother's route) to go to Hannibal's aid. Hasdrubal's army was however defeated at Metaurus in north Italy (207) before the Carthaginian armies could effect a junction. His last hope of making a recovery in central Italy thus dashed, Hannibal concentrated his forces in Bruttium, where with the help of his remaining allies he was able to resist Roman pressure for four more years.

The War in Africa.—Scipio, however, fresh from his victories in Spain, with the reluctant permission of the senate, struck at north Africa, breaking Carthage's principal ally, Syphax (203), king of the Massaesylian Numidians, and endangering Carthage. In order to go to the help of his country Hannibal abandoned Italy in 203. Although a preliminary armistice had already been declared and the Carthaginian armies had accepted Scipio's severe terms (winter 204–203), Hannibal concentrated the remnants of the Carthaginian forces at Hadrumetum (mod. Sousse). Almost at

the very moment when the ambassadors were returning from Rome with the preliminary peace proposals, the Carthaginians violated the armistice.

The details of the campaigns which followed are very differently related. Both Hannibal and Scipio, in order to link up with their respective Numidian allies—Scipio with Masinissa, king of the Massylian Numidians, and Hannibal with Vermina, king of the Massaesylian Numidians (son of Syphax)—moved up the Bagradas river to the region of Zama Regia. The authenticity of accounts of a meeting between the two commanders is doubtful, but if it took place, Scipio, from his advantageous military position, can only have imposed more onerous terms than before. If Livy's account is accepted, battle was joined near Zama at Naraggara (Sidi Youssef near the western border of Tunisia); according to one modern view, however, it may have been in the plain Draa-el-Metnam, southwest of Sicca Veneria (Le Kef). Hannibal was now deficient in cavalry; the mercenary troops of his front line and the African infantry of his second line together were routed and Scipio, seeing that Hannibal's third line, the veteran soldiers, was still intact, reformed his front and brought up the Numidian cavalry of Masinissa in the Carthaginian rear. Hannibal lost 20,000 men in defeat, but himself escaped Masinissa's pursuit.

Exile and Death.—The treaty between Rome and Carthage which was concluded a year after the battle of Zama frustrated the entire object of Hannibal's life, but his hopes of taking arms once more against Rome lived on. At home, however, the security of his command was imperiled: he was accused of having misconducted the war. This however carried little weight, for shortly afterward he was made a suffete (a civil magistracy) in addition to his military command, and in this office he was able to overthrow the power of the oligarchic governing faction at Carthage and bring about certain administrative and constitutional changes. With a certain faction of the Carthaginian nobility he thus became unpopular and according to Livy was denounced to the Romans as inciting Antiochus III of Syria to take up arms against the Romans. Before the arrival of the Roman envoy at Carthage Hannibal fled for refuge to the court of Antiochus at Ephesus (195). There he was at first welcome: Antiochus was preparing war with Rome. Soon however the presence of Hannibal and the sound advice he gave concerning the conduct of the war became a source of embarrassment, and he was sent to raise and command a fleet for Antiochus in the Phoenician cities. Inexperienced as he was in naval matters, he was defeated by the Roman fleet off Side in Pamphylia. Antiochus was defeated on land at Magnesia in 190, and one of the terms demanded of him by the Romans was that Hannibal should be surrendered. Again accounts of Hannibal's subsequent actions vary. According to Polybius he fled via Crete to the court of King Prusias of Bithynia, but according to Strabo and Plutarch he joined the rebel forces of Artaxias, one of Antiochus' generals in Armenia, before taking refuge with Prusias, who at this time was engaged in warfare with Rome's ally, King Eumenes of Pergamum. He served Prusias in this war, and about one of the victories he gained over Eumenes at sea it is told that he threw cauldrons of snakes into the enemy vessels.

Finally the Romans, by what means it is unknown, put themselves in a position to demand the surrender of Hannibal. Unable this time to escape arrest, Hannibal poisoned himself in the Bithynian village of Libyssa. The year is uncertain but was probably 183 B.C., when Hannibal was 64 years old.

Hannibal as a General.—In the conduct of the war with Rome, the project of the Alpine crossing probably originated with Hamilcar Barca. Strategically it was entirely successful and came to the Romans "as a thunderbolt" in the words of Florus. In men however it cost him dearly, between 5,000 and 10,000. Although it is said that he later regretted it, his action in not marching on Rome after Cannae is understandable. The city was strongly walled and supplied by sea and river; Hannibal had no siegecraft. Hannibal hoped by a series of lightning victories to detach Rome's allies from the Italic confederacy. This was his greatest mistake: he had little realization of the strength of the ties of the confederates to Rome. Perhaps his greatest weakness however was at sea. He had no supporting navy and appeared indifferent to that Roman naval supremacy which in the first place was able to cut off reinforcements and in the second to bring about unimpeded the invasion of Africa. Although his tactics in the field, as attested even by Scipio, were brilliant, and he himself by his personal appearances and quick marches up and down Italy dazzled the Romans and complicated their strategy, he was at a decided disadvantage as regards reinforcements and provisions. Neither Philip V of Macedonia nor the Syracusans were of material help. The winter of 216–215 spent idly at Capua and the refusal of the Romans thereafter to allow Hannibal to play the war as an army game provided the turning points in his success. Much that weighed against him was circumstantial and beyond his control; for all that went amiss in the conduct and policy of the war he cannot be entirely blamed; in tactics in the field he retained the mastery.

Hannibal's Personality.—It is not to be expected that his Roman biographers would treat him impartially, but Polybius and Dio Cassius give the least biased accounts. Against that cruelty so readily attributed to him by the Roman authors should be set the facts that he entered into agreement with Fabius for the return of prisoners and treated with respect the bodies of T. Sempronius Gracchus (consul 215) and L. Aemilius Paulus (216), the fallen enemy generals. Of avarice, the other charge commonly laid against him, no direct evidence is found other than the practices necessary for a general to finance a war: indeed he spared Fabius' farm. Much that was said against him (*e.g.*, cannibalism by Polybius) might have taken rise from individual activities of his generals, but even this is uncertain. His physical bravery is well attested and his temperance and continence were praised. His power of leadership is implied in the lack of rioting and disharmony in that mixed body of men he commanded for so long, while his humane disposition is spoken for by the care he took for his elephants and horses as well as his men. His treachery, that *punica fides* which the Romans detested, could from another point of view pass for resourcefulness in war and boldness in strategem, and in assessing Roman judgments of him, the wide gulf between Roman and Carthaginian moral standards must be borne in mind. Of his wit and subtlety of speech many anecdotes remain. He spoke Greek (Cicero, *de Oratione*) and Latin (Zonaras, viii, 24) fluently, but more personal information is absent from his biographies. He is shown in the only surviving portraits, the silver hexadrachms of Cartagena struck in 221, the year of his election as general, with a youthful, beardless and pleasant face. He married Imilce of Castulo (a town on the Guadalquivir river) and their only son was born during the siege of Saguntum. *See* also references under "Hannibal" in the Index volume.

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HANNIBAL, a city on the Mississippi river, in Marion county, Mo., U.S., 100 mi. N.W. of St. Louis. As the boyhood home of Mark Twain (*q.v.*), the town provided the setting for several of his finest books, including *The Adventures of Tom Sawyer* and *The Adventures of Huckleberry Finn*.

The site, part of old Spanish land grants, was given to Abraham Bird in 1818 as compensation for earthquake damage to his property in New Madrid, Mo. Hannibal's first settler, Moses Bates, arrived in 1819, and in 1845, with a population of about 1,000, Hannibal was incorporated as a city. A river landing in the Louisiana Purchase territory, the settlement took its name from the small stream (later Bear creek) flowing through the site, which was named in the classic tradition and mapped by a pioneer Spanish surveyor. The Mark Twain Memorial bridge (1935) spans the Mississippi river, linking Missouri and Illinois. The city lies

between two peaks, Lovers' Leap (225 ft.) and Cardiff hill, on which rises the Mark Twain Memorial lighthouse. Beyond is Riverview park (250 ac.) with commanding views of the mile-wide Mississippi. Once an important steamboat port, Hannibal's industries include railroad repair yards; shoe, machinery and drill tools factories; cement and printing plants; food, dairy and building products. The surrounding farm land is devoted to dairying, corn and grain. The Hannibal-La Grange college (Baptist) was moved from La Grange, Mo., to Hannibal in 1929.

Memorials to Mark Twain include: his boyhood home at 208 Hill street, built by his father in 1844; the city-built Mark Twain museum (1937); Judge J. M. Clemens' law office; the Becky Thatcher house; and the house of the Pilasters. The famous Tom Sawyer cave is 2 mi. S. Discovered in 1819 by Jack Simms, a hunter, it is reputed to have been a hiding place of Jesse James, and in slavery days a station on the Underground Railroad (*q.v.*). Jackson's Island, an adventure ground of Tom Sawyer and Huck Finn, lies across the river near the Illinois shore. Mark Twain's two-room cabin birthplace is preserved in the Mark Twain State park at Florida, 25 mi. S.W. of Hannibal. For comparative population figures *see* table in MISSOURI: *Population*. (J. A.)

HANNINGTON, JAMES (1847–1885), Anglican missionary and first bishop of Eastern Equatorial Africa, was born at Hurstpierpoint, Sussex, on Sept. 3, 1847, and was educated at St. Mary Hall, Oxford. Ordained in 1874, he became curate at Hurstpierpoint in 1875. In 1878 his thoughts were turned to mission work by the murder of two missionaries on the shores of Lake Victoria. He sailed in 1882, at the head of a party of six, for Zanzibar, and thence set out for Uganda, but was forced by illness to return to England in 1883. On his recovery he was consecrated bishop of Eastern Equatorial Africa (June 1884) and in 1885 reached Lake Victoria, only to be killed with his men within a few days by order of the king of Uganda. The story of this journey is given in his own *Last Journals* which were published in 1888.

See E. C. Dawson, *Life of James Hannington* (1887); F. E. Hansford, *James Hannington* (1953).

HANNO, a common Carthaginian name or possibly a title equivalent to the Greek *presbyteros*, "elder." It was held by at least 20 historical Carthaginian generals and statesmen, and it is difficult to distinguish one from another.

HANNO, known as THE GREAT (3rd century B.C.), leader of the aristocratic party in Carthage and a serious military rival to Hamilcar Barca and the latter's son Hannibal (*qq.v.*). His military reputation was founded primarily upon a series of campaigns against native African people subject to Carthage, and it was on the power he held over these tribes and the taxes he exacted from them that his political popularity at Carthage depended. In 241 B.C. the Carthaginian mercenaries employed in Sicily crossed to Africa and staged a rebellion because of pay deficiencies. Hanno was given command against them, but because of incompetence was soon forced to share his command with Hamilcar Barca. Together they completed the subjection of north Africa. During the Second Punic War he led the pro-Roman party at Carthage and was strongly opposed to the activities of Hannibal in Spain. Although he took no further part in military activities, he was one of the ambassadors sent to Scipio to sue for peace.

HANNO (5th century B.C.) was the Carthaginian who conducted a voyage to explore and colonize the west coast of Africa. His dates are disputed, but probably he was the father or the son (both called Hanno) of the general Hamilcar who was killed at Himera in 480 B.C. Having sailed past the Pillars of Hercules (the Strait of Gibraltar) with 60 penteconters and 30,000 men and women, he founded Thymiaterium (mod. Mehdia), built a temple at Soloeis (Cape Cantin) and passing thence by a lagoon (marshes of the Tensift river?) settled five more cities: Carian Fortress (Gr. Karikon Teichos), Gytte, Acra (Agadir), Melitta and Arambys. The Carian Fortress is perhaps to be identified with the isle of Mogador, where archaeological remains of Punic settlers have been found. Farther south he founded Cerne, possibly on the Senegal river, as a trading post, and, although geographical details are vague, reached the coast of Gambia or Sierra Leone, and possibly Cameroon if the textual distances are conservative.

An account of his voyage was written in the temple of Baal at Carthage and survives in a Greek manuscript of the 10th century A.D., probably based on an ancient Greek translation of the Punic and known as the *Periplus of Hannon*.

See D. B. Harden, "The Phoenicians on the West Coast of Africa," *Antiquity*, vol. xxii, pp. 141 ff. (1948). (WM. C.)

HANNOVER, Germany: *see* HANOVER.

HANOI, the capital of North Vietnam (Democratic Republic of Vietnam), lies on the right bank of the Red river (Song Koi) about 85 mi. from the sea. Pop. (1958 est.) 250,000. It takes its name from the Chinese meaning "a province surrounded by rivers." A tightly compacted, squatly built city, only a few of its streets are modernized, the rest being unpaved in a bicycle-infested warren of one-storied buildings of older Asiatic tradition with a few royal relics. In the old walled city to the northwest are the Pagoda of the Great Buddha, the One Column pagoda (11th century) and the Temple of Literature (Vanmieu) dedicated to Confucius. Across the artificial Petit Lac is a French-built residential and administrative area now encroached by native housing. In the town are a university, technical schools, a museum, a public library and two theatres. Hanoi stands centrally to the intensively farmed delta of the Red river whose major distributaries are embanked because the built-up area is largely below high-water levels. Local rainfalls are erratic but the 72 in. annual fall includes winter drizzles. The water channels are much used for country produce but only a tenth of production reaches the town markets. The channels necessitate ferrying and many bridges, the greatest being the mile-long Pont Doumer carrying road and railway. The main distributary is so silted that craft over seven-foot draft cannot use it, so that the city has an outport at Haiphong, reached from Gia Lam station on the other side of the river. The railway from Hanoi to K'un-ming has been rebuilt to strengthen commercial ties with south China. Hanoi has been associated with violent anarchism and anti-French agitation for years. Its people include many south Chinese playing a big part in trade and culture. Its industries include cotton and silk mills, brewing and the making of rubber goods, cigarettes, matches, soap, knitwear and enamelware. The Hanoi Engineering works were built with the technical help of the U.S.S.R. between 1958 and 1961.

Hanoi, first mentioned as the seat of a Chinese command in the 7th century A.D., was invaded and destroyed repeatedly by the Chinese and the Annamese. It then became the seat of the Lê dynasty (1428–1788) of North Annam, which expelled the Chinese. After the reunion of Annam in 1802, Hanoi became the capital of Tongking. The French occupied it for a short while in 1873 and again in 1882. It remained the capital of French Indochina from 1887 until the end of World War II. Hanoi was occupied by the Japanese from 1940 to 1945 and frequently bombed by the Allies (1943–45). It became the capital of Vietnam under the Vietminh in Aug. 1945 and of North Vietnam after July 1954. *See* INDOCHINA; VIETNAM. (E. H. G. D.)

HANOTAUX, ALBERT AUGUSTE GABRIEL (1853–1944), French statesman and historian, a member of the Académie Française, was born at Beaurevoir, Aisne, on Nov. 19, 1853. He simultaneously read law and studied at the École des Chartes, becoming *maître de conférences* at the École des Hautes Études in 1880. Meanwhile, in 1879 he had entered the ministry of foreign affairs as an archivist. There he gained rapid promotion, being appointed embassy councilor at Constantinople in 1885. After being deputy for Aisne from 1886 to 1889, he returned to the ministry of foreign affairs as director of the protectorates and in 1892 director of the consular department. Hanotaux was minister of foreign affairs under Charles Dupuy (1894–95), under Alexandre Ribot (1895) and under Jules Méline (1896). During his period of office he developed France's *rapprochement* with Russia, accompanying Pres. Félix Faure on his visit to Russia in 1897, and signed conventions with the Congo state and with China delimiting the frontiers of French Equatorial Africa and Tongking respectively. His hostility to Great Britain was no secret, and according to Augustin Baratier, second-in-command to Capt. J. B. Marchand (*q.v.*), it was he who told Marchand before the latter's departure for the Sudan, "You are going to fire a pistol shot on the Nile;

we accept all its consequences."

Hanotaux, who had also made his name as a historian, was elected to the Académie Française on April 1, 1897. In World War I he was sent on several propaganda missions, notably to the Vatican. He was French delegate to the League of Nations assembly in 1920 and 1921 and one of its vice-presidents in 1922 and 1923. He died in Paris on April 11, 1944.

Hanotaux's works include: *Origines de l'institution des intendants de provinces* (1884); *Études historiques sur les XVIe et XVIIe siècles en France* (1886); *Histoire du cardinal de Richelieu*, 6 vol., the last 3 jointly with the duc de la Force (1893–1947); *Histoire de la France contemporaine, 1871–1900*, 4 vol. (1903–08); *Histoire de Jeanne d'Arc* (1911); *Histoire illustrée de la Guerre de 1914*, 17 vol. (1915–26); *Le Traité de Versailles* (1919); *Histoire de la nation française*, 15 vol. (1920–30); *La Bataille de la Marne*, 2 vol. (1923). He also edited the *Instructions des ambassadeurs de France à Rome, depuis les traités de Westphalie* (1888).

HANOVER, a former state of northwestern Germany; an electorate of the Holy Roman empire from 1692 to 1806; a kingdom from 1814 to 1866; a Prussian province from 1866 to 1945; and for a short time in 1946 a separate *Land* before it was merged with Lower Saxony. The electorate of Hanover grew out of one of the divisions of the possessions of the house of Brunswick-Lüneburg (*see* BRUNSWICK). In 1636 Duke George established his residence in the city of Hanover after he had inherited the principality of Brunswick-Calenberg-Göttingen; *i.e.*, the southern part of the later administrative district of Hanover and the southern part of the present administrative district of Hildesheim, the two areas being separated by the territory of Brunswick-Wolfenbüttel. This principality, which soon came to be named after its principal town, Hanover, owed its subsequent rise both to lucky chances and to the skill of its rulers. Ernest Augustus (1630–98), bishop of Osnabrück from 1661 and duke in Hanover from 1680, brought about the union of the principality of Lüneburg with Calenberg by treaties with his brother George William of Celle and by the marriage of his own son George Louis (*see* GEORGE I, king of Great Britain) with Sophia Dorothea, George William's only daughter; these plans matured in 1705, with the death of George William. Ernest Augustus promulgated a law of primogeniture in 1682; and in 1692 he was able to persuade the Holy Roman emperor Leopold I to elevate the principalities of Calenberg and Lüneburg into an electorate. This was officially styled the electorate of Brunswick-Lüneburg, but soon—not least because of English usage—the terms "electorate of Hanover," "electoral Hanover" and, for the dynasty, "house of Hanover" became accepted, though it was not until 1814 with the creation of the "kingdom of Hanover" that the name was recognized in constitutional law.

Hanover and Great Britain in Personal Union.—The marriage (1658) of Ernest Augustus to Sophia of the Palatinate (1630–1714), great-granddaughter of James I of Great Britain, secured for the house of Hanover the British succession in 1714, by virtue of the Act of Settlement (1701) in favour of Sophia. The electress Sophia, who had kept up a brilliant court at Hanover and at Herrenhausen, patronizing Leibniz and Handel, did not live to take up the succession; she died, a few weeks before Queen Anne, on June 8, 1714. Her son, the elector George Louis, ascended the British throne as George I and began the 123-year-long personal union between Great Britain and Hanover.

Constitutionally both states were fully independent of one another, and despite the preference of the Hanoverian kings for their German hereditary land, Hanover did not influence British politics so much as was sometimes claimed. George I and George II (elector from 1727 to 1760) often visited Hanover; but George III never visited it, George IV (king from 1820 to 1830) visited it only once in his reign and William IV (king from 1830 to 1837) visited it only before his accession. All of them, however, devoted much care to their ancestral land. It was administered in the king's absence by the ministry in Hanover (the privy council directed from 1730 to 1770 by Gerlach Adolf von Münchhausen) and by the German chancellery in London. The electorate enjoyed good government and justice, received a university (Göttingen, 1737) and won access to the North sea through the acquisition of Bremen and Verden (1715; ratified 1720). In 1803 the bishopric of Osnabrück, which from 1648 had been administered alternately by Catholic bishops and Welf princes, was incorporated.

The British connection was fatal to Hanover whenever a foreign power tried to hit England by attacking this "Achilles heel" on the European continent. This happened in the Seven Years' War when much of the fighting was over Hanover (battle of Hastenbeck and capitulation of Kloster Zeven, 1757; battle of Minden, 1759), but especially during the French Revolutionary Wars from 1793 onward and in the Napoleonic Wars; Hanover was occupied twice by the Prussians (1801 and 1805) and twice by the French (1803 and 1806) and was eventually divided between Jérôme Bonaparte's kingdom of Westphalia and the French empire of Napoleon. During the years of foreign rule over Hanover (1803–13), many thousands of Hanoverians fought under British colours, in the King's German Legion, in all the theatres of war against Napoleon, particularly the Iberian peninsula; and Hanoverians contributed significantly to Wellington's victory at Waterloo.

Hanover, which had even been annexed by Prussia early in 1806, was not only re-established after the defeat of Napoleon in 1814, but also enlarged by the addition of Hildesheim, the Eichsfeld, East Frisia, Bentheim, Lingen and the Emsland, and in Oct. 1814 it was elevated to a kingdom. All this was achieved mainly through British influence—a very positive result of the personal union.

From 1815 the kingdom of Hanover was a member state of the German confederation. It was fourth in area (14,610 sq.mi.) after Austria, Prussia and Bavaria and fifth in population after those three states and Saxony. Though the provinces (Calenberg-Göttingen, Lüneburg, Hoya-Diepholz, Bremen-Verden, Osnabrück, Hildesheim and East Frisia) kept their own estates and individual representative assemblies, the kingdom received a general assembly of estates in 1814 and a constitution imposed by the king in 1819, which however did not much alter the exclusive preponderance of the nobility. Only as a result of the July revolution of 1830, which brought about a change of ruler in Brunswick and small-scale risings in Hanover, did the kingdom receive under William IV a liberal constitution on Sept. 26, 1833, after the fall of the hitherto all-powerful minister, Graf Ernst Herbert Münster. The popular Adolphus Frederick, duke of Cambridge, became viceroy. The constitutional law gave a share in political life to the middle classes and, to a very slight extent, to the peasantry; introduced a limited degree of ministerial responsibility; and subjected both state finances and royal revenues from crown lands to parliamentary control. At the same time the commutation order of July 23, 1833, chiefly the work of J. C. B. Stüve from Osnabrück, formed the basis for a gradual abolition of seigniorial prerogatives and for the maintenance of a healthy and efficient peasantry in what was still a preponderantly agricultural country.

King Ernest Augustus.—The death of William IV on June 26, 1837, terminated the personal union between Great Britain and Hanover. Since by Hanoverian law female succession was permissible only if there were no male heirs, Hanover passed not to William's niece Victoria, who succeeded him in Great Britain, but to his brother Ernest Augustus, duke of Cumberland (1771–1851). In England Ernest Augustus had shown himself an ultraconservative high Tory and an avowed enemy of all innovations. It was his ideal to restore the patriarchal authoritarian state of the *ancien régime*. Already before his accession he had registered a formal protest against the Hanoverian constitution, and on Nov. 1, 1837, he repealed it. This, and still more the dismissal of seven famous Göttingen professors who had protested against the king's action, roused a storm of indignation among liberals throughout Europe. From then onward Hanover was regarded as the bastion of reaction. Whether the action of the king, advised by his rigidly conservative minister Georg von Schele, should be described as a breach of the constitution or as a *coup d'état* was and still is disputed. Certainly it was a challenge to the progressive tendencies of the time. Yet the king made his decision only after months of deliberation and in the conviction that he was doing the best for his country; and his action was approved by the German confederation, with which the opposition had lodged a protest.

In any case Ernest Augustus was anything but a despot. This

was proved by his care for the well-being of his subjects, with whom he was soon very popular, and by his adroit as well as brave attitude at the outbreak of the revolution in 1848. The old king knew when to make concessions at the right time and without any loss of dignity. He appointed the former leader of the opposition Stüve as minister and thus brought Hanover through the turbulent years 1848–49 without any bloodshed. The country received a liberal constitution, and numerous reforms were introduced in justice and administration. Though he had maintained a cautious reserve over the Frankfurt national assembly's attempt to replace the German confederation by a more unified and freer Germany, he in 1851 renounced the customs union of 1834 with Oldenburg, Brunswick and Schaumburg-Lippe in favour of joining the German customs union.

George V.—Ernest Augustus died on Nov. 18, 1851. His son and successor George V (1819–78), blind since the age of 14, was a gifted monarch, devoted to the arts and sciences, though admittedly inclined to an exaggerated and romantic view of the divine right of kings. He did not approve the liberal reforms of 1848 and welcomed their partial repeal in 1855, through the efforts of the restored German confederation. His reign was characterized by the continual change of political influences and, therefore, ministries, which the blind king had to accept.

More decisive than the internal development of the kingdom was the great external danger from the collision of the great German powers, Austria and Prussia. In this conflict George tried to preserve the neutrality of his country, surrounded as it was by Prussia; and in the crisis of the German confederation in 1866 (*see* SEVEN WEEKS' WAR) he held fast to the federal constitution in order to avoid opposing either Prussia or Austria. Not content with Hanover's neutrality, Bismarck on June 17, 1866, gave the king the choice either of allying with Prussia and surrendering part of Hanover's sovereignty or of being treated as an enemy. George V refused this ultimatum as a "Christian, monarch and Welf" and left the country with his army. Hanover was immediately occupied by Prussia. On their march south toward their Bavarian allies the Hanoverians defeated a Prussian corps at Langensalza in Thuringia on June 27, but had to surrender to superior forces two days later. The king went to Austria and later to France as an exile. On Sept. 20 Hanover was annexed by Prussia.

The Prussian Period (1866–1945).—Without a peace treaty and under protest from the exiled royal house Hanover became a Prussian province for the next 80 years. Prussia however never fully succeeded in assimilating the annexed territory. Only a part of the population came to terms with the Prussian rulers, as did the former leader of the opposition and National Liberal statesman, Rudolf von Bennigsen (president of the province from 1888 to 1897). Very many Hanoverians, loyal to king and country, remained in bitter opposition, organized in the German-Hanoverian party and never fully reconciled. Though the province enjoyed limited self-government and shared in the prosperity of the Bismarckian German empire after 1871, Welf opposition in Hanover continued, even after the reconciliation of the houses of Hohenzollern and Brunswick in 1913 and even after the fall of the German dynasties in 1918. Thenceforward the German-Hanoverian party demanded a free Lower Saxony, but a plebiscite in May 1924 failed because of the solid opposition of the Social Democrats, the rulers of Prussia.

Only after the collapse of Hitler's *Reich* in 1945 and the dismemberment of Prussia was the *Land* Hanover re-established (Aug. 23, 1946) with the consent of all political parties, including the Socialists. However, on Nov. 1, 1946, the new *Land* was united with Oldenburg, Brunswick and Schaumburg-Lippe to form the *Land* Lower Saxony, of which Hanover constituted almost four-fifths. The former administrative district of Hanover, comprising the historic Calenberg, Hoya-Diepholz and Schaumburg, remained.

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HANOVER (HANNOVER), a city of Germany which after partition of the nation following World War II became the capital of the *Land* (state) of Lower Saxony, Federal Republic of Germany, stands 180 ft. above sea level in the valley of the Leine river, where the spurs of the Harz and Mittelgebirge mountains merge into the wide north German plain. Pop. (1961) 573,124.

During World War II about 60% of the city was destroyed, but on the ruins has arisen a replanned, modern city with an extensive industry, but still preserving the parks, public gardens and woods that earned for Hanover the title of "the garden city." Notable among these are the Königsgärten zu Herrenhausen, the great Hanover woods ("Eilenriede"), the Maschsee, the Tiergarten, the Hermann-Löns park, the Stadtpark and the zoological gardens. Most of the historic buildings were destroyed or severely damaged, and those that could not be rebuilt include the beautiful Leibniz house (1652), where the philosopher lived from 1676 until his death in 1716, the old palace (1752) and the old chancellery (1550). Buildings that have been reconstructed are the Old Rathaus (the oldest part dated from 1410), the Wangenheim palace (1829), the Opera (1842–52), the Market church (1349–59), a landmark of Hanover, the Neustädter church, which contains the tomb of Leibniz, and the Kreuzkirche (Church of the Cross; 1333). The ruins of the Aegidien church (1347) remain as a memorial to the victims of wars. New government offices have been built around the old Leine palace (1636–40, rebuilt 1817–42), the former residence of the Hanoverian court, which was also destroyed but is now reconstructed and is the home of the diet of Lower Saxony. Reconstructed museums include the Landesmuseum, with its natural history and prehistorical departments and extensive picture gallery, and the Kestner museum, with its rich treasures of European and Islamic fine handicrafts and Egyptian works of art. The Wilhelm Busch museum is now housed in the former little palace of Wallmoden and the Heimatmuseum is to have a new building on the historic site am hohen Ufer ("on the high banks"), on the Leine. Noteworthy educational institutions are the technical college, which in 1879 was established in the unfinished palace of the Guelphs; the veterinary college; the teachers' training college; the college of music and drama; the school of art; and the school of engineering.

Hanover is the most important railway junction in northwest Germany and, with the completion of the north-south *Autobahn*, it becomes equally important as a road centre. It is linked by both rail and *Autobahn* to Berlin via Helmstedt on the East-West German frontier. The city has an outer ring *Autobahn* for transit traffic and an inner ring road. The airport of Hanover, 5 mi. N., is of increasing importance. The city also has two ports on the Mittelland canal. There are many industries; most important are the vehicle, machine-building, rubber and chemical industries. Others include food products, textiles, dyes and inks, phonograph records and cigarettes. The German Industries' fair (first held in Hanover in 1947), now called Hanover fair, has had great influence on the city's development.

The town of Hanover was first mentioned in documents in 1100 but its real history began in 1241 with the granting of its charter, and it joined the Hanseatic league in 1386. From 1495 Hanover belonged to the Calenberg-Celle line of the house of Guelph, who resided there from 1636. In 1714 George Louis of that house became George I of England. From 1815 the town was the capital of the kingdom of Hanover until its annexation in 1866 by Prussia, and it later became the capital of Hanover province (*q.v.*) until its new status as capital of Lower Saxony in 1946. (H. LH.)

HANOVER, a village in Grafton county, west New Hampshire, U.S., is located on the east bank of the Connecticut river 5 mi. N. of White River Junction, Vt. The village precinct of

Hanover was organized in 1885 by state legislative action as a subdivision of the "town" of Hanover (chartered 1761). Since the village's first settlement in 1770 it has existed primarily as the seat of Dartmouth college. The college was an outgrowth of Moor's Indian Charity school organized in the 1750s by the Rev. Eleazar Wheelock in Lebanon (now Columbia), Conn. It was chartered as a college in 1769 under authority of George III, taking the name of the 2nd earl of Dartmouth, president of the trustees of English funds, and located on Hanover plain in 1770.

The college is a men's liberal arts institution with an undergraduate enrollment of approximately 3,000. It has three associated professional graduate schools: the Dartmouth medical school (1797); the Thayer school of engineering (1871); and the Amos Tuck school of business administration (1900). Baker library contains more than 800,000 volumes, and while it functions mainly for undergraduates, visiting scholars make it their headquarters for research every summer. A notable holding is the extensive Vilhjalmur Stefansson collection of arctic material, the chief American collection in this field. On the walls of the reading rooms are 3,000 sq.ft. of frescoes, "An Epic of American Civilization," a series of panels by the Mexican artist José Clemente Orozco. Located in the foothills of the White mountains, Dartmouth is nationally known for its pioneering in skiing and other winter sports and has attained fame as an "outdoor college."

Connected with the Mary Hitchcock Memorial hospital, the largest medical installation in northern New England, are the Hitchcock clinic with about 150 resident medical and surgical specialists, the Hitchcock foundation, a research organization, and the Dartmouth medical school. The village is primarily residential. For comparative population figures *see* table in NEW HAMPSHIRE: *Population.*

See Leon B. Richardson, *History of Dartmouth College* (1932).
(W. H. McCR.)

HANRIOT, FRANÇOIS (1759–1794), commander in chief of the Paris national guard during the Jacobin period of the French Revolution, was born at Nanterre, near Paris on Dec. 3, 1759, of a peasant family. In 1789, when the Revolution broke out, he was a clerk at one of the barriers where the octroi (toll) for Paris was collected; but on the night of July 12, when the Parisians set fire to the barriers, he deserted his post. Thenceforth a partisan of the Revolution, he showed great courage in the rising of Aug. 10, 1792, after which he was elected commandant of the national guard of the Sans-Culottes section of Paris. His coolness and his capability were decisive in the popular risings of May 31–June 2, 1793, against the Girondins. On May 31 the Paris commune appointed him provisional commander in chief of the Paris national guard, and on June 2 he surrounded the Convention with 80,000 armed men and 160 cannons and so forced it to decree the arrest of the 22 Girondin deputies. This action won him election as permanent commander in chief of the Paris national guard, thanks to the favour of the extremist sections. Thereafter he loyally supported Robespierre, but failed to save him or his friends when, on 9 Thermidor (July 27, 1794), the Convention ordered their arrest. For all his courage, his military countermeasures and leadership proved inadequate, and he missed the chance of marching on the Convention and seizing control. He was arrested and guillotined with the other Robespierrists on 10 Thermidor (July 28, 1794).
(A. So.)

HANSARD, the name of a family now inseparably associated with the publication of the British parliamentary debates. The connection was first established by LUKE HANSARD (1752–1828), who was born at Norwich on July 5, 1752, the son of a manufacturer, and, after an apprenticeship to a Norwich printer, became a compositor at the printing office of John Hughs (1703–71), printer to the house of commons, in Lincoln's Inn Fields, London. In 1774 he was made a partner, and in 1800 he became the sole proprietor of the business. He printed the *Journals of the House of Commons* from 1774 until his death in London on Oct. 29, 1828. He impressed particularly by the speed and accuracy with which he printed parliamentary papers (a notable example being the presentation to William Pitt of proof sheets of the report of the secret committee on the French Revolution 24 hours after receipt of the draft) and he devised numerous expedients for reducing publication costs.

Luke Hansard had three sons and two daughters. The eldest son, THOMAS CURSON HANSARD (1776–1833), after some years in his father's office, took over another printing business in 1805 and in 1823 established the Paternoster Row press. He was the first printer, and later publisher, of the unofficial series of *Parliamentary Debates* inaugurated by William Cobbett in 1803. The two younger sons, JAMES HANSARD (1781–1849) and LUKE GRAVES HANSARD (1783–1841), continued the business of their father, and were themselves succeeded by their respective sons, the business being carried on after 1847 by HENRY HANSARD (1820–1904), son of Luke Graves. In 1837 the firm was the defendant in the famous case *Stockdale* v. *Hansard,* being charged with the publication of libelous statements in an official house of commons report. Only after protracted litigation was the security of printers of government reports ultimately guaranteed by statute in 1840.

See J. C. Trewin and E. M. King, *Printer to the House* (1952).
(E. C. TN.)

HANSARD is the name given to the official report of the debates of both houses of the British parliament. It is so called after T. C. Hansard (1776–1833), the first printer, and later publisher, of the unofficial series of parliamentary debates inaugurated by William Cobbett in 1803. The series known as the fifth, dating from 1909, when the report first became both official and verbatim, comprised more than 200 volumes for the lords and over 600 for the commons by the early 1960s. The daily parts, of which these volumes are composed, are produced in the lords by an editor, assistant editor and six reporters and in the commons by an editor, assistant editor, 2 subeditors and 18 reporters. The complete report of the lords debate is generally in print by first post the following morning. The commons report, as published by that time, always covers the debate up to approximately 10:30 P.M. the previous evening, but, should the house have sat later, the report of the subsequent proceedings precedes the report of the following day. The reports of both houses are printed, and sold to the public, by the stationery office, which also issues a *Weekly Hansard* consisting of several daily parts. Printing is expressly sanctioned by both houses, for either, if it so desired, could withhold its proceedings from the public.
(E. C. TN.)

HANSEATIC LEAGUE, an association of north German towns and groups of German merchants abroad formed for the defense of their trading interests. During its heyday, which lasted from the late 13th century to the end of the 15th century, it dominated the commercial history of northern Europe.

The origins of the league are to be found in groupings of traders and groupings of trading towns in two main areas: in the east where north German merchants won a monopoly of the Baltic trade and in the west where Rhenish merchants (especially from Köln [Cologne]) were active in the Low Countries and in England. The Hanseatic league came into being when these various associations coalesced, a process encouraged by the natural interdependence of trade in these regions and largely initiated and controlled by those towns, notably Lübeck, which had a central position and a vital interest in trade between the Baltic and northwestern Europe.

Baltic Trade (12th–13th Centuries).—German mastery of Baltic trade was achieved with striking speed and completeness in the late 12th and early 13th centuries. Lübeck, after its capture by Henry the Lion in 1158, quickly became the main base for Westphalian and Saxon merchants thrusting northward and eastward; Visby, on the island of Gotland, was soon established as a main entrepôt for trade with the eastern Baltic and with Novgorod, the chief mart for the Russian trade. Flanking this main drive of the north German traders to Visby and Novgorod were several important towns established chiefly by Lübeckers and Westphalians on the east coast of the Baltic. In the first 25 years of the 13th century alone, Riga, Reval (Tallinn), Danzig (Gdansk) and Dorpat (Tartu) were developed as intermediaries in the Baltic trade and as outlets for the products of their hinterland, and well before the middle of the 13th century Germans had a near-monopoly of long-distance trade in the Baltic.

A prime condition for this expansion and this dominance was

that German traders should co-operate with each other. This they did in two main ways. Merchants far from their various home towns but with a common interest in some particular branch of foreign trade might form an association or "hanse" like that of the "Germans frequenting Gotland"; or the home towns themselves might form loose unions. These towns and their policies were dominated by great merchant families and these families were linked by kinship and by mutual interest. So it is not surprising that from the beginning of the 13th century there appeared associations of cities, associations which increased in size and intimacy and had as their fundamental purpose the removal of obstacles to trade. As early as 1210 Lübeck and Hamburg agreed that a common law should obtain between them in certain matters, and this *rapprochement* led in 1241 to a formal alliance to secure common action against robbers and pirates. This was only one of several such agreements, in which Lübeck was usually prominent, like that of 1259 between Lübeck, Rostock, Wismar and Stralsund; their principal objectives were always the suppression of piracy and other threats to trade.

Western Trade (to 1200).—In the west, merchants from Köln and other Rhenish towns had close trade relations with England and Flanders from a very early date. In London they enjoyed special royal protection by the end of the 10th century; and with the great expansion of their economic importance in England during the 12th century there was a corresponding growth of the power and privileges of the hanse of Köln merchants resident in the capital. Two landmarks are the charter of privileges granted by Henry II in 1157 and the rights granted by Richard I in 1194 in return for financial aid. The situation in Flanders is not so satisfactorily documented, but probably an association of Köln merchants was regularly constituted at Bruges by the middle of the 12th century to participate in that vast complex of trade which found a natural focus in the Low Countries.

Merging of the Associations.—From about the middle of the 13th century the co-operation between north German towns became much more extensive and to some extent regularized. By 1265 all the towns having the "law of Lübeck" were agreeing on common legislation for the defense of merchants and their goods; *i.e.*, for the suppression of piracy and robbery by land and sea. Strong in their control of the Baltic trade, Lübeck, Danzig, Riga and their satellites forced their way into the west. They entered the areas where Rhenish merchants had formerly been dominant, secured for themselves the privileges formerly reserved to the latter and finally joined the Rhinelanders in the creation of common German hanses in London and Bruges. At the same time the Lübeck group put the final touches to their control of the Baltic trade by reducing Visby to subservience with the capture of Gotland in 1293 and by fusing the two great hanses operating in Gotland into one great union largely dominated by Lübeck. The upshot was that the hanses in London, Bruges and the Baltic were united into a single grouping and with the association of German towns itself.

The decisive steps in this critical phase of Hanseatic history were all taken in the last half of the 13th century. The full and privileged entry of Lübeck and Hamburg into the trade of Bruges dates from their initiative of 1252 and the agreement of 1253. In London and other English centres the same two towns first won privileges and organization distinct from those of the Köln hanse and then forced union upon the latter, so that by 1282 the two groups were joined in a "German" hanse. Even before this amalgamation the Lübeck-Hamburg hanses operating in England and Flanders had united. Finally, in the 1280s, this confederation of German merchants trading in the west was closely joined to the association of north German towns which had reached maturity by the 1260s. During this same period the German cities rounded off their monopoly of the Baltic trade, linked the towns and the hanses conducting this trade closely to themselves and established their *Kontore* (counters) of Novgorod and Bergen. By the close of the 13th century all north German trading associations and trading towns and their bases for foreign commerce were bound together in a single league, including nearly every port from Bremen to Reval. The trade of the Baltic and of the North sea was in the hands of German merchants and at the same time the habits and methods of common action were being strengthened; for instance the "diets" of later years were clearly in being by 1300, though less formalized than they later became.

The League at Its Outset.—The Hanseatic league was now effectively in existence. Its existence and its importance were based on the fact that it controlled, by virtue of vigorous action and geographical position, the main currents of northern trade. These ran from the economically advanced and populous west, with its large markets for raw materials, its large production of manufactured goods and its contacts with the products of the Mediterranean and of the orient, to the "colonial" lands of eastern Europe, which could supply food surpluses and raw materials for industry. Grain, timber and pitch, tar, potash and charcoal, wax and honey, hemp and flax, all were drawn from the huge hinterland to the south and east of the Baltic and shipped to the industrial west. This east-west carrying traffic, with the economic leverage that the merchants secured in the countries which needed their goods, was the mainstay of Hanseatic power. Scandinavia, too, was brought into the Hanseatic orbit. Swedish copper and iron were exploited and the Norwegian production of whale oil and cod was monopolized. Nearer home, the herring fishery off the southern tip of Sweden was developed to an amazing productivity.

The major aims of the German merchants who built the Hanseatic league are clear. First, they wanted their traffic to be secure in the wild and often barbarous conditions of northern and eastern Europe. The overriding purpose of many of the associations which preceded the full league was to secure combined action against pirates and land-robbers, and the need for such action always remained. With the same general intent an increasing effort was also put into the provision of lighthouses, market buoys, trained pilots and other aids to safe navigation. Secondly, the Germans combined to obtain assured bases for their trade abroad and to secure the most favourable conditions in that trade. Finally the league could be used as an instrument for establishing a monopoly in those branches of trade and in those areas where it was firmly established.

This drive for monopoly and the protectionist and restrictive policies which went with it were not characteristic of the earliest period of the Hanseatic league. In northern Germany, the Baltic and Scandinavia the Germans had at first a natural superiority which led to a natural dominance; and in any case the opportunities during the boom times of the 12th and 13th centuries were so great, the openings for all comers so limitless, that there was little pressure for a conscious campaign for monopoly. Only in the west did competition between various German groups and between them and the native inhabitants force their strategy into a monopolistic and competitive mold from the beginning.

Political Organization to Oppose Competitors.—Conditions changed. The 14th century was marked by the growth of vigorous political power in areas where the Hanseatic merchants had hitherto penetrated with little opposition; and by the appearance of strong resistance from local merchants who were developing sufficient strength and experience to resent and try to oust the intrusive foreigner. Probably too the steady expansion in the volume of freight carried on the northern seas now ended or weakened, and this relative stagnation of trade exacerbated the other difficulties. Certainly from *c.* 1370–80 the Hanseatic merchants were forced into a position where their privileges and advantages had to be defended by actions which were increasingly severe, rigid and restrictive.

There were two main consequences. The scope and gravity of the political and economic problems meant that they could only be dealt with from a firm basis of political power, and there was no political power which the German merchants could use except that of their own cities. None of the German kings, except Charles IV, and none of the greater princes showed much interest in north German affairs. Thus the "German hanse" became in the middle of the 14th century a league of German cities: the great merchants identified the towns that they ruled with the old league that had united both towns and merchant associations, so that the "hanse of the merchants of Germany" became "the cities belonging to

the German hanse." Significantly this change is first documented in 1359, when the cities of the league sent representatives to a meeting to discuss the arrangements for a war against Flanders.

Second, from the middle of the 14th century onward, the great need was not to organize entry into new and expanding markets but to defend old markets against growing competition. The whole strength of the league was mustered to organize economic, political and military resistance against the forces of change, against all opposition to Hanseatic monopoly. The weapons of the German merchants in this struggle varied. They retained of course their initial advantages of geographical position and their ability to put a large merchant navy and great trading experience at the disposal of northern producers and consumers. They made increasing use of large gifts and loans to political leaders to secure their privileges and stifle opposition. When such means proved inadequate the withdrawal of Hanseatic trade was threatened and coupled with an economic embargo and blockade which broke most forms of resistance. Only in extreme cases, when vital interests had to be defended against enemies undeterred by less stringent methods, did the league engage in organized warfare.

Danish War (1368–70).—An early and famous example of such a war is the struggle with Denmark provoked by the expansionist policies of the Danish king Valdemar IV. Valdemar himself had secured the crown with the help of Lübeck and the hanse but soon began the conquest of the southwestern Baltic. In 1360 he annexed Skåne and the island of Öland; Denmark thereby won complete mastery of the Sound and control of the Skåne herring industry. Worse, Valdemar captured Visby in 1361. The very foundations of Hanseatic power were crumbling. An alliance of the hanse with Norway and Sweden was broken by Danish diplomacy; but in 1367 representatives of the Hanseatic cities met in Köln and decided on common military action. In 1368 the forces of the league inflicted a crushing defeat on the Danes and in 1370 Denmark had to submit to the peace of Stralsund. By its terms, outwardly the most dramatic demonstration of its power, the Hanseatic league won free passage for its ships through the Sound; control of the fortresses which dominated the herring fisheries; two-thirds of the revenues of Skåne; and the right to determine the succession to the Danish throne for the next 15 years.

The League in Its Final Form.—During the 14th century the Hanseatic league was molded into its definitive form. This form was neither clear-cut nor rigid. The league was not a true political federation, it was not a true corporation; it had no permanent governing body, no permanent officials, no permanent navy; it had no central treasury, no central court. It was "governed" by a diet which met generally at Lübeck and theoretically every three years; but these meetings were in fact held irregularly and their frequency declined after 1400 as divergencies between the various members grew and as the conduct of routine affairs was gradually transferred to the town-council of Lübeck. The diets were assemblies of delegates from the various towns and their decisions (*Recesse*) were determined by a majority vote of the towns represented. In practice the smaller towns, anxious to avoid the financial burden of an embassy, entrusted their interests to the representative of some larger town. In general, it was the views of a small group of leading cities which determined the policies of the league.

The membership of the league was essentially a membership of towns. The number of members fluctuated and is in any case uncertain, as no official lists were ever compiled. At its peak, about the middle of the 14th century, the total of participating towns certainly surpassed 100; but generally it was less, and it tended to decline in the 15th and 16th centuries. To qualify for membership a town had generally to be German, independent, represented at diets and a prompt payer of all dues imposed. There were exceptions, however, and various groups and individuals were members of the Hanseatic league, in the sense of participating in its privileges, without passing the aforementioned tests. There were foreign cities, such as Stockholm and Dinant, with full rights, and many towns in Poland which had partial rights; some hamlets in Westphalia which were important for their manufactures enjoyed the rights of membership, and so did various individuals and groups of merchants resident in Germany or as far away as Iceland, Ireland and Spain.

The other essential elements in Hanseatic organization were the *Kontore,* the establishments of Hanseatic merchants overseas. The four *Kontore* at London (*see* STEELYARD, MERCHANTS OF THE), Bruges, Bergen and Novgorod were communities enjoying exemption from the jurisdiction of the land in which they were established, administering their own (German) law and subject to the directives of the Hanseatic diet. Their members corporately owned a large complex of houses, halls, warehouses and other buildings where they lived a severely disciplined life and carried on their trade with the natives. Besides these major settlements, the league also possessed numerous local depots, such as those at Oslo and Tönsberg in Norway, at Aalborg in Denmark and at York, Boston, Lynn and Norwich in England. These depots were subject to the control of a *Kontor,* and major transactions were in any case confined to the latter.

As the main purpose of the league was the defense of its trading interests in all lands served by the northern seas, much of its activity naturally concerned non-German affairs. However, effective action against the outside world could only be achieved if there was solidarity at home and if control of trading conditions was as effective inside Germany as outside; so the internal policy of the league was the natural counterpart to its external policies. The league tried to ensure the maximum of peace and order at home: warfare between towns, civic strife inside towns and robbery on the highroads were all suppressed as far as possible. No city was allowed to make war on another without permission from its nearest neighbours, every member town and each citizen of such a town could claim justice and assistance from all others. All the Hanseatic cities had to make a common front against their common enemies; every town had to prohibit the permanent residence of foreign traders, every town had to see to it that no partnerships were made between their own merchants and foreigners and all had to boycott any person who robbed or broke his contract with a member. It was also of vital importance, in view of the fact that the league had no common treasury or navy, that there should be the maximum of co-operation from all cities in contributing proper shares to the financial and naval levies imposed by the diet. All these were great demands to make of so loose an organization, but they were met in great part while the towns were convinced of the mutuality of their interests and while the threat of "unhansing" (involving loss of all privileges and the arrest, boycott and confiscation of merchants, trade and goods) remained a fearful sanction.

Decline (15th–17th Centuries).—The decline of the Hanseatic league was a slow progress. It was caused by the destruction (1) of German monopoly, especially in the Baltic; and (2) of the mutuality of interest between the towns.

Political developments in the countries bordering the Baltic became a threat to Hanseatic interests almost immediately after the defeat of Valdemar IV had seemed to ensure German supremacy there. The union of Poland and Lithuania in 1386 did much to harm Hanseatic interests in the eastern hinterland; and soon afterward, in 1397, Denmark, Norway and Sweden were united under the rule of Queen Margaret of Denmark. This union did not last long but was symptomatic of that resurgence of Danish power which enabled Margaret to break the Hanseatic league's political dominance in her country and compel it to relinquish its castles and the tolls which it gathered on Danish territory. Before the end of the 15th century, moreover, Russia had joined in the attack on the league's Baltic monopoly: in 1478 the grand prince of Moscow, Ivan III, after capturing Novgorod, expelled the Hanseatic merchants living there; and in 1494 Saint Peter's court at Novgorod formally ceased to be a Hanseatic *Kontor.*

Not only were the nations of the Baltic region itself undermining the league's monopoly; there was intrusion from the west. The English and the Dutch, who had learned and gained so much from the Hanseatics, were growing in mercantile and industrial strength and were increasing their will and capacity to oust the Germans not only in the domestic markets, but also in the trade on the North sea and even in Germany and the Baltic. At first the

Dutch were more successful than the English in this aim. During the 14th century their economy grew rapidly in strength and their mercantile marine underwent a great expansion, while in the 15th century the growth of their textile and brewing industries made them far more independent of Hanseatic importers. At the same time their herring fishery in the North sea completely eclipsed that of Skåne—where, in the first quarter of the 15th century, for reasons still not satisfactorily explained, the herring catch declined catastrophically. Strong in the west, supported by the Danes and even by some eastern Hanseatic towns, the Dutch broke into the Baltic and by the middle of the 16th century were the major carriers of Baltic produce to the west. By the first decade of the 17th century Dutch ships were dominating the Baltic trade.

These grave and mounting external pressures set up severe strains within the league and destroyed its unity of purpose. In early Hanseatic days the overland route across the base of the Danish peninsula had formed the chief link between the Baltic and North sea. The initiative of Hamburg and especially of Lübeck in creating the league and their pre-eminence and central position within it when it was established owed nearly all to the fact that they controlled this passage and so acted as the natural focus of the widespread German trading system. During the 14th century this overland path was largely superseded by the direct sea route through the Danish Sound, a development which made possible the easier and cheaper transport of bulky goods; at the same time Dutch and English traders began to make increasing use of this new route and to do so with the encouragement of the Danes. As a result Lübeck lost its pre-eminent position, its wealth was threatened and its influence with other cities was weakened just when the town was under the greatest pressure to use the league to attack the foreign interlopers. At the same time some German towns were not too unhappy at the new developments; at least they were loath to follow the extreme policies of Lübeck. One group, centred on Köln, had such close and profitable connections with the Low Countries and England that they were unwilling to do anything to upset these countries—especially for a Baltic trade which meant little to them. Another group, centred on Danzig, were not displeased at being able to make use of the competitive terms offered by Dutch skippers, behind the back of the Lübeck monopolists, when exporting their Baltic produce.

Co-operation between the members of the league became increasingly difficult. Membership dwindled, effective common action became rare and other developments speeded the process of disintegration. A narrow parochialism, a concentration on local trading interests, supplanted the wider visions of earlier town councils. The strengthening of princely power in Germany forced the detachment of many cities from the league—notably Berlin and other towns of Brandenburg, which had to withdraw in the 15th century. By the end of the 16th century the Hanseatic league was moribund. The new patterns of European trade which slowly evolved in the age of great discoveries hastened its end. The last diet was held in 1669.

See also references under "Hanseatic League" in the Index volume.

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See further J. Schreiner, *Hanseatene og Norges nedgang* (1935) and *Hanseatene og Norge i det 16 århundre* (1941); K. Kumlien, *Sverige och hanseaterna* (1953); A. von Brandt, "Recent Trends in Research on Hanseatic History," in *History* (1957); F. Rörig, *Die europäische Stadt*, 3rd ed. (1958), and *Wirtschaftskräfte in Mittelalter: Abhandlungen zur Stadt und Hansegeschichte* (1959). (A. B. HI.)

HANSEN, EMIL CHRISTIAN (1842–1909), Danish botanist, whose pure-culture studies on yeasts revolutionized the brewing industry, was born on May 8, 1842, at Ribe, Jutland. He studied art at Copenhagen, but in 1871 turned to science. From 1879 he was head of the physiological department of the Carlsberg institute. Hansen's researches were concerned chiefly with fungi and alcoholic fermenting yeasts. He perfected the methods of culture and isolation begun by Pasteur. He devised a method of sowing cultures with a single cell and so isolating one species from another. He defined with precision the morphological and physiological characters of different species and crowned his work by devising a system of classification. The yeast grown from single cells was largely adopted in the bottom-fermentation breweries of the continent. Hansen died at Copenhagen on Aug. 27, 1909.

He wrote *Untersuchungen aus der Praxis der Gärungsindustrie*, 2 vol., 3rd ed. (1892–95; Eng. trans., 1896) and *Gesammelte theoretische Abhandlungen über Gärungsorganismen* (1911).

See also BREWING: *Fermentation*.

HANSEN, PETER ANDREAS (1795–1874), Danish astronomer, whose most important work was for the specific purpose of improving the theories and tables of the motion of the principal bodies in the solar system, was born on Dec. 8, 1795, at Tondern, in the duchy of Schleswig. He learned the trade of a watchmaker but in 1820 went to Copenhagen, where he won the patronage of H. C. Schumacher. He acted as Schumacher's assistant in work connected with the Danish survey, chiefly at the new observatory of Altona, 1821–25. He then went to Gotha as director of the Seeberg observatory, where he worked until his death there on March 28, 1874.

Hansen had great practical talents but the observatory was poorly equipped and it was not until 1857 that a new observatory was built for him. In the meantime he had made investigations into the theory of instruments and devised improvements in their construction and use. He also worked on theoretical geodesy, on optics and on the theory of probability. A paper on the mutual perturbations of Jupiter and Saturn won for him a prize of the Berlin academy in 1830. His two most important works on the theory of the motion of the moon are the *Fundamenta* (1838) and the *Darlegung* (1862–64). The tables based on his theory were printed in Great Britain in 1857 at the expense of the British government, the author receiving a gratuity of £1,000. These tables were used for the *Nautical Almanac*. A few errors had been corrected, but as the difference between theory and observation continued to grow, empirical terms calculated by S. Newcomb were introduced to bridge the gap. These terms had no theoretical foundation and it was later recognized that the discordances are largely due to irregular fluctuations in the rate of rotation of the earth. Hansen's tables remained in use until they were replaced by Brown's tables in 1923. From his theory of the moon Hansen deduced that the accepted distance of the sun must be reduced by about 3% and so obtained a value close to that now accepted. Hansen, assisted by Christian Olufsen, compiled new tables of the sun in 1854. He received world-wide recognition for his work, being twice awarded the gold medal of the Royal Astronomical society; in 1850 the Copley medal of the Royal society was awarded to him. (J. JN.)

HANSON, HOWARD (1896–), U.S. composer, conductor and teacher, and a representative of the romantic tradition in American music, was born in Wahoo, Neb., on Oct. 28, 1896. He studied with Percy Goetschius in New York city and spent three years (1921–24) in Italy as the winner of the American Prix de Rome. On his return to the U.S. he was appointed director of the newly organized Eastman School of Music in Rochester, N.Y. There he established annual festivals of American music and conducted hundreds of new works by young composers, among them many of his own pupils. In 1958 he organized the Eastman Philharmonia, a student orchestra, and in 1961–62 toured with it through Europe, the U.S.S.R. and the middle east.

Of Swedish ancestry, Hanson emphasized a kinship with his forefathers in his first symphony, the *Nordic* (1923). His second symphony, the *Romantic* (1930), which became his most successful work, represents a proclamation of his faith in romanticism. His fourth symphony, *Requiem* (1943), dedicated to the memory of his father, won him a Pulitzer prize. Also of religious inspiration is his fifth symphony, *Sinfonia Sacra* (1955). Among his other

works are *Lux Aeterna* for orchestra (1923), *Songs from "Drum Taps,"* after Walt Whitman, for voices and orchestra (1935), and some chamber music.

Hanson was one of the few American composers of operas accepted by the Metropolitan Opera company. His opera *Merry Mount,* on a subject dealing with Puritan New England, was commissioned by the Metropolitan and produced in New York city on Feb. 10, 1934. Though favourably received, it was not maintained in the repertory.

Hanson's style belongs to the mid-20th century but his harmonies, however complex, are euphonious. He has a sense of strong and varied rhythm and his orchestration is invariably effective. The influences of Sibelius and Mussorgsky, noticeable in his early works, do not obscure his individuality. He published a textbook for advanced students, *Harmonic Materials of Modern Music* (1960). (N. Sv.)

HANSON, JOHN (1721–1783), American Revolutionary leader, was the first president under the Articles of Confederation. Born in Charles county, Md., on April 13, 1721, he became a political leader of note in Maryland, serving in the general assembly from 1757, upon many important committees during the American Revolution, and as a representative of Maryland in the continental congress elected Dec. 22, 1779. On Nov. 5, 1781, he was elected by the continental congress "President of the United States in Congress Assembled," which office he held one year. He is sometimes referred to as "the first president of the United States," but he was a congressional presiding officer and had none of the powers of the first president under the constitution. Hanson died on Nov. 22, 1783, at Oxon Hill, Prince Georges county, Md.

HANSSON, OLA (1860–1925), Swedish poet, prose-writer and critic, belatedly recognized as one of the most original modern Swedish writers, was born at Grönby, Skåne, Nov. 12, 1860. After studying at Lund, he went to Copenhagen where he met many Danish writers. He was enormously influenced by foreign literature, especially by contemporary psychological writers who fostered his almost morbid sensitivity; yet, a descendant of a long line of Skåne farmers, he felt kinship with the placid plains of his native province. Out of this fundamental dichotomy came the conflict in his personality. His first publication, *Dikter* (1884), contains some poems describing nature and others inspired by social injustice. In *Notturno* (1885) he had already achieved poetic mastery, expressing in exquisite lyrics complex, subjective moods. His prose sketches, *Sensitiva Amorosa* (1887), in which he explored the "physiology of the soul," shocked contemporary Sweden and, embittered by their reception, from 1889 he lived abroad, first in Germany, and later in France, Switzerland and Turkey. In 1889 he married Laura Marholm, herself a writer, and they worked to make Scandinavian authors, especially Strindberg, known abroad and to introduce contemporary foreign writers to Sweden. Hansson's admiration for Nietszche was reflected in *Ung Ofegs visor* (1892; Eng. trans., *Young Ofeg's Ditties,* 1895). This was followed by remarkable short stories, the autobiographical novel *Resan hem* ("The Journey Home"; 1895), and numerous critical essays. Hansson later became a Roman Catholic for a time. His opinions became more violent and bizarre with age, but he continued to write, sometimes recapturing the lyrical beauty of his early poetry, until his death at Buyukdere, Turkey, Sept. 26, 1925.

His collected works were published in 17 vol. (1919–22); a further selection was edited by H. Gullberg, 5 vol. (1928–31).

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HANSSON, PER ALBIN (1885–1946), Swedish Social Democratic statesman, four times prime minister between 1932 and 1946, was born on Oct. 28, 1885, in Malmö. He attended an elementary school and worked as messenger boy from the age of 12. In 1903 he helped to form the Social Democratic Youth association and was appointed editor of its weekly journal *Fram.* A convinced antimilitarist, he left *Fram* in 1909 and joined the daily newspaper *Social Demokraten,* of which he became editor-in-chief in 1917. Elected to the second chamber of the *Riksdag* in 1918, he supported total disarmament and worked for an immediate reduction of the Swedish armed forces. He was appointed minister of defense in Hjalmar Branting's first government (March–Oct. 1920) and retained this portfolio in the following three Social Democratic governments (Oct. 1921–June 1926). The driving force in the disarmament debates in 1925, he argued that the savings in military expenditure should be spent on social services, thus strengthening national solidarity. Nevertheless, as chairman of the 1925 navy building committee, he supported expenditure for new battleships; and in 1928 and 1932 he opposed his party's suggestion for Sweden's total disarmament. On Sept. 24, 1932, he became prime minister; and it was due to his capable leadership that in 1933 an agreement was reached with the Farmers' party which supported the government in overcoming the consequences of the international crisis. On June 19, 1936, his government resigned over the defense question; but since his party held a dominating position in the second chamber Hansson formed another government on Sept. 28 in coalition with the Farmers. This government was responsible for a considerable strengthening of the national defense. On Dec. 13, 1939, after the outbreak of the Soviet-Finnish War, Hansson formed a national coalition government which sought to safeguard Sweden's neutrality. The great popularity that he had gained was an important factor in the success of this policy. At the end of World War II he formed a purely Social Democratic government on Aug. 1, 1945. He died in Stockholm on Oct. 5, 1946.

(A. H. Hs.)

HANSTEEN, CHRISTOPHER (1784–1873), Norwegian astronomer and physicist, associated with the study of terrestrial magnetism, was born at Christiania (Oslo) on Sept. 26, 1784. From the cathedral school he went to the University of Copenhagen, where he studied mathematics. In 1807 he began his inquiries into terrestrial magnetism. He was appointed lecturer at the University of Christiania in 1814 and two years later, professor of astronomy and applied mathematics. An astronomical observatory was erected in 1833, to which a magnetic observatory was added in 1839. To further his researches in terrestrial magnetism he traveled not only throughout Norway and Finland but in 1828–30 undertook an expedition to western Siberia with G. A. Erman. Various publications gave an account of his expeditions and the final results were published in 1863 (*Resultate magnetischer Beobachtungen*). He especially wrote on the magnetic poles and axes. Hansteen also supervised survey and topographical work in Norway begun in 1837. He continued his studies in magnetism after his retirement in 1861. He died at Oslo on April 11, 1873. (J. Jn.)

HANSWURST, a comic character in Viennese plays created by the Austrian playwright Joseph Anton Stranitzky (1676–1726), who replaced the somewhat tired Italianate Harlequin (*q.v.*) with a homebred clown type. Hanswurst sported the modified costume of a Salzburg peasant and supposedly embarrassed Lady Mary Wortley Montagu, who, in her letters, gave an account of the coarseness of his speech and gestures after she saw him perform in Vienna in 1716. In nontheatrical usage the name Hanswurst occurs first in 1519 in Sebastian Brant's satire *Das Narrenschiff* (1494). (A. M. N.)

HANTHAWADDY, a district in the Pegu division of Lower Burma, is the home district of Rangoon, from which the town was detached to make a separate district in 1880. Area 1,927 sq.mi. Pop. (1953) 595,991, of whom about 50,000 lived in the towns of Syriam, where the oil refineries are situated, and Thongwa. Maubin and Hanthawaddy are the two most densely populated districts in the Union of Burma. Hanthawaddy consists of a vast plain stretching up from the sea, and lies on either side of the Rangoon river by which the port of Rangoon is approached. The country is intersected by numerous tidal creeks, many navigable by large boats and some, like the Bassein creek which connects the Rangoon river with the To or China Bakir mouth of the Irrawaddy, by steamers. The Twante canal affords a more direct communication between the Rangoon and China Bakir rivers, and is used by regular steamer services between Rangoon and Bassein across the delta. Cultivation in the district is almost wholly confined to rice, and there are considerable tracts of unreclaimed marshland.

(L. D. S.)

HANTZSCH, ARTHUR (1857–1935), German theoretical chemist, won fame at the age of 25 by devising the celebrated synthesis of substituted pyridines from β-ketonic esters, aldehydes and ammonia. Born in Dresden, March 7, 1857, Hantzsch studied at Dresden and Würzburg universities. He became a professor at Zürich (1885), at Würzburg (1893) and at Leipzig (1903).

With his pupil, Alfred Werner (*q.v.*), Hantzsch founded the stereochemistry of nitrogen, enunciating the theory that the three valences of nitrogen are not coplanar, and elucidating and proving the configurations of the stereoisomeric oximes and hydrazones. An attempt to extend the work to diazo compounds led to the discovery that many diazonium compounds are salts or bases. Hantzsch demonstrated the transformation $ArN_2{+}OH \rightleftharpoons Ar\,NNOH$, whereby a strong base is changed into a nonelectrolyte and showed that similar transformations occur between the aciforms and normal forms of nitro compounds and in the triphenylmethane dyes.

In the last case, the transformation is accompanied by a colour change, the investigation of which led Hantzsch to make pioneer studies in spectrophotometry and in the relationship between colour and constitution. He advanced a theory of indicators, emphasizing that the amount of the dissociable form present, and not the extent of dissociation, determines the colour.

Hantzsch conducted an extensive study of the dissociation of acids at all concentrations and in various solvents. He demonstrated the formation of oxonium salts with water and ether and came to the conclusion that acid dissociation does not occur except after solvation or association of the acid molecules.

Hantzsch was a man full of ideas; he was responsible for nearly 1,000 papers. He was remarkable for his early adoption of the methods of the science of physical chemistry.

He wrote *Grundriss der Stereochemie*, 2nd ed. (1904); *Diazoverbindungen*, 2nd ed., with S. Reddelien (1921); and *Theorie der ionogenen Bindungen* (1923). He died in Dresden, March 14, 1935.

See T. S. Moore, *Journal Chemical Society*, p. 1051 (1936); Fr. Hein, *Berichte d. deutschen chemischen Gesellschaft*, 74A:147 (1941); and *Zeitschrift f. Elektrochemie*, 42:1 (1936). (P. O.)

HANUKKAH: *see* JEWISH HOLIDAYS.

HANUMAN, in Hindu mythology, the monkey-god, a central figure in the great Hindu epic Ramayana. Child of a nymph by the wind-god, he aided Rama to recover his wife, Sita, from the demon Ravana, bridging the strait between India and Ceylon with boulders brought from the Himalayas, with the help of a host of monkeys. Temples in his honour are numerous, especially in southern India. He is also a popular deity in Japan, where many temples are erected to his honour and districts of towns bear his name. The hanuman monkey (*Semnopithecus entellus*), called after the god, is one of the commonest Indian monkeys. *See* RĀMĀYANA.

HANWAY, JONAS (1712–1786), English philanthropist active in developing charitable organizations to help the poor, was born at Portsmouth, Hampshire, probably on Aug. 2, 1712. He became a merchant of the Turkey company in Portugal but, after returning to London, set up in partnership with Charles Dingley, a merchant of the Russian company. He went to St. Petersburg in 1743 and traveled through Russia and Persia, returning to England via Germany and the Netherlands in 1750 and publishing *An Account of the British Trade* (1753). Hanway became a governor of the Foundling hospital in 1756 and his policy of restricted admissions was adopted in 1760. He brought about many reforms in the workhouses, helped to found the Marine society to clothe men and to train poor children for the navy, was treasurer of the Misericordia hospital for venereal disease among the poor and a governor of the Magdalen house for repentant prostitutes and sought more humane treatment of chimney sweep apprentices. Said to have been the first Londoner habitually to carry an umbrella, he died in London on Sept. 5, 1786.

See J. Pugh, *Remarkable Occurrences in the Life of Jonas Hanway* (1787), and J. H. Hutchins, *Jonas Hanway* (1940).

HAN-YANG, a member city of the tri-city conurbation of Wu-han on the north bank of the Yangtze at the mouth of the Han river in Hupeh province, China. It was merged in 1950 with the adjacent cities of Hankow and Wu-ch'ang to form the single metropolis of Wu-han. *See* WU-HAN.

HAN YÜ (HAN WEN-KUNG) (768–824), Chinese poet and essayist of the T'ang dynasty, was born in Teng-chou, Honan, in 768. He regarded himself as a transmitter of Confucianism in the orthodox tradition of Mencius. As part of his program of returning to antiquity, he revived the literary style practised by the Confucians of the 4th and 3rd centuries B.C. The style he advocated was a free, simple prose unencumbered by the mannerisms and elaborate verselike regularity of parallel prose, the style then prevalent. In his poetry he reveals a tendency toward experimentation and unconventionality. His frequently polemical writings led him to be banished on two occasions, once in 803, when, as a member of the Censorate, he protested to the throne against overtaxation and the economic abuses of the eunuchs, and again in 819, when, in his famous Buddha-bone memorial, he attacked the veneration of a Buddhist relic on the grounds that Buddhism was a foreign religion. This memorial, together with the short essays "On the Way," "On Man," "On Spirits" and "On Inborn Qualities," became the most famous models of the prose style he espoused. His initial failure to find examiners sympathetic to his style kept him from embarking on the official career to which he aspired. He presented himself to the ministry of rites four times before being admitted to its examinations for the degree of Doctor of Letters. Having earned it at the age of 24, he spent the following three years attempting unsuccessfully to pass other qualifying examinations until, at the age of 28, he accepted his first post under a provincial governor. Later, as a compiler in the office of historiography, he edited the official record of the brief reign of the emperor Shun-tsung, which survives as the earliest example, and only T'ang specimen, of its genre. He served at times as vice-president in each of the ministries of justice, war and personnel. The prestige of his high office lent respectability to his literary reforms. At his death, in 824, the title of president of the ministry of rites was posthumously conferred upon him, as well as the epithet "Prince of Letters." *See* also CHINESE LITERATURE.

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HAPI: *see* APIS.

HARA KEI (HARA TAKASHI) (1856–1921), Japanese politician, the first untitled prime minister of that nation and the first authentic Japanese party boss, was born at Morioka on Feb. 9, 1856. He was educated in the justice ministry law school and entered the foreign service in 1882. Like many Japanese politicians of his era, he used the journalistic as well as the bureaucratic road to power, becoming chief editor of the *Osaka Mainichi* in 1897. When Prince Ito Hirobumi organized the Seiyukai party in 1900, however, Hara returned to politics as minister of communications. Elected to the house of representatives in 1902, he rose rapidly to become home minister in two Saionji cabinets (1905 and 1911) and Seiyukai president in 1914. Astute, often ruthless strategy brought him not only firm party control but the premiership on Sept. 29, 1918. This broke the hold of the Meiji oligarchy and ushered in almost two decades of "normal constitutional government" in which the Seiyukai party machine and its Mitsui business allies dominated civilian politics.

As prime minister, Hara pushed through a small-district electoral reform that gave the Seiyukai an absolute majority in the 1920 diet election. He failed to obtain approval of a racial equality clause in the covenant of the League of Nations or withdrawal of Japanese troops from Siberia.

Hara's administration opposed the universal suffrage movement and promoted the spoils system, primarily the close alliance of the Seiyukai with the Mitsui, and this corruption eventually helped to destroy public confidence in the party system. It inspired the young assassin who killed Hara in front of Tokyo station on Nov. 4, 1921. (D. H. ML.)

HARA-KIRI (literally "belly-cutting") was the honourable method of taking one's own life practised by men of the samurai

(military) class in feudal Japan. The word hara-kiri, although widely known abroad, is rarely used by Japanese, who prefer the Chino-Japanese synonym *seppuku*. The proper method was to plunge a short sword into the left side of the abdomen, draw the blade across to the right and then turn it upward. It was considered exemplary form to stab again below the chest and press downward across the first cut, and then to pierce one's throat. Being an extremely painful and slow means of suicide, it was favoured as an effective way to demonstrate the courage, self-control and strong resolve of the samurai and to prove sincerity of purpose.

There were two kinds of hara-kiri: voluntary and obligatory. Voluntary hara-kiri evolved during the wars of the 12th century as a method of suicide used frequently by warriors defeated in battle who chose to avoid the dishonour of falling into the hands of the enemy. Occasionally a samurai performed hara-kiri to demonstrate loyalty to his lord by following him in death, to protest against some policy of a superior or of the government that he considered to be mistaken, or to atone for failure in his duties. There have been numerous instances of voluntary hara-kiri in modern Japan.

Obligatory hara-kiri refers to the method of capital punishment for samurai to spare them the disgrace of being beheaded by a common executioner. This practice was common from the 15th century until 1873. Great emphasis was placed on proper performance of the ceremony. The ritual was usually carried out in the presence of a witness (*kenshi*) sent by the authority issuing the death sentence. The prisoner was seated on a red carpet and behind him stood a second (*kaishaku*), usually a relative or friend, with sword drawn. A small table bearing a short sword was placed in front of the prisoner. A moment after he stabbed himself, the second struck off his head. It also was common practice for the second to decapitate him at the moment that he reached out to grasp the short sword, his gesture symbolizing that the death was by hara-kiri.

See A. B. Mitford, *Tales of Old Japan* (1871); Basil Hall Chamberlain, *Things Japanese* (1939). (D. H. SH.)

HARALD I HAARFAGER or FAIRHAIR (more precisely Finehair) (9th to 10th century), the first king of all Norway, was the son of Halvdan the Black, ruler of part of southeastern Norway, and was said to descend from the Ynglingar, the ancient royal house of Sweden. Harald succeeded his father at the age of ten and in early youth, it is said, was inspired to conquer Norway by a woman, Gyda, who refused to be his wife until he could rank with the kings of Sweden and Denmark. Harald suppressed the petty kingdoms one after another, finally defeating his assembled opponents in Hafrsfjord, in southwestern Norway. The dates of Harald's career are not known precisely. Medieval historians differ in their calculations but in general date the battle of Hafrsfjord *c.* 872 and the death of Harald *c.* 933. Modern historians, however, place these events 10 to 15 years later. His conquests had far-reaching results. Some of the petty princes submitted to his authority and became his officers, but others fled to the British Isles and other lands. Iceland first became known to the Scandinavians at this period, and its settlement was said to be a direct result of Harald's oppression in Norway.

Sources for the story of Harald's life are of many kinds. The most reliable are contemporary poems, preserved orally until they were written down in Iceland in the 13th century, but the information that they give is poor. Harald's career is also described in detail in historical works written in Iceland, and partly in Norway, in the 12th and 13th centuries, but their veracity is questionable. The fullest account of Harald was written by the Icelander Snorri Sturluson (d. 1241) in the *Heimskringla*. Differences between Icelandic and Norwegian traditions about Harald sometimes come to light in the medieval histories. For Icelanders, Harald was a harsh tyrant, but for the Norwegians he was, rather, the king who brought peace and stable government. (G. T.-P.)

HARALD II GRAAFELL or GRAYCLOAK (Old Norse *Gráfeldr*) (d. *c.* 970), king of Norway, was the son of Eric Bloodaxe. Harald and his brothers were brought up in exile in Denmark and made repeated attacks on Norway, then ruled by Haakon the Good, who was killed by their forces *c.* 961. Afterward, Harald ruled Norway jointly with his brothers until *c.* 970, when he was killed in Denmark and his brothers fled. (G. T.-P.)

HARALD III HARDRAADE or HARDRULER (1015–1066), king of Norway from 1045 to 1066, was the son of Sigurd Sow (Syr), a petty king of eastern Norway, and of Asta, mother of St. Olaf. At the age of 15 Harald fought beside St. Olaf in the battle of Stiklestad, in which St. Olaf fell (1030). Harald then fled to Russia, where he served under Yaroslav the Wise (d. 1054), whose daughter Elizabeth (Ellisif) he afterward married. From Russia, Harald went to Constantinople, where he enlisted under the Byzantine emperor Michael IV (1034–41). After some ten years' service in the imperial armies fighting in Sicily and Bulgaria, it is said, he made a pilgrimage to Jerusalem. Harald became the most famous Norse, or Varangian, warrior in the Byzantine service; his exploits are mentioned by both Greek and Norse historians of the middle ages.

In 1045 Harald returned through Russia and Sweden to Norway, where his nephew Magnus I Olafsson was king. The two kinsmen agreed to share the kingdom. Together Magnus and Harald attacked Sweyn Ulfsson, king of Denmark, in 1047, but Magnus died during this expedition, leaving Harald sole king of Norway. Harald spent his next years largely in campaigns against the Danes, until 1062, when he defeated Sweyn in the battle of Niz and afterward made terms with him.

Harald was troubled by rebellious subjects at home, whom he put down with ruthless energy. He also quarreled with Adalbert, archbishop of Bremen, in whose province Norway lay, and was severely rebuked by the pope.

After the death of Edward the Confessor in England (Jan. 5, 1066), Harald joined forces with the rebel Tostig against the new king of England, Harold II Godwinsson. Harald sailed to England with a large fleet and landed in Northumbria. He defeated an English force at Fulford, York, and overcame the city (Sept. 20, 1066), but on Sept. 25 the Norwegians were routed by the English king at Stamfordbridge, where Harald Hardraade was killed. (G. T.-P.)

HARALD IV GILLE (*c.* 1103–1136), king of Norway from 1130 to 1136, was born in Ireland, where his name was said to be Gillikristr (Servant of Christ). He claimed to be the son of Magnus II Bareleg, king of Norway from 1093 to 1103. As a young man Harald went to Norway, announcing his rights to the throne. After he had passed through an ordeal of fire, the reigning king, Sigurd I Jorsalafar, a son of Magnus Bareleg, recognized him as a brother in return for the promise that he would not press his claims so long as Sigurd and his son, Magnus III, lived. When Sigurd died (1130) Harald broke his promise and was proclaimed king over half the kingdom. Magnus and Harald ruled peacefully for three years, but then war broke out between them. Harald was defeated in the first encounter, at Fyrileif (1134), but obtained reinforcements in Denmark. He attacked and captured Magnus in Bergen, had him blinded and maimed and forced him to take refuge in a monastery. Harald was now sole king of Norway, but a year later (1136) he was murdered in his bed by Sigurd Slembi, a pretender who claimed also to be Magnus Bareleg's son. (G. T.-P.)

HARAR (HARARGHE), a province of Ethiopia, occupies the eastern part of the country and has a varied scenery and climate. Pop. (1959 est.) 2,100,000. Area 156,000 sq.mi. (including the province of Balé, formerly part of Harar). The Chercher district in the north reaches nearly 10,000 ft. and the Balé mountain group in the southwest rises to Mt. Batu (14,131 ft.). These highlands have an abundant rainfall (35–60 in. annually), a temperate climate and extensive forested areas. They are fertile producing regions and the Chercher district has important coffee cultivation between 4,000 and 5,000 ft. Balé province, including the mountain regions, is inhabited by Galla peoples who (in places with sufficient rainfall) are settled cultivators. In the Chercher district extending toward Harar city also dwell large groups of Amhara peoples. From the highlands the land slopes gradually southwest toward the Indian ocean, to which the province drains by the Webbe Shibeli and Ganale Doria river systems. The eastern half is a gently sloping and eroded plateau, above 1,500 ft. except in the lower river

valleys near the southeast border. This arid region (rainfall 10–20 in. annually) includes the Ogaden and is inhabited by Somali tribes, mostly pastoral and some nomadic. North of the Chercher district, which is skirted by the railway from Addis Ababa to Djibouti on the coast, the province extends to the Hawash river as a desert and semidesert region inhabited by nomadic Danakil and Isu peoples. The Isu are Somali tribes chiefly confined to the eastern part of this region. The provincial capital is Harar town in the uplands just east of the Chercher district, and in the plain northward lies Dire Dawa, an important commercial centre on the railway. East of Harar lies Jijiga, a market town on the road to Hargeisa, Somali republic. Other market centres are Goba in the Balé mountains, Asba Tafari in the Chercher district and Wardere in the Ogaden. (G. C. L.)

HARAR, capital of Harar province in eastern Ethiopia, lies at an elevation of about 6,000 ft. in the east of the Chercher highlands, 35 mi. S.E. of Dire Dawa. Pop. (1956 est.) 40,500. Uniquely in Ethiopia, the old quarter of Harar is still enclosed by a wall with six impressive gateways. Harar, probably founded in the 7th century A.D. by immigrants from the Hadhramaut, eventually became capital of the Muslim state of Adal. It was in continuous conflict with the Christian kingdom of Ethiopia and with Galla forces which in 1577 compelled removal of the capital to the Aussa desert, about 100 mi. N. Harar in the 19th century was described by Sir Richard Burton (the first European visitor) and the French poet J. N. A. Rimbaud (*qq.v.*). In Egyptian occupation 1875–85, Harar was in Jan. 1887 conquered by Menelik II (Menelek II; *q.v.*), king of Shoa and afterward emperor of Ethiopia. Ras Makonnen, father of the emperor Haile Selassie I, then became governor of Harar province; his mausoleum lies west of the walled city. Harar's commerce passed to Dire Dawa (*q.v.*) when in 1902 the railway reached that town. It subsequently enjoyed a revival as the site of the government's teacher-training school, the military academy and, just outside the city, the Imperial Ethiopian College of Agriculture and Mechanical Arts (founded 1956). The population includes Amharas, Gallas, Somalis and (largely inside the walled quarter) the Harari or Adere, who speak a Semitic language (Adare) and have a literature using Arabic script.

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HARBIN (HA-ERH-PIN), a city of northeast China, on the southern bank of the Sungari (Sung-hua) river in Heilungkiang province, about 200 mi. N.N.E. of Mukden, is the transportation hub of northern Manchuria. Prior to the building of the Chinese Eastern railway in 1897 it was a small wheat-market town. Its population increased from 40,500 in 1911 to 332,000 in 1931, 662,000 in 1940 and 1,200,000 in 1953. The estimated population in 1957 was 1,552,000.

The city is the converging point of five railways—linking Lu-pin (Man-chou-li) in the west, Sui-fen in the east, the Korean border in the southeast, Ch'ang-ch'un in the southwest and Hai-lun-Ai-hun-Hei-ho in the north. Harbin is also connected by steamships and junks with all important towns on the Sungari river and its tributaries. The Peking-Siberia-Moscow airline stops there. In the metropolis, a network of streetcars, buses and sleds (in winter) forms an elaborate transportation system.

After 1949 Harbin was developed into a major industrial base of northeast China. The traditional food-processing industries comprise a complex of soybean-processing plants, sugar refineries, flour mills and tobacco, flax and linen factories. Modern enterprises include production of ball bearings, wire and cable, film projectors, tractors, electric-power generators and equipment for power and heat. Other industries were established there for the manufacture of nylon and plastics. The surrounding agricultural region, with fertile black-loam and yellow-clay soil, supports the cultivation of wheat, corn (maize) and soybeans, and Harbin is also a trade centre.

Because of Russian influence, Harbin became known as the "Moscow of the orient," and the Russian section forms one of the colourful areas of the city. Harbin was the headquarters of the Chungchang railway started by the Russian government and was a centre of tsarist activities in Manchuria in the generation after the October Revolution of 1917. (KN. C.)

HARBINGER-OF-SPRING (*Erigenia bulbosa*), a small North American plant of the parsley family (Umbelliferae), native to moist low woods from southern Ontario to Minnesota and southward to Pennsylvania, Alabama and Missouri. It is a low, smooth, almost stemless perennial, rising from a deep round tuber and bearing, near the ground, from two to four compound leaves thrice divided into narrow leaflets. The flower stalk (scape), three to nine inches high, terminates in small clusters of white flowers.

In the southern part of its range the plant blooms as early as February, and farther north in April, whence its name. It is somewhat rare and local in many sections and is of some use in the wild garden or the rock garden.

HARBORD, JAMES GUTHRIE (1866–1947), U.S. army officer, was Gen. John J. Pershing's chief of staff during World War I. Born at Bloomington, Ill., March 21, 1866, he graduated from the Kansas State Agricultural college, Manhattan, in 1886. He joined the 4th infantry as a private in 1889 and was commissioned in the cavalry in 1891. Thereafter he was promoted through the grades and in 1917 became brigadier general. He was chief of staff of the American expeditionary force in France, May 1917–May 1918, and again from May 1919. He commanded the marine brigade near Chateau-Thierry, June 1918, and the 2nd division of the A. E. F. in the Soissons offensive, July 1918, after which he was placed in command of the service of supply. He served as deputy chief of staff, U.S. army, 1921–22, and retired from the army as lieutenant general.

He became president (1923) and later chairman of the board (1930) of the Radio Corporation of America. Harbord died Aug. 20, 1947, in Rye, N.Y.

HARBOURS. A harbour is any part of an ocean, sea, river or other body of water that is sufficiently protected from wind, waves and currents to be used by vessels as a place of safety from storms or for the transfer of passengers and cargo from ship to shore. A harbour differs from a port in that a port always provides safety from storms and has facilities for the transfer of cargo and passengers; a harbour may provide only a haven of safety from the dangers of the water, with no facilities for loading or unloading a ship. A harbour is always a necessary part of a port.

The principal elements of a harbour are its natural features: protection from waves, shelter from storm winds and tides, freedom from strong currents, sufficient depth of water to permit a vessel to enter the protected area of the harbour, and a bottom adequate to hold a vessel's anchor. The principal elements of a port are the facilities provided by man for the transfer of cargo and passengers. These include docks, wharves, quays, warehouses, cranes for loading and unloading, repair shops and means for obtaining water, oil, coal, food and other provisions.

TYPES OF HARBOURS

Harbours are usually classified as either natural or artificial. Natural harbours are those that can be used without any improvement by engineering works; they are usually found in sheltered areas such as enclosed bays or the entrances (known as estuaries) to rivers that discharge into the sea. In primitive times—in fact until about the mid-1800s—almost all harbours were natural, although man had from very early times (perhaps as early as 2000 B.C.) built artificial harbours to serve his needs. Today's great harbours have developed from the natural harbours of times past.

Most harbours today may be classed as artificial harbours because they have been improved by the construction of works to afford more protection from waves and currents or to provide greater depths of water to accommodate larger ships. All of the modern artificial harbours of the world have been developed by improvement and expansion of natural shelter areas.

Harbours are sometimes identified in other ways, according to their purpose, usage, location or physical features. Examples are yacht harbours furnishing anchorage and docks for pleasure craft; naval harbours reserved for naval vessels; fishery harbours for

BY COURTESY OF THE CANADIAN NATIONAL RAILWAYS

VANCOUVER HARBOUR, B.C.

fishing vessels; and commercial harbours devoted to the varied needs of shipping involved in world trade. Landlocked harbours, such as San Francisco bay or Sydney, Austr., are so identified because they are surrounded by land except for a narrow passage to the sea.

HARBOUR TERMINOLOGY

Certain terms have particular meanings when employed in regard to harbours.

Exposure refers to the openness of a harbour to winds, waves or currents. Los Angeles harbour in California, for example, is described as a harbour with a southern exposure, meaning that it is exposed to winds and waves coming from the south.

Holding ground means the bottom of the harbour where a ship's anchor must be embedded to withstand the pull of the ship and to hold it in a desired location.

Anchorage refers to an area of the harbour set aside for ships riding at anchor without being tied to a dock. Most harbour charts show such areas, and ships are not permitted to anchor in other parts of the harbour. Some harbours, particularly those that are small, require ships to tie up at a dock or at dolphins (a cluster of piles) and do not provide anchorage areas. (*See* DOCK.)

A breakwater (*q.v.*) is a structure, usually built of stone or concrete, to protect a harbour from wave action of the open sea.

PHOTO BY R. BAUGIN

LANDLOCKED HARBOUR OF SYDNEY, AUSTR.

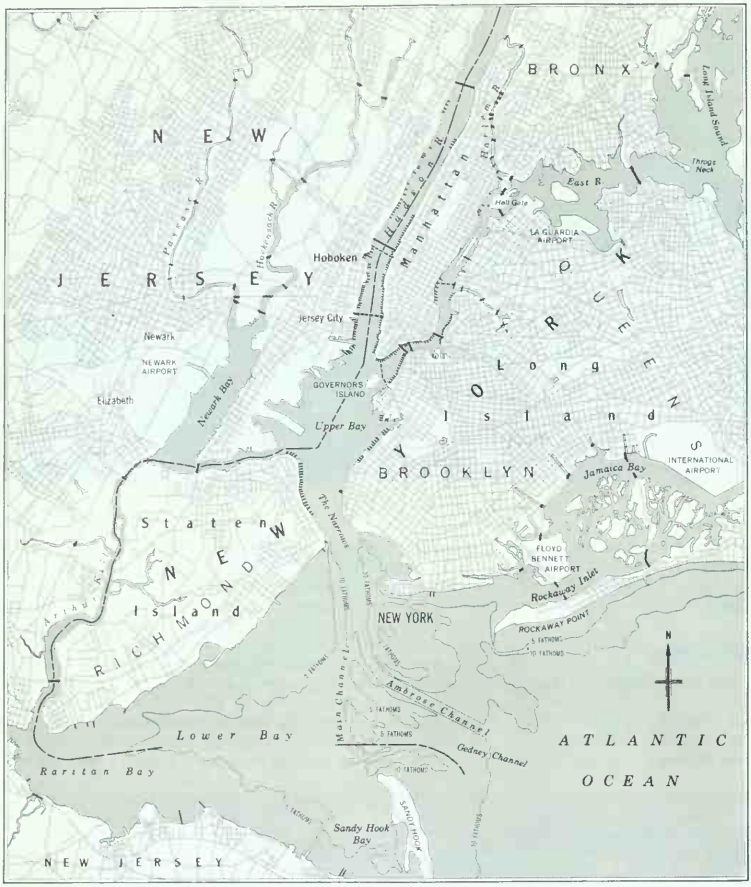

FIG. 1.—AREA OF THE NEW YORK CITY HARBOUR

A buoy (*q.v.*) is a floating object moored to the bottom to mark a navigation channel or to warn of the presence of an obstruction of some sort, such as a submerged wreck, a rock or shallow water. Harbour and navigation buoys carry numbers and vary in colour so that the navigator can tell his position from the buoys and a chart locating them.

The channel is the part of the harbour used for entrance and exit; it is the "main road" of the harbour.

The controlling depth in a harbour or harbour channel is the least depth of water in the navigable part of the harbour. Shown on charts and referred to a specified datum plane, it determines the maximum allowable draft of vessels entering the harbour.

The datum plane for a harbour is a horizontal plane at some elevation referred to the water, from which all water depths and elevations in the harbour are measured. The following are a few of the datum planes used:

Mean low water, for the Atlantic coast (U.S.), Argentina, Sweden and Norway
Mean lower low water, for the Pacific coast (U.S.)
Mean low water spring tide, for Great Britain, Germany, Italy, Brazil and Chile
Lowest low water, for France, Spain and Greece

Diffraction of water waves occurs when a portion of a wave is stopped by a breakwater, and the remainder of the wave enters the sheltered region behind the breakwater. Refraction of waves is the process involved in the change in direction of wave travel due to depth variation; the part of the wave in shallow water moves forward more slowly than the part in deep water.

An entrance to a harbour is a water passage through which ships enter and leave the harbour. Some harbours (*e.g.*, Cherbourg, France; Los Angeles) may have more than one entrance, but usually only one entrance is provided.

A jetty (*q.v.*), in U.S. usage, is a structure extending into a body of water to prevent the formation of shoals at a harbour entrance by sand moving along a coast. Jetties may be built of stone, concrete, steel sheet piles, wooden piles or other materials. In British usage jetty is synonymous with wharf or pier.

A seiche is a periodic oscillation of the entire body of water in a harbour. The period is determined by the geometry of the harbour and varies from a few seconds to an hour or more; the variation in water level may be as much as a few feet at any given point in the harbour. The seiche in Monterey bay harbour, Calif., is spectacular, all the craft in the harbour moving in step with it.

The tidal prism of a harbour is the quantity of water that flows in or out of a harbour because of the change in water elevation due to the tide. This is the quantity of water available to keep the harbour water clean by exchanging sea water for harbour water.

Wave direction and wind direction are the directions from which the waves or winds approach. For example, if the wave direction is west, the wave is traveling from west to east.

HISTORY

The use of natural havens and places of shelter must have been contemporary with the origins of navigation. There is no conclusive evidence as to the date or the locality of the first artificial harbour construction, but it is known that the Phoenicians built harbours at Sidon and Tyre in the 13th century B.C.

The great harbour of the ancient city of Alexandria was protected on three sides; on the open or eastward side it was protected by a pier built out from the mainland and by a line of reefs that made entrance to the harbour difficult. It was for this reason that Ptolemy built the famous lighthouse of Pharos.

Many other Mediterranean harbours, both natural and artificial, were of considerable commercial or military importance in Greek and Roman times. The natural harbours of Tarentum (Taranto) and Brundisium (Brindisi), both in Italy, are still in use. In Trajan's reign, Centum Cellae (modern Civitavecchia) was founded 30 mi. north of the mouth of the Tiber. As the name implies, the harbour was provided with 100 covered *cellae* or docks for warships.

In medieval times the prosperity of such Mediterranean cities as Venice and Genoa led to the building of harbour works for the

BY COURTESY OF THE PORT OF NEW YORK AUTHORITY

INNER HARBOUR OF NEW YORK CITY, WITH THE UPPER BAY IN THE FOREGROUND

accommodation of their sea-borne trade. Some of the early works at Genoa and on the Venetian lagoons remain to this day. Natural harbours suitable to the needs of the trade of the middle ages are more numerous in northern Europe than in the tideless Mediterranean sea. For many centuries these natural facilities, combined in some cases with artificial works of the simplest character, sufficed for the shipping of the times.

One of the earliest protective works built at a seaport in England was the Cobb at Lyme Regis, dating from the 14th century. Harbour works are said to have existed about 1250 at Hartlepool and at Arbroath in Scotland about 1394. Dover was a busy port in the time of Henry VIII, and a stone and timber breakwater was built there in his reign. Toward the end of the 16th century the first of the jetties at the entrance to the river Yare at Yarmouth was constructed; and in the 17th century protection piers were built at Whitby and Scarborough, portions of which still exist. It was not, however, until the second half of the 18th century, when John Smeaton (*q.v.*) began his career, that the building of harbour works on any considerable scale was undertaken in England. Smeaton must be regarded as the founder in England of the science of harbour engineering. His work and that of his successors, Thomas Telford and John Rennie, permanently established British seaports in the forefront of progress in harbour construction. On the other side of the channel, Le Havre, Dieppe, La Rochelle and Dunkerque were among the earliest ports to embark on harbour construction.

AEROFILMS AND AERO PICTORIAL LTD.

PORT OF LIVERPOOL, SHOWING THE MERSEY ENTRANCE

The history of harbour development on the American continent followed Mediterranean and northern European patterns. In early days, because ships were small and carried only small quantities of goods, natural havens offering protected anchorage were sufficient; but as the economy developed there was more and more need for sea transportation. Ships became larger and required greater depths of water in harbours. Few natural harbours were large and deep enough to provide shelter for the ships while loading and unloading. Shipping concentrated in the larger and deeper harbours, and the small, shallow harbours were left with little commerce. To meet the situation, efforts were made to improve the small harbours by constructing breakwaters and dredging channels to greater depths. After a time the larger harbours also had to be improved; most of the great harbours of the world have been improved by dredging and other works.

Adequate harbours are essential to the economic well-being of a nation; they provide the necessary means for the exchange of goods and raw materials that develops and maintains the agricultural and industrial commerce between nations. History records the importance of harbours in the relations between nations from ancient times down to the present day.

NATURAL HARBOURS

A sheltered anchorage in its simplest form is sometimes found under the lee of outlying reefs, sandbanks or islands. Where there is good holding ground and the shelter afforded is sufficient to give protection from heavy seas, such an anchorage is termed a roadstead. Examples are Boston, Mass.; Aden in southern Arabia; Callao, Peru; and Hong Kong. Others are found in deep embayments where shelter is afforded from the worst winds by projecting headlands, as in San Diego, Calif.; New York city; Sydney; and Yokohama, Jap. A well-known example of a roadstead protected by an island is that sheltered by the Isle of Wight.

Natural havens to which the term harbour is ordinarily applied are those inlets or arms of the sea that are almost completely landlocked. Where such natural shelter is found combined with ample depth of water, both in the approaches and in the anchorage, and in positions convenient for sea-borne trade, it is of great value to shipping. Such havens, even without artificial works, serve as harbours of refuge, and the necessary interior works of a port can usually be constructed in them without difficulty and at much less cost than in an exposed and open situation. Well-known examples in addition to those already mentioned are the harbours of Port Royal and Kingston in Jamaica; Southampton water in England; and the landlocked sea inlets of San Francisco; Cromarty firth and Scapa Flow in Scotland; Milford Haven in Wales; Queenstown in Ireland; Falmouth in England; and Kiel in Germany. In many situations, however, there are large enclosed water areas having openings into the sea that are either obstructed by a bar at the entrance (as in the lagoon harbour of Venice and the enclosed bay harbour of Durban, S.Af.) or are shallow. Works of considerable magnitude are often required for the improvement

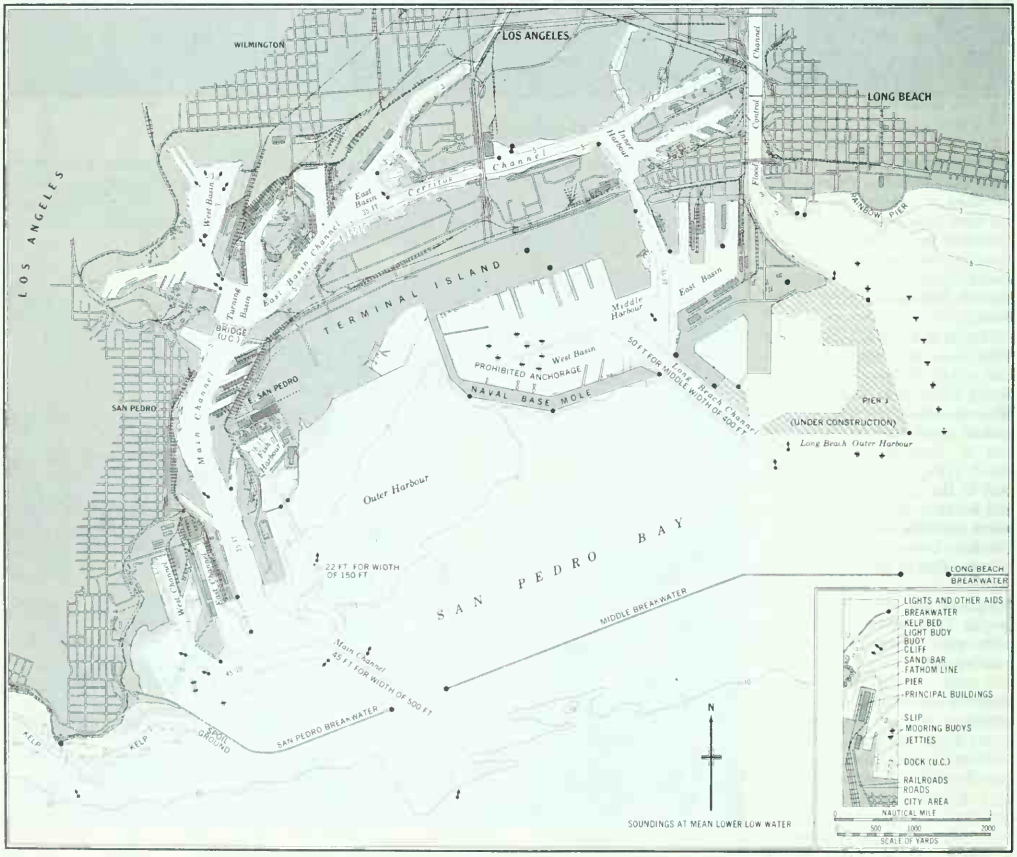

FIG. 2.—HARBOUR AREA OF LOS ANGELES

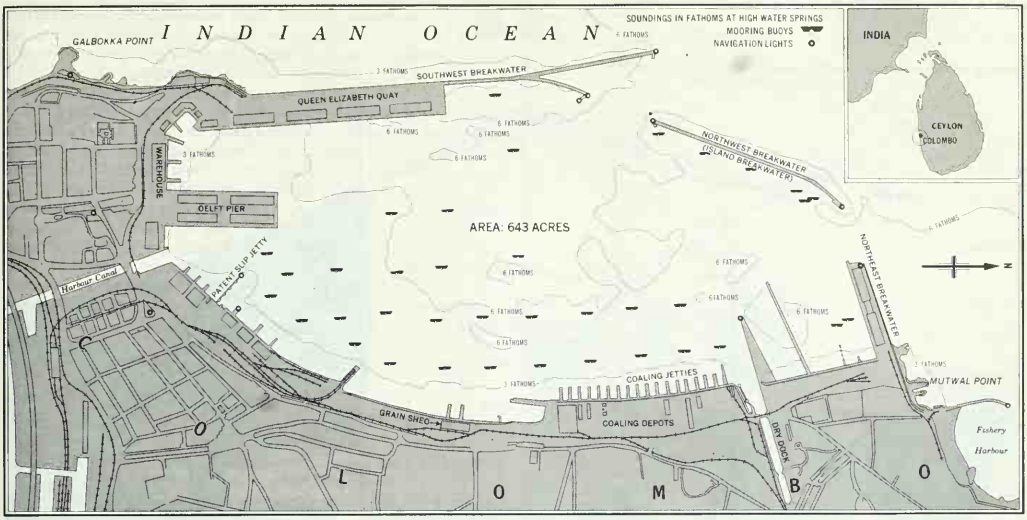

FIG. 3.—HARBOUR AT COLOMBO, CEYLON

and maintenance of such harbours.

Some river mouths at the sea provide excellent harbours. They are usually well protected from winds and waves, but access to the harbours may be difficult because of offshore bars at the entrance. This is particularly true of rivers that carry large quantities of silt to the sea. Among the important world harbours of this type are New York city; Liverpool; Buenos Aires, Arg., and Montevideo, Urug., at the mouth of the Río de la Plata; Le Havre, France; and Brisbane, Austr. It is interesting that no harbour has ever been developed at the mouth of the Orinoco river in South America, which carries one of the largest amounts of silt of any of the rivers of the world. (*See* RIVER AND RIVER ENGINEERING.)

New York Harbour.—The harbour of New York city (*see* fig. 1) is one of the most perfect natural havens in the world. It enjoys the advantages of ample water area and depth, shelter, good access, a small tidal range—no more than five feet as maximum—and moderate tidal streams. The outer harbour, or Lower bay, is sheltered by the New Jersey shore and Sandy Hook on one side and by Long Island on the other. The inner harbour is entered through a channel, called the Narrows, between Staten Island on the west (or New Jersey) shore and Brooklyn on the east. It comprises the deep Upper bay; the rivers which isolate Manhattan Island, namely the Hudson, East and Harlem; and numerous bays and creeks, of which Newark bay is the most important. The shore lines have a combined length of more than 480 mi., and if the total berthing space of the piers be added, this figure is increased by about 150 mi. Excluding the Lower bay, the sheltered water area within the harbour is approximately 150 sq.mi. The development of the trade of the port led to the building of shipping piers on an extensive scale in positions remote from the old centre of trade in Manhattan Island. In this way Staten Island, Jersey City, Newark and the Long Island shores became busy centres of maritime trade. Jamaica bay, a sheltered inlet on the south side of Long Island with access direct from the Lower bay, has been developed as a new centre of port activity.

The entrance to the Lower bay is open to the Atlantic, but shelter is afforded by outlying sandbanks. Sandy Hook itself is a long, low spit of sand. Until about 1885 the natural channels through the banks afforded, when suitably marked and buoyed, ample depth and width for all ships using the port. The deepening of the sea channels required by the growth in the dimensions of transatlantic vessels has already been referred to. The depths in the sea approaches are now maintained by periodic suction dredging.

The entrance to the harbour through Long Island sound from the north and east is sheltered, but the channel is obstructed by rocky islets and reefs. The navigation of this approach was at one time difficult and even dangerous; but it has been improved by the removal of many of the rocks by blasting and dredging, notably in the neighbourhood of Hell Gate, to provide a channel 35 ft. deep from Throgs Neck to the Brooklyn navy yard, and 40 ft. deep from there to the Upper bay, with widths from 300 to 1,000 ft. The Hudson river channel was dredged to a low-water depth of 40 ft. for full river width from Upper bay to W. 59th street; later the construction of a channel 45 ft. deep to W. 40th street, thence 48 ft. to W. 59th street, over a width of 2,000 ft., was undertaken. Many berths alongside piers and wharves in New York harbour have depths of 40 ft. or more at low water.

Liverpool, the Mersey Entrance.—The inner estuary of the

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COLOMBO HARBOUR, LOOKING NORTH

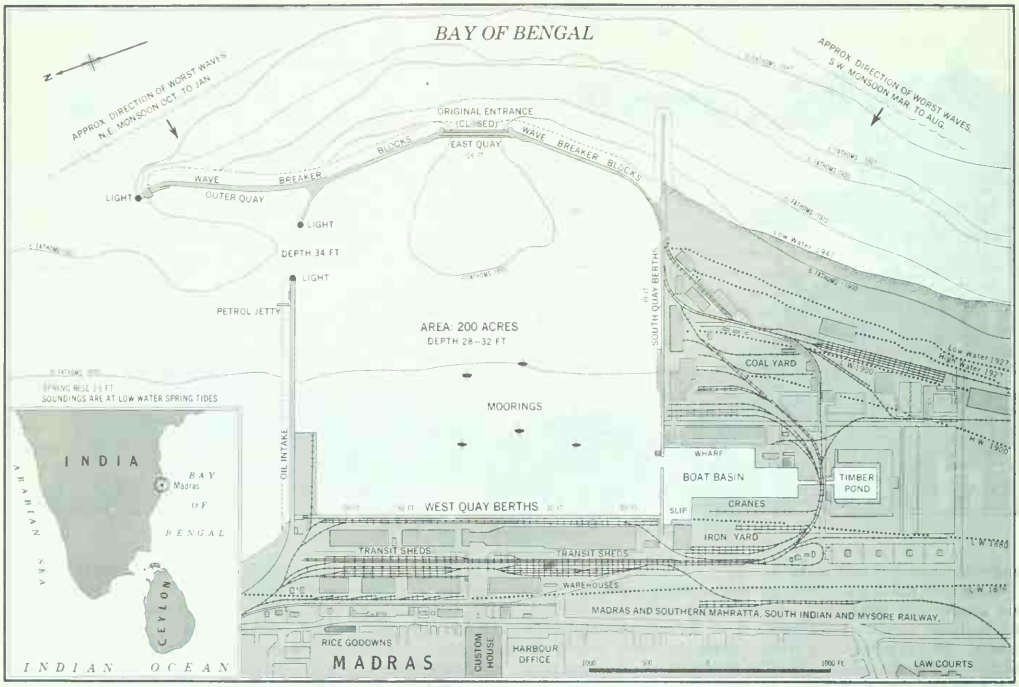


FIG. 4.—HARBOUR AT MADRAS, INDIA

river Mersey has a depth in some places of about 63 ft. at low water; however, in 1890 the bar in the principal channel maintained a depth of from 10 to 12 ft. at low tide. In 1890 dredging started and was later carried on continuously; there was thereafter no difficulty in maintaining a 30 ft. depth over the bar. By 1906, 105,000,000 tons of material had been removed. However, despite the dredging, the Queen's channel and Crosby's channel were becoming more and more distorted, and the growth of what later was named Taylor's spit continued. To fix the channel and prevent its encroachment on Taylor's bank, and in an effort to lessen the dredging required, building of the various submerged revetments and rubble stone training walls was begun in 1909 and proceeded almost continuously except for interruptions during World Wars I and II. As many as 22,000,000 tons were dredged from the sea channels in one year (1936), but after World War II this quantity was less than 10,000,000 tons annually. Construction of the Queen's training banks was still proceeding at mid-century. It was hoped that when the training works had reached their full length, the tides would work together and drain the river automatically.

Dredging in Natural Harbours.—There are very few natural harbours that do not require some dredging to permit all shipping to enter. Modern ships, when fully loaded, require controlling depths of from 30 to 40 ft. Vancouver harbour, British Columbia, is one of these few harbours. Located on Burrard inlet, an arm of the Strait of Georgia, which in turn is connected to Juan de Fuca strait, it is the finest natural harbour on the Pacific coast of North America. The harbour at the port of San Francisco, one of many located in San Francisco bay, is another example. The controlling depth in the Golden Gate, the only passage between the Pacific ocean and the bay, is 360 ft., although the entrance is so narrow (one mile wide) and so sheltered that Sir Francis Drake sailed past it in 1579 without noting its presence. The entrance was discovered almost 200 years later, in 1769, by Don Gaspar de Portola who was searching for Monterey bay. A wide semicircular bar with a controlling depth of 35 ft. is formed in the ocean outside the Golden Gate. Some dredging is done on a channel through the bar to permit very heavily laden ships to approach the entrance.

Most bay harbours are exposed in some direction to waves and currents, and require artificial protection to make the harbour usable under all conditions of weather. The protection is usually provided by a breakwater.

Shelter in Natural Harbours.—The adoption of a deepwater bay for a harbour reduces the necessity for providing artificial shelter and, in most situations, secures a site not exposed to silting, where sheltering works do not interfere with any littoral drift along the open coast. In favourable situations a deep and narrow bay or inlet may be sheltered by a single breakwater extended out from one shore across the outlet of the bay, with a single entrance between its extremity and the opposite shore. Where the exposure is from one direction only (approximately parallel with the coast line at the site), and there is some natural shelter in the opposite direction, a single breakwater extending at right angles to the shore, with a bend or curve inward at its outer end, is sufficient.

Cherbourg.—An important harbour of this type is Cherbourg. The breakwater across the wide but shallow bay forming Cherbourg harbour and roadstead is an example of an island structure. Begun in 1784, its construction was continued under Napoleon, but it was not completed until 1858. More than 2¼ mi. in length, it is built, for the most part, in a depth of about 42 ft. at low water. It is of composite construction, a solid superstructure surmounting a rubble stone mound. The sheltered water area is more than 2,000 ac. in extent, but less than half this area is of sufficient depth for large vessels. The two entrances on the east and west are between the breakwater ends and islands that are joined to the mainland by breakwater walls. In 1933 deepwater quays were brought into use, having a depth alongside of 46 ft. at low water.

Valparaíso.—The breakwater at Valparaíso, Chile, is a re-

markable structure projecting from the western shore of Valparaíso bay. The seaward termination is in a depth of 180 ft. of water. The water area, fully sheltered by the breakwater (approximately 3,230 ft. long), is small; and the cost (reported to be almost £800 per linear foot) very large in proportion to the benefit.

Los Angeles–Long Beach.—The outer harbours of Los Angeles and Long Beach, Calif., on San Pedro bay (*see* fig. 2), furnish examples of ports originally protected by a single embayment, later protected by a breakwater. From 1912 to 1937 the outer harbour of Los Angeles, on the western side of San Pedro breakwater, was protected by the 11,152-ft.-long San Pedro breakwater extending eastward from Point Fermin. In 1937 a 12,500-ft. section of island breakwater, separated from the San Pedro breakwater by a 2,200-ft. opening, was completed. This island breakwater has been extended in the easterly direction an additional 13,350 ft. The total protected area in the Los Angeles–Long Beach outer harbours would amount to approximately 6,000 ac. upon completion of the island breakwater. The entrance channel to the Los Angeles harbour is dredged to 45 ft.; the channel to Long Beach is dredged to 50 ft.

The inner harbour at Los Angeles contains a water area of approximately 800 ac. dredged to 35 ft., and consists of a series of channels with turning basins and numerous slips. Cerritos channel, 400 ft. wide and 35 ft. deep, connects the inner harbour of Los Angeles with the inner harbour at Long Beach.

The harbour at Long Beach was originally protected by the 7,300-ft. curved breakwater sheltering the area known as the East basin. The series of breakwaters, constituting in effect a single structure extending eastward from Point Fermin, now afford protection to the Long Beach outer harbour; and a second curved earth-moletype breakwater now protects the West basin in the outer harbour. The inner harbour is reached by a channel 35 ft. deep and 300 to 500 ft. wide.

ARTIFICIAL HARBOURS

The method generally adopted for the completion of the shelter of deeply indented bay harbours is the construction of a breakwater extended across the outlet from each shore, leaving a single entrance between their ends, where usually the deepest water is found. Examples of this type are to be found at Peterhead, Scot.,

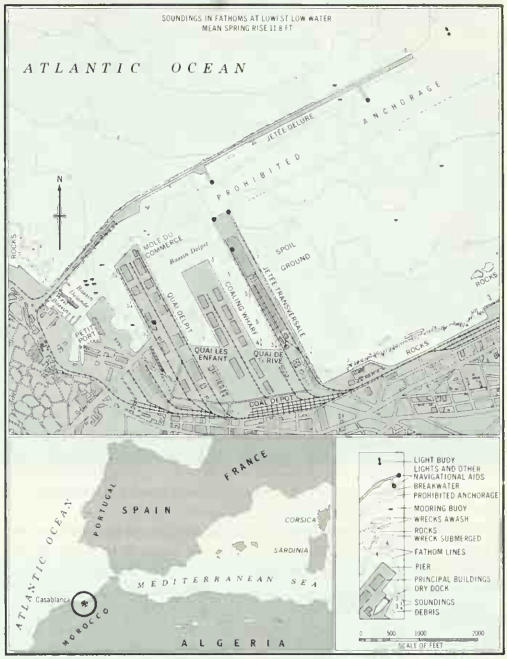
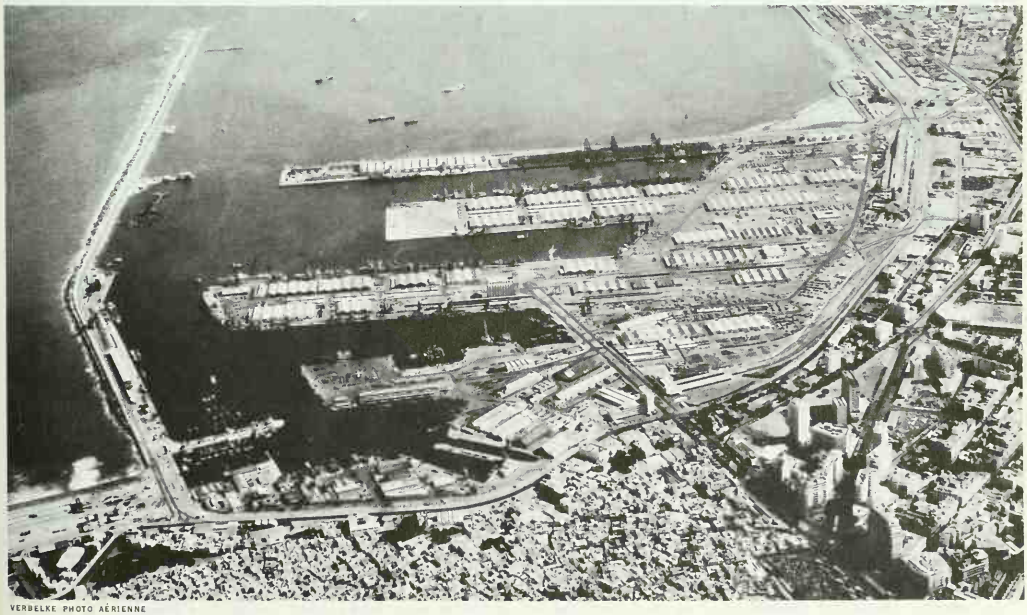


FIG. 5.—CASABLANCA HARBOUR



VERBELKE PHOTO AÉRIENNE

CASABLANCA HARBOUR, LOOKING EAST

ITALIA NOSTRA ASSOCIATION

THE LAGOON HARBOUR OF VENICE, ITALY

and at Monaco. If one breakwater placed somewhat farther out is made to overlap an inner one, and so to cover it to some extent from the direction of the heaviest seas, a more sheltered entrance is sometimes obtained. This arrangement was adopted when additional protection works were built at the entrance to the old bay harbour at Genoa and for the harbour in Bilbao bay, Spain, at the mouth of the Nervión. The breakwaters at Valletta, Malta, and those at the entrance to the almost landlocked Spanish naval harbour at Cartagena are also planned in this way. Many harbours formed in wide or open bays, and in other positions where some abrupt projection from the coast line has been utilized as providing shelter from one quarter, have their protection completed by two or more breakwaters enclosing the site. Colombo, Ceylon, furnishes a typical example.

The extension of artificial shelter has often been brought about not only by the demand for more complete protection against heavy seas and consequent range in a harbour but also by the growth in the dimensions of ships and the increase in the trade of a port. Thus, the building of breakwaters may provide greater depth of water, extended accommodation and improved shelter. During World War II an experiment was tried with the prefabrication in England of two artificial breakwaters, known as Mulberries, which were towed across the channel and assembled on the far shore. (*See* WORLD WAR II: *Allied Reconquest of Western Europe.*)

Colombo.—The artificial harbour at Colombo (*see* fig. 3), begun in 1874, occupies an exposed situation in an embayment on the west coast of Ceylon. The site is sheltered to some extent from southerly winds and to a lesser degree from the north. The breakwaters are fully exposed to westerly gales from the Indian ocean. The southwest breakwater, the first to be constructed, is 4,212 ft. long and was completed in 1885. Two additional breakwaters, the northwest and northeast, 2,670 ft. and 1,080 ft. respectively, were built between 1892 and 1906, thus completing the enclosure of the harbour except for two openings of 800 ft. and 700 ft. respectively. The shelter afforded was still insufficient to tranquilize the northern part of the water area, where are situated most of the coaling and oil berths, during the southwest monsoon. A sheltering arm 1,800 ft. in length was completed in 1912 as an extension of the original southwest breakwater. The harbour has an area of 643 ac. Of this, 246 ac. are dredged to greater than 36 ft.; another 246 ac. are dredged to 30 to 36 ft., and the remainder is less than 30 ft. deep. The western entrance has a navigable depth of 36 ft. above low water, and the navigable depth at the northern entrance is 30 ft.

Artificial Harbours on Open Coasts.—It sometimes happens that harbours have to be constructed where little or no natural shelter exists. When, in such cases, the only possible site is an open sandy shore, considerable littoral drift may occur. Breakwaters, carried out from the shore at some distance apart, and converging to a central entrance of suitable width, provide the requisite shelter. Such works may be necessary not only on open unindented coasts but also to afford increased shelter at a river mouth on an unprotected coast line. Harbours of this description have, for instance, been made at Madras, India, and at Ymuiden, Neth., on open shores.

If there is little littoral drift from the most exposed quarter, the amount of sand brought into the harbour during storms can be readily removed by dredging. The quantity is, moreover, smaller in proportion to the depth into which the entrance is carried; and the scour across the projecting ends of the breakwaters tends, in some cases, to keep the outlet free from deposit. If a river discharges into the harbour, the matter brought down by it and deposited in the harbour must also be taken into consideration.

On an open sandy coast where there is littoral drift in both directions caused by winds blowing alternately from opposite quarters, sand accumulates in the sheltered angles outside the harbour on both sides at the junction of the breakwater with the shore line. This has occurred at Ymuiden. Silting also frequently occurs just inside the breakwater heads under the shelter of the arms. The worst results occur when the littoral drift is mainly in one direction, so that the projection of a solid breakwater out from the shore causes a very large accretion on the side facing the exposed quarter, while, because of the arrest of the travel of sand, erosion of the beach occurs beyond the lee breakwater (*see* LAND RECLAMATION). Such effects have been produced by the works at Port Said, Egy., and at Madras. The harbour of Salina Cruz, Mex., on the Pacific coast of the Isthmus of Tehuantepec, where two breakwaters projecting from the shore were built (1900–06), rapidly sanded up; and narrow channels to the berths could be maintained only by constant dredging.

Madras.—This harbour (*see* fig. 4) furnishes an instance of difficulties and unforeseen happenings overcome by continuous effort and drastic modification of the original plans. The harbour of Madras, begun in 1877, comprised, when first completed, two breakwaters 3,000 ft. apart carried straight out to sea at right angles to the shore for 3,000 ft. with two return arms inclined slightly to seaward. The breakwaters originally enclosed an area of 220 ac. and left a central entrance, 515 ft. wide, facing the Bay of Bengal in a depth of about eight fathoms. The position and form of this entrance were determined mainly on navigational grounds as suitable to the needs of the sailing vessels still at that time largely employed in the eastern trade. The breakwaters, in a position of extreme exposure on an open coast without any natural shelter, suffered severe damage from the sea on many occasions and had to be rebuilt from time to time. The great drift of sand from south to north resulted in an advance of the shore against the outside of the south breakwater as it was projected seaward; and erosion, though to a lesser extent, occurred beyond the north breakwater. The progress of the foreshore in

course of time extended so far seaward as to produce shoaling at the entrance; so rapidly, in fact, that in the ten years from 1893 the depth was diminished by ten feet. Moreover, the original entrance, facing east, was exposed to the full force of waves during both the northeast and the southwest monsoons. At these seasons the range within the harbour was severe, and at times vessels could not ride at moorings in safety. A new entrance was therefore constructed by forming an opening in the breakwater on the north side of the harbour, protected by a sheltering arm, the original eastern entrance being closed when the new entrance had been made (1906–11). The harbour became comparatively tranquil, and vessels were able at all times to lie at the quays in safety.

The advance of the shore line seaward on the south side of the harbour averaged more than 25 ft. a year, but the rate of progression decreased as the sand deposit extended into deeper water. The drift of sand along the outside face of the eastern breakwater wall was checked by the construction of an extension seaward of the south breakwater 700 ft. in length, begun in 1924. This spur breakwater or groyne is protected by concrete blocks placed pell-mell on each side. Incidentally, the accretion of sand on the south side of the harbour was not an unmixed evil, for the value of the land so formed increased with the expansion of the city, and much of it has been sold for more than £3,000 per acre. After the tranquilizing of the water area in 1911, the quay accommodation was greatly increased.

Casablanca.—The making of this artificial port on the Atlantic ocean, the largest and most important harbour in Morocco, is an example of harbour construction carried out on a large scale on an exposed shore. The construction of a small inshore harbour and jetty began in 1907. The sheltering harbour, enclosing about 350 ac. and for the most part having a depth of 30 ft. or more at low water, was begun in 1913. The main harbour works were completed in 1927. Later the northern breakwater, more exposed, was further extended to more than 8,000 ft. The works are fully exposed to the Atlantic swell. (*See* fig. 5.)

DESIGN OF HARBOURS

In designing the works of a harbour, one of the most important considerations is that of exposure. Information obtained from reliable charts must be supplemented by more detailed marine surveys and soundings, and the nature of the sea bed must be ascertained by borings and probings. Among the points to be noted are the geological and other physical characteristics of the site; the slope of the sea bed; the depth of water seaward of the proposed site as well as over it; the presence of any outlying reefs, rocks, shoals or islands of which advantage can be taken as affording protection or as good foundations for sheltering works; and the tidal phenomena, such as the vertical range. Investigation must be made of the nature and directions of the currents and tidal streams; the effect of littoral drift; the nature and extent of natural shelter; the directions of the prevailing and of the strongest winds; the line of maximum exposure, or the greatest fetch or reach of the sea in any unobstructed line of direction; the probable maximum height of the waves due to the exposure; and the direction from which the heaviest seas come. These and other considerations determine the character of the works to be constructed. In the case of harbours proposed to be made at the mouths of rivers or in estuaries, other problems relating to river flow, bars, maintenance of channels, etc., call for investigation.

In planning a harbour to be formed in an exposed situation, the entrance should be placed so as to afford ample sea room for vessels entering or leaving the shelter of the outer and covering break-

CLYDE SUNDERLAND FROM FAIRCHILD

HARBOUR AT THE PORT OF SAN FRANCISCO, CALIF., IN THE SAN FRANCISCO BAY

water or breakwaters. The alignment of the works should be such as to minimize the refraction and diffraction of waves around a breakwater head and the projection of seas across the entrance. If possible, the entrance should be placed so that one breakwater overlaps the other in such a way that some shelter from the direction of the heaviest seas is afforded to a ship when passing the harbour entrance. The entrance should be planned so as to avoid strong currents sweeping across it. The width of the entrance should be sufficient for the safe passage of ships but should not be too wide, for upon the relation of the entrance width to the internal width and area of the harbour largely depends the reduction of range in the harbour. The entrance to a tidal harbour must not be so narrow as to produce through the opening a current interfering with safe navigation. The approaches to the entrance from seaward should not be obstructed by submerged dangers in or close to the recognized channel. If there be any such dangers in the vicinity of the harbour entrance they must be removed or at least suitably marked. There should be sufficient extra depth of water (over the nominal depth of the harbour) in the approaches and at and near the entrance to allow for the effect of range.

BY COURTESY OF THE CONSULATE GENERAL OF JAPAN, NEW YORK

YOKOHAMA HARBOUR, JAPAN

OPERATION OF HARBOURS

Adequate port facilities are essential to the conduct of a nation's sea-borne trade, and as their development and maintenance involve great expense, they are a government responsibility. Government control of harbour installations is exercised directly where nationalized undertakings are concerned, *e.g.*, in South Africa, or indirectly through bodies of commissioners regulated by statute. Alternatively, the ownership and control of port facilities may rest with municipalities (as at Bristol, Eng.) or with other political subdivisions of the national government (as in the Netherlands and Scandinavia).

Frequently statutory conservation boards are constituted to ensure an orderly foreshore development of a harbour or estuary as a whole, to maintain the depth of navigable waterways and to provide necessary navigation aids. Within the framework of an over-all conservation control, the ownership and management of terminal facilities for the transfer of passengers and goods may take many different forms. Sites may be leased or facilities assigned to private operators; *e.g.*, to railway administrations, steamship lines or wharf-operating companies. More generally the control of terminal operations is vested in separate statutory authorities.

The activities of marine terminal operators vary; all provide facilities for receiving, holding and delivering cargoes; some operate the facilities they provide, while others merely make them available and delegate operating functions to competent licensees. The Port of New York authority, the Port of London authority and the commissioners of the Port of Calcutta exercise complete jurisdiction over conservation and terminal operations. These special agencies are self-governing within the limits of their statutory powers and self-financing according to the volume of traffic they are able to attract. This form of administration enables the users of the public facilities to participate in their management.

AEROFILMS AND AERO PICTORIAL LTD.

SOUTHAMPTON WATER, ENGLAND

Statutory Port trusts may have jurisdiction over a number of separate harbour undertakings; the National Harbours board in Canada administers the principal tidewater ports while allowing to each a considerable measure of local autonomy; the Maritime Services board of New South Wales (Australia) administers the ports of Sydney, Newcastle and Port Kembla.

Port administrative practices are very diverse. The Port of Rotterdam (Netherlands) is administered by the municipalities

that also exercise local conservation control. Deepwater frontages are reclaimed by the authority and the basic site facilities obtained are in general turned over to private developers on long lease, either as terminals for shipping services or for other industrial use. The main approaches (the new waterway), however, form part of the national services and waterways system. The Manchester Ship Canal company, under powers embodied in the Manchester Ship Canal act, 1885, owns and operates port installations at Manchester (England). The company is controlled by a board of 21 directors, of whom 10 are elected by the shareholders and 11 by the town corporation.

The Port Authority establishes and enforces regulations involving a wide variety of activities, from the assignment of berthing and anchorage space to maintaining law and order. Through its operating divisions it may call on a number of government services. In the United States there are the coast guard, to maintain order, safety and aids to navigation; the coast and geodetic survey, for assistance in matters pertaining to navigation; the public health service, in matters related to the health and welfare of passengers or ships' crews and to the control of disease; and local authorities for police and fire protection.

Because harbours are confined spaces in sheltered locations, particular care is required in their operation. Vessels may not cruise at will about the harbour or pick and choose their anchorages or berths. A shipmaster desiring to enter a harbour must notify the harbour master when he expects his ship to arrive and what services he will need. The harbour master assigns the ship to a specific anchorage or berth, for the expected arrival time, and notifies that ship's captain of the assignment. He also tells him the conditions of weather, tide, water depth and traffic that are expected. The ship's captain uses a chart of the harbour to plan the course he will follow in the harbour to arrive at his assigned space without accident or danger to other ships in the harbour. In large and extensive harbours the harbour regulations may require that the ship be controlled by a harbour pilot, who boards the ship from a small boat before it enters the harbour and guides it to its assigned place. Most harbours have strictly enforced speed limits, rules for passing other ships and regulations prohibiting discharge of ballast, garbage and other matter while entering the harbour.

The harbour entrance and the channels in the harbour are marked by lights, buoys and other aids to navigation, enabling a ship to move about the harbour at any time in any weather. Some harbours have radar reflectors (square or round metal screens) installed on navigation aids, so that by using the ship's radar system the harbour can be entered or left even in dense fog or foul weather. These aids must be kept continually in operation by harbour authorities.

It is difficult to keep a harbour clean. Despite strict regulations, some undesirable materials are discharged from ships' sanitary systems, bilges and other sources in normal ship operation. The harbour, being sheltered, is a collecting place for these materials. Some harbours maintain trash and cleaning boats that cruise about collecting undesirable materials to be disposed of at sea or elsewhere; others depend on flushing of the harbour by normal tide action to keep the harbour waters clean. Fueling of ships is done with great care to prevent fouling of the harbour by fuel oil or coal. The harbour master may impose several penalties on owners whose ships cause unusual fouling.

A most important aspect of harbour operation is the maintenance of up-to-date information on the water depths available in the harbour and its channels. Tide gauges are kept in continuous operation, and frequent surveys are made of water depths in the channels, anchorages and berthing areas. Thus a ship's captain can obtain accurate information on depths at any time for any place in the harbour, so that he may be sure his vessel will not run aground. There are a few harbours in the world, known as tidal basin harbours (*e.g.*, Le Havre), where ships are berthed in tidal locks in which necessary water depths are maintained by closing watertight gates as the tide falls. The operation of such harbours is quite complicated and requires careful scheduling of ship movements and berth assignments.

See also PORT. For the military aspects of harbours *see* COAST DEFENSE.

See also references under "Harbours" in the Index.

BIBLIOGRAPHY.—The Nautical Charts and the Sailing Directions issued by the Hydrographic Office of the U.S. Navy and the Sailing Directions published by the Hydrographic Department of the Admiralty give full descriptions of the harbours of the world. For U.S. harbours, *see* the "Port Series" and "Lake Series" published by the Corps of Engineers, U.S. Army, and the charts issued by the U.S. Coast and Geodetic Survey.

The Corps of Engineers, U.S. Army, publishes many manuals and articles concerning particular harbours and problems of harbour design.

The *Proceedings* of the Permanent International Association of Navigation Congresses (PIANC) contain much detailed information on harbours of the world, as well as technical studies on harbour problems.

(N. G. G.; F. R. H.; MA. A. M.)

HARBURG, an industrial town of Germany which since 1937 has been a suburb of Hamburg (*q.v.*), lies 15 km. (9 mi.) S. of the city on the left bank of the southern arm of the Elbe river. It is the junction for the railways between Hamburg and Cuxhaven, Bremen and Hanover.

HARCOURT, a Norman family of the French nobility.

The lordship of Harcourt, northwest of Evreux, was held by the Norman Turchetil in the first quarter of the 11th century. His great-grandson Guillaume had two sons: Robert II, through whom the French line continues; and Ivo, who inherited the family's acquisitions in England and is the ancestor of the English Harcourts. Jean IV (fifth in descent from Robert II), from whom Harcourt was made a countship in 1338, was killed at Crécy in 1346. From his grandsons Jean VI, Jacques and Philippe descend the senior line of Harcourt, the line of Montgommëry (extinct in 1488) and the line of Bonnétable, respectively. Jean VI's son Jean VII (d. 1452) left the countship to his daughters Jeanne (d. 1456), wife of Jean III de Rieux, and Marie (d. 1476), wife of Antoine de Lorraine, comte de Vaudémont. The marriage (1531) of Louise de Rieux to René de Lorraine, marquis d'Elbeuf, eventually brought all the Harcourt senior line's titles into the house of Lorraine.

The line of Bonnétable was divided between barons de Bonnétable and barons de Beuvron by the two sons of Philippe's son Gérard (d. 1424). Pierre (d. 1627), 5th in descent from Gérard, became marquis de Beuvron in 1593. His great-grandson HENRY D'HARCOURT (1654–1718), French ambassador in Madrid during the crises over the Spanish succession (1698–1700), became duc d'Harcourt in 1700, when Louis XIV elevated his marquisate of Thury (southwest of Caen) and other possessions into a duchy under the family name. The duc moreover became a marshal of France in 1703 and a peer in 1709. This ducal title survives in the 20th century.

In the house of Lorraine, meanwhile, titles derived from the Harcourt countship were borne by sons of the ducs d'Elbeuf. The 2nd duc's eldest son Charles (1620–92) was styled prince d'Harcourt before succeeding his father in 1657; and the same title was later used by this prince's nephew Alphonse Henri Charles (1648–1719). Far more important was the 2nd duc d'Elbeuf's younger brother, HENRY DE LORRAINE, comte d'Harcourt (1601–1666), nicknamed Cadet-la-Perle because he wore a pearl in his ear. Having fought well in Piedmont (relief of Casal and capture of Turin, 1640) and in Catalonia (1645–46) during the Thirty Years' War, he served the government notably during the Fronde (*q.v.*) till in 1652 he seized Breisach for himself, so that the French government had to buy his loyalty back (1654). The countship of Armagnac, his from 1645, provided a title for his descendants.

HARCOURT, SIMON HARCOURT, 1ST VISCOUNT (*c.* 1661–1727), lord chancellor of England 1713–14, only son of Sir Philip Harcourt of Stanton Harcourt, Oxfordshire. He was identified with the Tories, particularly in his defense of Henry Sacheverell (1709). On the accession of George I he was deprived of office and retired to Cokethorpe, where he entertained famous writers such as Dean Swift, Alexander Pope and Matthew Prior, and was friendly with both Walpole and Bolingbroke. With Swift, however, he had occasional quarrels, during one of which the great satirist bestowed on him the sobriquet of "Trimming Harcourt." Harcourt was created a viscount in 1721 and returned

to the privy council; and on several occasions during the king's absences from England he was on the council of regency. He died in London on July 23, 1727.

HARCOURT, SIR WILLIAM GEORGE GRANVILLE VENABLES VERNON (1827–1904). English statesman, one of the great parliamentary figures of the Gladstonian Liberal period. He was the second son of Canon William Vernon, who took the name of Harcourt on the succession of his father Edward, archbishop of York, to the Harcourt estates in 1831. William was born at the Old Residence, York, on Oct. 14, 1827. He was educated privately at Dumford, near Salisbury, and at Preston, where he witnessed the bread riots of 1842. He went to Trinity college, Cambridge, in 1846, graduating with a first in classics and as a senior optime in the mathematics tripos. He was a member of the famous Society of the Apostles at Cambridge, and among his close friends were Fitzjames Stephen and Julian Fane. He was called to the bar by the Inner Temple in 1854, became a queen's counsel in 1866, and was appointed Whewell professor of international law at Cambridge in 1869. He quickly made his mark in London society as a brilliant talker; he wrote for the *Morning Chronicle* and *Saturday Review;* and he began in 1861 to write letters to the *Times* over the signature of "Historicus" on questions of international law arising out of the American Civil War. The earlier letters were directed against the recognition of the Southen states as belligerents in the American Civil War and toward defining the duties of neutrality on the part of England. These letters had a profound effect on public opinion. He maintained that the launching of the "Alabama" was an illegal act, and throughout the period was in close touch with Lord John Russell and Lord Clarendon.

Harcourt entered parliament as a Liberal in 1868. He was appointed solicitor general in Gladstone's government and knighted in 1873. But the Liberals remained in office for only three months more. In opposition Harcourt was a prominent and effective critic of Disraeli's foreign policy. He became home secretary on the return of the Liberals to office in 1880. His name was connected with the passing of the Ground Game act (1880), the Arms (Ireland) act (1881) and the Explosives act (1883). At the time of the dynamite outrages he acted promptly, and the Explosives act was passed through all its stages in the shortest time on record. He was constantly in conflict with the Irish members in the house of commons. In 1884 he introduced an abortive bill for unifying the municipal administration of London. He was recognized as one of the ablest and most effective leaders of the Liberal party; and when, after a brief interval in 1885, Gladstone returned to office in 1886, he was made chancellor of the exchequer. But the government fell on the Home Rule question in July, because Hartington and Chamberlain with over 90 followers had left the party. Harcourt made an effort to secure reunion in Jan. 1887, and the round table conference of Lord Herschell, Harcourt, John Morley, Joseph Chamberlain and G. O. Trevelyan met at his house. It failed disastrously.

Between 1886 and 1892 Harcourt acted as Gladstone's loyal and indefatigable lieutenant in political life. He became chancellor of the exchequer for the second time in 1892. Two years later he introduced and carried a memorable budget, which equalized the death duties on real and personal property. After Gladstone's retirement in 1894 and Lord Rosebery's selection as prime minister by Queen Victoria, Sir William became the leader of the Liberal party in the house of commons. But it was never probable that he would work comfortably in the new conditions. His title to be regarded as Gladstone's successor had been too lightly ignored and from the first it was evident that Lord Rosebery's ideas of liberalism and of the policy of the Liberal party were not those of Harcourt. Their acute differences were patched up from time to time, but the combination could not last. At the general election of 1895 the divisions in the party were obvious. The effect of Harcourt's abortive liquor licensing bills on the election was seen in his defeat at Derby, which gave the signal for the Liberal rout. The crisis arrived in Dec. 1898 and he resigned his leadership of the opposition, alleging as his reason, in letters exchanged between John Morley and himself, the cross-currents of opinion among his old supporters and former colleagues.

Harcourt strongly condemned the government's financial policy and their attitude toward the Transvaal in 1899–1900 and was a constant critic of Chamberlain's policy. At this time he engaged in a violent controversy, conducted in letters to the *Times*, against ritualism in the Church of England. His last great political effort was against Chamberlain's tariff reform proposals. Just after he had announced his intention not to seek election again to parliament, he succeeded, by the death of his nephew, to the family estates at Nuneham in March 1904. But he died there suddenly on Oct. 1 in the same year.

Sir William Harcourt was essentially an aristocrat, but was endowed with a remarkable capacity for popular campaign fighting and for journalism. He was one of those who really made the *Saturday Review* in its palmy days, and the "Historicus" letters on international law published in the *Times* showed him to be a great international lawyer. In later years he found himself somewhat isolated and disappointed. A tall, fine man with the grand manner, he was, throughout a long career, a great personality in the life of his time.

See A. G. Gardiner, *The Life of Sir William Harcourt,* 2 vol. (1923). (D. E. D. B.)

HARCOURT, WILLIAM VERNON (1789–1871), founder of the British association, was born at Sudbury, Derbyshire, in 1789, a younger son of Edward Harcourt, archbishop of York, youngest son of George Vernon, 1st Lord Vernon (Edward took the name Harcourt in 1831). William Harcourt served for five years in the British navy and then went to Christ Church, Oxford, took holy orders and held a living at Bishopthorpe, Yorkshire. He was one of the founders of the Yorkshire Philosophical society and its first president.

The laws and the plan of proceedings for the British Association for the Advancement of Science (*q.v.*) were drawn up by him, and Harcourt was elected president in 1839. In 1824 he became canon of York and in 1837 rector of Bolton Percy. His spare time until quite late in life was occupied with scientific experiments. Inheriting the Harcourt estates in Oxfordshire from his brother in 1861, he moved to Nuneham, where he died in April 1871.

HARDANGERFJORD, an inlet on the west coast of Norway in Hordaland *fylke* (county), penetrating 121 km. (75 mi.) inland apart from the deep fringe of islands off its mouth, the distance from the sea to the head of the fjord being 177 km. (110 mi.). Its extreme depth is about 454 fathoms. With Stordoy at the entrance, the general direction is northeast from that point. Magnificent mountains, from which pour many waterfalls, flank the fjord. The main fjord is divided into parts under different names, and there are many fine branch fjords. The fjord is frequented by tourists, and the principal stations have hotels. The outer fjord is called the Kvinnheradsfjord, flanked by the Melderskin (1,426 m.; 4,678 ft.); then follow Sildefjord and Bonde Sund, separated by the island of Varaldsöy. There Mauranger-fjord opens on the east; from Sunndal on this inlet the great Folgefonn snowfield may be crossed. Norheimsund and Öystese are stations on Ytre Samlen, which throws off a fine narrow branch northward, the Fyksesund. Roads run to Bergen. There follow Indre Samlen and Utnefjord, with the station of Utne opposite Oksen (1,241 m.; 4,071 ft.), and its northward branch, Granvin-fjord, with the picturesque station of Eide at its head, whence a road and railway run northwest to Vossevangen. From the Utne, terminal branches of the fjord run south and east; the Sorfjord, steeply walled by the heights of the Folgefonn, with Odda, with electrochemical and electrometallurgical factories, at its head; and the Eidfjord, with its branch Osafjord, terminating beneath a tremendous rampart of mountains, through which the sombre Simadal penetrates. A motor road along Sorfjord runs southward from Odda to Haugesund and eastward to the eastern and southern parts of the country; from Eidfjord, passing the beautiful Voringfoss it goes across Hardangervidda to Hallingdal and Oslo. (L. H. Hg.)

HARDANGERVIDDA (frequently VIDDA), a highland plateau in Norway, 3,500–4,500 ft. above sea level, extending about 50 mi. S. from Hallingskarvet by the Oslo-Bergen railway

and 40 mi. E. from the precipices descending to the innermost branches of the Hardangerfjord. It is a Pre-Cambrian peneplain partly covered by Cambrosilurian sedimentary rocks and even Plutonic rocks in thrust, the latter forming summits like the ice-covered Hardangerjøkelen (6,150 ft.) and Hårteigen (5,550 ft.). The plateau has numerous lakes and is crossed by many rivers, which mostly drain into the eastern valleys of the country. The rivers draining westward drop in huge falls like the Voringfoss (597 ft.) and Valurfoss through crevicelike valleys to the fjord. The main road from Oslo to Bergen crosses it in the north. There are many tourist stations (*Hytter*) and tracks for hikers.

(L. H. Hg.)

HARDAYAL (Har Dayal) (1884–1939), Indian revolutionary and scholar, was born in Delhi on Oct. 14, 1884, of a Kayastha family. After being educated in Delhi and Lahore, he went, on a government of India scholarship, to St. John's college, Oxford. In England he came under the influence of Shyamaji Krishnavarma, the editor of the *Indian Sociologist*, who was spreading revolutionary propaganda among Indian students, and in 1907 he resigned his scholarship and followed Krishnavarma to Paris. He did not work with him for long. In 1911 he settled in California, where he taught for a short time at Stanford university, joined the anarchist movement, and then devoted himself to the organization of rebellion against the British government of India. In March 1914 he was arrested by the U.S. immigration authorities as an anarchist. Released on bail, he fled to Switzerland. During World War I he worked in Berlin, with other Indian revolutionaries, for the German foreign office. After the war he announced that his ideas had greatly changed. In *Forty-Four Months in Germany and Turkey, February 1915 to October 1918* (1920), he recounted his wartime experiences with some distaste, describing the Germans as "semi-barbarous." He argued that in an age of violence, when the weaker countries of Asia could not maintain their independence, English or French imperialism was "a thousand times preferable to German or Japanese imperialism." He concluded that England had "a moral and historical mission in Asia." He turned to the study of religion, undertook research at the School of Oriental Studies, London university, and devoted the rest of his life to the propagation of what he called "constructive humanism," with the ultimate aim of a secular world state. He died in Philadelphia, Pa., on March 4, 1939, while on a lecture tour of the United States. (Ke. A. B.)

HARDEE, WILLIAM JOSEPH (1815–1873), Confederate general in the American Civil War, was born near Savannah, Ga., Oct. 12, 1815. He graduated from West Point in 1838 and distinguished himself in the Mexican War. He was the author of *Rifle and Light Infantry Tactics* (1855), an infantry manual used by both armies during the Civil War and popularly known as "Hardee's Tactics." From 1856 to 1860, he served as commandant of cadets at West Point.

When Georgia seceded in 1861, Hardee resigned his commission and took charge of Confederate forces in northeastern Arkansas. Promoted to the rank of major general (1861) and lieutenant general (1862), he amply demonstrated his skill at Shiloh, Perryville, Murfreesboro and Missionary Ridge. He was one of the most brilliant corps commanders in the army of Tennessee. After taking a leading part in the battles before Atlanta, he assumed command of the military department of South Carolina, Georgia and Florida, where he fought a skilful rear-guard action until he rejoined Gen. Joseph E. Johnston in North Carolina in 1865. After the war ended he retired to his plantation near Selma, Ala. He died at Wytheville, Va., Nov. 6, 1873. (H. L. T.)

HARDEN, SIR ARTHUR (1865–1940), English biochemist, was awarded the Nobel prize in chemistry for 1929 jointly with Hans von Euler-Chelpin (*q.v.*) for work on the fermentation of sugar and the enzyme action in the process. He was born Oct. 12, 1865, at Manchester, Eng. He studied chemistry at Owens college (later the Victoria University of Manchester) and at the University of Erlangen in Germany. After serving as lecturer and demonstrator in chemistry at the University of Manchester (1888–97), he took charge of the chemical and water laboratory at the Jenner Institute of Preventive Medicine (later Lister institute). From 1907 to 1930 he was head of the department of biochemistry. In 1912 he received the title of professor of biochemistry from the University of London. Harden applied the knowledge of a trained chemist to the investigation of biological phenomena. His studies of the fermentation of sugar by expressed yeast juice occupied most of his working time for over 30 years, and advanced the knowledge of the processes of intermediary metabolism in all living forms. He pioneered also in studies of bacterial enzymes and metabolism. His best-known work, *Alcoholic Fermentation*, appeared in four editions. He was co-author (with Sir Henry Enfield Roscoe) of a history of John Dalton's theories of atomic structure, published several chemical texts and numerous scientific papers and served as joint editor of *The Biochemical Journal* from 1913 to 1937. Recipient of the Davy medal in 1935, he was knighted in 1936. He continued his scientific work from the time of his retirement from the Lister institute in 1930 until his death at Bourne End, June 17, 1940.

(B. V.)

HARDEN, MAXIMILIAN (1861–1927), German journalist, was founder and editor of *Die Zukunft* (1892–1923), a sensational political weekly paper of considerable influence. Harden, whose real surname was Witkowski, was born in Berlin on Oct. 20, 1861. In *Die Zukunft* he appeared as a vigorous supporter of Bismarck, and his attacks on William II's circle led to a prosecution for libel (in which Harden justified his statements) and to the trial of the diplomat Philip zu Eulenburg und Hertefeld (*q.v.*). In the years before World War I and for the first part of the war Harden supported an aggressive nationalist policy. After 1918, however, he figured as a radical socialist. His questionable journalistic methods aroused sharp hostility but his influence was undoubted. His works include a collection of essays *Köpfe* (4 vol., 1910–24). He died at Montana, Switz., on Oct. 30, 1927.

See H. Delbrück, *Kautsky und Harden* (1920).

HARDENBERG, KARL AUGUST, Prince von (1750–1822), Prussian statesman, the creator of the pre-Bismarckian Prussia based on a liberal-conservative civil service, was born at Essenrode (Hanover) on May 31, 1750, the son of Christian von Hardenberg, a Hanoverian field marshal. He studied law at Göttingen and Leipzig, entered the Hanoverian civil service in 1770 and traveled in Germany, Holland, France and England. He married the countess Juliane von Reventlow in 1774. In England again, he applied for the post of Hanoverian minister in London, but in 1781 he had to leave the Hanoverian service because his wife had formed a liaison with the prince of Wales. He was in the service of the duke of Brunswick from 1782 to 1792 but had to leave this post too when, after being divorced from his wife, he married a divorcee. In 1792 he entered the Prussian service and became the minister for the administration of the margraviates of Ansbach and Bayreuth, which had recently fallen to Prussia. Thenceforth he was active in those spheres where he later gained historical significance, namely internal administration and foreign affairs.

Hardenberg reorganized finance, justice, education and transport and, as the plenipotentiary of the Prussian king, concluded the peace of Basel with the French republic in 1795 (*see* French Revolutionary Wars). In this Prussia agreed to the surrender of the left bank of the Rhine to France, receiving in exchange the reversion of rich imperial abbacies and bishoprics in northern Germany. Hardenberg formulated his program of foreign policy thus: "The aim of Prussian policy, as I see it, consists in the adroit use of circumstances whenever territory can be acquired or the frontiers of the state can be rounded off." In 1804 he became foreign minister. Up to 1806 he advocated neutrality toward France with a view to gains in Germany. In domestic affairs, Hardenberg, like Karl vom Stein (*q.v.*), aimed to abolish the so-called "cabinet" system of government and to establish the departmental ministers at the expense of the cabinet counselors, by obtaining for them direct access to the king as the king's most powerful advisers. This he finally achieved in April 1807.

After Prussia's collapse in the war of 1806–07 against France (*see* also Napoleonic Wars), Hardenberg, at Napoleon's behest, had to surrender his ministry and to withdraw from political life.

When in 1810 Prussia was faced with insolvency and could hardly maintain payments of the indemnity to Napoleon, Hardenberg offered his services to restore the states' finances. He had long held the trust of King Frederick William III and the sympathy of Queen Louise, and now Napoleon, to whom payment of the indemnity mattered most, agreed to his reinstatement. Thus in 1810 Hardenberg became prime minister (*Staatskanzler*) with full powers. At the same time he supervised the ministries of the interior and finance.

In domestic matters Hardenberg began the second stage of the reforms inaugurated in 1807–08 under Stein. After his enforced dismissal in the summer of 1807 the king had charged Hardenberg to draw up a report "on the reorganization of the Prussian state." He thereupon set out his fundamental principles for reform in the comprehensive "Riga memorandum." He held fast to the absolute monarchy but showed sympathy for the liberal principles of the French Revolution and the administrative reforms in France, completed under Napoleon. His theme was "democratic principles in a monarchical regime." He recommended these principles to the king as the only means of overcoming the crisis of the state. The reforming legislation of 1810–12, inspired by Hardenberg, grew from these convictions. This legislation simplified and unified the excise duties (hitherto levied only in the towns) and sought to impose the property tax on the nobility (hitherto exempted). It also introduced freedom of trade and a profit tax; regulated the redemption of peasant holdings from the great landed estates; and brought civic equality for the Jews. Further legislation gave greater and more rapid efficacy to the executive in the intermediary administrative spheres. Hardenberg even made a bold attempt to bring the people into closer contact with the affairs of state by inviting the co-operation of the upper-middle-class citizens—in accordance with the French example—and preparing a representative assembly (*Nationalrepräsentation*) with consultative powers. He hoped thus to win public opinion for the government and its unpopular measures, so often necessary during the emergency. However, the opposition of the aristocratic landowners and their influence with the king often attenuated the scope of his plans. The reaction after 1815 was unfavourable to the reforms and brought the agricultural reorganization to a halt, and the establishment of a representative assembly, which Hardenberg urged till his death, was postponed until 1847.

If Hardenberg gave less of his energies to reform after 1812 this was because foreign policy made ever greater claims on him. Early in 1812 Prussia had to sign a military alliance with France. After Napoleon's disastrous Russian campaign, Hardenberg preserved the appearance of the alliance but increased armaments and watched for the favourable moment for liberation. With great discretion, he advised the king to break away only when Prussia had an alliance with Russia. This was achieved, on the basis of the Russian proposals delivered by Stein on Feb. 27, 1813, in the alliance of Kalisz. Accommodating and ready for compromise, Hardenberg, who represented Prussia in numerous international negotiations between 1813 and 1822, steered his country through the conflicting interests of the great European powers. Particularly at the congress of Vienna, during the crisis between the great powers over the "Saxon-Polish question," he was able to bring about the *rapprochement* between Russia and Great Britain, the main adversaries: he yielded to pressure from Austria and Great Britain and waived the annexation of Saxony (which Prussia had stipulated as the price of consent to Russia's designs on Poland) in return for compensation elsewhere. In foreign affairs he associated himself, from 1815, with the conservative policy of the eastern powers (*see* HOLY ALLIANCE). He died immediately after the congress of Verona, on Nov. 26, 1822, in Genoa. He had been created prince in 1814.

An affable personality, versatile and charming, Hardenberg lacked Stein's depth and strength of character. He was an enlightened and optimistic 18th-century man of the world whose private life was riddled with scandal. Nevertheless his achievement as a statesman was extraordinary. His conception of equality before the law for all citizens made a great advance toward political liberalism and constitutionalism. His conduct of foreign policy saved Prussia in its greatest crisis since the Seven Years' War.

His memoirs (*Denkwürdigkeiten 1805–07*) were edited, with a biography, by L. von Ranke, five volumes (1877).

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(E. W. Z.)

ROCHE

HARDHACK (SPIRAEA TOMENTOSA)

HARDHACK (*Spiraea tomentosa*), a North American shrub of the rose family (Rosaceae; *q.v.*), called also steeplebush, native to open grounds from Nova Scotia to Manitoba and southward to Georgia and Kansas. It has an upright, woolly, reddish-brown stem, two to four feet high, bearing oval, pointed, sharply toothed leaves, which are grayish or yellowish and woolly beneath, and a slender, steeplelike flower spike crowded with tiny deep-pink flowers, blooming in late summer. The hardhack, which is sometimes planted for ornament, is especially abundant in eastern New York and New England, where in many localities it occurs in weedlike profusion, becoming pestiferous in meadows and pastures. *See* SPIRAEA.

HARDICANUTE (*c.* 1019–1042), king of the English from 1040 to 1042, son of Canute and Emma, daughter of Richard I, duke of Normandy, was made king of Denmark by Canute in 1028. On Canute's death in 1035, a party led by Emma and Earl Godwin wished to elect him king, but Earl Leofric of Mercia with the Londoners and the northern thegns obtained the appointment of Canute's illegitimate son Harold as regent, while Emma and her son's housecarls stayed at Winchester to guard Hardicanute's interests. His delaying in Denmark resulted in Harold's recognition as king in 1037 and in Emma's exile. Hardicanute joined her at Bruges in 1039, but before they had taken any action Harold died in 1040. Hardicanute became an unpopular king. He had Harold's body dug up and thrown into a fen. He levied a big tax to pay his fleet, and when two housecarls collecting it were killed at Worcester he sent an army which burned the city and ravaged the neighbourhood. The murder of Eadwulf, earl of Northumbria, when under Hardicanute's safe-conduct caused him to be described as a pledge-breaker in two manuscripts of the Anglo-Saxon Chronicle. He died on June 8, 1042.

See F. M. Stenton, *Anglo-Saxon England*, 2nd ed. (1947).

(D. WK.)

HARDIE, JAMES KEIR (1856–1915), British Labour leader, was the first independent Labour member of parliament, a dedicated and effective propagandist for ethical socialism and the symbol of the Labour movement in its early pioneering days. He was born on Aug. 15, 1856, in the Lanarkshire mining village of Legbrannock, Scot., the illegitimate son of a farm servant, although his mother married a ship's joiner and he became the eldest of a family of nine children. His childhood, passed partly in Glasgow and partly in the Lanarkshire coal field, was one of great hardship. He never went to school. At the age of eight he was employed as a messenger boy with a shipping company and at ten he began work in the mines.

Hardie was an active trade unionist from a very early age, and his strike activity had led to his being black-listed by the Lanarkshire mine owners by the time he was 24. He moved to the neighbouring county of Ayr and took on the secretaryship of the rudimentary miners' organization there. At times the organization was too weak to pay him any salary and he earned his living by working for the local paper. In 1887 he used this journalistic ex-

perience to launch *The Miner*, a monthly paper which dealt with wider political issues as well as with coal-field subjects. In the early 1880s Hardie would have counted himself a Liberal, but by this time his views, under the practical influence of mining hardship, were moving strongly in a socialist direction. In 1888 he contested Mid-Lanark as an independent Labour candidate, but he polled only 617 votes. This poor result led him to attempt an organization, and not merely a political position, independent of the traditional parties. The founding of the Scottish Labour party in 1889 owed much to him, and he provided much of the impetus which led in 1893 to the Bradford conference and the establishment of the Independent Labour party. By that time he was a member of parliament; he had been invited to contest West Ham (South) at the general election of 1892 and had secured a majority of 1,232 in a straight fight with a Conservative.

In the house of commons Hardie was in no way overawed by his minority position. He arrived (by accident rather than design, it transpired) in a deerstalker cap, and this unorthodox headgear became a symbol of Hardie's militancy and of Labour intransigence. He earned himself the title of "member for the unemployed," and in 1894 he resisted a motion of congratulation to Queen Victoria upon the birth of a great-grandson because there was not coupled with it a motion of sympathy to the victims of a major mining disaster which had occurred on the same day. Hardie lost his West Ham seat in 1895. He was out of the commons for five years and devoted his considerable energies to editing the *Labour Leader* (a paper which had grown out of *The Miner*), to incessant platform propaganda and to persuading the trade unions to sponsor a full-scale Labour party. The Independent Labour party he thought of as a socialist *corps d'élite*, but he wanted it to be buttressed by a Labour party sufficiently broadly based to be an effective instrument for electoral victory and reform. He greatly welcomed the resolution of the Trades Union congress in 1899 which led to the founding of the Labour representation committee in 1900, and he resisted attempts to give a narrow, sectarian basis to the new organization. Trade-union support should come first and socialist commitment, he believed, could be made to follow. With a flexibility and skill which are not always associated with his dedicated personality, Hardie worked hard and successfully to achieve these ends.

He returned to parliament in 1900 as one of the members for Merthyr Tydfil and continued to hold this seat for the remainder of his life. At this election the Labour Representative committee was successful in only two seats, and as the other member quickly moved into alliance with the Liberals, Hardie had to hold the fort alone. But in 1906 he was joined by 28 other Labour members and it was then possible to set up a party organization in the house of commons, with an elected leader, or chairman as he was then called, and separate whips. Hardie was elected the first chairman, but he was not wholly a success in this office. His parliamentary gifts were more suited to the gestures of defiance in which he had indulged in previous parliaments than to the leadership of a group or to the handling of day-to-day tactics. Ill-health soon added itself to his other difficulties, and he did not for long retain the leadership. But he remained the best-known and best-loved figure in the Labour movement in the country, and he continued to devote much of his energy to platform propaganda. As the danger of World War I increased, the strain of pacifism in his outlook, which had always been strong, became dominant. He sought to bind the Socialist International to declaring a general strike in all countries in the event of war breaking out. The complete collapse of these plans and the decision of a majority of the British Labour party to support the war filled Hardie with a deep sense of disillusion. He took little part in house of commons debates and became increasingly withdrawn from his colleagues. He died at Glasgow on Sept. 26, 1915. He felt that his life work had failed, but in fact he had laid foundations which changed the course of British politics for the next 50 years.

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HARDING, CHESTER (1792–1866), U.S. portrait painter, was born at Conway, Mass., on Sept. 1, 1792. He marched as a drummer with the militia to the St. Lawrence in 1813 and became subsequently chairmaker, peddler, innkeeper and house painter, painting signs in Pittsburgh, Pa., and eventually going on the road, self-taught, as an itinerant portrait painter. He soon became proficient, and in the early 1820s had such a vogue in Boston—80 portraits in six months—that he could afford a trip to England. He set up a studio in London and there met with great success, painting royalty and the nobility, and becoming, despite his lack of education and social experience, a favourite in all circles. Returning to the United States, he settled in Boston and painted portraits of many of the prominent men and women of his time. He died on April 1, 1866.

Harding's portraits may be seen at many galleries in the U.S., including the Essex institute, Salem, Mass.; the National Gallery of Art, Washington, D.C.; the Boston Athenaeum; and the Philadelphia Museum of Art.

HARDING, WARREN GAMALIEL (1865–1923), 29th president of the United States, was born near what is now Blooming Grove, Morrow county, Ohio, Nov. 2, 1865. His father, a farmer who also practised medicine, was of English and Scottish stock, and his mother was of English and Dutch descent. After local schooling, young Harding attended an academy at Iberia, known as Ohio Central college. He taught a term of school, after which he worked at various manual jobs until his family moved to Marion, O., then a town of less than 4,000, where his father had a better opportunity to practise medicine.

Harding read law for a short while but found it distasteful. He had managed his college newspaper and in 1884 found employment on a weekly paper, the *Marion Democratic Mirror*. He next formed a somewhat casual connection with the *Marion Star*, and late in 1884 he and a partner gave a mortgage to purchase the paper for $300 when it was about to be sold at sheriff's sale. For years the circulation was under 500 and the success of the venture was uncertain, but young Harding had found his vocation and soon bought out his partner. He collected news and advertising in person, set type and looked after the job printing until the paper began to prosper with Marion's growing population.

In 1891 Harding married Florence Kling De Wolfe, the daughter of a Marion banker. She was a widow with one child and was several years Harding's senior. She virtually took charge of the newspaper office and organized its first force of delivery boys. One of these, Norman Thomas, long afterward recalled that it was Mrs. Harding's "energy and business sense which made the *Star*. She was, for years, pretty nearly the whole show on the business side."

As the *Marion Star* prospered, Harding became a director in many local corporations and was prominent in fraternal orders. An able public speaker, and with an impressive presence, he participated in Republican campaigns and attached himself to Sen. Joseph B. Foraker's faction. In 1898 he was elected to the Ohio senate and at once became floor leader of the Foraker group there.

In his campaign for the senate, Harding became acquainted with Harry M. Daugherty who, at the end of Harding's second term in 1902, managed his nomination as lieutenant governor on the ticket headed by Myron T. Herrick, the candidate for governor. They were elected, and for two years Harding presided over the Ohio senate. Then, rejecting nomination for another term as lieutenant governor, Harding returned to his newspaper. In 1910 he was the Republican candidate for governor but lost to Judson Harmon by nearly 100,000 votes and believed his political career was over.

In 1912 Harding was chosen to present the name of Pres. William Howard Taft for renomination at the Republican national convention. In 1914 he won the nomination for U.S. senator over Foraker and was elected with a plurality of more than 100,000 votes, but his career in the senate was not conspicuous. He came to be known as a conservative who favoured high tariffs and other measures to aid big business and a nationalist who opposed the League of Nations. In 1916 he was the keynote speaker at the Republican national convention.

In 1919 Daugherty began promoting the somewhat unwilling Harding as a presidential candidate, but Harding showed no strength in the primary elections. At the Republican national convention in Chicago in 1920, three outstanding aspirants, Leonard Wood, Frank Lowden and Hiram Johnson, held their delegates firm for four ballots, whereupon the convention adjourned until morning. During the night, conferences of conservative leaders decided somewhat tentatively on Harding as one who, if elected president, would "go along" with them. They also were convinced that he could be nominated, possibly on the tenth ballot, which is how it turned out the next day. Calvin Coolidge was chosen as his running mate.

Harding, in conscious imitation of McKinley, did not make a speaking tour but conducted a "front porch" campaign. His intellectual limitations, however, could not be entirely concealed. In the election he was the beneficiary of the nation's feeling of war weariness and reaction against wartime restrictions and against the idealism of President Wilson implicit in the covenant of the League of Nations, which the senate had rejected. The electorate welcomed the "return to normalcy" proposed by Harding. Harding was the victor in the electoral college by 404 votes to James M. Cox's 127 and by 61% of the popular vote, a percentage that had not previously been attained by any candidate since election of presidential electors by popular vote had become the general rule. He resigned from the senate and was inaugurated as president on March 4, 1921.

President Harding immediately called congress into an extra session. Although he exerted no legislative leadership, congress, in accordance with his recommendations, established a budget system for the national government, passed the Fordney-McCumber tariff, revised wartime taxes, adopted a resolution ending the state of war with Germany and approved an act restricting immigration. Another outstanding event of his administration was the Washington conference of 1922 in which Secretary of State Charles Evans Hughes negotiated treaties limiting and reducing the naval strength of the leading powers. (*See* UNITED STATES [OF AMERICA]: *History;* WASHINGTON CONFERENCE.)

President Harding's cabinet, like most cabinets, was a mélange of men of native ability and political or industrial experience and party leaders who claimed office as a reward for services rendered the new president. The outstanding names were those of Charles E. Hughes and Herbert C. Hoover, who became secretary of state and of commerce, respectively. The distinguished career of the former and the widespread confidence in his ability and political integrity had marked him for the most important position in the cabinet, and there had been a general demand that the new administration utilize the organizing ability displayed by Hoover in many fields. The choice of Andrew W. Mellon, a wealthy banker and ironmaster of Pittsburgh, as secretary of the treasury was welcomed by men of business. Political and personal debts were paid by the choice of Albert B. Fall as secretary of the interior, Daugherty as attorney general and Will H. Hays as postmaster general. The conduct of administrative and political affairs by the latter group and others less prominent in the new administration soon brought intense criticism upon the president and the Republican party.

The most sensational scandal of Harding's administration concerned the Teapot Dome oil reserve. After having jurisdiction over certain naval oil reserves transferred from the department of the navy to the department of the interior, Secretary Fall leased Teapot Dome to oil interests for a bribe that eventually put him in a federal penitentiary and forced the resignation of Secretary of the Navy Edwin N. Denby, who had innocently consented to the transfer of the reserves. Attorney General Daugherty, who was charged with having received payments from violators of prohibition statutes, was eventually forced to resign by Harding's successor, Calvin Coolidge. (*See* OIL RESERVES SCANDAL [U.S.].)

In the spring of 1923 the public was as yet unaware of these scandals, though rumours of wholesale looting by the alien property custodian and by the director of the veterans bureau were afloat. Sen. Thomas J. Walsh was gathering evidence that would expose the oil-lease scandal. In the midst of the impending debacle of his administration, Harding, accompanied by his wife and a party of 65, set out on a transcontinental tour. The president went on to Alaska, where the receipt of a long cipher message from Washington almost prostrated him. Upon his arrival in San Francisco the doctors found him in a state of utter exhaustion. On Aug. 2 he died amid conflicting rumours as to the cause of his fatal illness. Personally free from corruption, Harding had imprudently appointed and trusted corrupt men whose betrayal of his trust broke his spirit and doubtless contributed to his untimely death. (C. SEY.; W. E. BY.)

HARDINGE, HENRY HARDINGE, VISCOUNT (1785–1856), British field marshal and governor general of India, was born at Wrotham, Kent, on March 30, 1785. He entered the army in 1799, passed through the Royal Military college, and served with distinction as a staff officer in the Peninsular war and as British commissioner at Prussian headquarters in the Waterloo campaign, being created a knight commander of the Bath for his services.

From 1820 to 1844 he was a member of parliament, serving as secretary at war in 1828 under the duke of Wellington and from 1841 to 1844 under Sir Robert Peel, and as chief secretary for Ireland in 1830 and again in 1834–35. He succeeded his brother-in-law, Lord Ellenborough, as governor general of India in 1844. There he encouraged education by offering government employment to the college-educated. He appointed Capt. Charters Macpherson to suppress human sacrifice in the Orissa hills and sought to prevent suttee (*q.v.*) and infanticide in the Indian states. He began construction of the Ganges canal and made plans for an Indian railway system. He tried to avoid any provocation of the turbulent Sikhs, but when in 1845 war came he personally took part in defeating them. He put himself under his commander in chief, Sir Hugh Gough, but could not refrain from unwisely overruling him at Ferozeshah. For his part in the victory Hardinge was created a viscount. By the treaty of Lahore, March 1846, he sought to re-establish a friendly, if much reduced, Sikh state, choosing as resident first Henry and then John Lawrence. His sale of Kashmir, part of the war indemnity, to the Dogra Rajput, Gulab Singh, was less happy.

In 1852 he succeeded Wellington as commander in chief of the British army. Though he was responsible for the establishment of the first training camp at Chobham, for the purchase of Aldershot and for the introduction of the Enfield rifle, his lax administration and unwise choice of commanders were partly responsible for the disasters of the Crimean War. Created field marshal in 1855 after the fall of Sevastopol, he died on Sept. 24, 1856, at South Park near Tunbridge Wells.

See C. Hardinge, *Viscount Hardinge* (1891); and R. S. Rait, *Life and Campaigns of Hugh, First Viscount Gough,* 2 vol. (1903). (J. B. HA.)

HARDINGE OF PENSHURST, CHARLES HARDINGE, 1ST BARON (1858–1944), British diplomat and viceroy of India, was born in London on June 20, 1858, the second son of the 2nd Viscount Hardinge. He was educated at Harrow and Trinity college, Cambridge, and entered the diplomatic service in 1880. He became assistant undersecretary for foreign affairs in 1903, ambassador to Russia in 1904 and permanent undersecretary for foreign affairs in 1906. Hardinge was appointed viceroy of India in 1910 and raised to the peerage. His government reversed Lord Curzon's unpopular partition of Bengal and transferred the capital of India from Calcutta to Delhi. Although Hardinge was wounded by a bomb at his state entry into Delhi in 1912, his viceroyalty saw a great improvement in the relations between the government and the nationalists. This was due not only to the Morley-Minto reforms (*see* INDIA-PAKISTAN, SUBCONTINENT OF) and the reversal of the partition but also to the efforts Hardinge made to cultivate a better understanding with nationalists. He expressed his sympathy for the grievances of Indians in South Africa, and when World War I broke out he impressed on the British government that Indian troops should fight in Europe without racial discrimination. On his return to England in 1916 he again became permanent undersecretary for foreign affairs. His subse-

quent offer of resignation because of criticism of his part, as viceroy, in the arrangements for the abortive Mesopotamian campaign was refused. Hardinge became ambassador to Paris in 1920 and retired in 1922. He died at Penshurst on Aug. 2, 1944. A volume of memoirs, *My Indian Years, 1910–1916,* was published in 1948.

(KE. A. B.)

HARDNESS TESTING. History is replete with references to the preoccupation of man with tools, that is, materials hard enough to cut or otherwise deform softer materials. Attempts to evaluate relative resistance to deformation are noted in early historical records, for example, the use of a file test in 1640 is recorded.

Although others anticipated it, F. Mohs' scale of resistance to indentation as judged by which material will scratch another has been widely accepted and is used by mineralogists. His scale, first described in 1812, assigns numbers to natural minerals (*see* MOHS' SCALE).

With development of the arts, there was an increasing demand for more precise evaluation of hardness, particularly of metals, characterized by some ability to deform without fracture. J. A. Brinell met this demand very effectively about 1900 with his test for hardness. As commonly used, a load of 3,000 kg. is applied to a hardened steel ball 10 mm. in diameter which is in contact with the plane surface of the metal. The load is maintained for 10 seconds or more and then removed. The diameter of the impression remaining is measured and its spherical area calculated, assuming the same radius for the ball indenter and the indentation. The Brinell hardness number is then obtained by dividing the load in kilograms by the area in square millimetres.

A limitation of the Brinell test is that its use is restricted to metals softer than the indenter. Metals used in tools frequently attain this level of hardness. The metallurgist Stanley P. Rockwell introduced, about 1920, a test applicable to high levels of hardness. It employs a diamond cone indenter with a spherical point. A hardness number is obtained from the difference between the depth of the impression in millimetres for the major load and that for a minor load. This number is read directly from a dial on the machine. Since fast and reliable readings are readily obtained, it is widely used in industrial inspection. The hardness scale used, however, is nonlinear relative to the Brinell scale and, moreover, has a limited range of high sensitivity, so a variety of other scales are in use and are described in the literature. These scales embrace a range of major loads from 15 to 150 kg. applied to spherical hardened steel indenters from $\frac{1}{16}$ to $\frac{1}{2}$ in. diameter, as well as to the diamond cone. Low loads and large indenters are used to test soft materials such as bearing metals and plastics.

The first hardness tester to meet acceptably the demand for a continuous sequence of comparable numbers over the very wide range of hardness found in metals was the Vickers hardness tester, apparently invented by R. L. Smith and C. E. Sandland. In this method a square-based diamond pyramid indenter is used with 136° angle between opposite faces. This angle was chosen as the mean for the range of penetrations recommended with the Brinell test. At this angle, identical hardness numbers are obtained on relatively soft metals with both the Brinell and Vickers tests. Loads from 10 to 100 kg. are used and the length of the impression diagonals is measured with a micrometer ocular in a microscope that swings over the work after the impression is made. While this machine is much preferred for laboratory work, its operation is rather slow for routine inspection.

There still remain many materials such as glass and minerals whose hardness is of interest but which will crack under the diamond indenters already described. The Knoop hardness test overcomes this limitation by use of an elongated diamond-shaped indenter. An undistorted impression has a length 7.1 times its width and 30.5 times its depth. With this indenter, the hardness of extremely brittle materials, including glass and even diamonds, can be measured without cracking or spalling either the indenter or the test piece.

The Knoop hardness test number embodies several important departures from conventional hardness testing practice. First, the hardness number is defined as the ratio of the load to the unrecovered lateral area of the indentation in kilograms per square millimetre. The unrecovered area, as distinct from the recovered contact area measured in the Brinell method, is the theoretical lateral area of the indentation while the load is being applied. The Knoop hardness number is found by measuring the length of the impression which is sharply defined and calculating the lateral area from the known ratio of width to length of the indenter. This area is equivalent to that under load because there is lateral spring back. However, width of the unloaded impression relative to length varies widely among the materials tested as a result of differences, among other things, in elastic deformation. A measure of this effect is taken as the ratio of the recovered impression width to that as loaded.

This concept of hardness evaluation found much support when the Brinell test was introduced though Brinell promulgated the use of the ratio of applied load to recovered contact area for an assumed unloaded ball diameter. In the late 1950s this was still current. Knoop *et al.* effectively justified their break with precedent in the following words:

> The use of areas which depend upon the elastic recovery of a material is rejected as a method of expressing the results of indentation tests because this associates an applied load with an area other than that involved at the time the load was applied. Furthermore, an unrecovered area is chosen to express the indentation number because it seems to afford the most rational interpretation of the results, placing as it does, vastly different materials such as rubber, copper, glass, and hardened steel in some logical order; whereas, no reasonable sequence results from the use of recovered areas. (F. Knoop, C. G. Peters and W. B. Emerson, "A Sensitive Pyramidal-Diamond Tool for Indentation Measurements," *J. Res. Nat. Bur. Stand.*, 23:39–61, July 1939.)

The merit of the Knoop test, as applied to brittle materials, is well attested to by the evaluation of minerals of the Mohs' hardness scale shown in the table.

Material	Hardness Number	
	Mohs	Knoop
Pitch (for optical polishers)	...	1–22
Gypsum	2	32
Calcite	3	135
Fluorite	4	163
Flint glass	...	180–390
Apatite (parallel to axis)	5	360
Apatite (perpendicular to axis)	5	430
Crown glass	...	420–470
Fused quartz	...	475
Albite	6	490
Orthoclase	6	560
Crystalline quartz (parallel to axis)	7	710
Crystalline quartz (perpendicular to axis)	7	790
Nitrided annealed high-speed steel	...	800
Chromium plate	...	850–900
Carboloy	...	1,050
Nitrided hardened high-speed steel	...	1,100
Topaz	8	1,250
Alundum	...	1,635
Silicon carbide	...	2,000
Boron carbide (molded)	...	2,230
Diamond	10	8,000–8,500

From F. Knoop, C. G. Peters and W. B. Emerson, "A Sensitive Pyramidal-Diamond Tool for Indentation Measurements," *J. Res. Nat. Bur. Stand.*, 23:39–61, July 1939.

BIBLIOGRAPHY.—General information on hardness testing is given in the *Metals Handbook*, pp. 93–105 (1948 ed.) and in Hugh O'Neil, *The Hardness of Metals and Its Measurement* (1934). Basic historical works are F. Mohs, *Grundriss der Mineralogie* (1822) and J. A. Brinell, *II Congres Int. des Methodes d'essai* (1900). The original description of the Vickers hardness tester is given in "Accurate Determination of the Hardness of Metals," *Engineering*, p. 518 (April 25, 1924). Also on the Vickers method is R. L. Smith and G. E. Sandland: "Some Notes on the Use of a Diamond Pyramid for Hardness Testing," *J. Iron St. Inst.*, 111:285–294 (1925). Detailed experience with the Knoop tester, including evaluations of many materials, is given in F. Knoop, C. G. Peters and W. B. Emerson: "A Sensitive Pyramidal-Diamond Tool for Indentation Measurements," *J. Res. Nat. Bur. Stand.*, 23: 39–61 (July 1939).

(HO. S.)

HARD OF HEARING: *see* DEAFNESS AND IMPAIRED HEARING; DEAF AND HARD OF HEARING, TRAINING AND WELFARE OF.

HARDOI, a municipal town and a district in the Lucknow division of Uttar Pradesh, India. The town, 63 mi. N.W. of Lucknow on the main Northern railway line between Bareilly and Lucknow, is an important grain market. Pop. (1961) 36,725.

HARDOI DISTRICT (2,320 sq.mi.; pop. [1961] 1,573,171) is a level tract watered by the Ganges, Ramganga, Deoha (or Garra), Sukheta Sai, Baita and Gumti rivers—the first three being naviga-

ble by small boats. Toward the Ganges on the southwestern border the land is uneven, often rising in sand hillocks cultivated at the base and covered with lofty munj grass (*Saccharum sarc*) on the slopes. There are several large *jhils*, or swampy meres, the biggest being that of Sandi in the south, 3 mi. long and ¾ mi. broad. Great tracts of forest jungle, thatching grasses, shrubs and bushes still exist. The main crops are millets, rice, wheat, gram, barley and sugar cane. Sandila, about halfway between Lucknow and Hardoi, is a hand-loom weaving centre. (B. St.)

HARDOUIN, JEAN (1646–1729). French Jesuit scholar who edited the councils of the church, was born in Quimper on Dec. 22, 1646. He entered the Society of Jesus in 1666 and was professor of positive theology in the Jesuit college at Paris from 1683 to 1718. A man of great learning, he early came to strange conclusions from his mass of evidence and tended to dismiss as spurious the works which provided evidence contrary to his opinion. As he aged, he was ready to jettison almost all the writers of Greek and Latin antiquity, holding them to be medieval forgeries, in order to preserve the orthodoxy of the early church. In 1724–25 he tried to demolish the validity of Anglican orders by a similar theory. After the publication at Amsterdam of his *Opera selecta* (1708) he was compelled to disavow publicly the theory of a forged antiquity, but it rapidly resumed its sway over his mind. In the course of these odd studies he provided a mass of accurate information, of great use to other scholars. His learning was best shown in his *Acta conciliorum*, 11 vol. (1715), one of the notable works of scholarship in that epoch, transforming the study of canon law, being the basis of all subsequent work, and still useful. Hardouin died in Paris on Sept. 3, 1729.

See list of Hardouin's works in C. Sommervogel, *Bibliothèque de la compagnie de Jésus*, vol. 4, col. 84–111 (1893); P. Bernard in A. Vacant (ed.), *Dictionnaire de théologie catholique*, vol. 6, col. 2042–46 (1920). (W. O. C.)

HARDWAR ("Door of Hari"; *i.e.*, of Vishnu), an ancient town of India and one of the great places of pilgrimage for Hindus, lies in the Saharanpur district of Uttar Pradesh, on the right bank of the Ganges at the point where it debouches from the foothills of the Himalayas into the plains. Pop. (1961) 58,513. The position is of great natural beauty, and the river at this point has special sanctity. The town has borne many names, being known originally as Kapila, from the sage Kapila. Hsüan Tsang, the Chinese Buddhist pilgrim, in the 7th century visited a city which he calls Mo-yu-lo, the remains of which still exist at Mayapur, a little to the south of the modern town. Among the ruins are a fort and three temples, decorated with broken stone sculptures. The goal of the vast numbers of Hindus who visit Hardwar is the Hari-ka-charan ("Vishnu's Footprint") bathing ghat, with the adjoining Daksheshwar temple at the spot called Gangadwara. The *charan* or footmark of Vishnu, imprinted on a stone let into the upper wall of the ghat, forms an object of special reverence, and water from the pool below is carried all over India for use on solemn occasions. A great assemblage of people takes place annually at the beginning of the Hindu solar year (April–May) when the sun enters Aries; every 12th year, when Jupiter is in Aquarius, a *Kumbh-Mela* (festival) is held. After 1892 many sanitary improvements were made for the benefit of the annual concourse of pilgrims. It is at Hardwar that the main Ganges canal leaves the river, and the headworks are an engineering feat of interest.

(J. B.-P.)

HARDWARE, a term applied to a large variety of metal goods, especially domestic ironware (ironmongery) and appliances, hand tools, small metal manufactures and garden appliances. The term includes builders' hardware, *i.e.*, hardware items used in the construction of new buildings of all kinds, and hardware supplies for gas and electrical and other industries.

Great Britain.—Birmingham is the centre of the English hardware manufacturing industry; practically every kind of hardware is made there. One leading branch is the manufacture of hollow ware—cast-iron, galvanized, enameled and aluminum products for domestic and other uses. Cast-iron pots are still made for both home use and export, but these products suffered first from the competition of enameled goods (*see* PORCELAIN ENAMELING) and later from aluminum ware. Aluminum hollow ware, which may be cast, deep-drawn under heavy pressure or spun from a flat disk of metal, is by far the most popular for cooking purposes. Cast-aluminum ware is the most expensive kind but is used largely for ships and hotel kitchens. Tin is used for baking tins, roasting tins and similar items, in which there is a big trade, as well as for inexpensive kettles and saucepans.

The manufacture of fireplace sets and fire screens is another great industry. New metals and finishes to eliminate the labour of cleaning have been adopted; the goods are made in copper, bronze, satin brass, oxidized silver and stainless steel.

Cutlery (*q.v.*) and electroplate trades have been centred in Sheffield for generations. Machine processes and mass-production methods have been increasingly applied in the cutlery industry. Hand-forged crucible steel blades are still made, but machine processes have been brought to a fine pitch of perfection, and the tradition for quality products is well maintained. The manufacture of stainless steel (*q.v.*) by Harry Brealey in the Brown-Fitch Research laboratory prior to World War I was one of the most far-reaching developments in the history of the hardware trades; not only did it largely revolutionize the cutlery trade but it also proved of great value for hollow ware and other uses. Just as progress has been recorded in regard to steel for cutlery purposes, so also there have been important developments in subsidiary materials and processes. For example, handles of plastic are now used for many table knives and great improvements have been made in precision grinding.

In plated goods, chromium plating applied to base metal is used not only for flatware such as spoons and forks but also for hollow ware, plumbers' fittings, bathroom fixtures and other goods for domestic and industrial uses where the "stainless" requisite is desirable.

Stainless steel and aluminum are utilized extensively and mechanical methods are rapidly superseding old laborious hand practices. Machine molding, for instance, is widespread. Large outputs of light castings are made by foundries at Rotherham, Leeds, Warrington, Birmingham, in the Black Country and at Luton. Wire manufacture is the chief industry of Warrington, and wire netting works are situated there and also in Manchester, Sheffield, Norwich, London, Bristol and Chichester. Willenhall and Wolverhampton are the most important centres for locks and latches. Corrugated iron is largely produced in London, Ellesmere Port, Glasgow and South Wales and in the West Riding of Yorkshire; metal casements are made in Essex; plumbers' brass foundry and fittings are made in various centres, but largely in Birmingham, and screws and nails also in the Midlands. There are still a few hand nail makers in the Black Country, but their output is negligible compared with the production of modern factories. Birmingham's output of screws is 3,000,000 to 4,000,000 per week, and there is a big output also at Leeds. Approximately 65% of the industry is located in Sheffield and 30% in the Birmingham area and both sections cover almost all aspects of the industry.

Sheffield manufacturers produce saws and woodworking tools, engineering tools and appliances, tools for road making and agricultural work and garden requisites. Agricultural implement making is carried on in Scotland, in the West Riding of Yorkshire and in the eastern counties. The domestic washing-machine trade is concentrated mainly in London and the home counties, the Midlands and Lancashire; most laundry machinery is manufactured in London and the home counties. Carpet sweepers and domestic mops are largely produced in Lancashire, and brushes of all kinds are made at Oldham, St. Albans, London and Wymondham.

An outstanding feature of the hardware trade is its tremendous scope and its varied range of patterns. The best minds in the trade are now directed toward simplification by the elimination of many patterns and sizes. Great progress has been made with standardization in Great Britain, largely as a result of the work of the British Engineering Standards association.

(N. F.; R. S. Wo.)

The United States.—At the beginning of the 19th century the term hardware meant chiefly mechanics' tools and builders' hardware, but in the United States it now includes all small metal

articles used in the construction of houses or for household purposes, tools of the mechanics' trades, the smaller articles for kitchen and dining-room use, tin plate, sheet iron, nails, screws, fence wire, etc. It is not uncommon for a large hardware firm to have in its catalogues nearly 100,000 kinds and sizes of articles.

In the early American colonial period supplies were brought from Europe. As the colonies assumed a definite shape, the village blacksmith established the foundation of American hardware manufacture by making tools, bars for doors and implements for agriculture. But greater development was both necessary and desirable because of the isolation of the colonies and the finding of coal and minerals in great abundance. Small home manufacture grew up to supply local demands, but the greatest part of the manufactured goods was imported. Immigrants brought their own tools, the patterns of which were at once copied and improved. Village blacksmiths in Connecticut and thereabouts began to make farm implements and simple hand tools about 1850, and by 1860 U.S. manufacturers had begun to win trade away from competitors by virtue of the higher quality of their goods. Labour-saving machinery was introduced later and foreign-made articles could not compete.

The hardware manufacturing industry in the U.S. had its beginnings in New England. The business gradually spread into the middle Atlantic states, especially New York and Pennsylvania. In the latter part of the 19th century New York became the undisputed centre of the trade. The majority of the great importing houses and the jobbers who distributed to the retail trade were located there. With the growth of the country, new manufacturing centres grew up, and New York was no longer the trade centre. After 1875, Ohio, Indiana, Illinois and Michigan were large producers. Later, Wisconsin, Iowa and Minnesota became important manufacturers of hardware. (W. H. Sie.; R. S. Wo.)

Cabinet, furniture and builders' hardware, which includes trimmings like knobs, handles, pulls, hinges and such items as small locks for cabinets, are manufactured in Pennsylvania, Wisconsin, Illinois and in several of the New England states, particularly Connecticut. Shelf hardware and padlocks are also made in the New England states, as well as in Pennsylvania and New York. Piano hardware is another group of products made largely in New England. Carpenters' and cabinetmakers' tools for working in wood, such as hammers, chisels, saws, planes and augers, are produced in the New England states, Pennsylvania, New York and Ohio; these states are renowned for the excellent hand and power saws that they produce. Most screws, including machine screws and wood screws, are produced in Rhode Island and Connecticut. (R. S. Wo.)

HARDWICKE, PHILIP YORKE, 1st Earl of (1690–1764), English lord chancellor, whose grasp of legal principle and study of the historical foundations of equity, combined with his knowledge of Roman civil law, enabled him to establish the principles and limits of the English system of equity. He was born at Dover on Dec. 1, 1690. Called to the bar at the Middle Temple in 1715, he afterward joined Lincoln's Inn, of which he was bencher and treasurer in 1724. He sat in parliament for Lewes (1719) and Seaford (1722–34); was solicitor general (1720), attorney general (1724), lord chief justice and baron Hardwicke (1733) and lord chancellor (1737).

For many years from 1740 onward Hardwicke held the controlling power in the government. During the king's absences on the continent he was an influential member of the council of regency, and he had to cope with the Jacobite rising of 1745. After Culloden he presided at the trial of the Scottish Jacobite peers. He carried out the great reform of 1746, which swept away the private heritable jurisdictions of the Scottish landed gentry; among his other great legal services was the reform of the English marriage laws (1753).

Hardwicke, who was created earl in 1754, retired with the duke of Newcastle in Nov. 1756, but helped to secure the coalition between Newcastle and William Pitt in 1757. He died in London on March 6, 1764.

Hardwicke was not a statesman of the first rank, but he was one of the greatest judges who ever sat on the English bench. Lord Campbell pronounces him "the most consummate judge who ever sat in the court of chancery, being distinguished not only for his rapid and satisfactory decision of the causes which came before him, but for the profound and enlightened principles which he laid down, and for perfecting English equity into a systematic science."

Born within two years of the death of Chief Justice Jeffreys, Hardwicke had a powerful influence in obliterating the evil traditions of the judicial bench under the Stuart monarchy.

Bibliography.—The contemporary authorities for the life of Hardwicke are voluminous, being contained in the memoirs of the period and in numerous collections of correspondence in the British museum. *See*, especially, the *Hardwicke Papers;* Horace Walpole, *Letters*, ed. by P. Cunningham, 9 vol. (1857–59); *see* also Lord Campbell, *Lives of the Lord Chancellors*, 8 vol., vol. v (1845). (W. T. Ws.; X.)

HARDWOODS, a trade term employed by lumbermen to designate timbers obtained from broad-leaved trees. Coniferous trees, in turn, produce the softwoods of the trade. These two terms often lead to confusion: they should be used only to indicate classes of material rather than specific mechanical properties exhibited by either class. Actually there are several hardwoods, such as yellow poplar, aspen or balsa, that in the mechanical sense are much softer than softwoods of the order of longleaf pine, Douglas fir or yew.

Many beautiful hardwoods are known to the trade, and to this group are traceable such renowned cabinet timbers as American black walnut, Indian rosewood, teak, ebony, primavera, maple, satinwood, American and African mahoganies, greenheart and vermilion. *See* Wood.

HARDY, ALEXANDRE (1572?–1632), French dramatist, one of the most fertile of all playwrights. He himself claimed to have written some 600 plays, of which, however, only 34 are preserved. Born in Paris, probably in 1572, he is the first Frenchman known to have made his living as a dramatist. He was a "hired poet" for troupes of actors, sometimes in the provinces and sometimes in Paris, at the Hôtel de Bourgogne. He was associated in 1611 (and, without doubt, for some years beforehand) with the *Comédiens du roi*, who were directed by the famous actor Valleran-le-Conte. In 1620, as *"poète du roi,"* he was working for a company run by Bellerose (Pierre Le Messier, d. 1670), *"Comédiens du roi,"* and in 1626–27 he was providing six plays a year for the company known as *Les Vrais comédiens du roi.*

His patrons were Henry II, duc de Montmorency, and Louis II, prince de Condé; and Théophile de Viau, François Tristan l'Hermite, Georges de Scudéry and Richelieu's agent, Isaac de Laffemas, all admired his work. However, his enormous output scarcely relieved his poverty. The actors who bought his plays allowed him to publish only very few of them and he was attacked by some of the young playwrights. Shortly after his death in 1632 his plays, which had often been produced during his lifetime, ceased to be performed.

It is impossible to do more than guess at the dates of his works. In 1623 he published *Les Chastes et loyales amours de Théagène et Cariclée*, in eight *"journées,"* and between 1624 and 1628 *Le Théâtre d'Alexandre Hardy parisien* in five volumes, which contains 12 tragedies, 4 untitled plays (tragedies and tragi-comedies), 5 pastorals and 2 mythological plays. Unlike some other 17th-century dramatists he did not take his themes from the Greek or Latin dramatists (except in his play *Alceste*), nor from the Bible; he turned instead to the works of the ancient historians, to Ovid, Claudian, Heliodorus, Montemayor, Cervantes, Boccaccio, etc., whose books he probably read in French or Latin translations. Because so many plays were demanded of him, his style is bad, and his vocabulary is antiquated. But though he did not play the leading part which E. Rigal claimed for him (in his *Alexandre Hardy*, 1889), he did exert considerable influence on the development of the French theatre.

In his tragedies he imitated the rhetoric of Robert Garnier (*q.v.*); but he introduced the freedom of the baroque theatre to the French stage, rejecting the unities of time and place, shortening soliloquies, cutting down or doing without the chorus and depicting acts of violence and murders on the stage. His plots are not so slow and have more movement in them than those of many

Renaissance tragedies; the action is linked with the psychology of the characters and the hero acts, develops and sometimes experiences inner conflict. Hardy wrote many tragicomedies which abound in sudden changes of fortune; he often violated conventional standards of dramatic propriety. His pastorals mark a distinct advance on those of the 16th century because of their fast-moving plots and the truth to life of the feelings expressed in them. Almost all the dramatists of the succeeding generation affected contempt for his work; but they profited from his dramatic technique.

BIBLIOGRAPHY.—*Le Théâtre d'Alexandre Hardy*, ed. by E. Stengel, 5 vol. (1883–84). *See* also E. Rigal, *Le Théâtre français avant la période classique* (1901); S. W. Deierkauf-Holsboer, *Vie d'Alexandre Hardy, poète du roi* (Proceedings of the American Philosophical Society, 1947); H. C. Lancaster, *A History of French Dramatic Literature in the 17th Century*, part 1 (1929). (RA. L.)

HARDY, SIR GODFREY HAROLD (1877–1947), English mathematician, one of the leading mathematicians of his time, was born at Cranleigh, Surrey, on Feb. 7, 1877, and died on Dec. 1, 1947. He was educated in Cranleigh school, Winchester college and at Trinity college, Cambridge, where he became a Prize fellow (1900–06). From 1906 to 1919 he was a lecturer in mathematics in Trinity college. In 1910 he was elected a fellow of the Royal society and in 1914 was made Cayley lecturer in Cambridge university. In 1919 he was appointed to the Savilian chair of geometry at Oxford university. He returned to Cambridge in 1931 as Sadleirian professor of pure mathematics, a post which he occupied until his retirement in 1942. He received a royal medal of the Royal society in 1920, the society's Sylvester medal in 1940 and its Copley medal in 1947. Many other distinctions and honorary degrees were bestowed upon him. His main mathematical interests lay in analysis and he wrote a number of treatises, contributing more than 300 papers to mathematical periodicals.

(D. MCK.)

HARDY, THOMAS (1840–1928), English novelist and poet, was born at Upper Bockhampton, near Stinsford in Dorset, on June 2, 1840. His father was a master mason, of a family originally connected with the Le Hardys of Jersey, who had settled in the west of England in the 15th century. His mother also came of a family long established in Dorset: smallholders in the parish of Melbury Osmond. Hardy owed much to his parents and their rural background, inheriting from his father a love of music, from his mother a love of reading, and from both strength of personality as well as the stability which connected him in an age of change with a world already vanishing.

He went first to the village school and then to a school in Dorchester, and added to the good grounding they provided by his own studies, teaching himself Greek and reading thoughtfully. In 1856 he was articled to John Hicks, an ecclesiastical architect in Dorchester; he continued his own reading, encouraged by William Barnes, the Dorset poet, who kept a school next door to Hicks's office, and by Horace Moule, the brilliant son of the vicar of Fordingbridge, to whose friendship he owed much intellectual stimulus. He continued to live at home, and to find in the life of the small rural community the refreshment and strength which were always necessary to him. In about 1857 he began to write verse and essays but, advised by Moule, decided not to give up architecture. After spending some time sketching and measuring many old Dorset churches with a view to their restoration, he went in 1862 to look for work in London. He became assistant to Arthur (later Sir Arthur) Blomfield, and worked hard at his profession (in 1863 winning both the medal of the Royal Institute of British Architects for an essay, *The Application of Coloured Bricks and Terra Cotta in Modern Architecture*, and the Architectural association's prize for design), although uncertain whether literature or architecture should be his life's work. He read and wrote, attended evening classes and went to art galleries and concerts. In March 1865 his first prose work, a humorous sketch, was published in *Chambers's Journal*, but he was more interested in poetry. Often lonely and depressed, he became ill, and in 1867 he returned to Dorset, working again for John Hicks, and, at Weymouth, for the architect who took over the business when Hicks died. During 1867 and 1868 he wrote a "purpose" story, *The Poor Man and the Lady*, which in 1869 was accepted by Chapman and Hall. It had been read by George Meredith, who asked the writer to call on him, and advised him not to print it but to try another with more plot. The manuscript was withdrawn and rewritten, but never published, and although Hardy made use of parts of it later, he destroyed the original.

In 1870 Hardy took Meredith's advice too literally, and constructed a novel that was all plot, which was published in 1871 under the title *Desperate Remedies*. In 1872 appeared *Under the Greenwood Tree*, subtitled "a Rural Painting of the Dutch School," in which Hardy found himself, and which he never surpassed in delicate perfection of art. *A Pair of Blue Eyes*, in which tragedy and irony come into his work together, was published in 1873. In 1874 Hardy married Emma Lavinia Gifford, whom he had met when working on a church in Cornwall. His first popular success was *Far From the Madding Crowd* (1874), which, on its appearance anonymously in the *Cornhill Magazine*, was attributed by many to George Eliot. Then came *The Hand of Ethelberta* (1876), subtitled not inaptly as "a Comedy in Chapters"; *The Return of the Native* (1878), the most sombre and, in some ways, the most powerful and characteristic of Hardy's novels; *The Trumpet-Major* (1880); *A Laodicean* (1881); *Two on a Tower* (1882), a long excursion in constructive irony; *The Mayor of Casterbridge* (1886); *The Woodlanders* (1887); a collection of *Wessex Tales* (1888); *A Group of Noble Dames* (1891); *Tess of the D'Urbervilles* (1891). Hardy's most famous novel; *Life's Little Ironies* (1894); *Jude the Obscure* (1896), his most thoughtful and least popular book; *The Well-Beloved* (1897), a reprint, with some revision, of a story originally published in the *Illustrated London News* in 1892.

In all his novels Hardy is concerned with one thing, under two aspects; not civilization, nor manners, but the principle of life itself, invisibly realized in humanity as sex, seen visibly in the world as what we call nature. He is a fatalist, perhaps rather a determinist, and he studies the workings of fate or law (ruling through inexorable moods or humours) in the chief vivifying and disturbing influence in life, women. His view of women is more French than English; it is subtle, a little cruel, not as tolerant as it seems, thoroughly a man's point of view, and not, as with Meredith, man's and woman's at once. He sees all that is irresponsible for good and evil in a woman's character, all that is untrustworthy in her brain and will, all that is alluring in her variability. He is her apologist, but always with a reserve of private judgment. No one has created more attractive women of a certain class, women whom a man would have been more likely to love or to regret loving. In his earlier books he is somewhat careful over the reputation of his heroines; gradually he allows them more liberty, with a franker treatment of instinct and its consequences. *Jude the Obscure* is, perhaps, the most unbiased consideration in English fiction of the more complicated questions of sex. There is almost no passion in his work, neither the author nor his characters ever seeming able to pass beyond the state of curiosity, the most intellectually interesting of limitations, under the influence of any emotion. In his feeling for nature, curiosity sometimes seems to broaden into a more intimate communion. The heath, the village with its peasants, the change of every hour among the fields and on the roads of that English countryside which he has made his own—the Dorsetshire and Wiltshire "Wessex"—mean more to him, in a sense, than even the spectacle of man and woman in their blind and painful and absorbing struggle for existence. His knowledge of women confirms him in a suspension of judgment; his knowledge of nature brings him nearer to the unchanging and consoling element in the world. All the entertainment which he gets out of life comes to him from his contemplation of the peasant, as himself a rooted part of the earth, translating the dumbness of the fields into humour. His peasants have been compared with Shakespeare's; he has the Shakespearean sense of their placid vegetation by the side of hurrying animal life, to which they act the part of chorus, with an unconscious wisdom in their close, narrow and undistracted view of things.

The order of merit was conferred upon Hardy in July 1910, and in his later years he received increasing recognition, not only

as a great novelist but also as a poet, until by common consent he was admitted the undisputed sovereign of English letters. His great epic-drama *The Dynasts,* in three parts (1903–04, 1906, 1908), a chronicle play of England's struggle against Napoleon, with an accompaniment of philosophic comment chanted by a chorus of "phantom intelligences," was in part produced by Harley Granville-Barker in the early months of World War I, and again at Oxford in 1920. Several volumes of lyric poetry followed. His first wife died in 1912, and in 1914 he married Florence Emily Dugdale, herself a writer of children's books and articles in periodicals.

Both on his 70th and his 80th birthday he received at Max Gate (the house he had built himself near Dorchester in 1883, and from which, latterly, he seldom moved) tributes of respect and admiration from the whole English-speaking world. When he died there, on Jan. 11, 1928, his death was felt as a loss, not only of a figure unique in literature because of his great age and of his eminence, but also as a snapping of the last link with the 19th century, and he was mourned as "the last of the great Victorians." His ashes were buried in Westminster abbey, but in consideration of his deep affection for his native Wessex and the peculiar inspiration it gave him, his heart was buried in his parish churchyard.

Aspects of Hardy's Genius.—Thomas Hardy's career naturally divides itself into three periods. The first of these contains his work as a novelist, and ends with *Jude the Obscure.* Throughout the series of the novels there gradually become more and more insistent—first as an element of irony, but later as the tragic essence of the narrative—a characteristic metaphysic, in which the strivings and passions of individuals are in fruitless conflict with the inexorable process of the world. *Jude the Obscure,* despite its splendid qualities, made it clear that such a theme could not be adequately developed in the form of the novel; a form was required in which the author could speak out his own convictions without violating aesthetic propriety.

Accordingly, the second period consists of *The Dynasts;* no doubt the greatest single achievement of his career. It may be said that this great poem was written in order to give full utterance, in artistic form, to his peculiar metaphysic. That, however, was not its originating intention, which was simply to celebrate in a chronicle play England's part in the Napoleonic Wars. But as the conception grew and deepened, and as to the human action the superhuman comment of "phantom intelligences" was added, the poem became the summation of Hardy's vision of life; and thereby achieved a unity which, in its intrinsic grandeur and in its perfect command over immense wealth of matter, can only be compared with such monuments of man's destiny as *Faust* and *Paradise Lost.* In diction, however, *The Dynasts* will not bear any such comparison.

The third period may be said to begin with *Time's Laughing Stocks* in 1909, and is devoted to lyric poetry. It is not often that an artist's life can be divided so definitely into separate stages, each stage characterized by the use of a different form; and, next to its length and plenty, and consistently noble idiosyncrasy, this tripartite division is, perhaps, the most remarkable feature of Hardy's career as a whole. The lyrical period, however, does not give us an entirely new development of his genius. While he was writing novels, he had occasionally experimented with poetry, and some of the results were published in *Wessex Poems* (1898) and *Poems of the Past and the Present* (1901), between *Jude the Obscure* and *The Dynasts.* The volumes published after *The Dynasts* also contained a good many more of these earlier poems. But after 1909 Hardy wrote little but lyrical poetry, and this may therefore be truly called his lyrical period. (*A Changed Man,* 1913, merely rescued from the periodicals of former years several stray pieces of minor fiction; *The Queen of Cornwall,* 1923, was a mummers' play written for a local group of players.) It represents a new concentration of his power, but certainly no diminution of it.

Devotion to lyrical expression produced a mastery almost as signal in its kind as his command of the art of fiction; and his 70th year saw him beginning, with *Time's Laughing Stocks,* the series of volumes—*Satires of Circumstance* (1914), *Moments of Vision* (1917), *Late Lyrics and Earlier* (1922), *Human Shows, Far Phantasies* (1925), and the posthumous volume *Winter Words* (1928), which revealed him as the most original, the most poignant and also the most copious of contemporary lyric poets.

The originality of the technique in these volumes did not by any means consist in a mere breach with the accepted conventions, but rather in its highly individual—to some, perhaps, rather disconcerting—compound of the conventional and the unconventional. Most of these lyrics maintain an exact and even rigid formality of stanza, in which a scheme of rhymes is imposed, as it seems, arbitrarily and at all costs. The effect is sometimes justified by its music; but more often by the compact force its pressure gives to language almost conversational in its idiom and choice of words. Yet the diction which defies poetic tradition and seems to despise the magic of elaborated verbal suggestion is oddly blended with stiff literary phrases and even with words one might expect only lexicographers to think of. The truth seems to be that, in lyrical technique, Hardy had no prejudices either for or against the conventions. He is simply concerned with the matter which intense feeling and profound understanding have enabled him to imagine in a way peculiarly his own, and to express this faithfully he has forged a technique peculiarly his own, out of whatever the language of literature or of speech could offer him. Readers who are willing to allow him this liberty can hardly fail to be impressed by the subtlety, depth and variety of his versions of the experiences common to humanity; the commonplace becomes in his hands something rich and strange. Naturally, the habits of thought and outlook on the world, which we find progressively insistent in the series of the Wessex novels, and which inspire the turbulent matter and monumental structure of *The Dynasts,* are evident also in the lyrics; which, indeed, are often in the nature of marginal comments on themes previously used.

But something like the quintessence of his tragic power may be found in such ballads as "A Trampwoman's Tragedy," or such keen discrimination of pathos as "Near Lanivet," and something too like the quintessence of his irony to be altogether comfortable in *Satires of Circumstance* or "Ah, Are You Digging on My Grave?" Nor is the rustic humour of his beloved Dorset villagers wanting, nor the vivid delight in nature, in the extraordinary range of his lyrical art. It is, in fact, the same Hardy in the lyrics as in the novels and *The Dynasts;* but a Hardy who, if his lyrics were all we had of him, would surely, by virtue of them alone, hold a secure, indeed a unique, position in modern English literature.

(L. A.; X.)

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HARDY, SIR THOMAS DUFFUS (1804–78), British antiquary and archivist, whose work in editing and publishing records and making them accessible did much to achieve a responsible public interest toward historical documents. A member of a family famous in the history of the British navy, Hardy was born at Port Royal, Jamaica, on May 22, 1804, and came to England at the age of seven. In 1819, under the influence of his uncle, Samuel Lysons, he entered the Record office at the Tower of London, where he became an able paleographer through the tuition of Henry Petrie. Upon retirement, Petrie entrusted Hardy with

the publication of *Monumenta Historica* (1848).

Hardy was deputy keeper of the Record office from 1861 until his death on June 15, 1878; he influenced the formation of the Historical Manuscripts commission in 1869, serving as one of the first commissioners. He edited numerous selections of documents for the commission, including the Close Rolls, *Rotuli litterarum clausarum, 1204–27* (2 vol., 1833–44), and the Patent Rolls, *Rotuli litterarum patentium 1201–16* (1835), and other manuscripts of the reign of King John. Knighted in 1873, Hardy's most famous work is the *Descriptive Catalogue of Materials Relating to the History of Great Britain and Ireland* (3 vol., 1862–71).

(J. M. Wi.)

HARDY, SIR THOMAS MASTERMAN, Baronet (1769–1839), British vice-admiral famous for his association with Nelson, was born on April 5, 1769, a member of the Hardy family from Portisham in Dorset. He began his naval career in 1781, became lieutenant in 1793, and in 1796, while in the frigate "Minerve," attracted the attention of Nelson. He continued to serve with distinction and in 1798, after the battle of the Nile, was promoted to be captain of the "Vanguard," Nelson's flagship. Later, in the "St. George," he did valuable work at the first battle of Copenhagen in 1801. Hardy was Nelson's flag captain in the "Victory" at the battle of Trafalgar in 1805, witnessed Nelson's will and was by his side when he was mortally wounded (*see* Nelson, Horatio Nelson, Viscount). Given a baronetcy in 1806, Hardy spent some years on the North American station and was made commodore and commander in chief on the South American station in 1819. He became rear admiral in 1825, first sea lord in 1830 and vice-admiral in 1837. He was responsible for escorting an expeditionary force to Lisbon in Dec. 1826—almost his last action at sea. Hardy was appointed governor of Greenwich hospital in 1834, in which he took an active interest and where he died on Sept. 20, 1839.

See A. M. Broadley and R. G. Bartelot, *Three Dorset Captains at Trafalgar* (1906); John Gore, *Nelson's Hardy and His Wife* (1935).

(O. M. W. W.)

HARDYNG, JOHN (1378–*c.* 1465), English writer of a metrical chronicle of England, was born in the north and as a boy entered the service of Sir Henry Percy (Hotspur), with whom he was present at the battle of Shrewsbury (1403). He then passed into the service of Sir Robert Umfraville, under whom he was constable of Warkworth castle, and served in the campaign of Agincourt in 1415. Umfraville made Hardyng constable of Kyme, Lincolnshire, where he probably lived till his death about 1465. Under Henry V he was employed to investigate the feudal relations of Scotland to the English crown. For this purpose he visited Scotland in 1418, at much expense and hardship. He says that for his services Henry V promised him the manor of Geddington in Northamptonshire. In 1439 he had a grant of £10 a year for similar services.

In 1457 there is a record of the delivery of documents relating to Scotland by Hardyng to the earl of Shrewsbury and of his reward by a further pension of £20. James I of Scotland is said to have offered him a bribe to surrender his papers, but the documents, which are still preserved in the Record office, have been shown to be forgeries, probably by Hardyng himself.

Hardyng spent many years on the composition of his chronicle. The original edition ending in 1437 had a Lancastrian bias and was dedicated to Henry VI. Afterward he prepared a version for Richard, duke of York, and the chronicle in its final form was presented to Edward IV after his marriage to Elizabeth Woodville in 1464. The first version is preserved in Lansdowne manuscript 204, and the best of the later versions in Harley manuscript 661, both in the British museum. Richard Grafton printed two editions in Jan. 1543, which differ much from one another and from the now extant manuscripts. Sir Henry Ellis published the longer version of Grafton with some additions from the Harley manuscript in 1812.

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HARE, SIR JOHN (John Fairs) (1844–1921), English actor-manager especially closely associated with the Garrick theatre, was born at Giggleswick, Yorkshire, on May 16, 1844. He appeared first in Liverpool in 1864, and in London in 1865, where he was for ten years with the Bancrofts, succeeding in T. W. Robertson's comedies. In 1875 he became actor-manager at the Court theatre and from 1879 to 1888, in association with the Kendals, brought success to the hitherto unlucky St. James's theatre. He became actor-manager of the Garrick theatre in 1889, producing Sir Arthur Pinero's *The Profligate* and *The Notorious Mrs. Ebbsmith* and making a personal success in Sydney Grundy's *A Pair of Spectacles*, and later at the old Globe theatre in *The Gay Lord Quex*. A fine character actor, Hare was popular in the United States, which he visited between 1895 and 1901. Knighted in 1907, he appeared for the last time in 1917 in *A Pair of Spectacles*. He died in London on Dec. 28, 1921. (W. J. M.-P.)

HARE, a name properly applied to any mammal of the family Leporidae (order Lagomorpha) whose young are born in the open, fully haired, with open eyes and in a sufficiently advanced stage of development so that they are able to hop about only minutes after birth (precocial young). The nature of their young distinguishes hares from rabbits (of the same family), whose young are born in a fur-lined nest, naked, blind and helpless. Hares are also usually larger than rabbits. The vernacular names hare and rabbit are often misapplied to particular species.

The typical species is the common hare (*Lepus europaeus*) of central and southern Europe, the near east and Africa from Ethiopia to Sudan. The blue or varying hare (*L. timidus*) occurs farther north and is probably the same species as the Arctic hare of extreme northern North America. In North America the hares popularly called snowshoe rabbit (*L. americanus*) and jack rabbit (*L. townsendii, L. californicus* and others) are widespread. One or more of the many other species occur naturally on all of the principal land masses except Australia, where the European hare was introduced during 1870–71 and has since become established. The so-called Belgian hare is actually one of many domestic breeds of the European rabbit *Oryctolagus cuniculus* (*see* Rabbit).

Hares have especially well-developed hind legs and ears usually longer than the head. Those that occur in northern latitudes are white in winter and usually return to the normal grayish-brown shade in summer, although some of the northernmost races are always white. At intermediate latitudes the colour changes only partially with the seasons. Hares are primarily vegetarians, feeding in summer on tender shoots and twigs and on succulent leaves and buds; in winter they feed on bark, twigs, moss lichens and needles of evergreens but may also seriously damage commercial nursery stock, orchards and crops. Occasionally they eat flesh. The food is chewed with a lateral motion of the jaws.

Hares tend to occupy a fairly small territory, usually only a few acres. Yet upon occasion they may undertake mass migrations, especially in the far north. They are active mainly at dusk and at night. When they are undisturbed, their characteristic gait is a series of short hops; when alarmed, they move with considerable speed, covering the ground with leaps of often 10–12 ft. in length. They dodge with bewildering speed when attempting to elude a pursuer and sometimes leap high in the air to obtain a better view of their surroundings. Hares are preyed upon by a variety of predators, mammalian, avian and reptilian. Because they are usually numerous, in many areas they form the staple diet of carnivores and thus relieve the predation pressure on more valuable species. The coyote was a particularly good control till its numbers were reduced

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BLACK-TAILED JACK RABBIT (LEPUS CALIFORNICUS), A NORTH AMERICAN HARE

by man. For reasons not fully understood, hares, like many other small mammals, undergo remarkable fluctuations in abundance. (K. R. Kn.)

HAREBELL (Bluebell) is a well-known perennial wild flower, *Campanula rotundifolia,* a member of the bellflower family (Campanulaceae), found throughout boreal Eurasia and in North America from the arctic to the mountains of Pennsylvania, the Rockies and Sierra Nevada. The harebell has a very slender, slightly creeping rootstock, and a wiry, erect stem. The leaves at the base of the stem, to which the specific name *rotundifolia* refers, have long stalks and are roundish or heart-shaped with a wavy or toothed margin; the lower stem leaves are ovate or lance-shaped, and the upper ones linear, almost stalkless, acute and entire. The flowers are slightly drooping, usually solitary or in sparse clusters, and have a smooth calyx, with narrow pointed erect segments; the corolla bell-shaped, with slightly recurved segments; and the capsule nodding, and opening by pores at the base. The plant is found on heaths and pastures throughout Great Britain and flowers in late summer and in autumn. It is there called bluebell of Scotland and witches thimbles, but as bluebell is also applied to a squill (*Scilla*), the vernaculars are often confused. Cultivated in gardens are the blue-flowered form and double-flowered and white varieties. *See* Campanula. (N. Tr.)

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HAREBELL (CAMPANULA ROTUNDIFOLIA)

HARELIP (Cleft Lip), associated in about 50% of cases also with cleft palate, is a congenital deformity resulting from failure of certain tissues of the face to join properly during prenatal development. It may be corrected by surgery soon after birth. *See* Speech Disorders.

HAREM (Arabic *harim,* "forbidden"), a name applied to that part of a house in Muslim countries set apart for the women; the form *hareem* is used collectively for the women themselves. *Zenana* (from Persian *zan,* "woman") is the term used in India; *andarun* (Persian "inner part" of a house) in Iran. The Indian harem system is also known as *purdah,* literally "curtain."

Before the Prophet Mohammed, women of the desert dwellers went unveiled and those of the town covered their faces. In the tribe of the Prophet—the Quraish (Koreish)—veiling was the rule. In the Koran (xxxiii, 59 ff.) the Prophet's own wives and daughters, and those of believers, were commanded to protect themselves by long veils when in public. Later, in definite rules regarding modest conduct and chastity, women were enjoined not to display their charms to any men except their husbands, or persons so closely related to them as to come within prohibited degrees for marriage (Koran xxiv, 31 ff.). Included in this were slaves (eunuchs particularly) and children too young to be conscious of difference of sex.

The harem system and seclusion of women are variously ascribed to influences from Iran or to the rule of the Omayyad caliphs of Damascus. By the time of the great Harun al-Rashid of Baghdad (reigned 786–809) the system was fully established. Mohammed did not originate the idea. He borrowed it from older Semitic cultures. It existed in Ur of the Chaldees as a divine social institution and is found in the Old Testament; but wherever Islam spread this institution went with it, with its religious sanctions. The four legal wives and a man's additional concubines had the security of their own quarters and were completely protected from the outside world.

Large harems were common in Arab countries through the early decades of the 20th century. In some great polygamous households each wife had her own set of rooms and servants. In others three or four wives lived together, the children all brought up as one family. Men's quarters were a separate house, connected to the women's by an inside door. Lower in the social scale, a room at the entrance to the house was reserved for the man of the family. Poorer people sublet part of a house and screened it off to secure privacy. In the second half of the 20th century the harem system still existed in conservative parts of the Arab world, the four legal wives of one ruler having identical palaces, thus observing the Koranic exhortation that all wives should receive equal treatment.

In Turkey the sultan was the temporal and spiritual head (caliph) of all Islam, and the imperial seraglio in Constantinople was a unique institution affecting the whole Ottoman empire. An elaborately organized community, with disciplinary and administrative officers, it was ruled over by the sultan's mother, the *valide sultan,* who exercised authority through a female superintendent and a large retinue of subordinates.

In India during the British regime the extent and rigidity of *purdah* observance demonstrated the tenacious adherence of a highly conscious minority to its Islamic traditions and religious and social customs. The level of culture and education in the upper and middle classes of the *zenanas* was noticeably raised by the energy of a small group of enlightened individuals and by the collective efforts of women's organizations. The pattern of harem life in other Muslim countries followed the usual lines, based on the seclusion and veiling of women, with every country showing the trend toward reform by both men and women leaders.

In Indonesia the harem system was never developed, as there was no veiling of women.

As the 20th century progressed the harem as an institution was fast becoming an anachronism. Legislation in certain countries produced drastic changes. In 1926 Turkey adopted the Swiss code, which made polygamy illegal and established equal divorce rights for women. Unveiling for certain official groups was required; the example was soon followed and general unveiling became the rule. In Iran the compulsory unveiling of women decreed in 1935 by Reza Shah marked the date line of social change for Persian women. Throughout the near and middle east the trend away from the veil was accelerated by the rapid advance of education and the efforts of women themselves. In India the unveiling of Muslim women was an evolutionary process, through education, and inevitably was influenced by the development of Indian nationalism. In 1955 the Hindu Marriage act outlawed polygamy and gave men and women equal rights of divorce. Compulsory for Hindus only, it could be applied to the minority groups by choice; thus it widely affected the Muslim community and reform movements in other countries. Pakistan, a Muslim state, had an unveiled minority of women leaders who actively promoted the general advance of women, including unveiling, as a national necessity. Pakistan and Indonesia both had the problem of social inequality in family law, and legislative reform was being promoted within the Islamic framework. An abortive attempt to abolish the veil in Afghanistan in 1928 was followed by 30 years of universal veiling and seclusion. The year 1959 brought almost overnight the unveiling of Afghan women, permissive and not compulsory, through the public appearance of women of the court, and a new era began.

Throughout this period the practice of polygamy was steadily declining among the educated classes of Islam, although it remained common in the lower economic groups. The disabilities of women under the laws of polygamy and unilateral divorce were a cause of concern to all women of the Muslim east and were the object of co-ordinated effort by women leaders in several countries for legislative reforms. Rapid social changes, especially the advancement of women, had altered the whole structure of eastern society, and sex segregation was becoming anachronistic. Over a long period, western cultural and educational influences had been penetrating the east. Nationalism, education, public opinion and economic pressure have been changing the status of women and making the harem an outmoded symbol.

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HARFLEUR, a port of northwestern France in the *département* Seine-Maritime, lies in the valley of the Lézarde, near the estuary of the Seine, 7 km. (4.3 mi.) E. of Le Havre by road. Pop. (1962) 3,787. The church of St. Martin with its lofty stone steeple forms a landmark for the pilots of the river. It dates from the 15th and 16th centuries. Of the old castle there are only insignificant ruins. Vessels drawing 18 ft. can moor alongside the quays of the new port, on a branch of the canal, which has some trade in coal, timber and grain and carries on fishing. The industries include distilling, metal founding, flour milling and the manufacture of oil and grease.

Harfleur is identified with Caracotinum, the principal port of the ancient Calates. In the middle ages, when its name, Herosfloth, Harofluet or Hareflot, still indicated its Norman derivation, it was the principal seaport of northwestern France. In 1415 it was captured by Henry V of England, but in 1435 the people of the district of Caux rose against the English and freed themselves. Between 1445 and 1449 the English were again in possession, but the town was recovered for the French by Jean, Comte de Dunois. In the 16th century the port began to dwindle in importance because of the silting up of the Seine estuary and the rise of Le Havre. In 1562 the Huguenots pillaged Harfleur and its registers and charters were destroyed, but its privileges were restored by Charles IX in 1568, and it was not till 1710 that it was subjected to the taille. The port was improved on the opening of the Tancarville canal in 1887 connecting it with the port of Le Havre and with the Seine. (M. No.)

HARGEISA, the capital of former British Somaliland (from 1960 part of the Somali republic) in Hargeisa district, lies in a valley, 4,000 ft. above sea level, which runs from west to east and is enclosed by steep hills. Because of its altitude the climate is fairly equable. Pop. (1961 est.) 42,000. Originally the summer capital of British Somaliland, Hargeisa became the permanent capital in 1941. Most of the houses are single storied, and there are areas in which nomadic hutments may be erected. Among the public buildings are the offices of the central and local governments, the meeting hall of the legislative council, schools, a broadcasting station and a power station. A network of roads connects Hargeisa with other towns in the former protectorate and with Berbera, the chief port, which lies on the Gulf of Aden, 117 mi. N.E. Frequent air services from Hargeisa airport to Aden and Nairobi link it to the rest of the world. There are no industries but the town is an important watering and trading centre for the nomadic stock herders who form the majority of the population.

The principal exports are fresh meat, sent by air to Aden, and livestock, skins and ghee (clarified butter), which are shipped from Berbera. Imports are mainly confined to tea, sugar, cotton cloth and other consumer goods. (J. A. Bn.)

HARGREAVES, JAMES (? –1778), inventor of the spinning jenny, the first practical application of multiple spinning by a machine, was a poor and uneducated spinner and weaver living at Standhill, near Blackburn, Eng., at the time he devised the machine. Nothing is known of his early life and no paintings or engravings of him are extant. His earliest inventive efforts were directed toward a carding engine, which realized no success. The idea for his hand-powered multiple spinning machine, which increased the work output of a spinner eightfold, is said to have been conceived when Hargreaves (in about 1764) observed the actions of a spinning wheel that had been accidentally overturned by his young daughter, Jenny. As the spindle continued to turn in an upright position, Hargreaves reasoned that many spindles could be so turned. Several jennies, which he named after his daughter, were built and sold to help support his large family. However, the local hand spinners, fearing unemployment, broke into his house and destroyed the jennies. Hargreaves moved to Nottingham in 1768 and with a partner, Thomas James, built a small mill in which they used the jennies to spin yarn for hosiers; he received a patent for the jenny on June 12, 1770. He worked at the mill with moderate success until his death in Nottingham on April 22, 1778. (G. R. Co.)

HARGREAVES, JAMES (1834–1915), prolific English inventor of industrial chemical processes, was born at Hoarstones, Lancashire. In 1856 an attempt to devise a method of recovering sulfur from alkali waste brought him in contact with W. Gossage, the soap manufacturer, who employed him until 1865; during this period he discovered a method of bleaching the brown soap in common use, invented blue mottled soap, and devised a method of recovering chromates from the fats and oils used in soap manufacture. Hargreaves also worked out a process for the recovery of phosphates from the slag of blast furnaces. In 1873 he erected works for the manufacture of hydrochloric acid by the action of the gases from pyrites burners on common salt; these works were eventually acquired by the United Alkali company. In conjunction with one of his employees, Bird, he invented the Hargreaves-Bird process for the manufacture of soda by the electrolytic decomposition of salt. This method was extensively adopted in Europe and the United States. In addition to his chemical investigations, Hargreaves invented an engine which ran on gas tar and was the forerunner of the diesel engine. Hargreaves died at Widnes, Lancashire, on April 4, 1915. (Rt. S. C.)

HARI (Djambi; Jambi), a river of central Sumatra, Indonesia, is 350 mi. long and drains an area of about 16,000 sq.mi. One of its sources, the Gumanti, drains Lake Atas, the other, the Hari proper, originates south of the lake. The two streams unite 35 mi. from the Hari's source. Downstream the Hari receives its largest tributary, the Tembesi, before entering the coastal plain. At Jambi, 92 mi. from the sea, the river is over 300 yd. wide; below the town it splits into several distributaries, but only the Sungai Niur is deep enough for ships of more than six-foot draft. (J. O. M. B.)

HARINGEY, one of the 32 London boroughs that came into existence on April 1, 1965, under the provisions of the London Government Act 1963 which reorganized local government in the metropolis and the area around it. These 32 London boroughs constitute Greater London (*see* London). Haringey, in the north, is composed of areas that were previously in Middlesex: the former municipal boroughs of Hornsey, Tottenham, and Wood Green. *See* Hornsey; Tottenham; Wood Green.

HARINGTON, SIR JOHN (1562–1612), Elizabethan courtier, translator, author and wit, provides through his career and writings a unique insight into the life of the Elizabethan age. His father, John Harington of Stepney, enriched the family by marrying an illegitimate daughter of Henry VIII; his second wife was an attendant on Princess Elizabeth, who later stood as godmother for Sir John, born in 1562. Sir John was educated at Eton, Cambridge and Lincoln's Inn, London. In 1583 he married Mary Rogers, who bore him many children. Because he translated and circulated among the ladies a wanton tale from Ariosto, Elizabeth banished him from court until he should translate Ariosto's entire *Orlando Furioso*. Published in 1591, this remains one of the major translations of the age, more faithful to the spirit and style of the original than to accurate line-by-line reproduction. Probably while working on the Ariosto, Harington invented the flush lavatory (toilet) and installed one for the queen in her palace at Richmond, Surrey. In 1596 in *The Metamorphosis of Ajax* (a jakes, or privy) he described his invention in terms more Rabelaisian than mechanical. Again he was banished from court. In 1599 he accompanied the earl of Essex on his expedition to Ireland, where he won his knighthood. Harington was included in the queen's fury with Essex upon their return, but he softened her anger with the account he had written of the expedition (published in *Nugae Antiquae*, 1769–75).

Although active in his county of Somersetshire, Harington made his real career the court. The wantonness of his writings and the barbed wit of his personal epigrams won him a reputation as the

queen's "saucy godson," a sort of jester about court, but he gained no advancement thereby. He met with even less success under James I, although he continued to write tracts and epigrams until he died at Kelston, Somerset, on Nov. 20, 1612.

His miscellaneous writings were collected by H. Harington in *Nugae Antiquae*, 2 vol. (1769–75). His *Letters and Epigrams* were edited by N. E. McClure (1930). For a study of the man and his work *see* T. Rich, *Harington and Ariosto* (1940). (T. Rh.)

HARIRI, AL- (Abu Mohammed al-Qasim al-Hariri) (1054–1122), Arab writer regarded as one of the supreme masters of style in Arabic literature, was born at Mahsan near Basra in 1054. His name denotes "the manufacturer or seller of silk." He is said to have held a government post, but devoted much of his life to studying the niceties of the Arabic language. On this subject he wrote a poem, *Mulhat al-'Irab* (French trans. by L. Pinto and A. Destrées, 1911); a work on the faults of the educated, *Durrat al-Ghawwas* (ed. by H. Thorbecke, 1871); and some smaller treatises (ed. by F. A. Arnold in *Chrestomathia Arabica*, pp. 202–209, 1853). His fame rests mainly on his 50 *maqamat* (ed. by F. Steingass, with English notes, 1896; Eng. trans. by T. Chenery, 1867, and by F. Steingass with valuable introduction, 1898).

The *maqamat* take the form of romances or anecdotes in rhymed prose and are of the same type as those of Hamadhani (*q.v.*), though far surpassing them in command of language. As a model of Arabic writing they came to rank next only to the Koran. They tell of the adventures of a fictional character, the rascally Abu Zayd, and are full of allusions to Arab history, poetry and tradition and to problems of grammar. The dialogue form adopted in them was the Arab's nearest approach to drama.

HARI RUD (in U.S.S.R., Tedzhen), the ancient Arius river of Afghanistan, rises as the Sar-i-Jangal in a narrow basin with Koh-i-Baba (16,873 ft.) at its head. Its upper course is remarkably straight and its watershed restricted to a narrow zone. The few tributaries follow subparallel courses; *e.g.*, the Haftqala, Ishlan and Tarbulak. The Sar-i-Jangal becomes the Hari Rud near Daulet Yar, at 6,118 ft., about 50 mi. from the source. After a further 200 mi. near Herat (which stands three miles north of the river) it begins to bend northward, forming for many miles the frontier between Iran and Afghanistan from Kuhsan to Zulfikar, and between Iran and the Turkmen Soviet Socialist Republic from Zulfikar to Sarakhs. In this section it receives more tributaries from the west; *e.g.*, the Jam. West of Herat it irrigates a rich agricultural region amid a near-desert upland, practically all its waters being used for this purpose. As it approaches the Turkmen S.S.R. the waters diminish until, watering the Tedzhen oasis, the river finally loses itself in the desert sands after a course totaling about 700 mi. Tedzhen lies on the Trans-Caspian railway. Except where irrigation is practised, the valley is sparsely inhabited. (B. L. C. J.)

HARISHCHANDRA, a legendary Hindu king, 28th in the Solar dynasty. He wanted a son, and to obtain one vowed him in advance to Varuna, the god of righteousness. But when the god came to claim his due, the king put him off on various pretexts. Eventually he bought from a poor Brahmin one of his sons, named Shunashepa, and offered the latter to Varuna. The victim, however, was saved in the nick of time by the intervention of the war god Indra and of Vishnu the saviour, to whom Shunashepa addressed prayers.

The above story occurs in the Aitareya Brahmana. In later accounts Harishchandra is seen as a great giver of charity and, inconsistently enough, as a respecter of the plighted word. According to the Markandeya Purana, for instance, Harishchandra gave up his kingdom and sold his wife, his only son and himself into slavery in order to keep a promise to the sage Vishwamitra. He became a graveyard watchman, and his reunion with his wife occurred when she brought her son's corpse for cremation. His sense of duty won the admiration of the gods, who restored his son to life and offered him a place in heaven, but Harishchandra would not accept it until his wife and faithful subjects were permitted to follow him there.

The story of Harishchandra, told in all the Indian languages and enacted on the popular stage, has influenced Hindus throughout the centuries. His name is a byword for truth-speaking and integrity. (M. N. S.)

HARITH IBN HILLIZA AL-YASHKURI, pre-Islamic Arab poet, was the author of one of the poems generally included among the *Mu'allaqat* (*q.v.*). He was a chieftain of the tribe of Bakr, but nothing is known of the details of his life.

HARIZI, JUDAH BEN SOLOMON (*c.* 1170–1235), man of letters, the last representative of the golden age of Spanish Hebrew poetry, was born in Spain and wandered through Provence and the near east, translating Arabic poetry and scientific works into Hebrew. His version of the *Guide of the Perplexed* of Maimonides (*q.v.*) is more artistic if less accurate than that of Ibn Tibbon. His skilful adaptation of the difficult *Maqamat* of Hariri (*q.v.*), under the title *Mahberot Ithi'el*, encouraged him to compose original Hebrew *maqamas* entitled the *Tahkemoni*, on which his fame primarily rests. This work was partly translated by S. I. Kaempf in *Nicht-andalusische Poesie andalusischer Dichter* (1858). His writing is characterized by its rich vocabulary and remarkable linguistic dexterity.

See J. Schirmann, *Ha-Shirah ha-'Ibrit be-Sefarad u-be-Provence*, vol. 2 (1956) for bibliography. (D. Pa.)

HARKER, ALFRED (1859–1939), British petrologist whose investigations of igneous rock complexes in the isles of Inverness-shire were pioneering achievements in igneous geology, was born at Kingston-upon-Hull, Feb. 19, 1859. He was educated at St. John's college, Cambridge, where he was elected a fellow in 1885. In Yorkshire, where he spent part of his school days, he became interested in the geology of his native county; this interest in rocks grew at the university and led him to make petrology his life work at Cambridge, where he became, in 1918, reader in the subject.

His early work was on slaty cleavage in rocks, the result of these studies being published in a notable report to the British association (1886). Later, through his study of the mineral complex that girdles the Shap granites in Westmorland, he was able to offer a new interpretation of the thermal metamorphism of rocks. In 1895, at the instance of Sir Archibald Geikie, he was seconded to the Geological Survey of Scotland for summer work in Skye, where he made detailed geological maps of the Cuillins and the Red hills of central Skye.

His standard work, *The Natural History of Igneous Rocks* (1909), treating of the broad aspects of magmatic descent and the controlling influence of tectonic environment, had a strong influence on petrology and, with his later treatise *Metamorphism* (1932), fills an important place in the literature of petrology. He was elected a fellow of the Royal society in 1902 and was awarded its royal medal in 1935. He died at Cambridge, July 28, 1939. (C. E. T.)

HARLAN, JOHN MARSHALL (1833–1911), associate justice of the U.S. supreme court, best known for his part in decisions involving amendments of the Reconstruction period, was born in Boyle county, Ky., on June 1, 1833. He was the grandfather of John M. Harlan (1899–), also a member of the U.S. supreme court. The elder Harlan graduated from Centre college (Danville, Ky.) and studied law at Transylvania university (Lexington, Ky.). He served as county judge of Franklin county, Ky., in 1858–59. The following year he was a presidential elector for the Constitutional Union party. At the outbreak of the Civil War he recruited the 10th Kentucky U.S. volunteer infantry regiment and served as its colonel through numerous engagements. He resigned his commission in 1863 and in the same year was elected attorney general of Kentucky by the Union party. He was re-elected to the office in 1865. In the presidential campaign of 1864 Harlan emerged as a strong critic of the Lincoln administration and supported the candidacy of Gen. George B. McClellan. He later cast his lot with the Republican party and twice, in 1871 and 1875, was that party's unsuccessful candidate for governor. In 1877 he was appointed by Pres. Rutherford B. Hayes to a commission instructed to resolve the competing claims of two rival state governments in Louisiana. On Nov. 29 of the same year he was appointed to the U.S. supreme court by President Hayes. He remained a member of the court until his death almost 34 years later, a period of tenure exceeded by only two other justices in

the court's history. In 1892 he was appointed by Pres. Benjamin Harrison to serve in the arbitration of the Bering Sea controversy with Great Britain. He died in Washington, D.C., on Oct. 14, 1911.

Although Harlan had opposed ratification of the 13th amendment, which prohibits slavery and involuntary servitude, as an undue infringement of state powers, as a judge he vigorously urged a broader interpretation of the amendments than any of his colleagues on the bench. His position is well illustrated by his notable dissent in the *Civil Rights Cases*, 109 U.S. 3 (1883). The majority of the court held that congress could not authorize punishment of private individuals who had discriminated against Negroes, since the 14th amendment applies only to "official" or "state" action. Harlan found congressional authority in both the 13th and 14th amendments and advanced a broader concept of "state action" than the court was or has since been willing to accept. In a series of cases involving state criminal procedures, Harlan, in dissent, urged that the 14th amendment imposed on the states the same limitations as are placed on the federal government by the first nine amendments of the U.S. constitution. This view, although never taken by the court, missed acceptance in 1947 by the narrow margin of one vote. The decision of *Plessy* v. *Ferguson*, 163 U.S. 537 (1896), upholding the validity of segregated seating on common carriers, inspired Harlan's eloquent protest and the assertion that "our constitution is colour-blind." His view was vindicated by the 1954 decision of the court in the school segregation cases. While rejecting the "natural rights" theories of Justice Stephen J. Field, Harlan nevertheless frequently voted to invalidate state regulation of economic activity. In *Adair* v. *United States*, 208 U.S. 161 (1908), his opinion for the court invalidated a congressional statute outlawing the so-called "yellow-dog" clause in labour contracts. Other notable opinions include his dissents in the Insular cases in which Harlan opposed withholding the federal bill of rights from unincorporated territories of the U.S. and argued that the constitution "follows the flag." One of his most famous dissents is his opinion in *Pollock* v. *Farmers' Loan and Trust Co.*, 158 U.S. 601 (1895), in which the court invalidated the federal income tax and necessitated adoption of the 16th amendment.

Harlan's opinions are not distinguished by subtlety or fine discrimination. He was at his best in dissent, and many of these opinions are notable for their great power and conviction and their capacity to expose fundamental issues. He was not one to suppress his disagreements with the majority of the court, and the vigour of his language sometimes bordered on harshness. Harlan is one of the most distinctive figures in the history of the court. Many of his views, rejected by the court on which he sat, attained renewed importance in the years after his death. (F. A. A.)

HARLECH, the ancient capital of Merioneth, Wales, lies on the coast 10¾ mi. N. of Barmouth by road. Pop. (1951) 1,206. It was created a free borough by a charter of Edward I in 1285. Its ruined castle, crowning the cliff, dominates the coast line for miles round. Although there is no recorded evidence to prove any occupation of the castle rock before the construction of the Edwardian fortress between 1280 and 1284, the site has associations with Branwen, daughter of Bran Fendigaid, and with the Mabinogion (*q.v.*); one tower of the castle (Weathercock tower) is known as Branwen's tower. Another tradition has it that a fortification known as Caer Collwyn, built or repaired by a 10th-century lord of Ardudwy, occupied the site of the present structure. The latter, a fine example of the Edwardian concentric castle, was built by James of St. George whom Edward I brought to England from Savoy in 1277 or 1278 to superintend the building of his new fortifications in Wales. James was constable of Harlech from 1290 to 1293. The castle has known a stirring history of occupation and siege. Associated pre-eminently with the name of Owen Glendower (Owain Glyndwr), it was held by him for four years and a parliament summoned within its precincts. It sheltered Margaret of Anjou, wife of Henry VI, following that monarch's capture at the battle of Northampton in 1460, and it was the last fortress in England and Wales to surrender to the Yorkists in 1468. The battle song "March of the Men of Harlech" commemorates this. During the Civil War, Harlech was held for the king, its active history coming to an end only with its surrender to Maj. Gen. Thomas Mytton in 1647. The town itself, situated on the slopes and summit of a 200-ft. hill overlooking Cardigan bay forming part of the area known to geologists as the Harlech dome, is an admirable centre for tourists. It has a sandy beach with safe bathing and the magnificent St. David's golf course set in mountain scenery. Today, Harlech is known to Welshmen not only for its castle but also for its residential adult-education college, known as Coleg Harlech, which provides yearly courses and summer schools for working men and women. The Morfa Harlech Nature reserve, declared by the Nature conservancy in 1958, covers an area of 445 ac. and forms part of Traeth Bach and Morfa Harlech, including the sandspit known as Harlech point. This reserve is particularly valuable for studying contemporary changes in the coast line, for observing the transition between salt marsh and sand dune and the role played by the characteristic plants of each in the accretion of silt and sand respectively.

(D. W. J.-W.)

HARLEQUIN, the English name for one of the comic masks of the *commedia dell'arte*. The Italian name Arlecchino has been traced back to the medieval French Herlequin, which denoted a jester with devilish features who had found his way into the mystery plays. The Italian actor Tristano Martinelli (*c.* 1557–1630) is commonly regarded as the creator of the Arlecchino mask in improvised comedy. As a member of various traveling *commedia* companies he specialized as a witty comic servant under the stage name of Arlecchino. The standard Harlequin costume consisted of breeches and a jacket with multicoloured triangular patches sewn onto the garment. The actor carried a lath, the slapstick, which his English descendant in the 18th century used in the Harlequinades as a magic wand for the enactment of transformation scenes. As a rule, Harlequin (and Arlecchino before him) was in love with Columbine. *See* also CLOWN; PANTOMIME. (A. M. N.)

HARLEQUIN BUG, in North America, a hemipterous insect of tropical or subtropical origin, *Murgantia histrionica*, belonging to the stink bug family (Pentatomidae). It is about half an inch in length, shield-shaped and coloured brilliantly with red and black. First observed in Texas in 1864, it thereafter spread rapidly over the United States, reaching New Jersey in 1892 and Long Island in 1894. Now ranging from the Atlantic to the Pacific, the bug is rarely injurious north of about the 40th parallel.

It sucks sap from the leaves and veins of cabbage and other cruciferous crops, causing the plants to wilt and die. Fifty or sixty mature individuals may be found feeding on a large plant. The adult overwinters in sheltered sites. The barrel-shaped white eggs ringed with black are usually laid in double rows on the undersides of leaves. Within a month the eggs hatch, and the active young—wingless, but otherwise resembling the adults—molt five times before reaching full growth. In the south there may be four or five generations annually. Clean culture methods, especially thorough removal of host plants when a crop is harvested and the use of trap crops such as mustard on which the bug can concentrate in the spring and subsequently be killed by insecticides, will reduce losses of cabbage, Brussels sprouts and others.

ROSS E. HUTCHINS

HARLEQUIN BUG (MURGANTIA HISTRIONICA), PEST ON CABBAGES AND OTHER CRUCIFEROUS CROPS IN THE SOUTHERN U.S.

In small plantings handpicking is an effective means of control. Many insecticides are injurious to the plants or leave dangerous residues in the cabbage heads. A rotenone dust or spray applied according to manufacturer's directions will provide safe and effective control.

In South America the name has been used for a longhorn beetle (*Acrocinus longimanus*); and in Australia a hemipterous insect (*Dindymus versicolor*) injurious to apples and other fruits is called the harlequin fruit bug.

(R. I. Sr.)

HARLEQUIN FLY, a popular name of small mosquitolike flies, or midges, of the genus *Chironomus*. The larvae of some species, called bloodworms, are bright red because of the presence of the same pigment, hemoglobin, that is found in the blood of vertebrates; they are aquatic and live in foul or very deep water where there is little oxygen. The flies often occur in large swarms in the evening. *See* also FLY.

HARLINGEN, a city of Cameron county in southern Texas, U.S., is 28 mi. N.W. of Brownsville. It was founded in the early 1900s and was named for Harlingen, Netherlands, by its pioneer settler, Lon C. Hill, Sr., when it became a station (once known as Six-shooter Junction) of the St. Louis, Brownsville and Mexico railroad. Harlingen, a central city of the Brownsville–Harlingen–San Benito standard metropolitan statistical area (*see* BROWNSVILLE), was incorporated as a city in 1910 and adopted a council-manager form of government in 1947. Pop. (1960) 41,207. (For comparative population figures *see* table in TEXAS: *Population.*)

The city, modern and well planned, is located in the centre of an intensively cultivated agricultural region. It has food-processing plants and is a major transportation and distribution hub of the Lower Rio Grande valley for citrus fruits and vegetables. Port Harlingen, with a grain elevator, oil terminals, chemical plants and other industries, is on a spur of the Gulf Intracoastal waterway. There is a Valley Mid-Winter fair, mainly for citrus fruits. (O. Mo.)

HARLOW, the first urban district created (1955) as the result of the development of a New Town (*see* NEW TOWNS). It is located in the Epping parliamentary division of Essex (with a small part of the New Town in Hertfordshire), Eng., 25 mi. N.N.E. from Charing Cross, London, by road. Harlow village lies on the main London-Cambridge road and the New Town is to the west of it. The population of the village before development (1951) was 5,829; in 1961 it had reached 53,475 and the estimated final figure is 80,000. A railway line runs through the north of the town, with a new station close to the east industrial estate and the town park, and beyond is the navigable river Stort, a tributary of the Lea. In 1955 a helicopter landing ground was opened. Wheeled traffic is not allowed in the market square, where markets are held twice a week and which is one of several enclosed spaces for pedestrians only. There are special cycle tracks and footpaths with underpasses beneath main roads. Between the town centre and the residential areas is a belt of car parks and in the centre are two tower blocks of flats. Industries in Harlow New Town include printing, metallurgy and the making of glass, surgical equipment, scientific apparatus, tools and furniture.

HARMATTAN, a hot, dry wind over the southern Sahara desert that blows from the northeast, primarily in winter. It is a trade wind which is strengthened by the low-pressure area over the north coast of the Gulf of Guinea. The harmattan is accompanied by blowing sand in the desert, reducing visibility and making travel extremely uncomfortable. Suspensions of fine dust are noticeable along and off the west coast of North Africa, where aircraft operations are handicapped by lowered visibilities. At the height of the winter season, the harmattan reaches the Guinea coast, carrying with it clouds of red dust which form a dense haze and impede river navigation.

Locally, the wind is termed "the doctor" for, notwithstanding its disadvantages, it forms a welcome relief from the damp heat of the previous season. (E. M. Bs.)

HARMODIUS AND ARISTOGITON (d. 514 B.C.), the *tyrannoktonoi,* or "tyrannicides," were popularly supposed to have freed Athens from the Pisistratid tyrants. Their statues were set up in the agora, and when the original group was carried off by Xerxes (480) it was replaced by a new one by Critius (a copy of one of these groups survives in the National museum, Naples). They were celebrated in drinking songs as the deliverers of Athens, and their descendants were entitled to free hospitality in the prytaneum (*q.v.*).

The truth was less edifying. Thucydides (vi, 54–59) explains how the plot against the tyrants derived from Aristogiton's resentment of the advances of Hipparchus, younger brother of the ruling tyrant Hippias, toward his young friend Harmodius. The two friends with a small band of accomplices planned to kill both Hippias and Hipparchus during the armed procession at the Panathenaic festival (514). The plot miscarried and only Hipparchus was killed. Harmodius was killed immediately; Aristogiton was captured and died under torture. The tyranny of Hippias became more ruthless and continued for four more years. (R. ME.)

HARMON, MILLARD FILLMORE (1888–1945), U.S. army officer, military commander in Pacific theatres during World War II, was born on Jan. 19, 1888, at Fort Mason, Calif. In July 1942, after 30 years in the army—most of it as a flyer, staff officer and commander in the air corps—Harmon became commanding general of all U.S. army forces, both ground and air, in the South Pacific. He showed great skill and tact in co-ordinating his operations with those of the navy, which exercised over-all command of the area. A lieutenant general, he exercised supervision over army troops engaged in the air and ground campaigns that reconquered Guadalcanal and the other major islands in the Solomons from the Japanese. Harmon moved to the central Pacific in July 1944 as commanding general of the army air forces, Pacific ocean area. There he made an invaluable contribution to the war against Japan by pressing ahead vigorously with construction of air bases for B-29 bombers in the Marianas. After directing the launching of the strategic air war against Japan by the 20th air force in Nov. 1944, he was lost on a flight between Kwajalein and Johnston islands in the Pacific on Feb. 26–27, 1945. His plane was never found. (A. GG.)

HARMONIA, in Greek mythology, the daughter of Ares and Aphrodite, according to the Theban account; in Samothrace, daughter of Zeus and the Pleiad Electra. When Cadmus (*q.v.*) came to Samothrace in search of Europa, he carried off Harmonia; or, in Thebes, she was given him by the gods as his wife. In either case, all the gods honoured the wedding with their presence. Cadmus or one of the gods presented the bride with a robe and necklace, the work of Hephaestus. This necklace brought misfortune to all who possessed it; it led to the death of Amphiaraus (*q.v.*), of Eriphyle, of Alcmaeon (*q.v.*), of Phegeus and his sons. (Even in historic times its baleful influence continued. Phayllus, one of the Phocian leaders in the Sacred War, 352 B.C., carried it off and gave it to his mistress. After she had worn it for a time her son was seized with madness and set fire to the house, and she perished in the flames.) Both Harmonia and Cadmus were ultimately metamorphosed to snakes.

Harmonia is also the name given to the Greek personification of order and symmetry, and according to Euripides (*Medea,* 824) is daughter of the nine Muses. (T. V. B.)

HARMONICA, a term applied both to the mouth organ and, earlier, to a musical instrument of glass resonators sounded by friction.

The mouth organ was first produced by C. F. L. Buschmann of Berlin in 1821 as the *Mundäoline.* It consists of a number of free metal reeds, fixed in slots in a small wooden box enclosed in metal plates, and supplied with wind through two parallel rows of wind channels. The notes of the diatonic scale are obtained by the player alternately blowing and sucking as he moves the instrument across his lips and uses his tongue to cover those channels not required. Chromatic models have two sets of reed chambers pitched a semitone apart, a finger-operated mechanism enabling the player to use either set at will. Compass varies between two and four octaves and bass models are used in harmonica bands. The virtuosity of some modern players has inspired several eminent composers to write for the instrument.

The glass harmonica was derived from the *vérillon,* fashionable in the 18th century, which consisted of glasses, holding different amounts of water and thus yielding different notes, placed on a sounding board. Sound was produced by rubbing moistened fingers round the rims or, rarely, by striking the glasses. Gluck wrote a concerto for this instrument, performing it in 1746 at London. In 1761 Benjamin Franklin, who

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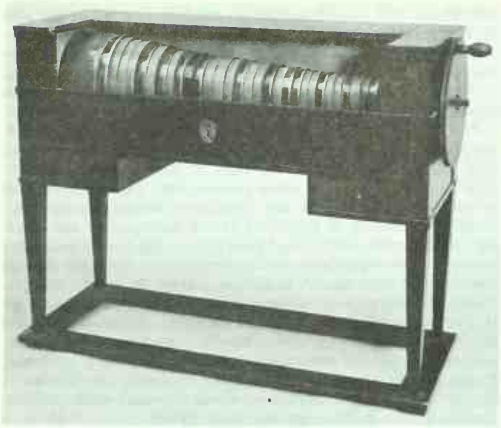
MODERN HARMONICA (MOUTH ORGAN)



COURTESY OF THE METROPOLITAN MUSEUM OF ART, THE CROSBY BROWN COLLECTION OF MUSICAL INSTRUMENTS, 1889

GLASS HARMONICA FROM THE 18TH CENTURY

had been impressed by the playing of an Irish virtuoso, Richard Pockrich, produced an instrument with treadle-rotated and self-tuned glasses that he named the armonica or harmonica. About 1785 a German maker added a keyboard. Both Mozart and Beethoven wrote for the instrument. (J. BL.)

HARMONIC ANALYSIS is a mathematical procedure by which phenomena of a periodically recurrent nature can be subjected to measurement. Problems of great intricacy have been reduced to manageable terms by its technique of breaking complicated mathematical curves into comparatively simple components. Its applications range from analysis of the vibrations of machines to the study of sunspots.

A description of this versatile science was given by one of its pioneers. Jean Baptiste Joseph Fourier, in his classic thesis, *Analytical Theory of Heat* (1822):

> The analytical equations, unknown to the ancient geometers, which Descartes was the first to introduce into the study of curves and surfaces, are not restricted to the properties of figures . . . they extend to all general phenomena. . . . If matter escapes us, as that of air and light, by its extreme tenuity, if bodies are placed far from us by the immensity of space, if man wishes to know the aspect of the heavens at successive epochs separated by a great number of centuries, if the actions of gravity and of heat are exerted in the interior of the earth at depths which will be always inaccessible, mathematical analysis can yet lay hold of the laws of these phenomena. It makes them present and measurable.

Historical Background.—Much of the history of harmonic analysis is the story of the strange marriage of mysticism and mathematics.

In the 6th century B.C., Pythagoras taught that the essence of harmony was inherent in the miraculous power of numbers; but his mysticism was allied with keen observation and deduction. For example, he knew that the musical note produced by a string of fixed tension was converted into its octave when the length was reduced one-half, and its fifth when reduced two-thirds.

The great astronomer Johannes Kepler (*q.v.*) in the 16th and 17th centuries was imbued with the mysticism of Pythagoras, which was enjoying a revival in the centres of learning, particularly in the Italian universities. Kepler, while not accepting in a physical sense the "music of the spheres" of Pythagoras, believed it was possible to represent the motion of every planet in terms of musical notation. Stimulated by the quest for a basic harmony in arithmetic, geometry and music, Kepler opened a new era of mathematics with his discovery of the laws of planetary motion. Even in his lyrical moods, Kepler maintained the mathematician's quest for precision. For example, his staff notation of the tune appropriate to Mercury indicated, in strongly accented arpeggios, that its orbit is more elliptical than that of the other planets.

Another scientist who drew his inspiration from mysticism and his technique from mathematics was Isaac Newton. Newton, who was a disciple of the mystic Jakob Böhme, wrote in the *Principia*, published in 1687: "Nature is pleased with simplicity, and affects not the pomp of superfluous causes." But it is the hardheaded mathematician who is speaking in this excerpt from one of Newton's letters: "For the best and safest method of philosophizing seems to be, first diligently to investigate the properties of things, and establish them by experiment, and then to seek hypotheses to explain them."

Newton gave the first mathematical treatment of wave motion in the *Principia*. His calculations gave the ellipticity of the earth as 1/230; the figure accepted today is 1/297. (*See* also WAVE MOTION.)

In connection with the study of the vibration of musical strings Daniel Bernoulli and Leonhard Euler laid the groundwork for Fourier's elaborate mathematical structure. The equations known as the Fourier series were first published by Bernoulli in 1728.

In keeping with the ancient traditions of harmonic analysis, James Clerk Maxwell in the 19th century pronounced Fourier's *Analytical Theory of Heat* "a great mathematical poem."

In *Science and the Modern World* (1925), Alfred North Whitehead notes that "we have in the end come back to a version of the doctrine of old Pythagoras, from whom mathematics, and mathematical physics, took their rise. He . . . directed attention to numbers as characterizing the periodicity of notes of music. . . . And now in the 20th century we find physicists largely engaged in analyzing the periodicities of atoms."

Basic Theory.—Many physical phenomena, such as sound waves, alternating electric currents, tides, machine motions, etc., may be periodic in character. Such motions can be measured at a number of successive values of the independent variable, usually the time; and these data, or a curve plotted from these data, will represent a function of that independent variable. Thus the ordinate of the curve at any point is $y=f(x)$. Generally the mathematical expression for $f(x)$ will be unknown.

However, with the periodic functions found in nature, $f(x)$ can be expressed as the sum of a number of sine and cosine terms. Such a sum is known as a Fourier series (*q.v.*) and the determination of the coefficients of these terms is called harmonic analysis. The term harmonic analysis can also be used in the broader sense of the analysis into any kind of periodic components, such as spherical harmonics, cylindrical harmonics, tesseral harmonics, etc. However, this article shall be confined to the development into Fourier series, which development has found more extensive practical application than any of the others. One of the terms of such a series has a period equal to that of $f(x)$ and is called the fundamental. Other terms have shorter periods, which are integral submultiples of the fundamental. These are called harmonics.

Applications.—Harmonic analysis is of great value in mathematics, in physics and in engineering. A sound wave, for instance, can cause the vibration of a thin diaphragm, whose motion is photographed in the form of a continuous curve by the use of the Phonodeik of D. C. Miller, or by other methods such as the cathode-ray oscilloscope. The shape of the resulting curve will depend on the quality of the sound and will generally be quite complicated. However, it can be analyzed into its fundamental and harmonics or overtones by use of Fourier series. It is the number and magnitude of these harmonics which determine the quality of the sound, and therefore such investigations are of great value in the scientific study of music and speech. Similar methods are used extensively by the electrical engineer in the study of alternating currents. In mechanical engineering they can be used in the investigation of valve motion and other mechanical movements.

Harmonic analysis may be also used in the study of tidal records; and, by the use of such information as it affords, the prediction of tides is possible. (*See* TIDES.)

All the above applications have been for cases where the movements are truly periodic. In a large class of other phenomena, such as the weather, sunspots, magnetic deviations, river flow,

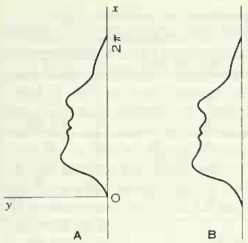


FIG. 1

atmospheric strays in radio reception, etc., the fundamental period is usually not evident and the periods of the harmonics are not simple submultiples of the fundamental. Even in such cases, however, modified methods can be used to some extent to give an analysis into a series of sine or cosine terms.

Any ordinary nonperiodic curve of finite length can also be analyzed by the harmonic method, the scale being changed in the x-direction so that the length is 2π units. An example taken from D. C. Miller's excellent book, *The Science of Musical Sounds* (1903), is shown in fig. 1(A), where a profile of a face is analyzed and found to have the equation:

$$\begin{aligned} y = {} & 49.6 \sin(\theta+302°)+17.4 \sin(2\theta+298°) \\ & +13.8 \sin(3\theta+195°)+7.1 \sin(4\theta+215°) \\ & +4.5 \sin(5\theta+80°)+0.6 \sin(6\theta+171°) \\ & +2.7 \sin(7\theta+34°)+0.6 \sin(8\theta+242°) \\ & +1.6 \sin(9\theta+331°)+1.3 \sin(10\theta+208°) \\ & +0.3 \sin(11\theta+89°)+0.5 \sin(12\theta+229°) \\ & +0.7 \sin(13\theta+103°)+0.3 \sin(14\theta+305°) \\ & +0.4 \sin(15\theta+169°)+0.5 \sin(16\theta+230°) \\ & +0.5 \sin(17\theta+207°)+0.4 \sin(18\theta+64°) \end{aligned}$$

These harmonics were then combined, giving the result shown in fig. 1(B).

Numerical Methods.—In 1822 Fourier stated that a function $y=f(x)$ could be expressed between the limits of $x=0$ and $x=2\pi$ by the series:

$$y = a_1 \sin x + a_2 \sin 2x + a_3 \sin 3x + \cdots + b_0 + b_1 \cos x + b_2 \cos 2x + \cdots \quad (1)$$

provided the function is single-valued, finite and continuous except for a finite number of discontinuities. The coefficients are

$$\left.\begin{aligned} b_0 &= \frac{1}{2\pi}\int_0^{2\pi} y\,dx \\ b_k &= \frac{1}{\pi}\int_0^{2\pi} y \cos kx\,dx \\ a_k &= \frac{1}{\pi}\int_0^{2\pi} y \sin kx\,dx \end{aligned}\right\} \quad (2)$$

where $k=1, 2, 3, \cdots$

With the further restriction that there be only a finite number of maxima and minima, the theorem was proved by Lejeune Dirichlet in 1829.

Equation (1) can be written in the alternate form:

$$y = c_1 \sin(x+\phi_1)+c_2 \sin(2x+\phi_2)+c_3 \sin(3x+\phi_3)+\cdots \quad (3)$$

where

$$c_k = \sqrt{(a_k^2+b_k^2)}, \qquad \phi_k = \tan^{-1}\frac{b_k}{a_k} \quad (4)$$

Assume that a record has been obtained of some periodic phenomenon expressed as a curve or as a set of data which can be plotted and called $f(x)$. Even although $f(x)$ cannot be expressed as a simple function, equation (1) can be used to approximate it, and the coefficients a_k and b_k can be determined. It will be necessary first to find the period of the function; that is, the distance between corresponding points on successive waves. This distance will be called 2π radians or 360°, and can then be divided into any convenient number of parts, say n. The first n ordinates are measured and their values substituted in equation (1), giving n equations in the n undetermined coefficients. These equations can be solved to obtain a_k and b_k. The n equations have the form:

$$y_k = b_0 + b_1 \cos x_k + b_2 \cos 2x_k + \ldots + a_1 \sin x_k + a_2 \sin 2x_k + \ldots$$

where $k=0, 1, 2, 3, \ldots (n-1)$ successively; y_k is the kth ordinate of the curve, and x_k is the corresponding abscissa expressed in degrees. From these it can be shown that

$$\left.\begin{aligned} b_0 &= \frac{1}{n}(y_0+y_1+y_2+\cdots+y_{n-1}) \\ b_k &= \frac{2}{n}(y_0 \cos kx_0+y_1 \cos kx_1+\cdots+y_{n-1}\cos kx_{n-1}) \\ a_k &= \frac{2}{n}(y_0 \sin kx_0+y_1 \sin kx_1+\cdots+y_{n-1}\sin kx_{n-1}) \end{aligned}\right\} \quad (5)$$

A curve plotted from (1) using the coefficients (5) will pass through all the values y_k exactly, but probably will not coincide with the experimental curve at other points. Obviously, the use of a larger number of terms will increase the accuracy. In some applications the function can be very closely approximated by a few terms. In other cases, particularly if the wave has sharp corners, a large number of terms is necessary to get a sufficiently accurate expression. It is often possible to tell something about the coefficients by inspection, thus simplifying the mathematical work of analysis. If positive and negative loops of the curve are the same, then even harmonics are absent. This is practically always the case with alternating currents. Also, if the curve for $x<0$ is the reflection in the y-axis of the curve for $x>0$, there will be no sine terms; while if the curve is symmetric about the origin, there are no cosine terms.

Schedule Methods.—The use of equation (5) is the basis of numerous so-called schedule methods of analysis. These are merely short cuts for solving this equation, many of the routine multiplications being combined and tabulated in a schedule. Of these, the best-known is probably that of C. Runge. It can best be explained by an example. For this a six-point schedule has been selected. Only odd harmonics are considered, and the zero is taken where the curve crosses the x-axis. Then the six equations are:

$$\begin{aligned} 3b_1 &= y_1 \cos 30°+y_2 \cos 60°+y_3 \cos 90°+y_4 \cos 120°+y_5 \cos 150° \\ 3b_3 &= y_1 \cos 90°+y_2 \cos 180°+y_3 \cos 270°+y_4 \cos 360°+y_5 \cos 450° \\ 3b_5 &= y_1 \cos 150°+y_2 \cos 300°+y_3 \cos 450°+y_4 \cos 600°+y_5 \cos 750° \\ 3a_1 &= y_1 \sin 30°+y_2 \sin 60°+y_3 \sin 90°+y_4 \sin 120°+y_5 \sin 150° \\ 3a_3 &= y_1 \sin 90°+y_2 \sin 180°+y_3 \sin 270°+y_4 \sin 360°+y_5 \sin 450° \\ 3a_5 &= y_1 \sin 150°+y_2 \sin 300°+y_3 \sin 450°+y_4 \sin 600°+y_5 \sin 750° \end{aligned}$$

All can be expressed as functions of 30°, 60° and 90°:

$$\begin{aligned} 3b_1 &= (y_2-y_4)\sin 30°+(y_1-y_5)\sin 60° \\ 3b_3 &= -(y_2-y_4)\sin 90° \\ 3b_5 &= (y_2-y_4)\sin 30°-(y_1-y_5)\sin 60° \\ 3a_1 &= (y_1+y_5)\sin 30°+(y_2+y_4)\sin 60°+y_3 \sin 90° \\ 3a_3 &= (y_1-y_3+y_5)\sin 90° \\ 3a_5 &= (y_1+y_5)\sin 30°-(y_2+y_4)\sin 60°+y_3 \sin 90° \end{aligned}$$

It will be noticed that, except for y_3, all the coefficients occur as sums or differences. In the schedule given above, y_0 has been added so that the curve does not have to cross the x-axis at $x=0$. If $f(x)=0$ when $x=0$, as in the previous equations, then of course y_0 disappears. The work can be tabulated as shown in Table I. Table II is a numerical example given by F. W. Grover. This has been plotted in fig. 2. The heavy curve is the one to be analyzed. The six points used in the above schedule are enclosed by circles. Since the wave is nearly sinusoidal, the analysis results in a large fundamental sine curve and very small higher harmonics. Synthesis gives the light curve of fig. 2. It will be noted that this passes through all six points, but does not exactly coincide with the original curve throughout. By taking a larger number of points and, therefore, a different schedule, a much closer approximation would be obtained.

A method of selected ordinates has been devised by J. Fischer-Hinnen. This appears to require slightly less computation than the Runge method, but has the disadvantage that a new set of equally spaced ordinates must be measured for each pair of coefficients. Other methods of computation of the coefficients have been worked out by C. P. Steinmetz, S. P. Thompson and others. Various graphical methods have also been devised. C. S. Slichter, for instance, uses a special graph paper which introduces the sine or cosine factor without computation. The area under the

TABLE I.—*General Schedule*

Measured ordinates	Sums	Differences		Sine terms 1st and 5th	Sine terms 3rd	Cosine terms 1st and 5th	Cosine terms 3rd
y_0		d_0					
y_1 y_{11}	S_1	d_1	sin 30°	S_1		d_1	
y_2 y_{10}	S_2	d_2	sin 60°				
y_3 y_9	S_3		sin 90°	S_3	S_1-S_3	d_0	d_0-d_2
				S_1 S_2	S	D_0 D_2	D
				$a_1=\frac{S_1+S_2}{3}$	$a_3=\frac{S}{3}$	$b_1=\frac{D_1+D_2}{3}$	$b_3=\frac{D}{3}$
				$a_2=\frac{S_1-S_2}{3}$		$b_2=\frac{D_1-D_2}{3}$	

curve is measured with an ordinary planimeter. It requires the replotting of the curve for each coefficient, and it is doubtful if any time is saved over the schedule method. Other graphical methods have been used by W. K. Clifford, J. Perry, Harrison, Ashworth, Beattie and Rottenburg.

Mechanical Methods.—The above methods all require a large amount of labour, especially if many coefficients are to be determined. If much of the work is to be done, therefore, some

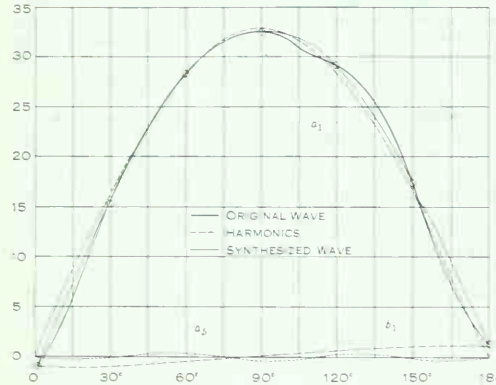


FIG. 2

machine method is advisable. Equation (2) is used in most of the mechanical analyzers.

If the curve $y=f(x)$ of fig. 3(A) is to be analyzed, it is merely necessary to multiply the ordinates by sin x (fig. 3[B]) and obtain the area under the resulting curve (fig. 3[C]). This gives

$$\int f(x)\sin x\,dx$$

which is proportional to a_1. The other coefficients are obtained similarly. Most of the machines, therefore, consist of some means of multiplying the ordinates of the curve by sin kx or cos kx and integrating the product.

The first mechanical harmonic analyzer was invented in 1876 by Lord Kelvin. Another machine working on a similar principle is that invented in 1894 by O. Henrici and A. Sharp. For descriptions and illustrations of these early machines *see* MATHEMATICAL INSTRUMENTS. The Henrici machine was improved by G. Coradi. This very beautiful instrument makes use of a number of glass spheres which are moved an amount equal to the ordinate of the curve. The readings are obtained by two Amsler integrating wheels bearing on each sphere, one reading sine components, and the other cosine components. A five-sphere machine will thus give ten coefficients for one trace of the curve. The machine is speedy and accurate, but its expense and delicacy have limited its use to some extent. The Michelson and Stratton analyzer will handle up to 80 coefficients at once. It works equally well as a synthesizer and has been extensively used in tide prediction. The Chubb analyzer differs from all others in that it uses a polar graph instead of a rectangular one. The curve, in the form of a cardboard template, is fastened to the table of the machine. The table moves back and forth with a sinusoidal motion as it turns, and the result is integrated by an ordinary planimeter. The machine can evaluate only one coefficient at a time and is therefore slow. It is very rugged, and finds considerable use in connection with polar oscillograms.

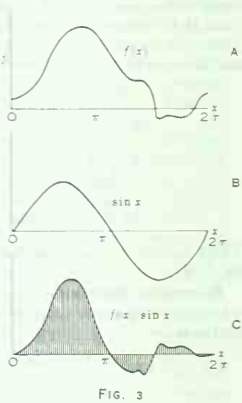


FIG. 3

A product integraph developed at the Massachusetts Institute of Technology can obtain the integral of the product of any two functions. Its primary use is in the mechanical solution of differential equations, but it can be used for harmonic analysis. In fact, it will develop curves in terms of various other series as well as the harmonic series of Fourier. Many other machines have been proposed, notably by O. Mader, Rowe, Wiechert and A. Sommerfeld, Bashforth, G. U. Yule, J. Le Conte, Terada, F. S. Dellenbaugh and D. O. Woodbury. Most of these machines work on the principle previously mentioned, though the Dellenbaugh uses the schedule method, while the Woodbury is based on the Fischer-Hinnen method.

Direct Analysis.—The above methods make use of an experimentally determined curve or set of data. In the case of electric currents or voltages, an entirely different method is possible. This direct method was suggested by M. I. Pupin in 1894, and was developed by the Bell System laboratories. Instead of first getting an oscillographic record of the voltage or current and analyzing it mathematically, the analysis is performed directly on the electric quantity by making a record of the response when the natural frequency of a tuned circuit is varied through a wide range.

TABLE II.—*Schedule with Numerical Example*

	Ordinates	Sums	Differences		Sine terms 1st and 5th	Sine terms 3rd	Cosine terms 1st and 5th	Cosine terms 3rd
0	−1·13 . . .		−1·13					
1	15·15 17·13 . .	32·28	−2·98	0·82	+16·200		−0·425	
2	28·0 28·85 . .	60·85	−0·85	0·86		−40·233		−1·300
3	32·35	32·35		1·00	32·350		−1·300	0·850
		Sums			48·550	40·233	1·825	1·005	0·050	−0·450
		S_1			40·233	−0·653	1·005	0·180
		$a_1=$			32·504		−3·630	$b_1=-1·210$	$b_3=-0·150$
					$a_1=-0·228$		$a_3=0·017$ $b_1=0·060$	

A large number of methods are available for the harmonic analysis of complex waves. The direct mathematical method is unnecessarily long and arduous. This has been simplified by schedules which are fairly quick and are the methods generally used if only a small amount of such work is to be done, or if a punched card system or some other form of digital computer is available. If much harmonic analysis is required, it may be advisable to use a machine analyzer, such as the Henrici-Coradi, the Michelson and Stratton, or the Chubb. Of these the first appears to offer advantages if five or ten coefficients are sufficient. If a very large number of terms is required, the Michelson and Stratton is advisable.

The reverse process of synthesis is also used to a considerable extent, particularly in tide prediction. Various machines have been built for this purpose, the first being designed by Kelvin. An extremely compact form of Kelvin synthesizer was built by D. C. Miller for use in his work on the theory of musical sounds. The Michelson and Stratton machine is also very good for synthesis. In fact, any of the analyzers can be used for this purpose, though some are much more convenient than others. Some synthesizers display the sum of suitable voltages on an oscilloscope. *See* also FOURIER SERIES; SOUND; TIDES.

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HARMONIUM, or reed organ, a keyboard musical instrument of the free-reed class; the wind is supplied by foot bellows through a pressure-equalizing air reservoir. The reeds comprise metal tongues, or vibrators, screwed over slots in metal frames. There are no pipes. Different tone colours in imitation of the organ are provided mainly through separate sets of reeds, each set varying in the size and shape of the tone chamber surrounding each reed. Constricted chambers, for instance, induce powerful vibration and incisive tone. Volume is controlled by an air valve operated by a knee lever, or directly from the bellows pedals by an "expression" stop that allows the wind supply to bypass the reservoir. The U.S. equivalent of the harmonium, the American organ, differs a little in the detail of reeds and chambers and in the direction of air flow, the bellows exhausting the reservoir instead of filling it. The earliest of the harmonium group was Anton Haeckl's physharmonica (Vienna, 1818). Other types, now extinct (John Green's seraphine, etc.), followed before Alexandre Debain produced his harmonium (Paris, 1840). The main improvements since 1850 have been by Victor Mustel in Paris and Jacob Estey in the U.S.

BY COURTESY OF GEORGE MOWARTH AND SONS, LONDON; PHOTOGRAPH BY ARNOLD BEHR

HARMONIUM BY JACOB ALEXANDRE (1804–76), PARIS

The free reed as known in the west stems, at least in part, from the Chinese mouth organ, *sheng*, recorded from the 1st millennium B.C. In this, the reeds are fixed over slots in wood or bamboo pipes, these being held in a small wind chest. Each reed tongue is cut in the thin brass of its frame (instead of being attached separately, as done in the west) and can bend to either side of the frame, vibrating equally whether the player blows or sucks. Before the reed can speak, a fingerhole in the pipe must be covered; otherwise the hole breaks the acoustic coupling between reed and pipe. Late in the 1770s the *sheng* aroused the interest of certain European physicists and musicians (notably C. G. Kratzenstein and G. J. Vogler) and various experiments followed in Paris and elsewhere to incorporate a stop of free reeds in small pipe organs. There exists, however, no definitive account of the events leading up to Haeckl's invention of 1818 and to C. F. L. Buschmann's of 1821, which launched the portable free-reed instruments of the west (*see* ACCORDION; HARMONICA). (A. C. BA.)

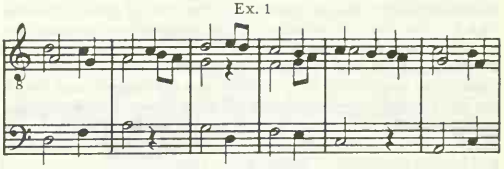
HARMONY, in broad musical terms, is the science of combined sounds. Theoretically, it is distinct from melody in that it is the result of the creation of a musical texture in at least two parts: from counterpoint in that these parts need have no melodic life of their own; and from rhythm in that harmony implies pitch. In practice, however, melody, counterpoint and rhythm each have a function in harmony. (In the course of this article the system of figured bass [*see* THOROUGH BASS] employed for *continuo* parts in the 17th and 18th centuries is used, since it is the best shorthand notation for harmony. The figures under any bass note show the intervals between each note of the parts above and the bass. The following conventions are employed: [1] Any unfigured bass note signifies $\binom{8}{5}_{3}$ [the octave is always understood]; an accidental alone refers to the third. [2] Movement of parts is shown by intermediate figures.)

In this article the letter name of a note is printed followed by a figure; the note so named is presumed to be the bass.

HARMONY BEFORE 1550

The earliest known harmony in western European music is called "parallel organum" (*see* ORGANUM) and dates from the 9th century. In this a plain chant melody was doubled at the octave, fifth or fourth below, and examples of organum occur in two, three or four parts. In England the interval of the third is recorded. In the 11th century a free organum style was introduced, so called because the chant was doubled at a variety of intervals. Although the voices sang note against note, the intervals varied so that contrary motion occurred as well as parallel movement. The plain chant was usually the lower part. In this style the feeling of a cadence emerges since both parts end on the "final" of the mode. A new development occurred in the first half of the 12th century. In the added part two or more notes were sung to one note of the plain chant. At the same time the octave and the fifth emerge as characteristic intervals marking the beginning and end. In ex. 1 octaves and fifths occur at important points of rest.

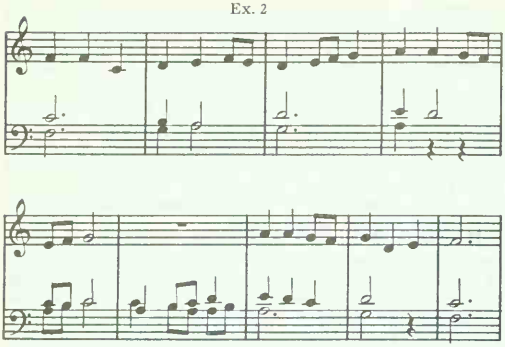
Ex. 1



The harmonic collisions in bars 2 and 5 in the above example were doubtless the result of methods of composition whereby each extra part was added to the original plain chant, as opposed to the much later methods of considering the parts as a whole. The counterpoint, however, was not entirely independent since the mode determined some sort of correlation between the parts. In ex. 2, from a motet, *c.* 1250, decorated movement between fifths and octaves produce a $\frac{7}{3}\,\frac{6}{3}$ progression on the last beat of bar 7, and the feeling of a cadential approach to the octave by contrary motion (bar 8), establishing a form of the cadence that persisted until the Renaissance and beyond (*see* CADENCE).

This example shows the systematic movement of fifths and octaves as a harmonic basis of counterpoint. Polyphonic music of the immediately succeeding period differed little harmonically,

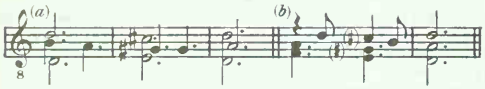
Ex. 2



though it developed greater rhythmic and melodic complexities. The interval of the third, however, was used more often, notably in the well-known rota (round) "Sumer is icumen in" (*q.v.*).

The innovations of the Ars Nova (*q.v.*), concerned chiefly with form, melodic design and counterpoint, did not greatly affect the existing harmonic technique. Two related features are, however, connected with these innovations. To avoid the tritone (the interval of three whole tones written as an augmented fourth, F-B, or, in the form of its inversion B-F, as a diminished fifth) the procedure in ex. 3*a* was evolved; and the cadence in ex. 3*b*, probably motivated by the desire to resolve the sixth to what was held to be the more consonant fifth, became commoner a little later.

Ex. 3*a* and 3*b*



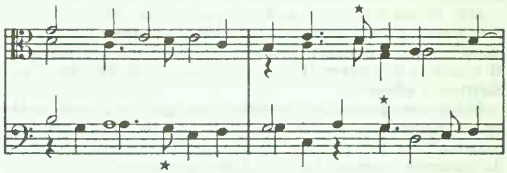
Ex. 3*b*, in which the cadence note D is preceded by notes a second and third below, is called the "Landini cadence," though it is not first found in, nor confined to, the work of Francesco Landini, being current all over Europe at this period.

The 15th-century practice of faburden, consisting of three-part harmony in which a melody is accompanied by two lower parts in parallel fourths and sixths, was a distinctly harmonic system. This was again a type of organum, deriving perhaps from the earlier English fondness for thirds. The English style at this period was in any case inclined to be harmonic—a *Kyrie* in the Old Hall manuscript consists almost entirely of $\frac{6}{3}$ chords—and these harmonic tendencies were incorporated in the work of John Dunstable (*q.v.*). Not only do certain cadence progressions become systematic in Dunstable's work but the third ceases to be merely part of a chord of the fifth, becoming an important interval in its own right. The sixth becomes commoner and the seventh and fourth are often treated as dissonances by suspension. Pausing on one point or another of the mode with evident design, Dunstable appears to have differentiated between various forms of cadences, and he also anticipated a feeling of tonality.

These features are also illustrated in the works of the Burgundians, Guillaume Dufay and Gilles Binchois, and in the later Flemish school of Jean d'Okeghem and Jakob Obrecht. Though their general style differs from that of Dunstable the systematization of cadences in their work becomes more marked. The Landini cadence, though still appearing, was gradually replaced by one in which the sixth did not fall to the fifth before moving upward, and the $\frac{6}{3}$ chord became a commonly used feature of the musical language. A fuller harmony was obtained by the Flemish composers since they normally wrote in four parts as opposed to the typical three-voice texture of Dunstable's time.

With Heinrich Isaak, Josquin Desprès and Pierre de la Rue harmonic methods were established that were to remain, with few changes, until the end of the 16th century. The treatment of dissonance by Josquin became more systematic. In the works of Okeghem leaps from dissonant notes were not uncommon, as ex. 4 shows. In Josquin only the first instance of such leaps (known as the *nota cambiata*) was normal. In fact, Josquin's treatment of dissonance differed only in detail from that of Palestrina.

Ex. 4



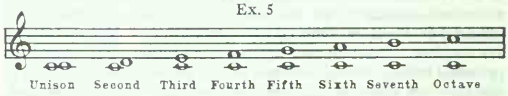
The most important changes of harmonic style in the century and a half culminating in Josquin were thus: (1) the replacement of parallel movement between perfect concords (fifths, octaves and fourths) by imperfect concord movement (thirds and sixths), though in Dunstable consecutive fourths are not uncommon and were even used, between upper parts, by Tomas Luis de Victoria a century later; (2) the systematization of dissonance treatment and cadences. From this system, with its delicate relation between dissonance and pulse, arose the whole conception of modern harmonic rhythm. (See *Tonality, Time Scale, Movement and Modulation* below.)

HARMONY *c.* 1550–1900

Late 16th-Century Style.—From about 1550 onward the main elements of the harmonic method in use to the end of the 19th century are discernible. This method is based on the movement of parts and the intervals resulting from their relation to each other. After the modes were discarded, new chromatic possibilities of the diatonic system arose (*see* SCALE: *Diatonic Scale*). But the harmonic and contrapuntal method remained fundamentally unchanged. The main principles of this method are:

Harmony is reducible to the effect of intervals. Intervals from the note C are as follows:

Ex. 5



Unisons, fourths, fifths and octaves are perfect intervals and perfect concords. Since Dunstable the fourth, while remaining a perfect concord in theory, has been treated as dissonant when it occurs between the bass and another part and as concordant between upper parts.

Thirds and sixths are imperfect concords.

Seconds, fourths (*see* above) and sevenths are discords.

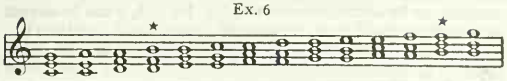
The properties of intervals are repeated in each octave, *i.e.*, a ninth has the harmonic properties of a second, etc.

Imperfect concords and discords, excepting the fourth, are further designated major or minor. In ex. 5, all are major and may be made minor by flattening the upper or sharpening the lower note. Minor and perfect intervals may similarly be diminished by flattening the upper or sharpening the lower note, and major and perfect intervals may be augmented by a reverse process. Whatever its quality, an interval's numerical name is derived from counting the number of note names, *i.e.*, C-G remains a fifth whatever accidentals are added. The change from major to minor does not affect consonance, but all augmented and diminished intervals are dissonant.

Hence the following three-note chords (in C major) are concordant, their constituent notes being concordant with each other. The chords marked with a star containing the tritone (F-B and B-F), a dissonant interval, were treated as essential discords in the 16th century and so in one sense are concordant. (See *Essential Discords* below.) As with octave multiples of intervals, in-

version of the upper notes of triads (three-note chords) does not alter their harmonic significance.

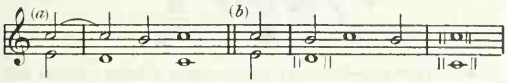
Ex. 6



Treatment of Dissonance.—Practice in the late 16th century confines dissonance treatment to the following:

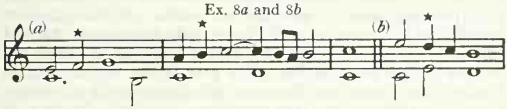
(1) Suspensions. Notes prepared as concords on weak beats are tied to dissonances on succeeding strong beats and resolved on the following weak beats to concords one note below (ex. 7*a*). The only exception to this treatment on a strong beat is the dissonant preparation called the consonant seventh or fourth, the latter being commoner in three- and four-part writing. The consonant seventh (D-C) occurs over a pedal (a held or reiterated note) bass in ex. 7*b*.

Ex. 7*a* and 7*b*



(2) Passing notes. Unaccented passing notes are discords "passing" between concords by step and between pulse beats (ex. 8*a*). Accented passing notes occur on weak beats and in this period are nearly always descending (ex. 8*b*).

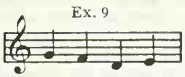
Ex. 8*a* and 8*b*



Ex. 8*a* shows, at the conclusion of bar 2, one of the common methods of decorating the resolution of a suspension.

Dissonances were quitted by step except in the following pattern where the second note is often dissonant:

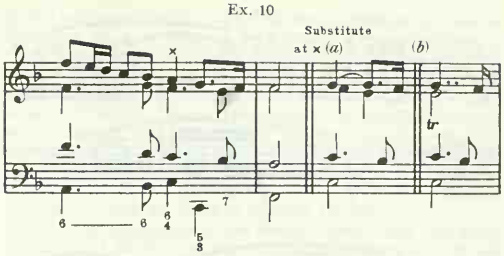
Ex. 9



These principles of 16th-century method are discussed fully in books concerning the style of the period, notably in those by Knud Jeppesen and Tillman Merritt, but perhaps most interestingly by the 16th-century composer, Thomas Morley, though he curiously omits mention, except by implication, of the relationship between dissonance and pulse. Particularly interesting to the modern reader is Morley's insistence on the interval structure of harmony, a conception that descends directly from the ancient methods of adding parts to an existing part.

Opposed to Morley's treatise was the inversion system of the 18th-century composer, Jean Rameau (*q.v.*). This system, widely used by pedagogues from the middle of the 19th century onward, is derived from Rameau's theory of the "fundamental bass." It teaches that all three-note and other chords are derived from fundamental triads, a $\frac{6}{3}$ chord having, for instance, an imaginary bass on the note figured as 6 and a $\frac{6}{4}$ chord on its fourth. Such a system fails to explain the augmented sixth, cannot effectively explain the diminished seventh as a fundamental discord and complicates the explanation of quite simple phenomena such as appoggiatura. Its explanation of the $\frac{6}{4}$ is perhaps its weakest point, since it argues that a $\frac{6}{4}$ on the dominant is the second inversion of the tonic chord, though usage always demonstrated this chord to be a dissonant version of the dominant chord. In the following example of a typical final cadence by Handel, the reduction of the cadential $\frac{6}{4}$ to its original dominant meaning is shown. It must

Ex. 10



be stressed that this passage is meaningless unless the bass note at that point is C (the dominant).

Neither does the system explain how $\frac{6}{3}$s on succeeding notes of the scale were held to be satisfactory while the fundamental triads of these same chords were prohibited. The system is mentioned here because of its almost universal dissemination up to the middle of the 20th century. Despite its fallacies, most 20th-century harmony textbooks were based on it.

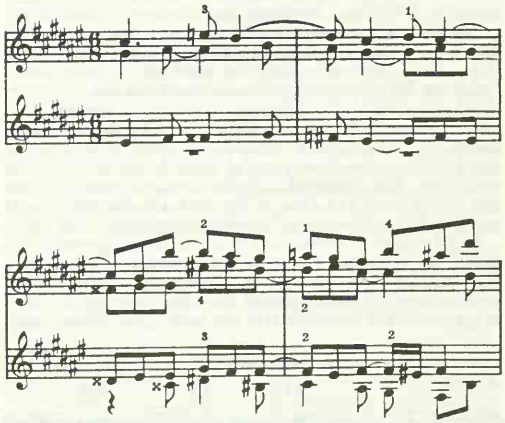
The Diatonic Age

Under this heading further developments, most of them dating from the 17th and early 18th centuries, may be approached. In this period concords remain as before. Though style changed greatly between 1650 and 1900 the fundamentals of harmonic method did not, though their application varied. The main features of this new application will now be classified.

Treatment of Dissonance.—As a general principle any dissonant note, however approached, resolves by falling or rising one note to a consonance, though there may be intervening notes decorating the resolution. Upward resolutions of accented discords are normally of a semitone, rarely a tone, although the resolution of a tone is common when moving in thirds or sixths. Different types of accented dissonance are given below. They are so called because of the nature of the approach to the dissonant note.

(1) Accented passing note. (2) Suspension. (3) Changing

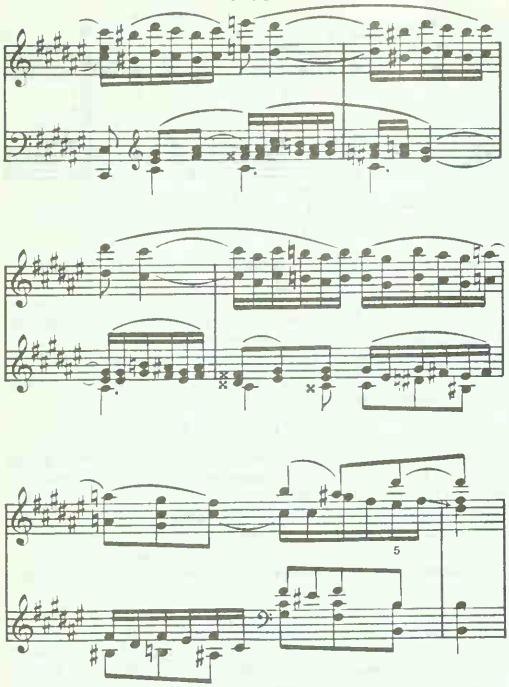
Ex. 11



note (a harmony note approached through notes on each side). (4) Appoggiatura (a dissonance approached by leap).

The above example is a simplified skeleton, slightly altered to make certain dissonances appear more obvious, of a passage from Beethoven's "Hammerklavier" Sonata, Opus 106. This includes the fifth type of dissonance of fairly frequent occurrence, the *note échappée*, or changing note (5 in ex. 12), a two-note de-

Ex. 12

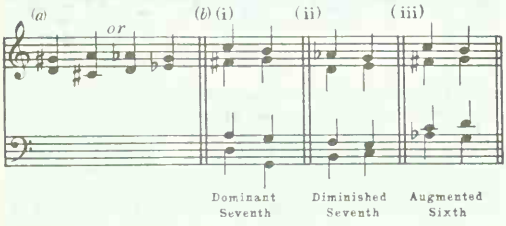


scending figure, which, usually leaping a third, is the only normal exception to the principle of quitting a dissonance by step (apart from decorated resolutions). Its dissonant note is always unaccented. Ex. 12 is altogether highly decorated and affords many examples of dissonance treatment, in particular of changing notes.

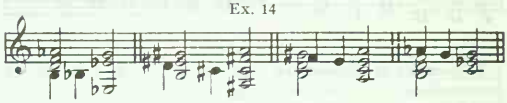
Essential Discords.—In modal usage the tritone was handled with care. Where its effect was ambiguous it was usually made into a perfect interval by an added accidental. Certain chords containing the tritone are known as essential discords. They are said to be essential when they can resolve to new harmony. An essential discord is, therefore, a multiple discord requiring multiple resolutions. The tritone's ambiguity is shown in ex. 13*a*. In 13*b* are shown the three essential discords with their normal resolutions. The augmented sixth often contains a fourth harmony note (which could be a D or an E♭ in ex. 13*b*, iii) which would not affect the essential harmonic and tonal meaning of the chord.

With the rise of diatonicism the strong leading properties of the tritone encouraged the use of it wherever a tonal sense was required. The term "leading note" is commonly used in a limited sense to mean the seventh note of the scale, the semitone leading to the tonic. But the fourth note also tends to lead down a semitone to the third. The tritone consists of both these notes, and this fact, coupled with its dissonant quality, gives it its motive power. As the tritone itself can be ambiguous, so the chords it contains can be altered enharmonically. Ex. 13*b*, ii can be altered as follows:

Ex. 13*a* and 13*b*

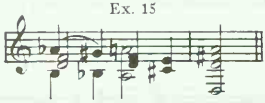


Ex. 14



Furthermore, depending on the arrangement of the notes, the dominant seventh harmony on the second crotchet of all these may become an augmented sixth by enharmonic means (*i.e.*, A♭ = G♯) as shown in ex. 15.

Ex. 15

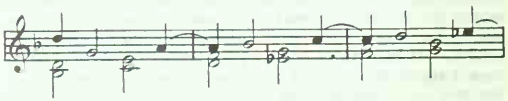


Part Writing.—Normally, simultaneous passing notes in different parts are concordant with each other but much depends on the texture of the harmonic progressions, on tempo and on whether the parts are in similar or contrary motion.

In similar motion, movement is by imperfect concord (thirds and sixths) and not by perfect concord (unisons, fourths, fifths and octaves) though similar movement of fourths between upper parts is usual; consecutive or parallel octaves and fifths produce the effect of mixture stops on the organ, a doubling rather than the addition of parts, so that in part writing consecutives reduce the number of real parts, giving undue prominence to the parts so doubled. Deliberate doublings of whole phrases at the octave are, of course, commonplace (they occur in ex. 12), and although such doubling was extended to fifths in the 20th century, it rarely occurred between 1650 and 1900. In Bach's *St. John Passion*, "If this man were not a malefactor" (no. 23), flutes doubling the vocal tenor line at the octave move in fifths with the first oboe and first violins in bar 3 of the chorus. The ear, however, perceives the tenor line in fourths below the upper voices. There are isolated examples of consecutives in the works of great masters in this period, but they are rare, and they usually are placed so that either their effect is inconsiderable or the harmony or figuration forces the ear to disregard them as contrapuntal progressions. More common types of consecutives can be found in Bach's chorale *Freuet euch, ihr Christen* (cantata no. 40) in four of the cadences between soprano and tenor; in Mozart's Violin Sonata in A, K. 526, in the opening notes of the last movement between top and bass; in Handel's Violin Sonata in E in the opening notes between violin and bass; and in Beethoven's Pianoforte Sonata, Opus 31, no. 1 (second movement, bars 109, 111 and 113).

This discussion is made necessary by the fact that forbidden consecutives have long dominated the teaching of harmony. It is necessary for students to distinguish between doublings that are a sign of impoverished part writing and those that are legitimately used for added sonority. As a rule parallel octaves are found less often than parallel fifths. The common syncopated avoidance of direct fifths, as in ex. 16 from Thomas Morley, is never found with octaves.

Ex. 16



Chromatic Harmony.—Chromatic harmony presents no difficulty once the harmonic principles of diatonic harmony have been grasped. Ex. 11 shows the use of chromatic dissonance and certain

aspects of transitory modulation. Most chromatic chords are normal diatonic chords with one or more notes altered chromatically, very often in this way producing a species of artificial leading note.

Tonality, Time Scale, Movement and Modulation.—The chief problem of composition has always been the problem of the extension of an idea. Renaissance composers discovered means of composing without using an existing *cantus firmus* (see COUNTERPOINT), and as a result various methods became standard: (1) canon and fugue; (2) *ostinato* methods including the device of isorhythm; (3) sectional vocal forms allied to the continuity of the text. All of these depended on the extension of an existing melodic or literary feature.

The monodists of the *nuove musiche* had to find other methods since imitative devices were hardly possible in truly monodic works. Hence the 17th-century predilection for forms of ground bass. This device was borrowed from dance music as bass and harmony patterns already existed for decorated repetitions in dance music; *e.g.*, the *passamezzo antico*. Such patterns were related to previous *ostinato* methods in that once a pattern was composed (like an isorhythmic talea) it was merely repeated.

But variation patterns alone could produce only one kind of extension. The other great factor that enabled composers to expand the time scale of music was the emergence of diatonic tonality. The modes provided a distinctive character and colour but little movement and few possibilities of extension. In the succeeding major and minor key system, however, the tonal centre or tonic became such a strong characteristic that any movement away from it forced continuation, since the piece was felt to be incomplete until it rested again on the tonic. This is, of course, a simplified view of a process that took considerable time to evolve, especially as modal methods were in use until the 17th century; works by Dietrich Buxtehude and John Blow, for example, contain final cadences that 100 years later would not have been thought to establish tonics.

In spite of the relation between dissonance and pulse (rhythmical beating) in 16th-century style, melodic rhythms themselves only partly depended upon the pulse; *i.e.*, insofar as they were related to other melodic parts. The rhythmic independence of various parts gradually disappeared with the development of tonality, and as a result the bass came into prominence as support of the harmonic structure. This led to the so-called "tyranny of the bar line." But this was no more tyrannical than the tyranny of modal thought or of pulse in 16th-century dissonance treatment. The real tyranny was one of a homophonic nature, namely that of the "top" and "bottom" parts with harmonic support in the inner parts.

By compensation there arose the delicate balance of movement, harmonic rhythm and time scale. Time scale may be illustrated in the fact that it is scarcely possible to tell from the first 20 bars of a madrigal or motet of the 16th century whether the whole piece will last two, five or ten minutes, but that this is usually possible after a few bars of a work by Beethoven.

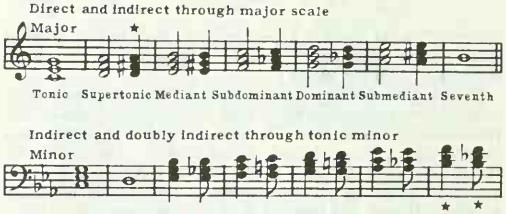
Harmonic rhythm is the name given to the pulse rhythm of harmony changes. While the 16th-century treatment of accented discords was considerably widened in scope and became less rigidly applied, the principles remained, if only because dissonance produces accent and resolution repose. In addition, the tonal meaning of harmonies in the diatonic system enabled composers to use, instead of discords, other chords that had more or less motive power.

Extension of movement can be obtained in various ways, not all of them tonal. Among the non-tonal means extending movement are: (1) overlapping of melodic phrases, *i.e.*, one phrase starting at the point at which the previous one ends; (2) contrapuntal overlapping; (3) use of suspensions and other dissonances; the need of resolution, often delayed by further decoration, compels a forward movement; (4) use of non-final chords and progressions, such as interrupted cadences.

The most important voice in all harmonic progression is the bass. The bass must provide good counterpoint with the upper parts, and it also determines the tonal movement of every phrase. At the end of a piece in C major, for example, a melody has as its last two notes B and C. A normal bass to these notes would be G C—the dominant followed by the tonic. This progression is called the perfect cadence or full close. A bass that had D C, though perfectly feasible (and indeed formed the basic final cadence long before the G C progression), would not sound so final. A bass E C would be distinctly unusual. Such considerations necessarily apply to the movement of the bass, especially regarding the approach to the aptly named dominant. In music that constantly moves dominant harmony is likely to be much commoner than tonic harmony, since the dominant always requires some movement at least to return to the tonic for finality.

One of the phenomena of the diatonic style is that once a key is established, progressions involving directly related keys do not alter the tonic. Key relations to C major may be shown by the keys of the triads involving the perfect fifth on each degree of the scale. Direct relations are shown as minims (half notes); indirect relations are shown as crotchets (quarter notes); and doubly indirect relations as quavers (eighth notes). Relations to the minor tonic may be found by reversing the process; similarly, the direct relation to C minor is triads based on notes of the minor key. All relations are reciprocal. No relationships involve a third key; *e.g.*, in G major in a modulation to B♭ and E♭ minor the last key is the flat submediant of G major. It is not related through B♭.

Ex. 17



Keys marked with a star are ambiguous in effect; the chromatic supertonic insists on becoming the dominant of the dominant, and the seventh chords in the minor insist on leading to the minor mediants.

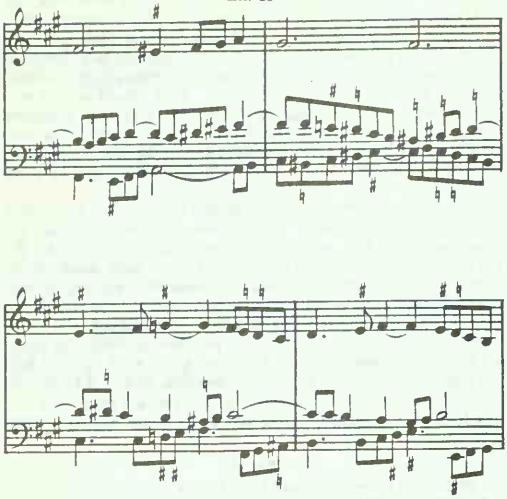
An understanding of the principles of tonal relations will make the apparent complexities of chromatic harmony clear. Hence in an analysis of Beethoven's First Symphony there is a transitory modulation to the supertonic of C in bar 7 of the *allegro con brio* of the first movement. It would be misleading to call this supertonic D minor because that would encourage the misbelief that the D was a new tonic. This may be tested by adding as many perfect cadences in D minor as are desired and then stopping altogether. It will be found that C is still the tonic. Such a test is useless, however, unless C is established as a tonic at the outset, as it is by Beethoven. If before playing those seven bars B♭ major were established then the D minor chord would be the mediant of B♭.

Thus transitory modulation differs from real modulation in that real modulation denotes movement to a new tonic, whereas transitory modulation moves to a tonal relation of the established tonic. Real modulation occurs in two ways: (1) over a distance in time involving various modulations, as in the exposition of a sonata movement; and (2) where no properly established tonic exists, as in parts of development sections of sonata movements.

In the early 18th century nearly all modulation was transitory, except in movements on the largest scale like the first *Kyrie* of Bach's B minor Mass. A good illustration of Bach's method in detail may be found in bar 11 onward of Fugue XIV of Book I of *Das Wohltemperierte Klavier* (ex. 18).

If these bars are played omitting all accidentals except those specifically concerned with F♯ minor (marked below and above) the tonal meaning of the whole passage is not altered, though from chord to chord the differences are huge. Of course, some of the counterpoint becomes ugly, if not nonsensical, showing that artificial leading notes produce their own melody and counterpoint.

Ex. 18



Nevertheless, the lesson is a tonal one; *i.e.*, Bach making artificial leading notes colour more strongly progressions to chords directly relative to F♯ minor.

The question of tonal and real answers in fugue (*q.v.*) was earlier bedeviled by pedagogues who failed to distinguish between different kinds of modulation. The most real of Bach's answers does not leave the tonic established by the subject. The episode between the second and third entries in Fugue XIV is not necessary for modulatory purposes, however vital it may be to the melodic extension and phrasing at that point; omission of bar 7 proves this.

The new style adopted by Bach's sons was associated with a dramatic element in music rather than with melodic and contrapuntal development and ornamentation. The Viennese style of the late 18th century concentrates on changes of key and texture rather than on extension of melody. The natural result of this change of style was the expansion of time scale. A movement lasting ten minutes will contain more real modulation than a piece lasting two minutes. Likewise, if there is much real modulation the time scale will be greater than in pieces with little or no real modulation. The reason for this is that the human ear normally refuses to listen to music without movement. From time to time a composer achieves the improbable by compelling interest in a deliberately static movement. But this is rare and in the nature of a tour de force. The second movement of Beethoven's Violin Concerto is a triumph of this kind. Of course many successful sets of variations stay in the same key, or the listener's interest may be held by the composer's decorative skill, as in this particular movement. Larger sets of variations use the tonic minor, with a variety of transitory modulation, or a variety of basic progressions within the variations themselves. In the early baroque period, the great age of variation writing, composers normally used modulating ground basses for longer movements and, even so, often took pains to conceal the final cadence of the ground bass pattern by unequal phrases, suspensions and so forth.

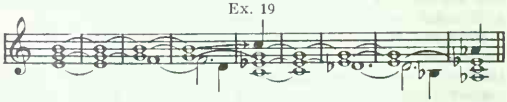
The possibility of establishing a new tonic by real modulation led to the rise of the sonata form (*q.v.*). Sonata form sprang from simple binary forms, such as are common in the dance movements of Bach's suites for keyboard. As soon as the time scale and modulatory scheme was large enough to make the close at the double bar a full close in a new tonic, some sort of modulatory process was necessary to prepare for the return to the original tonic—hence, the development section. Nineteenth-century textbooks obscured matters by inventing the term "shortened sonata form" to describe those movements where a development section is unnecessary. But the reason for its omission is the absence of real modulation to a new tonic. Thus, the exposition of the second movement of Beethoven's Piano Sonata, Opus 2, no. 1, ends with a dominant chord of F, not a tonic chord of C, and in this case the return to F presents no problem. The term "shortened sonata form" is misleading because binary form without a development section preceded full compound binary form. The latter is an expanded version of the former, and not vice versa.

In movements in binary form without a development section the second group of subjects is usually shorter, and certainly not longer, than the first group. In a compound binary movement the reverse is true, the second group being usually at least twice as long as the first group. This is because it is difficult to establish a second key without preparation over a considerable time, whereas at the beginning of a piece a key can be established by a single chord.

The development sections of compound binary movements differ in detail. Some of them are contrapuntal, some homophonic, some consist largely of passage work and some do not even use material from the exposition at all, while many introduce much new material. But they do not differ in their general tonal method, which is to avoid all sense of the new tonic reached at the end of the exposition by means of wide modulation. Many development sections are more complex in that they contain large episodes in some new tonic; *e.g.*, Beethoven's *Eroica Symphony*, first movement, and his *Appassionata* sonata. In cases like the first movement of Beethoven's Piano Sonata, Opus 14, no. 2, a new tonic is introduced as if it were the original tonic—a false recapitulation, so to speak; further modulation and very long dominant preparation occur before the real recapitulation starts in the original tonic.

Methods of modulation vary according to the scale of the work. In the exposition of compound binary movements, the enhanced dominant (the dominant of the dominant) is often used to herald the second group of subjects in the second key. This is not to say that the second key becomes an established tonic at the beginning of the second group. Rarely is such the case and, as Beethoven's style developed, the so-called transition section gradually becomes indistinguishable from the second group. If, indeed, the second group were to start in an already established new tonic, it would need to be a very short second group or it would become static. One of Beethoven's favourite devices in establishing a second key is to modulate widely just after the beginning of the second group, using the same methods as in the development section, only not so drastically, *e.g.*, the first movement of his Piano Sonata, Opus 2, no. 2. Certain concepts are common to development modulation, namely, the use of tritone chords with their inherently ambiguous properties, and the principle that most chords will be compatible if they have a common note. The chord structure of Beethoven's Piano Sonata, Opus 57, first movement, bars 79–88, is as follows:

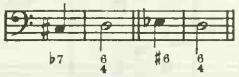
Ex. 19



This type of procedure can be described as a pedal link. Other methods of development modulation are the alteration of the quality of triads from major to minor or vice versa, producing different sets of relations, and, related to this procedure, the effect of certain notes on the aural imagination. If the note G is reiterated 20 times, the listener may still hear it as a tonic, but if A♭s are introduced the G tends to become a dominant, an effect strengthened by the subsequent introduction of an F♯. Whatever the explanation, such phenomena exist. Another example of this kind of note behaviour is shown in the alteration of a dominant chord from major to minor: the minor chord has less dominant and more tonic character than it had before, *e.g.*, the third bar of the introduction to the rondo of Beethoven's Piano Sonata, Opus 53. Such note behaviour is an important part of a composer's resources, since he is often concerned with modulation

from dominant to dominant in the course of development. Certain procedures establish new dominants fairly easily. The following progression

Ex. 20



shows how the function of certain notes together with a succeeding $\frac{6}{4}$ causes a strong presumption of a tonality of the dominant of G. In general it may be said that if, at a moment of no discernible tonality (as at the prolonged diminished seventh chord just before the return to the tonic in the first movement of Beethoven's *Appassionata* sonata), a pedal or one of the dominant-ward progressions shown above is introduced, there is no difficulty in establishing a key. This procedure forms the tonal basis of many development sections that obliterate previous tonics with wide modulation, preparing for the return of the original tonic. Finally, there are types of modulation that are repeated on different degrees; these types are common from the 17th century onward and are used in sonata developments throughout the period.

The 19th Century

Several factors combined, during the great romantic age, to alter some of the characteristic methods of diatonic harmony. First, since tonal principles were essentially abstract, forms arising from them became less common. Increasingly, themes symbolizing moods determined musical designs. An important factor in this development was the emergence of the solo song as a genre. Earlier developments of the solo song had sometimes been bound to specific musical forms or to lyrics designed for musical setting and therefore symmetrical or repetitive.

From the early middle ages to the Renaissance, songs used a structure containing a repeat, a refrain or an *envoi* in the form of paired lines, or forms of a ternary or rondo (*q.v.*) pattern. This was inevitable at periods when poets were closely identified with music. The early Italian cantata, however, was built on a ground bass and on various rondo structures, the less formal sections being set in recitative, or arioso, and later in the form of the *da capo* aria. A pattern of libretto writing was evolved to conform to the demands of the musician, leading to the opera librettos of P. Metastasio (1698–1782).

The poems of the romantic period were generally literary achievements in their own right. The revolt against formal designs, as part of the romantic ideal, ensured a wide formal independence in the settings of these poems in the form of the German lied (*see* Song: *German Song*). A lied may begin in one key and end in another and it is even common to find quite short songs displaying bold changes of texture and tempo. Not surprisingly, Goethe preferred Carl Friedrich Zelter's settings of his poems to those by Schubert. Schubert recreated Goethe's poems, producing a new art form, while Zelter, whose settings seem stilted, merely served them.

The miniature scale of the typical song focused attention on the expressive rather than the functional qualities of harmony; hence the use of suspensions and appoggiaturas, single and multiple, with delayed resolutions, changing notes, chromatic decorations and the wide variety of romantic dissonance. It is not surprising that Bach was rediscovered in the early 19th century since his style, though disguised in contrapuntal forms, contained many features beloved by the romantics. It is interesting, since his chromatically colourful style was new to the romantics, that they regarded Bach as revolutionary, a view still widely held in the middle of the 20th century, though the chromaticisms and other contrapuntal decorations of Bach and, indeed, of Purcell were actually old-fashioned features of their style.

At the same time dramatic forms were adapted or enlarged to illustrate lyrical or poetic concepts. The symphonic field divides into the categories of abstract and program music. In the abstract field the procedures of Schubert and Brahms were typical. Their problem was to introduce (into forms based on the tonal schemes of Beethoven) longer and more lyrical melodic ideas in place of the shorter themes of the earlier Viennese composers. This resulted in the change of certain features of compound binary form but not of its essentials. By their very nature program symphonies and symphonic poems introduced new designs and, compensating for the partial absence of compound binary patterns, certain formal features became prominent, among them the leitmotiv (*q.v.*) and the metamorphosis of themes. Thus emphasis in design lay in melodic and textural variation and in repetition rather than on key structure.

As with the lied the function of harmony became more decorative and impressionistic. With the development of the late 19th-century taste for fully saturated sound, harmonic colours became rich and complex and, while the basis of harmonic progression was still contrapuntal, the frequent doublings and complexities of texture tended to obscure this contrapuntal basis. Pedagogically, harmony was perceived more and more as the function of vertical chords.

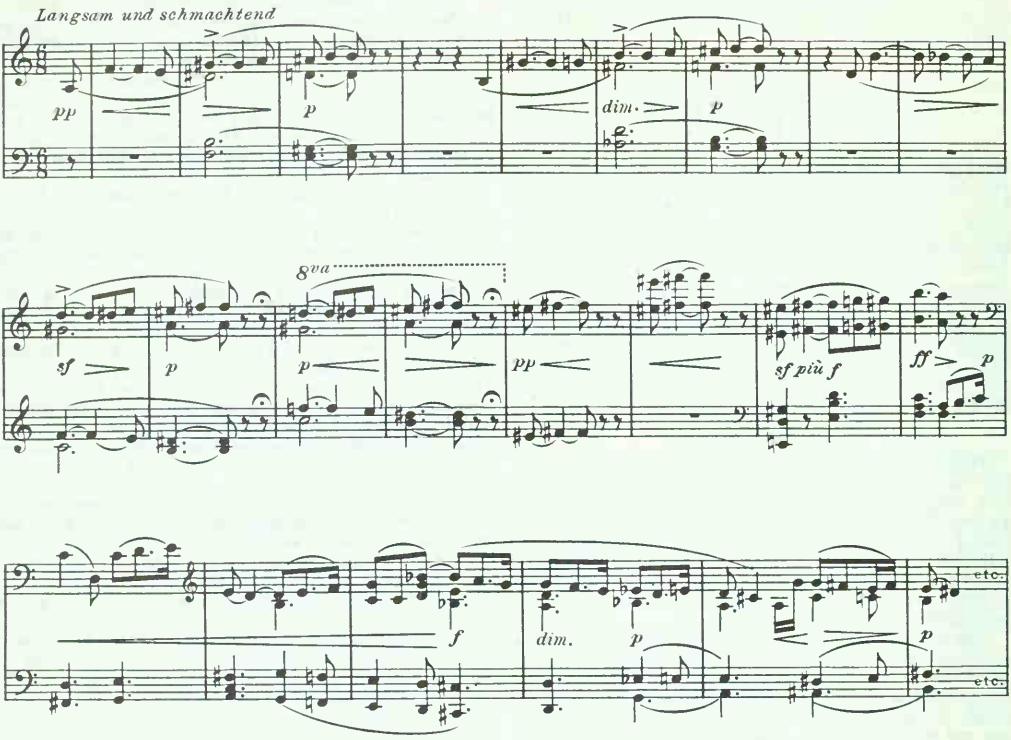
Nineteenth-century opera is dominated by the figures of Wagner and Verdi, whose conceptions of harmony were not dissimilar. They differed, of course, in their treatment of the voice, the orchestra, the time scale and in their conception of the theatre. But their forms and treatment of harmony and tonality were fundamentally melodic in outlook, Wagner placing emphasis on the orchestra and developing his concept of the leitmotiv; Verdi giving prominence to the vocal line. It is significant that in his later, orchestrally richer operas Verdi used the Wagnerian leitmotiv technique. The harmonic detail of both composers was decorative and fluid, in Verdi's later work particularly, loosely based on the modulatory principle of moving from dominant, or other related key, to dominant rather than from tonic to tonic. A well-known illustration of this harmonic fluidity is the opening of *Tristan und Isolde* (ex. 21).

The key suggestions in the extract are as follows: bar 3, dominant of A minor; bar 7, dominant of C (major or minor); bar 11, dominant of E (the enhanced dominant of A in view of bars 1–3); bar 16–17, what looks like the eventual close in A minor is interrupted and steered through the dominant of C (18), the supertonic of C (20–21) becoming more like the subdominant of A minor (D minor) in the last half of 21, and in 22 and 23 returning obliquely to the dominant of A minor (recognizable only from the effect of the previous A minor).

Wagner's complex harmonic counterpoint is well illustrated in this example. There was at one time much discussion of the first chord in *Tristan*, and Donald Tovey showed its origin in a well-known but overcomplex series of examples. This chord is simply an augmented sixth in a common enough form (the so-called French sixth), with an appoggiatura, G♯, resolving normally to A. The dissonance is unprepared but represents nothing new. The novelty of the opening of *Tristan* derives from the fact that, unlike the opening of Haydn's *Creation*, it has no tonic unison establishing tonality in the listener's mind. In this it does not differ fundamentally from the opening of Beethoven's First and Ninth Symphonies, both of which proclaim the nature of their opening chords after their first appearance. There are few chords in Wagner that cannot be explained in simple harmonic-contrapuntal terms, though his constant use of chromatic detail engendered the belief, widely held, that his harmonic methods were revolutionary.

The function of tonality in opera is necessarily different from that in symphonic movements. The capacity for tonal memory over long periods is limited. Critics who postulate tonal theories depending on the possession of the faculty of absolute pitch (a form of acute and permanent musical memory that, like other forms of memory, becomes less acute with age) assume that composers have written their music for enjoyment by the few possessed of this faculty. The facts of history are otherwise. The very length of an opera, or even of one act of an opera, precludes the normal symphonic usage of tonality, except on rare occasions. Instead, key is used for dramatic emphasis, bright and dark keys being contrasted to underline dramatic action. Act II of *Tristan* provides many instances of the methods of Wagner: the change

Ex. 21



from B♭ to C major at Tristan's arrival; the changes from A♭ to G♭, from A♭ to G major and to the much brighter B major at various stages in the love music; and particularly the use of the much darker D minor at King Mark's entrance, becoming D major at the words "Dies wundervolle Weib," a moving use of tonal word illustration.

POST-WAGNERIAN HARMONY

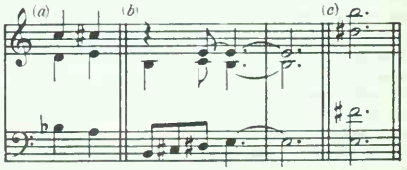
Widely different methods characterize the symphonic schools at the turn of the 19th century, although all of them used the harmonic resources of Wagner to some degree. Mahler stressed the lyrical aspects of the symphony, Sibelius, the architectural, while the Russian schools were preoccupied with harmonic colour. The harmonic technique of these composers added little to Wagner's language despite their different applications. Richard Strauss, believed in his youth to be a revolutionary, was later seen as a complicator of Wagner's language.

The 19th-century harmonic language was particularly extended by Debussy. Much of Debussy's harmony may be analyzed as tritone discords with additional and altered notes, and its departure from traditional methods was later seen to be less fundamental than was at first supposed. Certain new elements, however, were introduced: consecutive-fifth chord movement, a more common use of modal elements and, following the example of Liszt and others, the use of the augmented triad with added notes in the form of the whole-tone scale. Some of these elements blurred tonality and made movement more difficult, a consideration that sometimes caused Debussy to use more traditional methods, encouraging also the use of pedal figures. Pedals were also used freely by Sibelius and, indeed, became an increasingly important feature of 20th-century music.

Nationalist schools, developing their own variations of harmonic technique, produced a number of different styles. Often, consecutive triads, fourths and seconds were used, and novel scales and modes were introduced, resulting largely from the study of folk music. No system of harmony was, however, codified, except one by Hindemith based on a new view of traditional methods. Scriabin's system of chords quickly proved its limitations. Schoenberg's system of dodecaphony (*q.v.*) was designed to provide the composer with a method of composing in place of the connecting thread of tonality, but it was not basically a harmonic system since the harmony of each piece differs according to its "row."

Nevertheless, certain methods were common to 20th-century composers whose music was based on tonality of some kind. In avoiding traditional cadences and progressions new uses were made of artificial leading notes such as in ex. *22a*, an instance as contrapuntal as the two-part cadence of the 16th century, and ex. *22b* from Lennox Berkeley's String Trio. The combination of certain upper harmonies was viewed as concordant; this view is the basis for the most probable explanation of Stravinsky's predilection for chords such as ex. *22c*. Another addition to the language was the doubling of melodic lines at various intervals to produce chordal polyphony. False relations were used in increasing complexity

Ex. *22a*, *22b* and *22c*

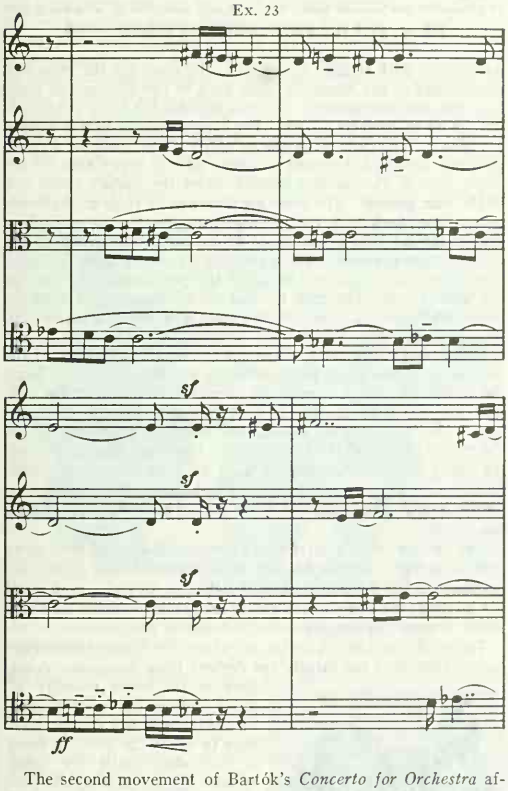


and nonresolving *acciaccature* were used in the form of note clusters. The resolution of such *acciaccature* has the effect of a cadence.

Certain composers, notably Darius Milhaud, experimented with polytonality, the simultaneous use of more than one key. Though it produced interesting by-products, polytonality itself proved disappointing, possibly because of the limitations of the human ear.

Extensions of traditional methods of colour variation through harmony were used. In Béla Bartók's music harmonies are associated with intervals occurring in the thematic material. His fondness for seconds is generally attributable to a combination of contrapuntal cadence methods and highly rhythmic forms of harmony. This combination is used in conjunction with numerous scale patterns, sometimes derived from Balkan folk music. His Fourth String Quartet concentrates on the interval of the second not only thematically but also contrapuntally and harmonically. Ex. 23 demonstrates the thesis of this work.

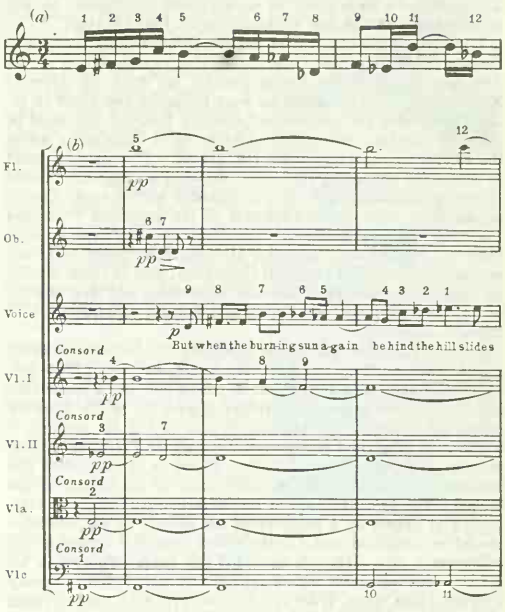
Ex. 23



The second movement of Bartók's *Concerto for Orchestra* affords a striking demonstration of his methods. Pairs of instruments enter using parallel motion as follows: (1) bassoons in sixths (supporting harmony traditional); (2) oboes in thirds (harmony traditional with much use of thirds; *e.g.*, bars 33–39); (3) clarinets in sevenths (harmony almost exclusively in sevenths); (4) flutes in fifths (many fifths in harmony); (5) trumpets in seconds (harmony largely combinations of seconds).

Such harmony is, of course, contrapuntal in origin and thus has some resemblance to serial methods. An illustration of the serial technique appears in ex. 24, taken from Humphrey Searle's *Put Away the Flutes*. Here (a) is the opening melody (row); (b) is the start of the final section. The voice continues (from the previous section) with an inverted backward presentation of the row

Ex. 24



while the instrumental harmony is an inversion of the row. The figures show the relationship of the individual notes to the row.

The resemblance between Bartók's contrapuntal harmony and Schoenberg's serial technique is, however, not more than superficial. Bartók's music is fundamentally tonal even though it is highly coloured by the use of unusual scales. Moreover, contrapuntal methods of harmonic structure, though characteristic of much modern tonal music, do not necessarily constitute the whole of its harmony. On the other hand, though contrapuntal possibilities exist in serialism, the serial technique is not, properly speaking, contrapuntal. In ex. 23 the harmony of seconds arises out of successive imitative entries at the second, not from the seconds in the thematic material. In contrast, Searle's harmony derives from the intervals occurring in a single melodic line. *See* also references under "Harmony" in the Index volume.

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(P. C. A. W.)

HARNACK, ADOLF VON (1851–1930), German theologian and church historian, the leading patristic scholar of his time, was born on May 7, 1851, at Dorpat, Estonia, where his father, Theodosius Harnack (1817–89), was professor of practical theology. Adolf studied at Dorpat and at Leipzig, becoming *Privatdozent* in church history in 1874 and professor *extraordinarius* in 1876. As full professor he occupied chairs at Giessen (1879–86), Marburg (1886–89) and the University of Berlin (1889–1921). Harnack was a member of the Prussian Academy of Science (of which he prepared a three-volume history in 1900), founder and president (1902–12) of the Evangelical-Social con-

gress, director of the Royal library (1905–21) and president of the Kaiser Wilhelm Society for the Advancement of Science. He was ennobled in 1914 and died at Heidelberg on June 10, 1930.

Harnack's intellectual career led him through the orthodoxy of Dorpat and Erlangen and the historical-critical approach of the Tübingen school to the liberal position set forth by Albrecht Ritschl (*q.v.*). The Ritschlians were primarily concerned to relate Christianity and culture, and Harnack believed this could be achieved only by a historical understanding of Christianity where the essence is separated from the dogma. This essence could be isolated by employing a scientific historical method that abjured all metaphysical speculation and included source study (hence his initiation, with O. von Gebhardt, of the important *Texte und Untersuchungen zur Geschichte der altchristlichen Literatur* series [Leipzig, 1882 *et seq.*], to which Harnack contributed 49 monographs); analysis of the cultural factors that help to shape historical events; the assessing of historical institutions and their relation to the *Geist* that produces them; and faithful representation of the facts.

Harnack's greatest work is his *Lehrbuch der Dogmengeschichte* (3 vol., 1886–89; Eng. trans. *History of Dogma*, 7 vol., 1894–99), universally acclaimed as brilliant in conception and a monument of liberal historiography. Christian dogma, by which Harnack means the authoritative doctrinal system of the 4th century, is traced in its origin and development through the Protestant Reformation. His thesis is that Christian dogma in its conception and development is a work of the Greek spirit on the ground of the Gospel. The process begun at the Reformation—viz., the overcoming of dogma by a recovery of the essence of the Gospel—should be completed, and it is the historical-critical approach that will achieve this. Harnack defended this value-judgment in his most famous work, *Das Wesen des Christentums* (1900 and many later eds.; Eng. trans., *What Is Christianity?*, 1901), which evoked violent and prolonged opposition.

Harnack's other major works include *Geschichte der altchristlichen Literatur bis Eusebius* (3 vol., 1893–1904), incomplete; *Die Mission und Ausbreitung des Christentums in den ersten drei Jahrhunderten* (1902; Eng. trans., 2 vol., 1904–05; 2nd Ger. ed. 1924); a collection of papers, *Beiträge zur Einleitung in das Neue Testament* (7 parts, 1906–16; Eng. trans. of 6 parts, 1907–25); a collection of speeches and articles, *Reden und Aufsätze* (7 vol., 1904–30, vol. vii edited by Axel Harnack); *Marcion, das Evangelium vom fremden Gott* (1921). A bibliography of Harnack's writings, listing 1,611 items, was prepared by F. Smend under the title *Adolf von Harnack: Verzeichnis seiner Schriften* (1931).

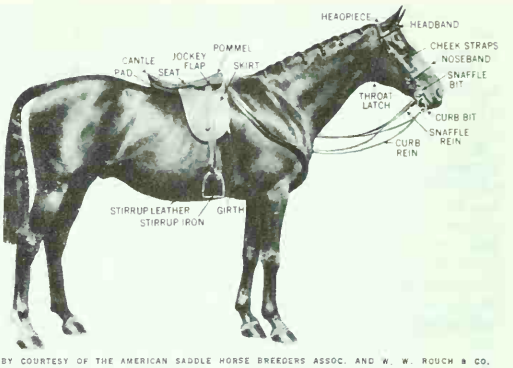
See *Adolf von Harnack,* a biography by his daughter, Agnes von Zahn-Harnack (1936). (G. W. GL.)

HARNESS AND SADDLERY, the equipment for any animal used for packing, traction or riding. Harness is the general term for the gear and tackle for such animals. Saddlery in the sense used in this article applies to articles produced by a saddler, a person who makes, repairs or sells saddles and related equipment, such as bridles, bits, stirrups and hames.

Bridles and Other Head Gear.—The bridle, a harness of horses and mules, is a set of straps that make the bit secure in the animal's mouth and thus ensure human control. The headstall portion of the bridle consists of the headpiece passing behind the ears and joining the headband over the forehead; the cheek straps run down the sides of the head to the bit, to which they are fastened; in the blind type of driving bridle the blinkers, rectangular or round leather flaps that prevent the animal from seeing anything except what lies in front, are attached to the cheek straps; the noseband passes around the front of the nose just above the nostrils; and the throatlatch extends from the top of the cheek straps underneath the head.

The martingale, sometimes used on riding horses, passes between the horse's forelegs with one end fastened to the saddle girth and the other to the head harness. It keeps the horse from throwing back its head.

The bit is the metal contrivance inserted in the mouth to which the reins are attached. There are three general types of bits: the straight bar, snaffle and curb. The snaffle has a jointed steel



BY COURTESY OF THE AMERICAN SADDLE HORSE BREEDERS ASSOC. AND W. W. ROUCH & CO.

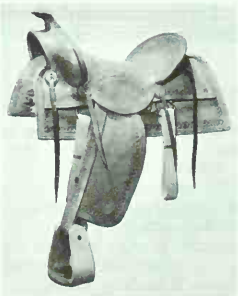
FIG. 1.—GEAR OF A MODERN BRIDLE AND ENGLISH SADDLE

mouthpiece with straight cheek bars, the rings for the reins and cheekpieces of the headstall being fixed in the bars at the junction with the mouthpiece. The bars prevent the horse from pulling the bit through its mouth. The snaffle without bars is termed a bridoon. The curb bit is one to which a curb chain or strap is generally attached, fastened to hooks on the upper ends of the cheek bars of the bit and passing under the horse's lower jaw in the chin groove. The reins are attached to rings at the lower ends of the cheek bars, the leverage thus pressing the curb chain against the jaw. The mouthpiece of the curb bit is unjointed and in the centre commonly has a port, *i.e.*, a raised curve, allowing liberty for the tongue and bringing the pressure on the base of the horse's jaw. The curb bit and the bridoon can be used together with separate headstalls and reins, and there are many combination bits.

Saddles.—The skeleton of the riding saddle is composed of the tree, or framework, the parts of which are the pommel or head, the projection that fits over the animal's withers, and the side bars that curve around to the back to form the cantle, or hind bow. The rigid parts are almost always covered with leather. To the tree are fastened the stirrup bars. On either side of the saddle are a leather skirt and hanging flaps to protect the rider from the mount's sweat. In saddles to be used with unbroken or unruly horses, knee rolls are often placed on either side behind the cantle.

The saddles of Asia, Africa and continental Europe tend to be heavy and high. But the English saddle, removed from all utilitarian purpose, has developed extreme lightness for sport, racing and fox hunting; the pommel and cantle are greatly reduced, and provision is made for clinging with the knees in jumps.

The saddles of Latin America and of western North America are highly diversified but largely are derived from equipment developed in the cattle industry of Spain during the middle ages. On the pommel is a sturdy metal horn to which the lariat or lasso is tied when cattle are being roped. The cantle is high to prevent the rider from slipping off the seat when the horse sits back on its haunches at the moment of roping. The saddle is made secure by one or two surcingles called cinches, or girths; these are held to the tree rings by latigos, long leather straps. The sides and front of the stirrups are covered by leather taps (Sp. *tapaderas*), a casing that prevents them from snagging in brush.



BY COURTESY OF BONA ALLEN, INC.

FIG. 2.—NORTH AMERICAN STOCK OR WESTERN SADDLE

Harness.—Many types of har-

ness are used in different parts of the world for oxen, zebus, asses, reindeer, elephants, camels, water buffaloes, yaks and dogs. In the basic occidental harness for horses and mules, a leather collar, heavily padded, passes over the head and rests firmly on the shoulders; two hames, rigid curved pieces of metal, rest on this collar and are fastened at top and bottom by hame straps. To the hames are attached the traces, straps that pass along the animal's sides and are connected to the ends of the whippletree (also called whiffletree, singletree or swingletree), a horizontal bar connected to the load by a centre link.

When the animal is harnessed between shafts, the shafts are usually supported by a back pad; the pad is a narrow leather cushion resting on the back, attached to the shaft by straps and held in position by a girth or bellyband as well as by a backband and crupper, a loop strap passing under the tail. Reins pass through terrets, or rings, on the hames and pad. The other harness on the animal's hindquarters consists of the breeching, straps passing around behind the haunches to help in backing, braking and stopping the vehicle, and the hip strap fastened to the breeching and passing over the hindquarters.

The checkrein (bearing rein), a device sometimes used to add to the elegant arch of a horse's neck, consists of a separate bridoon bit with the reins passing through rings on the collar and then attached to a hook on the pad.

Historical Sketch.—With the possible exception of the sail, harness represents man's first attempt to employ nonhuman power for his purposes. In pre-Columbian times, the new world knew no harness except for llamas and dogs carrying packs, dogs pulling travois on the North American plains and dog sleds among the Eskimos. The Indian failure to develop harness may be due to the scarcity in America of animals anatomically suited to it and to the failure to observe systematically the effects of gelding.

BY COURTESY OF THE ORIENTAL INSTITUTE OF THE UNIVERSITY OF CHICAGO

FIG. 3.—COPPER WAR CHARIOT FROM TELL AGRAB, IRAQ, SHOWING TYPE OF HARNESS USED ABOUT 2800 B.C.

The earliest old-world form of harness, which presupposes gelding, is the yoke resting on the withers of two animals, first used in the near east perhaps by 4000 B.C. to attach a pair of oxen to a plow. By about 3000 B.C. the yoke was employed in Mesopotamia with onagers to draw light wagons and chariots, and by about 2000 B.C. it was applied to horses, then newly arrived from central Asia. Asses were used as pack animals in Egypt by 3000 B.C., but there is no evidence that any animal was ridden until about 1300 B.C.

The first use of the camel for labour is of very uncertain date. Presumably it is early, since the single-humped camel appears as a pack animal by 1000 B.C. in Mesopotamia. In the region north of the Altai mountains reindeer were used for traction earlier than horses, to judge from the fact that horses drawing the funeral sled of a chieftain buried at Pazirik about 400 B.C., which were sacrificed and buried with him, wore reindeer masks.

Bits.—Both oxen and onagers were controlled by rings through the nose. The horse, however, appears from the beginning to have been governed normally by a bridle and bit, sometimes of bone but generally of metal. At first this was a simple bar with a ring at each end for reins, although by 1400 B.C. the jointed snaffle was known throughout the near east. While there were many variations of both bar and snaffle bit, no basic innovation appeared for a thousand years; in the 4th century B.C. Xenophon speaks of the curb bit. During the European middle ages the development of mounted shock combat demanded that the knight have absolute control of his charger, with the result that heavy and very severe curbs were produced. But no basic new idea in bits has appeared for the past 23 centuries.

Spurs.—The simple prickspur appears in Celtic graves of about 400 B.C. Although its use became habitual in Europe and eventually in the Americas, it seems not to have spread widely in the orient or Africa. Rowel spurs which replaced the single prick with a wheel of radiating points first were found in 9th-century Spain.

BY COURTESY OF THE METROPOLITAN MUSEUM OF ART, CICK FUND, 1942

FIG. 4.—(TOP) IRON PRICKSPUR OF THE LA TENE CULTURE, 3RD–2ND CENTURY B.C.; (BOTTOM) IRON CAROLINGIAN STIRRUP, 7TH–8TH CENTURY

Saddles.—For at least 12 centuries after horses were first ridden there were no saddles but only saddle cloths attached by surcingles or bellybands. These cloths were gradually supplemented by cushions or rolls that improved the rider's comfort but did not add greatly to his stability. Saddles with rigid frames, pommels and cantles but without stirrups appear in China during the Han dynasty (206 B.C.–A.D. 220) and are found in Roman Gaul in the 1st century A.D., probably as an introduction from the barbarian world. The development of mounted shock combat in the middle ages required that the saddle become a large seat giving maximum support to the knight. In early modern times, as shock combat in warfare and the tournament as sport went out of fashion, saddles steadily grew lighter. The decline of the saddle into the so-called English saddle of the late 19th and 20th century is a sign of the technological obsolescence of the horse among those using such saddles. Herdsmen continued to use very substantial saddles.

The sidesaddle developed from an ancient pack saddle with a pannier, a board suspended on one side upon which the woman rider could rest her feet for support. By Frankish times the term *astraba* referred specifically to the footrest of such a saddle, and the word conveniently labeled the stirrup when it came from central Asia.

During the middle ages and early modern times, the sidesaddle was varied in many ways from the basic device.

Stirrups.—The first stirrups appeared as big-toe stirrups in India in the late 2nd century B.C. These were diffused wherever Hindu culture had contact with barefoot aristocracies, from Timor and the southern Philippines on the east to Ethiopia on the west. The wave of Indian culture that took Buddhism to China likewise carried the idea of the stirrup which the booted Chinese, in their chillier climate, expanded into the foot stirrup by the 5th century A.D.

The foot stirrup reached Korea in the 5th century and Japan and some of the central Asian countries in the 6th century. In A.D. 694 Muslim armies in northern Iran received the stirrup from

Turkestan. Shortly afterward it was found in Byzantium, and by the early 730s it had arrived in the Frankish realm.

Before the support of the stirrup supplemented that of pommel and cantle, a mounted warrior could thrust his spear only with the strength of his own arm. With stirrups he could lay the spear at rest under the upper arm while his hand guided the blow that was now delivered by the force of his charging horse. The increase of violence was immense. Since it made possible mounted shock combat, the stirrup is the most significant invention in the history of warfare prior to gunpowder. In the early 730s Charles Martel saw the military potentialities of the stirrup, seized great areas of church lands, distributed them to retainers as endowment on condition that they serve him by fighting in the new manner and thus instituted the feudal regime.

Modern Harness.—The Bronze Age transfer of the yoke from oxen to onagers, horses, etc., was not successful for anatomical reasons: a horse, ass or similar animal could be attached to such a yoke only by two straps running from the end of the yoke around the animal's neck and under its belly. The neck strap pressed on the windpipe and jugular vein in proportion to the pull of the animal, while the withers were so high a point of traction as to be mechanically inefficient. The modern harness, with its padded collar supporting rigid hames on the shoulders in a way that does not interfere with breathing or blood circulation, enables the animal to throw all its weight into pulling. It has been shown experimentally that a team of horses equipped with modern harness can pull a load between four and five times heavier than the same team can pull with the ancient yoke harness.

Modern harness appears to have been introduced into Europe from Asia. China under the Hans developed a type of single-horse chariot drawn by lateral shafts, and the modern harness is found in frescoes of about 500 A.D. in Kansu. The first modern harness in Europe was seen about 800 A.D.

Animals and teams could not be harnessed tandem, or in sequence, until the 1st or 2nd century A.D., when suddenly the evidence of such harness is found in Gaul, Italy and China. When this was later combined with horse collar and traces, horsepower became available for plowing and heavy hauling. The first evidence of habitual plowing with horses comes from Norway toward the end of the 9th century. Two hundred years later plow horses were common over much of northern Europe, from the Ukraine to Normandy. In the 11th century the whippletree began to equalize the pull of traces on the load, and the pivoted front axle, known in Roman times, became common. By the 12th century the big four-wheeled wagon drawn by several teams of horses was revolutionizing land transport. It was the ancestor of all later European coaches and wagons, including the Conestoga wagons of the American frontier and the railroad coach.

See DRIVING AND COACHING; HORSEMANSHIP AND RIDING.

BY COURTESY OF ANHEUSER-BUSCH, INC.

FIG. 5.—EIGHT-HORSE TEAM HARNESSED TO PULL A WAGON

BIBLIOGRAPHY.—C. Singer *et al.* (eds.), *History of Technology*, I (1954), II (1956), III (1957); R. Lefebvre des Noëttes, *L'attelage et le cheval de selle à travers les âges* (1931); P. A. Rollins, *The Cowboy*, rev. and enl. ed. (1936); A. D. H. Bivar, "The Stirrup and Its Origins," *Oriental Art*, new series (1955); J. Martin, *Der Reitersporn, seine Entstehung und früheste Entwicklung* (1921). (L. T. W.)

HARNESS HORSE RACING: *see* HORSE RACING AND BREEDING.

HARNEY, GEORGE JULIAN (1817–1897), English socialist and Chartist agitator, was born at Deptford on Feb. 17, 1817. His education was rudimentary and as a youth he was several times imprisoned for selling unstamped radical newspapers. He became leader of the London Democratic association, the largest left-wing Chartist body in the capital, editor of the unstamped *Democrat* and a strong physical-force Chartist agitator (*see* CHARTISM). Although he saw that this agitation required an organized mass backing, he never secured it. Harney twice stood for parliament, for the West Riding of Yorkshire in 1841 and against Lord Palmerston at Tiverton in 1847, without success in either case. He edited *The Northern Star* from 1845 to 1850 and through it came to know Friedrich Engels and Karl Marx, some of whose ideas he shared. The ineffectiveness of the Chartist petition of 1848 convinced him that a successful working-class movement must be socialist as well as democratic. He helped Marx in the early days of the Communist International, but quarreled with him in 1851, for he was too independent-minded to follow Marx's lead in everything. Thereafter Harney's influence waned. He moved to Jersey in 1855 and to Massachusetts in 1863, where he worked as a clerk. He returned to England in 1888 and died at Richmond, Surrey, on Dec. 9, 1897.

See A. R. Schoyen, *The Chartist Challenge* (1958). (M. R. D. F.)

HARO, LUIS DE (1598–1661), Spanish statesman who governed Spain as the favourite of Philip IV during the critical years between the defeat of Rocroi (1643) and the peace of the Pyrénées (1659), was born at Valladolid, the son of Diego de Haro, marqués del Carpio (whose title he inherited in 1648), and of Francisca de Guzmán, sister of the conde-duque de Olivares. He went to court at an early age and quickly gained the friendship of Philip IV, whose amity Haro was able to reconcile with opposition to the king's minister Olivares, whom he succeeded in 1643. Less able and less ambitious than his uncle, Luis de Haro was unable to improve his country's situation: for most of his administration the war with France continued and the economic crisis worsened. When he led the Spanish delegation to negotiate the treaty of the Pyrénées he was no match for Mazarin, but for his services in arranging the peace his marquessate was raised to a dukedom. Haro died in Madrid in 1661.

HARO (CLAMEUR DE), the ancient Norman custom of "crying for justice," still surviving in the Channel Islands. The wronged party must on his knees and before witnesses cry: "Haro! Haro! Haro! à l'aide, mon prince, on me fait tort." This appeal has to be respected, and the alleged trespass or tort must cease till the matter has been thrashed out in the courts. The "cry" thus acts as an interim injunction, and no inhabitant of the Channel Islands would think of resisting it. This method of appeal is said to be identical with the "Legatro of the Bavarians and the Thuringians," and the first mention of it in France is to be found in the "Grand coutumier de Normandie." A similar custom, only observed in criminal charges, was recognized by the Saxon laws under the name of "Clamor Violentiae." Thus there is reason to think that William the Conqueror found the "cry" fully established in Eng-

land as far as criminal matters were concerned. Later the "cry" was made applicable to civil wrongs, and, when the administration of justice became systematized, disappeared altogether in criminal cases. It was long retained in northwestern France in cases of disputed possession, and was not actually abrogated until the close of the 18th century. *See* also HUE AND CRY.

HAROLD I (HAREFOOT) (d. 1040), king of the English from 1037 to 1040, an illegitimate son of Canute by Aelfgifu of Northampton. He was made regent of England after his father's death in 1035, until the legitimate son, Hardicanute (*q.v.*), should arrive. Because the latter delayed in Denmark, Harold was made king in 1037 and banished Emma, Canute's widow. In 1036 he was responsible for the cruel treatment of a party brought from Normandy by a son of Aethelred II the Unready, Alfred, who was blinded and soon died. A Welsh raid in 1039, when Earl Leofric's brother Edwin was killed, and an unsuccessful Scottish attack on Durham *c.* 1040 are the only other recorded events of this reign. Harold died at Oxford on March 17, 1040.

See F. M. Stenton, *Anglo-Saxon England,* 2nd ed. (1947).

(D. WK.)

HAROLD II (d. 1066), king of the English from Jan. 6–Oct. 14, 1066, was the second son of Earl Godwin (*q.v.*). In 1044 he became earl of East Anglia, including Cambridgeshire and Hertfordshire. He shared his father's banishment in 1051, going with his brother Leofwine to Ireland. He returned with a fleet in 1052 and joined his father in the advance on Southwark which brought about their reinstatement. He succeeded Godwin as earl of Wessex and Kent in 1053 and relinquished East Anglia to Aelfgar, son of Leofric of Mercia. His brother Tostig was made earl of Northumbria in 1055, and after the deaths (1057) of Earl Leofric and Earl Ralf the Timid of Herefordshire, Harold received Herefordshire, his brother Gyrth East Anglia, and his brother Leofwine an earldom that included Middlesex and Hertfordshire. The only rival to Harold's power was the house of Leofric of Mercia. In 1055 Leofric's son Aelfgar, outlawed on a charge of treason, raided Mercia with Welsh and Irish help and burned Hereford. Harold led the English army and forced the enemy to retire. In the peace that followed, Aelfgar was restored, but in 1058 he was again outlawed and again came back with the help of Gruffydd of Wales and a Viking fleet led by Magnus, son of Harald Hardraade. He was probably dead when in 1062 Harold took the offensive against his ally, Gruffydd, and in some skilful campaigns in conjunction with his brother Tostig reduced Wales, bringing as a trophy to the king the head of Gruffydd, who had been killed by his own men. Perhaps soon after this Harold married Ealdgyth, daughter of Earl Aelfgar.

Harold's influence received a setback in 1065, when the Northumbrians revolted from Tostig, and he had to accede to their demand to have as their earl Morcar, son of Earl Aelfgar and brother of Edwin, earl of Mercia. Harold's concurrence in Morcar's appointment made Tostig his relentless enemy.

Harold had paid a visit to Flanders in 1056. Norman sources tell of another continental visit which probably occurred in 1064. According to the Bayeux tapestry (*q.v.*), he was driven out of his course and arrested by Guy of Ponthieu, who was made by Duke William to surrender him. He fought for William against Conan of Brittany, became William's man and took some solemn oath. If, as later authorities suggest, it was an oath to support William's claim to the English throne, it may have been given under duress. Native chroniclers know nothing of this story.

Edward the Confessor, when dying, recommended Harold as his successor, and he was crowned on Jan. 6, 1066, the day after Edward's death. Some reluctance of the Northumbrians to receive him was overcome by the arguments of Wulfstan, bishop of Worcester. Early in May, Tostig, with a force of Flemings, raided the south and east coasts but was defeated in Lindsey and Yorkshire and retired to Scotland. Harold kept men and ships on the south coast in expectation of an invasion by William, until September, when supplies failed and they disbanded. Soon after, Harald Hardraade came from Norway with 300 ships and joined Tostig, and together they sailed up the Humber and defeated the earls Edwin and Morcar at Fulford on Sept. 20. The men of York made peace with them and agreed to join them in a southern march, but Harold took them by surprise at Stamfordbridge on Sept. 25, where Tostig and Harald Hardraade were killed. William landed in Pevensey bay on Sept. 28; Harold marched south at once and engaged the enemy at a place called Senlac on Oct. 14. After a fight lasting all day, he and his brothers Gyrth and Leofwine were killed (*see* HASTINGS: *The Battle of Hastings*). He was buried at Waltham.

Harold appears in the sources as a strong ruler and a clever general. The efficiency of his short reign is shown by his coinage. Little is known of his character, but it should be noted that he was a friend of the saintly Wulfstan and the founder of a house of canons at Waltham.

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HARO STRAIT, a channel forming part of the international boundary between Canada and the United States, is located east of the southern end of Vancouver Island, B.C., and joins the straits of Juan de Fuca and Georgia. The San Juan islands of Washington state lie east of Haro strait. Depths in mid-channel average between 100 and 150 fathoms, but at its southern end where there are submerged islands the water is only about 10 to 50 fathoms deep. Deep-sea vessels approaching Vancouver usually follow the Haro strait through the islands in the gulf of Georgia.

Throughout the strait the ebb or south-going tidal stream has a much greater rate than the flood or north-going tide. Tide rips are common off headlands. The ebbing tides carry surface water from the Fraser river, which is warmer than the deeper water which comes from Juan de Fuca strait. (J. L. R.)

HARP, a plucked stringed instrument of great antiquity. Typically, the harp is either triangular or bow-shaped, with one string for each note and with a resonator to which the plane of the strings is perpendicular or nearly so. The gradation of string length from short to long corresponds to the gradation from high to low pitch. The word harp is often used inaccurately to describe instruments that are properly zithers or lyres.

The modern harp is a combination of the basic structure and method of sound production of the ancient harps, with a complex mechanism to obtain a full chromatic range.

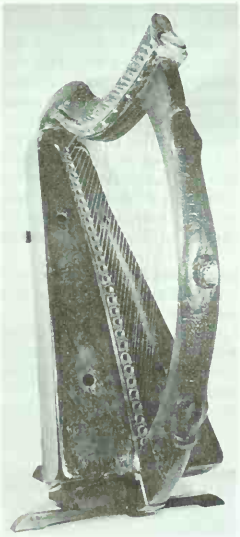
The modern double-action pedal harp covers 6½ octaves (3 below and 3½ above middle C) and consists of (1) a hollow sound box, rectangular or semicircular in section to which the belly, or sounding board is attached; (2) the harmonic curve, or neck, carrying the tuning pins, a set of wrest pins and two sets of rotating brass disks; (3) the forepillar, which joins the end of the neck to the base; (4) the strings, of gut or nylon and, in the bass, bound wire, which, at the upper end, are fixed through the tuning pins and, at the lower end, are pegged to holes in the belly; (5) the mechanism, concealed inside the forepillar and the deep metal plates that run along both sides of the neck. This mechanism is worked from seven pedals (one for each string in the harp's 7-note octave) set in the base of the harp; each of these pedals acts upon all the strings of a certain pitch name throughout the harp's compass. Depression of the pedal to the first notch (single action) shortens the appropriate strings by a semitone; to the second notch (double action) by a whole tone; the shortening is effected by means of the rotating disks on the neck that grip the string at the appropriate point. This harp is normally tuned diatonically in C♭; thus, depression of all pedals to the first notch puts it into C, and to the second notch into C♯. Its technique demands skilled co-ordination between the hands, which pluck the strings with the fleshy part of the finger tips, and the feet, which, with the pedals, select the necessary pitch changes on the strings.

True harps of great size are depicted in the tomb of Ramses III (*c.* 1200 B.C.) and harps of various forms and sizes were much used in the ancient Mediterranean civilizations, the exceptions being Greece and Rome, where the lyre and cithara were more important. There are few extant specimens of these ancient harps,

but their use ultimately spread to Africa and the far east and the form of the small Egyptian bow harp survives in the tribal harps of east Africa and the old Burmese harp. Ancient harps had no forepillar and, presumably, were strung at rather low tension.

The frame harp, with a forepillar joining the forward ends of neck and sound box, appears to have developed in northern Europe during the 10th and 11th centuries of the Christian era. From the 12th century two main forms are recognizable, one Irish and one European. The characteristic features of the Irish harp, or *clarsach*, were a huge sound box carved from a solid block of wood, a heavy neck and a deeply curved forepillar. It was designed to bear great tension from thick brass strings, which were plucked by long fingernails to produce a ringing, bell-like sound. It belonged to the world of strongly coloured medieval instruments, but, because of the static nature of the aristocratic Irish society into which it was integrated, it survived almost unchanged to the end of the 17th century. Its long resonance was out of keeping with the harmonic nature of 18th-century music, and by the end of that century it had disappeared.

The modern harp is derived from the more delicate European harp, which differed from the Irish in having a thin, shallow sound box, slender neck and forepillar and, at least from the 16th century, gut strings plucked with the finger tips. The simple 16th century form is preserved in the rustic harps of Latin America, taken there by the Spaniards and adopted by the Indians, who still play vivacious dance music on them, together with drums, guitars and maracas.



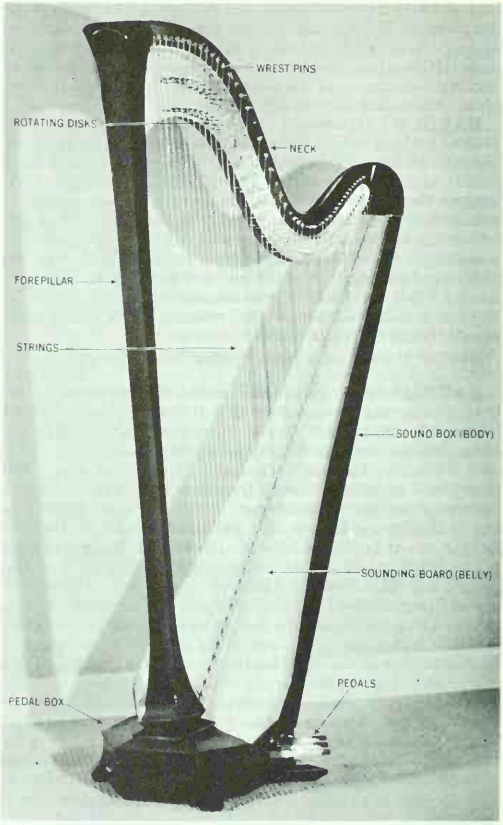
BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM AND THE BOARD OF TRINITY COLLEGE, DUBLIN

FIG. 1.—SMALL IRISH HARP, PROBABLY 14TH CENTURY

From the 17th century onward, the harp was progressively mechanized to give it the chromatic notes demanded by changing musical styles. The first attempt was made by Tirolean harp makers, who placed a number of hooks on the neck close to the strings, to be turned by hand when required. Although this mechanism made it possible to sharpen the pitch by a semitone, it also pulled the hooked strings out of plane, and its operation left only one hand free to play. In 1720, Celestin Hochbrucker, a Bavarian, attached the hooks to a series of levers in the forepillar (which henceforth became hollow) controlled by seven pedals. In 1750 Cousineau of Paris replaced the hooks by metal plates that gripped the strings while leaving them in plane. In 1792 Sébastien Érard substituted the rotating disk for the metal plate and in 1810 added a second disk for each string and produced the double action for the pedals; Érard's changes virtually established the modern form of the harp.

The Welsh triple harp with three parallel ranks of strings and the chromatic harp invented and improved by members of the Pleyel firm in Paris in the late 19th century were attempts to chromaticize the harp without using mechanism. The so-called Irish harp of the 19th and 20th centuries is derived from the gut strung pedal harp and has little connection in construction or technique with the historic Irish harp.

In the absence of exact instrumentation, medieval harp music can only be inferred. Much 17th- and 18th-century solo music is alternatively for harp or keyboard instruments and is, with the exception of Mozart's concerto for flute and harp, unremarkable. The tonal and technical possibilities of the modern harp, particularly its sweeping glissandi and mysterious harmonics, make it most effective in impressionist or "atmosphere" music, and its solo and ensemble repertoire is largely modern.



BY COURTESY OF LYON-HEALY

FIG. 2.—DOUBLE-ACTION PEDAL HARP

Parts specifically written for the harp are rare in early concerted music, Monteverdi's opera *Orfeo* (1607) and Handel's oratorio *Esther* (1730) being notable exceptions; the double-action pedal harp, however, became a standard part of the orchestra from 1830 onward.

See also references under "Harp" in the Index volume.

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HARPER, JAMES (1795–1869), founder of the U.S. publishing firm of Harper and Brothers, was born in Newton, Long Island, N.Y., on April 13, 1795. At the age of 16, after a country school education, he was apprenticed to a printer in New York city. In 1817, with his younger brother John, he established in New York a printing business that soon became a publishing firm. The business was successful and two younger brothers, Joseph Wesley and Fletcher, were brought into the firm. In 1833 Harper and Brothers was adopted as the name of the firm. The abilities of each of the brothers supplemented those of the others and the firm attained an eminent position in the publishing business. James was elected mayor of New York city in 1844 but declined thereafter to run for public office. He died in New York on March 27, 1869.

See J. H. Harper, *The House of Harper* (1912). (H. J. SG.)

HARPER, ROBERT ALMER (1862–1946), U.S. botanist whose early research on the cytology of reproduction in the fungi and later work on fundamental problems of morphogenesis came to be considered classic contributions to the understanding of living things, was born in Le Claire, Ia., Jan. 21, 1862. He was graduated from Oberlin (O.) college in 1886. From 1889 to 1898 he was at Lake Forest (Ill.) college, where he became professor of botany and geology. In 1898 he was appointed professor and head of the department of botany at the University of Wisconsin, Madison; he remained there until 1911, when he accepted the chair of Torrey professor of botany at Columbia university. He died on May 12, 1946, in Bedford, Va. (R. Bo.)

HARPER, WILLIAM RAINEY (1856–1906), U.S. Hebraist and first president of The University of Chicago, was born on July 26, 1856, at New Concord, O. His interest in Hebraic studies began in Muskingum college, New Concord, from which he graduated in 1870. In 1875, when only 19 years of age, he received his Ph.D. at Yale for studies in the Indo-Iranian and Semitic languages. In 1880, after several years of academy teaching, he was given a professorship in Hebrew at the Baptist Union Theological seminary in Chicago. There he founded *The Hebrew Student* and *Hebraica* and organized the American Institute of Hebrew. He published a number of textbooks and study helps for the teaching of Hebrew which found wide use. In 1886 he accepted a professorship in Semitic languages at Yale and in 1889 was appointed Woolsey professor of biblical literature, filling both positions simultaneously. In 1891 he became president of the newly established University of Chicago (*q.v.*). His liberal aims and comprehensive plans for the new university attracted wide attention. Harper remained its president and head of the department of Semitic languages until his death on Jan. 10, 1906.

Among his more important books are *Religion and the Higher Life* (1904); *A Critical and Exegetical Commentary on Amos and Hosea* (1905); *The Prophetic Element in the Old Testament* (1905); *The Trend in Higher Education* (1905).

HARPERS FERRY, scene of John Brown's dramatic raid, Oct. 16–18, 1859, has become a quiet residential town with a population of about 600 in Jefferson county, W.Va., U.S., located at the confluence of the Potomac and Shenandoah rivers where the states of West Virginia, Virginia and Maryland converge, about 60 mi. N.W. of Washington, D.C., and 70 mi. W. of Baltimore, Md. (For details of the raid *see* Brown, John.)

In 1747 Robert Harper established a ferry across the Potomac river and a grist mill on the bank of the Shenandoah river. The purchase of land from Harper's heirs in 1796 for the establishment of a federal armoury provided economic stimulus needed for the growth of the town. Pres. George Washington selected the site, recognizing the water-power potential of the rivers. The armoury attracted workmen whose need for goods resulted in the expansion of mercantile operations.

In the mid-1830s the Chesapeake and Ohio canal, Baltimore and Ohio railroad, and Winchester and Potomac railroad all were completed as far as Harpers Ferry. Gradually the town became a commercial, industrial and transportation centre for northern Virginia. Confederate forces under Gen. Thomas J. "Stonewall" Jackson captured the town, Sept. 13–15, 1862, and took more than 12,500 prisoners, the largest surrender of Union forces in the American Civil War. War-battered and flood-damaged Harpers Ferry never fully recovered and became a virtual ghost town in the years that followed.

Recognizing the scenic beauty and historical importance of Harpers Ferry, the national park service embarked on a program, authorized in 1944, of development and restoration. The old business section of the town and surrounding Civil War sites comprise Harpers Ferry National monument. (H. H. K.)

HARPIES, the Greek *harpyiai,* or snatchers, were fabulous creatures, probably wind spirits. Their presence as tomb figures, however, as on the famous Harpy tomb of Xanthus in Lycia, makes it not impossible that they were ghosts; the two ideas are not wholly contradictory. In Homer's *Odyssey* they are plainly winds that carry people away; for example, they have carried off Odysseus (*i.e.*, he has been lost at sea). They are sometimes connected with the powers of the underworld; thus they carried off two orphan sisters whose marriage was being arranged by Aphrodite and gave them to the Erinyes, the deities of vengeance, as servants. Homer mentions one Harpy, Podarge (Swiftfoot), who seems to be of equine nature, since, according to the *Iliad,* she became by the West Wind the dam of Achilles' horses. Hesiod mentions two, Aello and Okypete (Stormwind and Swiftwing), daughters of Thaumas and of Electra, the daughter of Oceanus.

These Harpies were in no way disgusting. Later, especially in the Argonautic saga, they were represented as birds with the faces of women, horribly foul and loathsome. They are sent to punish the Thracian king Phineus for his ill-treatment of his children, or for some other offense, and nearly starve him to death by carrying off most of his food and befouling the rest. Calais and Zetes, the sons of Boreas, deliver him and chase the Harpies away. Virgil imitates the episode in the *Aeneid;* he calls the chief Harpy Celaeno (Dark).

HARPIGNIES, HENRI (1819–1916), French landscape painter and engraver, was born at Valenciennes on June 28, 1819. He took to painting comparatively late in life, entering Achard's atelier in Paris at the age of 27. Between 1850 and 1865 he studied and painted in Italy and France, coming more and more under the influence of Corot, and the water colours executed during this period are among his finest work. Harpignies scored his first great success at the Salon, in 1861, with his "Lisière de bois sur les bords de l'Allier," and after that year he was a regular exhibitor at the old Salon. In 1886 he received his first medal for "Le Soir dans la campagne de Rome," which was acquired for the Luxembourg gallery. Many of his best works were painted at Hérisson in the Bourbonnais, as well as in the Nivernais and the Auvergne. He died on Aug. 28, 1916, at St. Privé (Yonne), where he had settled in 1878.

Harpignies's landscapes are distinguished for constructive drawing and breadth of treatment; a silvery tone pervades them. They may be seen in several galleries in the United States, including the Toledo Museum of Art and the Boston Museum of Fine Arts.

HARPOCRATES (Har-pe-khrad, "Horus the Child"): *see* Horus.

HARPOCRATION, VALERIUS (?2nd century A.D.), Greek grammarian, whose lexicon provides valuable information on a variety of subjects, was born in Alexandria. Two works were attributed to him, an anthology which has not survived, and the *Lexeis ton deca rhetoron* ("Lexicon of the Ten Orators") which survives in two forms—one virtually complete and an epitome made from an earlier and better version of the text which is now lost. The *Lexicon rhetoricum Cantabrigiense* edited by P. P. Dobree in 1834 contains a series of extra articles from the margin of a Cambridge manuscript of the fuller version. The lexicon of Harpocration explains words, phrases, names and events mainly from the works of the canonical ten Athenian orators and is arranged in alphabetical order. It is valuable both for its explanations of technical terms and Athenian institutions and for the numerous quotations it preserves from tragic and comic poets, from the Atthidographers and other historical writers, and from Alexandrian scholars such as Didymus and Callimachus. It gives the fullest known explanation of many points in Athenian law and has notes of great interest on religious and architectural matters.

See edition by W. Dindorf, 2 vol. (1853); J. E. Sandys, *History of Classical Scholarship,* vol. 1, 3rd ed. (1921). (G. B. Kb.)

HARPOON, a barbed spear used mainly for spearing whales or large fish, and either thrown by hand or fired from a gun (*see* Whale Fisheries).

HARPSICHORD, one of the most important keyboard instruments of the 16th, 17th and 18th centuries. The harpsichord probably originated in the 14th century. It is believed to have derived from the application of the keyboard mechanism to a stringed instrument of the dulcimer type. So much may be deduced from the early term *clavisimbalum,* "keyed dulcimer," whence the Italian name for the instrument *clavicembalo* or *cembalo* and the French *clavecin.*

Little information on the early history of the harpsichord is available before the manuscript treatise of Henri Arnault of Zwolle (d. 1466), which includes a drawing of a harpsichord with nearly three octaves, B-a″, adequate for all the music in the Buxheim "organ" book (*c.* 1470). The alternative hammer mechanism described by Arnault also suggests that the harpsichord may have developed from an earlier pianoforte of inefficient mechanism.

Mechanism.—Each note has normally three, sometimes two, strings made of steel except for those of the lowest octave, which are of brass. The strings are plucked by the jacks, vertical strips of pearwood or beech that rest on the far ends of the keys and pass through a lower fixed jack guide and an upper jack slide, level with the soundboard. Above this point is a pivoted tongue, pierced in its upper half to take a small plectrum of crow's quill. The tongue is kept upright by a weak spring of hog's bristle or wire. When the key is depressed, the jack rises and the quill plucks the string. When the key is released, the quill again meets the string but the tongue swings back a little and allows the quill to drop back past the string without replucking it. At this moment a small square of cloth, let into the top of the jack, rests on the string and damps the vibrations. A padded wooden jack rail that passes about one-half inch above the jacks keeps them from jumping out of their slots. This rail has been removed in fig. 1 and 2 in order to show the jacks and jack slides.

BY COURTESY OF THE VICTORIA AND ALBERT MUSEUM

FIG. 1.—HARPSICHORD (WITH JACK RAIL REMOVED) BY GIOVANNI ANTONIO BAFFO, VENICE, 1574

Fig. 1 shows a soundboard from above. Two sets of strings at unison ("8-ft.") pitch are hitched to pins in a strip of wood fixed just inside the curved side, pass over the curved 8-ft. bridge on the soundboard, between the two rows of jacks, over the near bridge or "nut" and round the tuning, or wrest, pins fixed in an oak plank over the keys. As the two jacks for each note must be in line with their key, the two 8-ft. strings pass on either side of the jacks. Consequently the jacks face in opposite directions and the principal 8-ft. strings are slightly longer than the corresponding "second unison" strings. The harpsichord in fig. 2 has the full three sets of strings, the third sounding an octave higher at "4-ft." pitch. These strings are half the length of the 8-ft. strings and have a separate bridge in the middle of the soundboard and have their own third row of jacks. The different sets of strings may be used separately or together by small sideways movements of the jack slides. The sustained tone of a harpsichord depends on the proportions, lightness and resonance of the soundboard and case, and the scaling of the strings.

"Registers" signify particular combinations of the strings and jacks designed to give various tone qualities, and therefore resemble the stops of the organ. These differences of tone quality largely depend on the relative plucking point. This point varies from about 10% of the length of the string in the bass to 20%–30% for the principal 8-ft. register and to about 40% for the second unison in the top octave. Thus the principal 8-ft. is brilliant and the second unison is rounder in tone, especially in the treble.

Schools of Harpsichord Building.—*Italy.*—From the early 16th century, Italy produced a series of fine though simple instruments. Typical is that by Baffo in fig. 1 with both bridges on the soundboard, with only two 8-ft. stops and with both rows of jacks permanently engaged at an angle to the keyboard. Italian instruments were lightly constructed, usually of cypress and with boxwood topped keys, and could be lifted out of their protective outer cases. Their design and construction differed little during 250 years. They have a very rich and brilliant sound and served as well for Domenico Scarlatti's sonatas as for the music of Girolamo Frescobaldi, written *c.* 1600.

Flanders.—Antwerp also produced many fine harpsichords, especially from 1570 to 1680, a large proportion being made by members of the Ruckers family and circle. This school was apparently the first to build harpsichords with a regular 4-ft. stop and with a second keyboard. The additional manual was initially for transposition, but after the middle of the 17th century the keyboards were changed to the same pitch. At the same time the registers were rearranged to give one 8-ft. stop on the upper manual, with the other 8-ft. and the 4-ft. on the lower manual. The upper 8-ft. stop could be added to the lower keyboard by means of a coupler. These four-octave Flemish harpsichords largely supplied the demand throughout most of northern Europe. The rapidly developing keyboard schools of the second half of the 17th and early 18th centuries demanded an increased compass, especially in the bass.

By this time, the old Flemish harpsichords were so highly prized for their tone that they were conserved by adding a few extra notes in place of the key blocks and eventually enlarged to accommodate a five-octave compass, especially in France, where this process was known as *ravalement*. This enlargement usually meant replacement of everything except the soundboard and sometimes part of the casework. This enlarged instrument without the modern 16-ft. register was that for which Bach, Handel, the Couperins and all the other great baroque masters wrote and on which their music sounds best.

England.—In the 16th century many Italian instruments were imported into England. Comparatively few English harpsichords were built before 1720, but after that date England rapidly became the leading centre for harpsichord making, largely because of the success of the fine full-sounding harpsichords by B. Shudi and J. Kirckman. These differed from the harpsichord of *c.* 1700 by having the two 8-ft. rows of jacks placed together, with the 4-ft. farthest from the player and allowing the principal 8-ft. jacks to play from both manuals. Thus a key depressed on the upper manual lifts only the near 8-ft. jack while one on the lower manual lifts all three jacks. The instrument illustrated in fig. 2 shows the changing styles in harpsichord design by having a Hans Ruckers soundboard of 1612 extended in the treble, an early 18th-century case and compass and the English disposition of jacks. Most English harpsichords also included the lute stop, an extra row of jacks that plucked the principal 8-ft. strings at the 4% position, provid-

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FIG. 2.—HARPSICHORD WITH SOUNDBOARD BY HANS RUCKERS, AMSTERDAM, 1612

ing an attractive dry, almost brittle, sound.

Germany.—Few harpsichords were produced in Germany, but in the middle of the 18th century the Hass family built some fine specimens with the English disposition and including one or two exceptional and elaborate specimens with 16-ft. registers and one with three manuals and a 2-ft. stop. These are indicative of a change in musical taste that set in after Bach's time. In Germany the makers tended to design the harpsichord like an organ; in France it was made to sound like a pianoforte through the use of plectra of soft buff leather. By 1790 it was accepted that the pianoforte was more suitable for the new romantic music.

Modern Developments.—Throughout most of the 19th century, the harpsichord was considered quaint and old-fashioned, but the growing interest in older music after the middle of the century resulted in a revival of the commercial manufacture of harpsichords, starting in the 1880s.

Twentieth-century harpsichords vary considerably because of the different demands of two repertories: (1) that of the great masters of the past, which only requires two 8-ft. and one 4-ft. stops but a very resonant instrument; and (2) the growing modern repertory, which demands 16-ft. tone, greater contrasts and variety in tone colour, rapid stop control while playing, and a frame that will resist strenuous conditions. (G. F. Ol.)

HARPY EAGLE, powerful eagles named after the mythological half-bird, half-woman monsters (*see* Harpies). They are largely South American and include the great harpy or Mexican imperial eagle (*Harpia harpyja*), most powerful of eagles, ranging to southern Brazil, and the crowned harpy (*Harpyhaliaetus*). Elsewhere are found the New Guinea harpy (*Harpyopsis*) and the large Philippine monkey-eating forest eagle (*Pithecophaga jefferyi*).

BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

HARPY EAGLE (HARPIA HARPYJA)

Most harpy eagles stand over three feet high and present a formidable appearance. Although slow of flight, they are powerfully armed with hooked beak and large talons. *See* also Eagle.

HARRAN (Haran; Rom. Carrhae), a historic site of strategic importance on the Belikh river, is in modern times a small town 24 mi. S.S.E. of Urfa (Edessa) in the Urfa *il* of Turkey. The ancient town lay on the road that ran westward from Nineveh to the crossing of the Euphrates at Carchemish and was regarded as of considerable consequence by the Assyrian kings. Its chief cult in Assyrian times was that of the moon-god. As Haran, the town is frequently mentioned in the Bible. It was there that Abraham's father, Terah, settled with Abraham and all his family when they had left Ur of the Chaldeans (Gen. xi. 31–32). The story of this migration, and of Abraham's further migration from Haran after Terah's death, is told again in Acts vii. 2–4.

In Roman times Harran, as Carrhae, was the scene of the disastrous defeat of Crassus by the Parthians in 53 B.C. (*see* Carrhae, Battle of). Three and a half centuries later the emperor Galerius was defeated at Carrhae by the Persian king Narses (A.D. 296). Meanwhile the emperor Caracalla had been murdered there in 217 while preparing for a campaign against the Parthians.

Still a place of importance in the 12th century, Harran was again the scene of a battle when Bohemund, the Norman prince of Antioch, was defeated there by the Turks in a decisive battle (1104). Later in the century Harran formed part of the principality of the atabeg Zangi.

HARRIER, any hawk in the genus *Circus*, subfamily Circinae, with face feathers arranged into a disc and oval nostrils. They are moderate in size (17–23 in., females larger and usually much different in colour) and, in most species, display a distinct white rump-patch. These predators, with wings somewhat angled up, fly low over open country, particularly marshes, in search of small mammals, reptiles, insects, frogs and sometimes birds. The nest is usually on the ground in marshes, or in tall grass, with four to six dull whitish or bluish eggs; the spotted harrier (*Circus assimilis*) of Australia and Celebes is noted for tree-nesting habits.

ERIC HOSKING FROM NATIONAL AUDUBON SOCIETY

MARSH HARRIER (CIRCUS AERUGINOSUS) WITH YOUNG

The best known is the hen harrier (*C. cyaneus*), ranging across Europe and Asia from the arctic tundras south to the Pyrenees, Italy, Turkestan and Tibet. An allied form, the marsh hawk (*C. c. hudsonius*) lives in North America, from Alaska and Newfoundland south to California, Texas, Ohio and Virginia; in winter it shifts southward. Females and young are brown; the bluish-ash males, whitish below, are known as blue hawks. Also common is the marsh harrier (*C. aeruginosus*), over most of Europe and the Mediterranean shores of north Africa to Mongolia, and Montagu's harrier (*C. pygargus*), having the same temperate range but with longer wings, more slender body and darker colours. The pallid harrier (*C. macrourus*) breeds from the Baltic to southeastern Europe and central Asia. Allied species are the cinereous harrier (*C. cinereus*), Peru to the Straits of Magellan; long-winged harrier (*C. buffoni*), over all of South America, especially east of the Andes; South African marsh harrier (*C. ranivorus*), ranging north to Uganda on the east; pied harrier (*C. melanoleucus*), central eastern Asia from Lake Baikal to northeastern China; allied harrier (*C. approximans*), Australia, New Zealand, New Guinea, New Caledonia and the Fijis; eastern marsh harrier (*C. spilonotus*), central Asia and Madagascar; and black harrier (*C. maurus*), southern South Africa.

See also Hawk. (G. F. Ss.)

HARRIGAN, EDWARD (Ned) (1845–1911), U.S. actor, producer and playwright, was born in New York city on Oct. 26, 1845. His theatrical career began in San Francisco, Calif., where, in 1861, he was singing with Lotta Crabtree at the Bella Union. After developing his skill as a comedian, Harrigan formed a team with Sam Rickey and returned to New York. In 1872 he formed a new partnership with Tony Hart (original name Anthony Cannon), and Harrigan and Hart remained a team until 1885. In 1876 they became co-managers of the Theatre Comique. After a new theatre was destroyed by fire in 1884, Harrigan became sole manager of Harrigan's Park theatre.

During his long career Harrigan wrote several hundred sketches and plays, mostly burlesques. His most popular creation was *The Mulligan Guard*, first produced in 1873. Harrigan died on June 6, 1911. (S. W. H.)

HARRIMAN, EDWARD HENRY (1848–1909), U.S. financier and railroad magnate, was born at Hempstead, N.Y., Feb. 25, 1848. He became a broker's clerk in New York at an early age, and in 1870 was able to buy a seat on the New York Stock exchange on his own account. Harriman's career in railroad management started with executive positions with the Illinois Central. In 1898, his career as a great railway organizer began with his formation, by the aid of the bankers, Kuhn, Loeb & Co., of a syndicate to acquire the Union Pacific line, which was then in the hands of a receiver. Having brought the Union Pacific out of bankruptcy into prosperity, he utilized his position to draw other lines within his control, notably the Southern Pacific in 1901. His abortive contest in 1901 with James J. Hill for the control of the Northern Pacific led to one of the most serious financial crises ever known on Wall Street. At his death, on Sept. 9, 1909, his influence was estimated to extend over 60,000 mi. of track. Har-

riman's methods excited the bitterest criticism, culminating in a stern denunciation from Pres. Theodore Roosevelt in 1907.

His son, WILLIAM AVERELL HARRIMAN (1891–), entered the employment of the Union Pacific in 1915 and was board chairman, 1932–46. Although he held numerous positions in the business world, Averell Harriman was best known for his governmental service, beginning with an administrative position with the NRA in 1934. He was ambassador to the U.S.S.R. (1943–46) and to Great Britain (1946); secretary of commerce (1946–48); and director of the Mutual Security agency (1951–53). In 1954 he was elected governor of the state of New York; in 1958 he was defeated for re-election. Pres. John F. Kennedy called upon Harriman to undertake a variety of assignments related to foreign affairs and in April 1963, at the age of 71, Harriman became undersecretary of state for political affairs. (W. H. D.)

HARRINGTON, EARLS OF. The English title earl of Harrington was first created for the diplomatist and politician WILLIAM STANHOPE (*c.* 1683–1756), a distant cousin of the more famous statesman James Stanhope (1673–1721), 1st Earl Stanhope. Educated at Eton, William Stanhope was British ambassador in Spain 1721–27 and 1729–30 and was created Baron Harrington in Jan. 1730. He was secretary of state for the northern department from 1730 to 1746 except for a short interval (1742–44), when he was president of the council. He was created earl of Harrington in 1742. He was lord lieutenant of Ireland (1746–50) and died in London on Dec. 8, 1756.

LEICESTER (1784–1862), 5th earl, was a soldier and a politician of advanced views, who worked with Lord Byron in the cause of Greek independence, although his later speeches in the house of lords displayed a much more conservative temper. WILLIAM (1922–), 11th earl, succeeded his father in 1929, and is also heir presumptive to the viscountcy of Stanhope.

HARRINGTON (HARINGTON), **JAMES** (1611–1677), English political philosopher, best known for his major work *Oceana*, a treatise on the ideal state which must be understood in terms of the political and economic conditions of 17th-century England, but which contains ideas that have gained importance far beyond their historical context. Harrington, a member of the English nobility, was born at Upton on Jan. 7, 1611. (He should not be confused with his cousin, Sir James Harrington, a member of the commission which tried Charles I.) He studied at Trinity college, Oxford, and traveled extensively in continental Europe. Although he was a devoted exponent of the ideas of republican government, he won the esteem of Charles I, whom he served and whose execution he deeply deplored. Moreover, Harrington's ideas initially failed to gain Cromwell's approval. *Oceana* was confiscated while it was being printed; only after the intervention of Cromwell's daughter was it published in 1656.

Harrington's persistence in his republican views after the restoration of the monarchy led to his imprisonment in 1661, from which he was released after he had become physically and mentally ill. He died on Sept. 11, 1677 at Westminster.

"Oceana" is the name of the ideal state which Harrington envisaged for England. Olphaus Megaletor, a pseudonym for Oliver Cromwell, is its protector, who retires into private life after a republican government under a constitution has been firmly established. The treatise *Oceana* has been regarded as a Utopia. However, such developments in American political history as the adoption of written constitutions, the reliance on bicameral legislatures, rotation in office, the use of the secret ballot and the provision for indirect election of the president must be understood, in part, in terms of the influence of Harrington's ideas.

Of particular interest is Harrington's idea that political power follows economic power. This idea, which was extensively developed in *Oceana*, may be regarded as the first important restatement of Aristotle's theory of constitutional stability and revolution. In his *Politics*, Aristotle emphasized that constitutional stability in a polity is attained by a unification of political and economic power. The contemporary version of this aspect of Aristotle's theory is that democracy is most stable where there is a strong middle class. The other, corresponding aspect of Aristotle's theory is that whenever political and economic power are separated, a revolution is likely to occur. Through Harrington's influence this theory appears in American political thought in such diversified forms as Jefferson's defense of an agrarian democracy and the antitrust policies of Roosevelt and Wilson.

In 20th-century research in the social sciences, the Pareto-Davis theory of income distribution and political disturbances has provided a mathematical index for measuring the concentration of economic power and its relation to civil wars and revolutions. In terms of such a wide perspective, it may be suggested that Harrington's idea of the relation of political and economic power represents a fusing link between classical Greek thought, modern political history and contemporary research.

John Toland's edition of Harrington's *Works* was first published in 1700; subsequent editions appeared in 1747 and 1771. *Oceana* has been edited by H. Morley (1887) and S. B. Liljegren (1924).

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For a discussion of the Pareto-Davis theory in relation to Aristotle's and Harrington's concepts of political and economic power, *see* F. Kort, "The Quantification of Aristotle's Theory of Revolution," *American Political Science Review*, vol. 46:486–493 (June 1952). (F. KT.)

HARRIOT (HARRIOTT), **THOMAS** (1560–1621), English scientist, who specialized in mathematics and astronomy, was born and educated at Oxford. Sir Walter Raleigh made him scientific adviser on the expedition of 1585–86 to Roanoke, Va. Harriot's observations are found in *A Brief and True Report* (1588), often reprinted, *e.g.*, in Richard Hakluyt's *Voyages* (1600). He became the leading scientist of the circle around Raleigh and received a pension from the earl of Northumberland. In his algebra, *Artis analyticae praxis ad aequationes algebraicas resolvendas* (1631), he improved the theory of equations, noting the relation between coefficients and roots, and also improved notation, introducing the signs $>$ (greater than) and $<$ (less than). The book was influenced by François Vieta and, in turn, influenced John Wallis. Harriot constructed telescopes—the first one contemporaneously with Galileo—studied sunspots and comets and corresponded with Kepler on the refraction of light. He died July 2, 1621, in London.

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HARRIS, SIR ARTHUR TRAVERS, 1ST BART. (1892–), British air marshal, best known for his outstanding work as air officer commander in chief, bomber command, was born at Cheltenham, Gloucestershire, on April 13, 1892, and was educated at Gore court, Sittingbourne. In World War I he first served with a Rhodesian regiment in German West Africa, and then, commissioned in the Royal Flying Corps, flew as a pilot in France and with the home defense command. Afterward he served in India and the middle east and on the planning staff in England before commanding a bomber group.

From 1940 to 1941 he was deputy chief of air staff, and in the latter year headed a delegation to the United States. He held the most important and arduous post of commander in chief of bomber command with the greatest resolution between Feb. 1942 and Sept. 1945. During his command the bombing offensive against Germany was developed on an immense scale and is generally thought to have contributed greatly to the defeat of that country. Sir Arthur Harris was created a baronet in 1953. (E. B. BN.)

HARRIS, GEORGE WASHINGTON (1814–1869), U.S. writer, one of the humorists of the old southwest who preceded and to some extent prepared the way for Mark Twain, was born in Allegheny City, Pa., on March 20, 1814, and lived most of his life at Knoxville, Tenn., and in the surrounding Great Smoky mountains. From the early 1840s until his death, Dec. 11, 1869, he wrote humorous tales for Tennessee newspapers, the New York *Spirit of the Times* and other publications which were reprinted widely over the entire country. The best of his tales, published in a book, *Sut*

Lovingood's Yarns (1867), surpasses anything before Twain, in the words of a leading critic, "for vivid imagination, comic plot, Rabelaisian touch, and sheer fun." Harris achieves this high level of excellence by being an oral storyteller with a rare kind of dramatic imagination. He gets his tales going by introducing his comic narrator Sut Lovingood, a "long-legged, short-bodied, small-headed, hog-eyed, natral-born durn'd fool" who takes the reader into a wonderful world of fantasy where anything can happen—and does. There camp meetings, quiltings, frolics, horse races and even political gatherings spring to life in scent, sound, form, colour and motion that are hilariously comic. The manuscript of another book, accepted by the publishers, was lost when Harris died on the train returning home.

See Walter Blair, *Native American Humor* (1937; new ed., 1960) (D. Dy.)

HARRIS, JOEL CHANDLER (1848–1908), U.S. author, creator of the American folk character, Uncle Remus, was born in Eatonton, Ga., Dec. 9, 1848. As apprentice on a weekly plantation paper, *The Countryman,* he obtained the real basis for his later work. He established a reputation as a brilliant paragrapher, humorist and writer of dialect while employed on newspapers at Macon, Ga., New Orleans, La., Forsyth and Savannah, Ga., and finally on the staff of the *Atlanta* (Ga.) *Constitution* for 24 years. In 1879 the "Tar-Baby Story" appeared in the *Atlanta Constitution* and created a vogue for a distinctive type of dialect literature. This and successive Uncle Remus stories won for Harris a secure place in American literature. The pattern was new: Uncle Remus, the wise, genial old Negro, tells animal stories to the little boy, son of a plantation owner, and interweaves his philosophy of the world about him. Harris recorded the speech of the plantation Negro faithfully. Speaking through Uncle Remus, he captured not only what the Negro said but how he said it—the poetic impulse, gift for narrative and condensation, humour and pictorial language. *Uncle Remus: His Songs and Sayings* was published in book form in 1880, followed by *Nights With Uncle Remus* (1883), *Daddy Jake, the Runaway* (1889), *Uncle Remus and His Friends* (1892), *The Tar Baby* (1904), *Uncle Remus and Brer Rabbit* (1906) and other volumes of a similar type. Included in a series of children's books were: *Little Mr. Thimblefinger and His Queer Country* (1894), *The Story of Aaron* (1896) and *Aaron in the Wildwoods* (1897). *Mingo, and Other Sketches in Black and White* (1884), *Free Joe and Other Georgian Sketches* (1887), *Sister Jane, Her Friends and Acquaintances* (1896) and *Gabriel Tolliver* (1902) reveal Harris' ability to vitalize other southern types. *On the Plantation* (1892) is valuable because of its autobiographic nature. From 1907 until his death in Atlanta, on July 3, 1908, he edited *Uncle Remus's Magazine.*

Harris' works are among the finest examples of the "local colour" literature that flourished in the 1870s and '80s. With an unerring instinct for dialect and a firm grasp of character, he depicted the vanishing plantation life with charm and sympathy.

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HARRIS, JOHN (*c.* 1666–1719), English writer, best known as the editor of the *Lexicon technicum,* or *Dictionary of the Arts and Sciences* (1704), which is the earliest English encyclopaedia (*see* also Encyclopaedia), and as the compiler of a *Collection of Voyages and Travels* (1705). Harris was a scholar of Trinity college, Oxford, and afterward took orders. In 1698, at St. Paul's cathedral, he delivered the seventh series of the Boyle lectures—*Atheistical Objections Against the Being of God and His Attributes Fairly Considered and Fully Refuted.* Between 1702 and 1704 he gave at the Marine coffeehouse, Birchin lane, London, the mathematical lectures founded by Sir Charles Cox. The friendship of Sir William Cowper, afterward lord chancellor, secured for him a series of church preferments. He showed himself an ardent supporter of the government and engaged in a bitter quarrel with the Rev. Charles Humphreys, afterward chaplain to Henry Sacheverell, who held him up to ridicule in *The Picture of a High-Flying Clergyman* (1716). Harris was one of the early members of the Royal society and for a time acted as vice-president. He died on Sept. 7, 1719.

HARRIS, ROY (1898–), U.S. composer who helped establish the distinctive features of the modern American school, was born in Lincoln county, Okla., on Feb. 12, 1898. Harris' musical development came relatively late. After studying in California with Arthur Farwell, Arthur Bliss and others, he went to Paris in 1926 to study with Nadia Boulanger. His first significant work was a concerto for clarinet, piano and string quartet (1927). After returning to the U.S. in 1929, he accepted various teaching positions and was also active as an organizer of music festivals.

Harris' works are marked by broad tonal melodies and asymmetrical rhythms. Some of his works reflect scenes of American life: *When Johnny Comes Marching Home,* a symphonic overture on a Civil War song (1935); *Folksong Symphony* with chorus (1940); *Kentucky Spring* (1949). His Sixth Symphony (1944) bears the subtitle *Gettysburg Address,* its four movements inspired by Lincoln's ideals.

Of his seven symphonies, the best known is the third (1939), written in a single movement with contrasting sections of lyrical and dramatic nature. His Fifth Symphony (1943) has a vigorous proclamatory quality and his Seventh, performed in 1952, shows his characteristic harmonic, melodic and rhythmic features to be further strengthened and developed.

In chamber music Harris follows classical models. He wrote three string quartets, a piano trio, a piano quintet and a string quintet. Particularly interesting is his third string quartet (1939) in the form of four preludes and fugues in modal harmony.

See N. Slonimsky, "Roy Harris," in *The Musical Quarterly,* Jan. 1947. (N. Sy.)

HARRIS, WILLIAM TORREY (1835–1909), U.S. educator, probably the most widely known public school educator and philosopher in the United States during the late 19th century, was born in North Killingley, Conn., on Sept. 10, 1835. He attended Yale college and then worked as a teacher and later superintendent of schools in St. Louis, Mo. (1868–80). He served as U.S. commissioner of education from 1889 to 1906. As a practical school man, Harris was an effective administrator and innovator. He introduced into the curriculum such studies as art, music, science and manual arts, and he favoured the professional study of education for teachers in training. He worked to extend the public high school and incorporated the kindergarten into the regular school system of St. Louis. As a philosopher and psychologist, Harris was conservative and synthetic rather than original, embracing German idealism, American transcendentalism, Christianity, phrenology and mental discipline. He lectured for several summers at the Concord School of Philosophy, but Hegelian idealism was retreating and Harris was not creative enough to stem the tide of Naturalism. (*See* also Neo-Hegelianism.)

A prolific writer of several hundred philosophical and educational articles, Harris was also editor of the *Journal of Speculative Philosophy,* Appleton's International Education Series and Webster's *New International Dictionary.*

Harris died at Providence, R.I., on Nov. 5, 1909.

See Kurt Leidecker, *Yankee Teacher* (1946). (R. F. Bs.)

HARRISBURG, capital city of Pennsylvania, U.S., and seat of Dauphin county, lies on the east bank of the Susquehanna river, 101 mi. W.N.W. of Philadelphia.

The population was 79,697 in 1960; 89,544 in 1950; and 83,893 in 1940. Ringed by independent boroughs and townships, Harrisburg was unable to expand its boundaries, and the central city lost population. The trend toward suburban living was aggravated in Harrisburg by slum clearance and public works projects that reduced housing in once thickly settled downtown sections. A truer picture of the community's growth is reflected in the figures for the standard metropolitan statistical area (Dauphin and Cumberland counties) which had a population of 345,071 in 1960; 292,241 in 1950; and 252,219 in 1940. (For comparative population figures *see* table in Pennsylvania: *Population.*)

Incorporated boroughs adjacent to the city include Steelton, Paxtang and Penbrook in Dauphin county; Camp Hill, Lemoyne, New Cumberland, Shiremanstown, West Fairview and Wormleysburg in Cumberland county. Other significant communities in the metropolitan area are Middletown, Hummelstown and Hershey in Dauphin county; and Mechanicsburg, Carlisle and Shippensburg in Cumberland county.

Located at the head of the Cumberland and Lebanon valleys and at the site of one of the best fords on the Susquehanna, the Harrisburg area has been a communications crossroads since Indian times. John Harris, an Englishman from Yorkshire, received a licence to trade with the Indians in 1705; and about 1718 he established a trading post on the site of Harrisburg and soon began to operate a ferry. The settlement, known as Harris' Ferry, grew and in 1785 when Dauphin county was created, a town was laid out by John Harris, Jr., assisted by William Maclay, which for a time was called Louisbourg in honour of Louis XVI. This title was never widely used, being first set forth in commissions issued by the supreme executive council to justices of the peace for the town in 1786; the borough charter of 1791 used the name Harrisburg as did the city charter of 1860.

With the removal of the state capital to Harrisburg in 1812, it became a political and governmental centre as well as the hub of interior transportation. Among the notable political events in the city were the national tariff convention of 1827, the Buckshot War of 1838, and the first national Whig nominating convention in 1839, which named William Henry Harrison for U.S. president. In transportation, key events included the laying of the first lock in the famous Pennsylvania canal in 1827, the establishment of the first railroad in 1836, and the building in 1847 of the first link in the main line of the Pennsylvania railroad from Harrisburg to Pittsburgh.

Harrisburg's role as a governmental and communications centre made it the first major objective of the Confederate army when Gen. Robert E. Lee invaded Pennsylvania in June 1863. Confederate forces occupied Carlisle on June 27, and two days later a skirmish between Confederate and Union outposts was fought at a point about 3 mi. W. of Harrisburg in present Camp Hill. The invading forces then withdrew to concentrate at Gettysburg, where they were defeated in a three-day battle on July 1–3, 1863.

In the period after the Civil War, Harrisburg continued to be an important transportation centre and also enjoyed growing industrial development. Civic planning and improvement kept pace with 20th-century progress; and by mid-20th century the city had become the metropolis for an expanding group of industrial and residential suburbs.

Harrisburg has a diversified economy based upon manufacturing, transportation, wholesale and retail trade and governmental activities. The leading types of manufacture are steel and steel products, food products, airplane parts, clothing and shoes. Both the Reading and the Pennsylvania railroads maintain large freight classification yards. Many people in Harrisburg are employed by the state government, while others work at the nearby Olmsted air force base at Middletown, the naval supply depot at Mechanicsburg, and the New Cumberland army general depot.

The city is dominated by the group of state capitol buildings, which occupy a 68-ac. park in the downtown section. The main capitol, completed in 1906, was built to replace the first capitol which was completed in 1822 and destroyed by fire in 1897. The 272-ft. capitol dome, patterned after St. Peter's in Rome, is the most prominent feature of the Harrisburg landscape. The paintings, statuary and other decorative features of the capitol are justly famous. Eight other major buildings, including the Pennsylvania State museum, are in the capitol group.

Cultural facilities in the Harrisburg area are excellent and include a symphony orchestra, a community theatre, an art association, a historical society and the state library. Parks, golf courses and other recreational facilities are numerous in Harrisburg and vicinity. An outstanding scenic attraction is the five-mile-long parkway along the Susquehanna. (S. W. Hm.)

HARRISON, (THOMAS) ALEXANDER (1853–1930), U.S. painter, whose reputation rests primarily on his marine pictures, was born in Philadelphia, Pa., on Jan. 17, 1853, and studied at the Pennsylvania Academy of Fine Arts and the École des Beaux-Arts, Paris, where he went in 1878. Chafing under the restraints of the schools, he went into Brittany, and at Pont Aven and Concarneau turned his attention to marine painting and landscape. In 1882 he sent a figure piece to the Salon, a fisher boy on the beach, which he called "Châteaux en Espagne." This piece attracted much attention. He received many awards, including the Temple gold medal, Philadelphia (1887), first medal, Paris exhibition (1889), and medals in Munich, Brussels, Ghent, Vienna and elsewhere. Harrison died in Paris on Oct. 13, 1930.

Harrison's brother, (Lovell) Birge Harrison (1854–1929), was also a painter. He is identified especially with the Woodstock (N.Y.) art colony.

HARRISON, BENJAMIN (1833–1901), 23rd president of the United States, was born at North Bend, near Cincinnati, O., Aug. 20, 1833. His great-grandfather, Benjamin Harrison of Virginia, was a signer of the Declaration of Independence and three times governor of Virginia (1781–84). His grandfather, William Henry Harrison (*q.v.*; 1773–1841), was the 9th president of the United States. His father, John Scott Harrison (1804–78), served as Whig congressman from the 2nd Ohio district in the national house of representatives from 1853 to 1857.

Benjamin was born of his father's marriage to Elizabeth Irwin of Mercersburg, Pa., and was one of eight children by this marriage, only six of whom grew to maturity. He spent his youth on his father's farm at the junction of the Big Miami and Ohio rivers. He was prepared for college by private tutors, studied for three years at the Farmers' college in Walnut Hills near Cincinnati, and in 1852 graduated from Miami university at Oxford, O. He was a diligent student, leaning particularly to political science and history, and during his college life showed a marked talent for extemporaneous speaking. After graduation he devoted himself to the study of law and in 1854 was admitted to the Ohio bar.

At the age of 21, Harrison moved from Ohio to Indianapolis, then a town of only 16,000 inhabitants but the fast-growing capital of Indiana. While engaged in building up his law practice he became active in the new Republican party and was elected city attorney of Indianapolis in 1857 and reporter of the supreme court of Indiana in 1860. But both his legal and his political careers were interrupted by the Civil War. In 1862 he helped to recruit the 70th regiment of Indiana volunteers, becoming its colonel. For the next year and a half his regiment guarded railroads and engaged in minor skirmishes in Kentucky and Tennessee. It was then attached to Gen. William T. Sherman's command and participated in hard fighting in the Atlanta campaign. In recognition of his "ability and manifest energy and gallantry in command of a brigade" he was promoted to the brevet rank of brigadier general.

At the close of the Civil War, Harrison resumed the practice of law in Indianapolis. He also worked diligently to advance the interests of the Republican party, publicly castigating the Democratic party as the party of treason and supporting the program of the Radical Republicans toward the South. He opposed the Liberal Republican schism of 1872, spoke out against the inflation advocated by the Greenback party (*q.v.*), and played a leading role in bringing about a peaceful solution of a strike in 1877 in Indianapolis. Becoming a candidate for the Republican nomination for governor of Indiana in 1872 he failed of nomination, and when nominated in 1876 failed of election.

His energetic campaign for the governorship brought him national prominence. As chairman of the Indiana delegation to the Republican national convention in 1880 he swung his delegation to James A. Garfield (*q.v.*) and later campaigned for Garfield's election. In Jan. 1881 he was elected by the Indiana legislature as U.S. senator and chose to fulfill the duties of his new position rather than accept a cabinet post that was offered him. His influence with the White House waned after Garfield's assassination and his Indiana rival, Walter Q. Gresham (*q.v.*), was appointed to the cabinet of Pres. Chester A. Arthur (*q.v.*).

Senator Harrison favoured the merit system for federal appointments and supported the Pendleton act of 1883. He served on committees dealing with military affairs, Indian affairs, trans-

portation routes to the seaboard, foreign relations and territories. As chairman of the last-named committee he sponsored a bill establishing civil government in Alaska, worked to preserve and enlarge the national parks and took an active part in urging the admission of new states. Six states—North Dakota, South Dakota, Washington, Montana, Idaho and Wyoming—were later admitted during Harrison's term as president. He opposed President Cleveland's vetoes of pension bills, helped to enact the Interstate Commerce act in 1887 for the regulation of the nation's railroads, and throughout his senatorial term supported the protection principle in the tariff legislation of his party.

He failed of re-election by the Democratic state legislature in 1887 but became Indiana's "favourite son" for the Republican presidential nomination at the Chicago convention in the following year. Indiana's position as a doubtful state, the support of his devoted friends there and the endorsement of James G. Blaine (*q.v.*) gave him the nomination. In the ensuing election he defeated Cleveland, receiving 233 electoral votes to Cleveland's 168.

Harrison's presidency (1889–93) was marked by new ventures in foreign policy and a deteriorating domestic situation. During his administration the United States participated in the first International Conference of American States (*see* PAN AMERICAN CONFERENCES) presided over by Secretary of State Blaine; was represented in the Berlin conference concerning the Samoan Islands; convoked an international monetary conference; concluded treaties of commercial reciprocity with many foreign countries; resolved peaceably a bitter controversy with Chile; and negotiated a convention for the arbitration of a troublesome dispute with Great Britain involving fur seals in the Bering sea. In domestic affairs enactment of the Sherman Anti-Trust act in 1890 was to have far-reaching results in the future. Of more immediate importance were the beneficial effects of the McKinley tariff bill on American industry, but they were partly offset by the inflationary results of the Sherman Silver Purchase act. The Democrats won a majority in the house of representatives in the election of 1890. The growing Populist discontent and the Homestead and other strikes that occurred after Harrison's renomination at the Minneapolis convention in 1892 largely accounted for his defeat for a second term by an electoral vote of 145 to 277 for Cleveland. (*See* also UNITED STATES [OF AMERICA]: *History.*)

After leaving the White House, Harrison returned to his law practice in Indianapolis. He contributed articles to magazines and wrote two books, *This Country of Ours* (1897) and *Views of an Ex-President* (1901). In 1898–99 he served as leading counsel for Venezuela in the arbitration of its boundary dispute with Great Britain at Paris.

Harrison's outstanding traits displayed in his public career were his legal acumen, industry, high moral principles, devotion to duty and loyalty to the principles of the Republican party. As president he accepted the constitutional limitations of his office. Conceiving himself as the legal advocate of the American people he discharged his duties conscientiously and with dignity and ability but failed to provide magnetic leadership. After the war with Spain (1898) he criticized the policy of denying full constitutional rights to the newly acquired territories.

Harrison was married twice, first in 1853 to Caroline Lavinia Scott, by whom he had a son and a daughter and who died in the White House in Oct. 1892, and second to Mrs. Mary Scott Lord Dimmick in 1896, by whom he had a daughter. He died at Indianapolis on March 13, 1901.

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HARRISON, FREDERIC (1831–1923), English jurist and man of letters, one of the founders of the Sociological society in London and a leader of the positivist movement in England, was born in London on Oct. 18, 1831. He was educated at King's college school, London, and at Wadham college, Oxford, where, after taking classical first-class honours in 1853, he became a fellow. In 1855 in Paris he talked with Auguste Comte and became a devoted follower of his thought and writings.

Harrison was called to the bar in 1858 and practised in equity. His interest in the betterment of the workers led to his appointment on the Royal Commission on Trade Unions, 1867–69, and through its reports he had a paramount influence on the shape of trade union law between 1868 and 1906. In 1869 he was secretary to the Royal Commission for Digesting the Law. From 1877 to 1880 he was professor of jurisprudence and international law under the Council of Legal Education. In 1889 he became an alderman of the newly formed London County council, resigning in 1893.

Harrison's life may best be understood, however, as an attempt to introduce the sociology of Auguste Comte into England. As president of the English Positivist committee from 1880 to 1905, he lectured and wrote extensively on these principles and on the religion of humanity. *The Positivist Review* carried his views beyond the audience of Newton hall, the London centre of the English positivists. In addition to this work he also took an active part with Sir Patrick Geddes in the foundation of the Sociological society (later, the Institute of Sociology) in 1903; this society attempted to combine the philosophical and historical approach of Comte with that of the practical field enquiry into social problems.

In mid-life he virtually retired from political life and legal practice to devote himself to writing. From 1900 onward books and essays flowed from his pen; he wrote on famous men, on history, on morals and on religion, as well as on the political issues of the day. He died at Bath, Somerset, on Jan. 14, 1923.

Harrison's principal works include *Oliver Cromwell* (1888); *Humanity: Religious Systems of the World* (1890); *Positivism: Its Position, Aims and Ideals* (1901); *Ruskin* (1902); *The Creed of a Layman* (1907); *National and Social Problems* (1908); *Autobiographical Memoirs*, 2 vol. (1911); *The Positive Evolution of Religion: Its Moral and Social Reaction* (1913).

See Austin Harrison, *Frederic Harrison* (1927). (J. MY.)

HARRISON, JANE ELLEN (1850–1928), English classical scholar whose view of the ritualistic origin of mythology has been endorsed by modern anthropologists, was born at Cottingham, Yorkshire, Sept. 9, 1850. Overcoming the obstacles of a conventional upbringing, she went to Newnham college, Cambridge, to read classics, later studying Greek archaeology and art at London and Athens, and becoming a lecturer in Greek at Newnham, 1898–1914, and in Russian, which she learned during World War I. She died in London, April 15, 1928.

The Mythology and Monuments of Ancient Athens (1896) had won her recognition as a scholar, but her chief work is *Prolegomena to the Study of Greek Religion* (1903), which altered the approach to the subject. In it she investigated the actual ritual of Greek festivals, to discover what underlay the Olympic theogony. In *Themis* (1912) she went further, using evidence from anthropology to illuminate the whole field of Greek religion. Her *Epilegomena* (1921) also considered modern religion in the light of psychology. Her *Reminiscences of a Student's Life* was published in 1925.

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HARRISON, JOHN (1693–1776), British horologist, the inventor of the first practical marine chronometer, was born at Foulby, near Pontefract, Yorkshire. He lived at Barrow-upon-Humber, Lincolnshire, from 1700 to 1736, when he settled permanently in London.

In 1714 the British government offered an award of £20,000 for a timekeeper which would enable longitude to be determined within an accuracy of half a degree at the end of a voyage to the West Indies. Harrison set himself to solve this difficult problem and by 1759 had constructed a large watch. In this, compensation for the change of stiffness of the balance spring with temperature change, which affects the rate of the watch, was achieved with the aid of a bimetallic strip, the two metals enabling the effective length of the strip to vary. Harrison's expectations of accuracy were realized, for when tested at sea in 1761–62 his watch erred by only five seconds on arrival in Jamaica, corresponding to an error in longitude of only 1¼′. Harrison claimed the award but it was not until 1773 that he was paid in full.

Earlier in his career Harrison made two other important inventions, since widely applied: his "gridiron" pendulum, devised about 1726, whose effective length does not vary with temperature, and a simple device which keeps a clock going while it is being wound up and the normal weight or spring drive is not in operation. He died in London on March 24, 1776.

See R. T. Gould, *The Marine Chronometer* (1923). (F. A. B. W.)

HARRISON, ROSS GRANVILLE (1870–1959), U.S. biologist, was the first to employ tissue culture methods. In one important experiment he demonstrated the outgrowth of nerve fibres in culture medium thereby providing the foundation for modern nerve physiology and neurology. He also performed early experimental studies of embryological asymmetry. He was born in Germantown, Pa., and after receiving his schooling in that area went to the Johns Hopkins university where he took his baccalaureate degree and began his zoological studies. He completed his work for the degree of doctor of philosophy under the guidance of W. K. Brooks. After teaching at Bryn Mawr college, he returned to the Johns Hopkins medical school where he taught anatomy. He went to Bonn where he worked with Moritz Nussbaum and took his degree in medicine in 1899. He came to Yale in 1907 and assumed the headship of the department of zoology which he held until his retirement in 1938.

Using amphibian material he was able to show that the three axes of the limb become fixed at different times in development. During embryonic development, when material which normally would form a left limb is moved to the animal's right side but turned upside down, it will develop a right limb. From this and other experiments, Harrison was able to formulate the rules for the development of asymmetry which hold for all the vertebrate forms so far tested. The same material also provided the information that the middle germ layer is predominantly responsible for the formation of the limbs.

Upon retirement in 1938, Harrison became chairman of the National Research council, a position which he held throughout World War II. In association with Frank B. Jewett, then president of the National Academy of Sciences, the council and the academy were combined in essential services to the country. Harrison's work in administration was characterized by the extreme deliberation and logical analysis which he employed in his scientific approach. (J. S. Ns.)

HARRISON, THOMAS (1616–1660), English parliamentarian general and Fifth Monarchist leader, who did much to bring about the execution of Charles I, was born in Newcastle-under-Lyme in the summer of 1616. He was apprenticed clerk to an attorney in Clifford's Inn and after military training enlisted in the earl of Essex' life guard in 1642. In the first phase of the Civil War he fought at the battle of Edgehill and when Charles Fleetwood formed a cavalry regiment in the earl of Manchester's army in 1644, he appointed Harrison captain. Harrison fought as a major at Marston Moor and at Naseby where he distinguished himself. He was elected member of parliament for Wendover in 1646. In 1647 he served in Ireland but returned and was appointed colonel of a cavalry regiment. In the army debates, Harrison wanted to prosecute Charles I as "a man of blood," to abolish the house of lords and suhstitute a government of "saints." He belonged to the sect known as the Fifth Monarchy men who believed in the imminent return of Christ and were willing to govern until he came.

Harrison's regiment fought in the second phase of the Civil War in 1648, when he was wounded at Appleby in Westmorland, but he had recovered sufficiently by December to command the guard that brought Charles I to London for his trial. Harrison helped Cromwell to suppress mutinies in the army and then was given a command in Wales where his extreme Puritanism created some resentment, returning to take command in London when Cromwell invaded Scotland in 1650. Harrison became a member of the council of state on Feb. 20, 1651, and fought at Worcester (Sept. 3). He pressed Cromwell to dissolve the "Rump" parliament and was the leading advocate of the subsequent "parliament of saints." When it collapsed, Harrison refused to acknowledge the protectorate, lost his commission in the army (Dec. 1653) and was imprisoned several times.

At the Restoration he was exempted from the Act of Indemnity and defended himself with dignity at his trial. "Where is your Good Old Cause?" asked one of the spectators as he was taken to his execution. He clapped his hand on his breast and cried "Here it is, and I am going to seal it with my blood." He died on Oct. 13, 1660, and there is a tradition that his remains were finally buried in St. Giles' churchyard, Newcastle-under-Lyme. He was an honest fanatic and a brave soldier. (M. P. A.)

HARRISON, WILLIAM (1534–1593), English topographer and social historian, whose valuable and entertaining *Description of England* forms an important part of *The Chronicles of England . . .* of Raphael Holinshed (*q.v.*), was born, by his own account, in London on April 18, 1534. He was inducted early in 1559 to the rectory of Radwinter, Essex, on the presentation of Sir William Brooke, Lord Cobham, to whom he had formerly acted as chaplain; and from 1571 to 1581 he held the living of Wimbish in the same county. He became canon of Windsor in 1586, and died there in 1593.

His *Description of England* was undertaken for the queen's printer, Reginald Wolfe, who designed the publication of "an universall cosmographie of the whole world . . . with particular histories of every knowne nation." After Wolfe's death in 1576, this comprehensive plan was reduced to descriptions and histories of England, Scotland and Ireland. The historical section was to be supplied by Holinshed, the topographical by Harrison. The work was published in 1577 as *The Chronicles of England, Scotland and Ireland . . .* by Raphael Holinshed and others. Harrison's final share consisted of one book of topographical description of the island of Britain, two books of description of England's institutions and a translation from the Scots of John Bellenden's version of Hector Boece's Latin description of Scotland.

The *Description of England* is an exhaustive survey of the political, religious and social condition of Elizabethan England. Although Harrison was ill-qualified as a topographer, his insatiable spirit of inquiry enabled him to produce a vivid and detailed portrait of his countrymen and their institutions. His work throws particular light on the economic changes and consequent social upheavals of his time. His famous contemptuous account of "how gentlemen are made in England" reveals how rapidly the redistribution of wealth was altering the traditional structures of society. Harrison wrote in a voluble and homely style; he apologized that his "foule frizeled treatise" was "scrambled up," but its very lack of literary polish enables it to reflect not only current colloquial speech but also the pronounced individuality of its author.

The second and third books of Harrison's *Description of England* were edited by F. J. Furnivall for the New Shakespere society, with extracts from his unpublished "Chronologie" from the creation to Feb. 1593 and also from other contemporary writers, as *Shakespere's England* (4 vol., 1877–1908).

HARRISON, WILLIAM HENRY (1773–1841), 9th president of the United States, was born at the plantation of Berkeley in Charles City county, Va., on Feb. 9, 1773, the third son of Benjamin Harrison. His father, long prominent in Virginia politics, served his state in a number of capacities: as a member of the Virginia house of burgesses; as a delegate to the Continental Congress (1774–77); as a signer of the Declaration of Independence; and as governor of Virginia (1781–84). William Henry Harrison attended Hampden-Sidney college from 1787 to 1790, and later enrolled at the College of Physicians and Surgeons in Philadelphia. He withdrew in 1791 to enter the army as an ensign in the 1st regiment at Ft. Washington, Cincinnati. Promoted to lieutenant the following year, he later acted as aide-de-camp to Gen. Anthony Wayne (*q.v.*) in the campaign against the Indians that ended in the battle of Fallen Timbers on Aug. 20, 1794. In 1797 Harrison received his captaincy but elected to resign his commission the next year. Soon afterward he was made secretary of the Northwest Territory. In 1799 the Jeffersonian party there sent him to congress as territorial delegate.

In May 1800 Pres. John Adams appointed Harrison governor of the newly created Indiana territory. Sworn into office on Jan. 10, 1801, he served as governor until Sept. 1812. In 1803 he

became a special commissioner to the Indians and in this role negotiated a number of treaties that opened new areas of land to white settlement. Greatly dissatisfied with these treaties, the Indians, led by Tecumseh (*q.v.*) and his brother, "The Prophet," and undoubtedly encouraged by the British, began the hostilities that terminated at the Tippecanoe river on Nov. 7, 1811. Here, Harrison, leading a force of regulars and militia, won the victory that not only established his military reputation but also gained for him the national prestige which made possible, in part, his subsequent election to the presidency.

When war broke out with Great Britain in the summer of 1812, Harrison was appointed a major general in the Kentucky militia. A few weeks later he was made a brigadier general in the regular army of the United States and placed in command of all the troops in the northwest. On Oct. 5, 1813, after reoccupying American territory previously surrendered to the enemy, troops under his command defeated the British at the battle of the Thames. (*See* WAR OF 1812.)

Harrison resigned his commission in 1814 and shortly afterward was appointed to negotiate a second treaty of Greenville with the Indians (July 22, 1814). Settling at this time in Ohio, Harrison quickly became important in the politics of his adopted state. He served in congress from 1816 to 1819 and in the Ohio senate from 1819 to 1821. From 1825 to 1828 he served in the U.S. senate. In 1828 he was appointed the first U.S. minister to Colombia, but retained this position for less than a year. For the next several years he lived in semiretirement at North Bend, O.

Early in 1835 Harrison began to receive favourable mention as a candidate for president on the Whig ticket and was later "nominated" at large public meetings in Pennsylvania, New York and Maryland. In the election of 1836 he led the candidates running against Martin Van Buren (*q.v.*), but received only 73 electoral votes, while the "Little Magician" won 170 electoral votes. Harrison's military record and his noncommittal political views made him the most "available" candidate for the Whig party nomination in the election of 1840. He received the Whig nomination at the party's convention in Harrisburg, Pa., in Dec. 1839. Largely to attract the votes of discontented and anti-Jacksonian Democrats, the Whigs nominated John Tyler, lately identified with the Democrats, for the vice-presidency. The campaign of 1840 was notable for the use of campaign songs, political slogans and party insignia. When the Democrats derisively referred to Harrison as the "log cabin and hard cider" candidate, the Whigs quickly adopted miniature log cabins and cider jugs as their major identifying symbols. The cry of "Tippecanoe and Tyler too!!" echoed throughout the land. In the November election Harrison overwhelmingly defeated his Democratic opponent, receiving 234 electoral votes to Van Buren's 60.

William Henry Harrison took his oath of office on March 4, 1841, and delivered a long inaugural address for the occasion. One month later, on April 4, 1841, he died, the first president to die in office. Vice-president John Tyler (*q.v.*) succeeded him. It is generally agreed that Harrison died of pneumonia, but his illness was complicated by the excitement and fatigue brought on by the innumerable demands of office seekers who plagued him incessantly. His body was permanently interred at North Bend, O.

In 1795 Harrison married Anna Symmes (1775–1864), daughter of John Cleves Symmes. Their grandson, Benjamin Harrison (*q.v.*), became the 23rd president of the United States (1889–93). *See* also UNITED STATES (OF AMERICA): *History*.

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HARRIS TWEED, a distinctive cloth originally handspun, warped, woven and finished by the inhabitants of Lewis-and-Harris, North and South Uist, Barra and other islands of the Outer Hebrides off the northwest coast of Scotland, from the virgin fleece of native sheep.

Harris tweeds are relatively coarse and open in appearance but strongly characterized by a soft texture with excellent tailoring and wearing properties. Because of the steady increase in demand, most of them are now made from machine-spun yarns. Cloths spun and woven on the islands have an unmistakably peaty odour. The superiority claimed for the homespun and woven cloth is attributed to the incorporation of longer fibres in the yarn as compared with the shorter fibred machine-spun yarn employing more twist. The Harris tweed industry has been affected by the competition from cheaper imitation cloths manufactured on the mainland, in Europe and in the far east. These may be made from wool-cotton or wool-shoddy blends containing other fibres.

Two organizations—the Harris Tweed Association Ltd. and Independent Harris Tweed Producers Ltd.—watch over the interests of the trade. The first controls the "orb" mark, while the second employs arms that form the basic design for hanging tickets and woven labels. Both marks are affixed only to tweeds handwoven in the Outer Hebrides. (A. DR.)

HARROGATE, a municipal borough (1884) and spa in the Harrogate parliamentary division of the West Riding of Yorkshire, Eng., 15½ mi. N. of Leeds and 21½ mi. W. of York by road. Pop. (1961) 56,345. It stands about 400 ft. above sea level, on the Pennine foothills. Harrogate is the principal inland watering place in the north of England, containing 88 known mineral springs. It owes its rise and development, which started in the 17th century (the Queen hotel was built in 1687), to the presence of chalybeate, sulfur and saline springs. There is some light industry but the chief employment is catering for visitors to the spa, delegates to conferences and tourists to the moorlands and dales of Yorkshire and to Knaresborough, Fountains abbey, Bolton abbey, etc. Harrogate consisted of two scattered townships, now united—Low Harrogate and High Harrogate. A common, the Stray, secured by act of parliament against being built upon, covers 200 ac. in front of the main lines of houses. The chief of the many beautifully laid out gardens is the Valley gardens (17½ ac.) adjoining the Royal Pump room (1842) in Bogs field. There are more than 540 ac. of open spaces. At Harlow Car are the Northern Horticultural Trial grounds.

There were "holy wells" in Harrogate from early times, the best-known being that of St. Mungo. There are five main chalybeate springs: Tewit well, discovered in 1571 by William Slingsby and called the "English Spaw" by Timothy Bright; the Royal Chalybeate spa or John's well, discovered in 1631; Muspratt's Chalybeate spring or the Chloride of Iron well, discovered in 1819; Kissingen (Royal Baths Iron) wells; and the Pure Chalybeate spring. The chief sulfur springs are the Old Sulphur well, discovered about 1656; the Magnesia well; and the Montpellier or Royal Baths wells, the chief of which was discovered in 1822 on the grounds of the Crown hotel. The first account of the Harrogate springs was written by Edmund Deane of York in 1626 and called *Spadacrene Anglica or the English Spaw Fountain*. The Royal baths (1897, greatly extended in 1939) are owned by the borough corporation and are on the site of the old Victoria baths. The municipal offices were built in 1930 on the site of the new Victoria baths. The spa is also equipped with apparatus for thermal and electrical treatment. Harrogate also contains the Royal hall, opened in 1903, and the Royal Bath hospital, founded in 1824.

HARROW, a municipal borough (1954) of Middlesex, Eng., which under the London Government Act 1963 was to become the new London borough of Harrow on April 1, 1965 (*see* LONDON). It is 11 mi. N.W. of Hyde Park corner. Pop. (1961) 208,963. Area 19.6 sq.mi. It includes Harrow-on-the-Hill, Wealdstone, Pinner, Hatch End, Harrow Weald, Stanmore and part of Edgware. Harrow-on-the-Hill, which stands on an isolated hill cap of Bagshot sands and gravels resting on the London clay, rises to 408 ft. On the summit is St. Mary's church, founded by Lanfranc, archbishop of Canterbury, and containing Norman work, and at Wealdstone is a moated house, a residence of the archbishops of Canterbury until 1545. Harrow is first mentioned in 767. It is a residential area with more than 1,000 ac. of open spaces including Stanmore and Harrow Weald commons. Grim's dike crosses the northwest of the borough. There are glass, opti-

cal, photographic and printing works. Harrow returns three members to parliament.

Harrow School.—The school was founded in 1571 by John Lyon (d. 1592), whose brass is in the church. A yeoman of the neighbouring village of Preston, he had yearly during his life set aside 20 marks for the education of poor children of Harrow. The charter was granted by Elizabeth I in 1571 and the statutes drawn up by Lyon in 1590, but it was not till 1611 that the first building was opened. In about 1660 the headmaster began to receive "foreigners," *i.e.*, boys from other parishes, who were to pay for their education. Control was originally vested in six persons of standing in the parish, but under the Public Schools act of 1868 the governing body consists of six members who are elected respectively by the lord chancellor, the universities of Oxford, Cambridge and London, the Royal society and the assistant masters of the school. The principal buildings are of the 19th century but the fourth form room dates from 1611 and on its panels are cut the names of many eminent alumni among whom are Robert Peel, H. J. Temple (Lord Palmerston), R. B. Sheridan, Lord Byron and Henry Cardinal Manning. Other famous pupils include Lord Rodney, Anthony Trollope, Lord Shaftesbury and Sir Winston S. Churchill. The Vaughan library, named after the distinguished headmaster C. J. Vaughan (1844–59), was built by Sir George Gilbert Scott who also built the chapel. The war memorial building, near the chapel, is the work of Sir Herbert Baker. Some features peculiar to the school are the Harrow songs, illustrating its history and traditions; the ceremony of Bill (roll call) in the schoolyard; Harrow football, specially adapted to the heavy clay soil; and the Harrow hats, of straw with shallow crowns and broad brims, worn all the year round. The Eton and Harrow cricket match takes place yearly at Lord's Cricket ground in London.

HARROWBY, DUDLEY RYDER, 1st Earl of (1762–1847), English statesman, was unobtrusively in office for most of the first quarter of the 19th century. The eldest son of Nathaniel Ryder, 1st Baron Harrowby, he was born on Dec. 22, 1762, and educated at St. John's college, Cambridge. Entering parliament in 1784, he held various minor offices: undersecretary for foreign affairs (1789–90); member of the India board (1790); paymaster general (1791–1880); vice-president of the board of trade (1790–1801); treasurer of the navy (1800–01). He succeeded his father as 2nd Baron Harrowby in 1803 and joined the younger Pitt's second ministry in 1804 as foreign secretary. An accident compelled him to resign in 1805, but later in the year Pitt appointed him chancellor of the duchy of Lancaster. In the duke of Portland's ministry he was president of the board of control (July–Nov. 1809), and given an earldom and was subsequently in the cabinet without portfolio (1809–12). Like Lord Liverpool, under whom he served (1812–27) as lord president of the council, he was one of the least ambitious of politicians; three times he refused an offer of the premiership and never again held office after Aug. 1827. It was at Harrowby's London house that the cabinet was to have been assassinated by the Cato Street conspirators in Feb. 1820 (*see* Thistlewood, Arthur). He died on Dec. 26, 1847.

(A. Al.)

HARRY (Henry) **the Minstrel** (Blind Harry) (fl. 1470–1495), author of the Scottish historical romance *The Actis and Deidis of the Illustre and Vaillyeand Campioun Schir William Wallace Knicht of Ellerslie*. He has been traditionally identified with the Blind Harry named among the poets in William Dunbar's *Timor mortis conturbat me* and among recipients of the royal bounty in the treasurer's accounts for 1490–92, and with the blind minstrel described in John Major's famous *History* as a gatherer and itinerant reciter of legends about Wallace. He was no mere beggarly rhymer; his work shows his acquaintance with the poetry of John Barbour and Chaucer, and with Scots, Latin and French chronicles. He imitates Barbour's claim to historicity, citing as his main authority a Latin life of Wallace by Wallace's comrade-in-arms, John Blair; but Blair and his book have not been identified, and may be literary fictions.

The *Wallace*, which runs to 11 books and nearly 12,000 lines in decasyllabic couplets, is a historical novel in verse, fabricated from the events of the War of Independence, a mass of popular legend about Wallace and earlier romances. It is not improbable that the poem in its present form is an edited and improved version of a series of *gestis* on the hero's exploits, gathered up by the minstrel into his repertoire; and the improver may have been John Ramsay, the Perth scribe who wrote the one surviving manuscript and also transcribed Barbour's *Bruce*. Judged simply as a romance, the *Wallace* is inferior to the *Bruce* in arrangement and literary finish. It has, however, great energy and patriotic spirit and its author is readier than Barbour both with tears and a rather grim laughter.

On external evidence the *Wallace* may be dated between 1474 and 1479; the manuscript in the National Library of Scotland is dated 1488. There seems to have been an edition printed at Edinburgh by W. Chepman and A. Myllar about 1508; but the earliest surviving edition was printed by R. Lekprevik for Henry Charteris in 1570. Reprints are numerous. The poem was modernized by William Hamilton of Gilbertfield in 1722—the version which provoked so much patriotic fervour in Burns. The first critical edition is J. Jamieson's (1820); the standard edition is by J. Moir for the Scottish Text society, 3 vol. (1885–89).

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(J. Ky.)

HARSDÖRFER, GEORG PHILIPP (1607–1658), German poet, who, with Johann Klaj, founded in Nürnberg in 1644 the literary society of the *Pegnitzschäfer* ("Pegnitz Shepherds"), for the purification of the German language. He was born in Nürnberg, Nov. 1, 1607, and died there, Sept. 22, 1658. His best-known works are his *Frauenzimmer-gesprächspiele*, 8 vol. (1641–49), a collection of entertaining anecdotes, and his *Poetischer Trichter*, 3 vol. (1647–53), a treatise on poetry written in an euphuistic style. He also wrote religious and secular lyrics, numerous collections of stories and a novel, *Dianea* (1634). There is a selection of his poems in *Bibliothek deutscher Dichter des 17 Jahrhunderts*, vol. ix (1826), ed. by W. Müller.

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HARSHA (Harshavardhana) (reigned A.D. 606–647), emperor of northern India. Son of Prabhakaravardhana, king of Sthanvisvara (Thanesar, Punjab), he came to the throne at the age of 16, after the assassination of his elder brother, Rajyavardhana. His accession occurred in the midst of a great war, in which the king of Magadha and Malwa and Sasanka, king of Bengal, were attacking Grahavarman, the Maukhari king of Kannauj with whom Harsha's line had a matrimonial alliance. Grahavarman was killed, and, as he left no heirs, Harsha became king of Kannauj, which was henceforth the capital of his empire.

For some years the young king waged war in many parts of India and succeeded in bringing most of the north under his hegemony. He appears to have made no attempt at building a centralized empire but ruled according to the traditional pattern, leaving conquered kings on their thrones and contenting himself with tribute and homage. His influence extended from Gujarat to Assam, but the area directly under his control probably comprised no more than the modern Uttar Pradesh, with parts of Punjab and Rajasthan. He attempted to conquer the Deccan (*c.* 620), but was driven back to the Narmada river by the Chalukya emperor Pulakesin II.

Harsha is known mainly through the works of Bana, whose *Harshacharita* describes his early career in flowery language, and of the Chinese pilgrim Hsuan Tsang (*q.v.*), who became a personal friend of the king. The pilgrim depicts Harsha as a convinced Buddhist, though in the earlier part of his reign he appears chiefly to have supported orthodox Hinduism. Hsuan Tsang describes Harsha as a model ruler, benevolent, energetic and just, and praises the efficiency and mildness of his administration and the prosperity of his empire.

In the pattern of Indian history Harsha's reign seems to mark

a transition from the ancient to the medieval period, when decentralized regional empires continually struggled for hegemony. (*See* INDIA-PAKISTAN, SUBCONTINENT OF.) Like many other Indian kings, Harsha was a patron of literature and the arts and was himself an author. Three Sanskrit dramas attributed to him survive. *See* SANSKRIT LITERATURE.

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HART, ALBERT BUSHNELL (1854–1943), U.S. historian, who was the author, joint author or editor of about 100 volumes, was born at Clarksville, Pa., on July 1, 1854. He graduated from Harvard college in 1880, and studied in Europe at Paris, Berlin and Freiburg. After receiving a Ph.D. at Freiburg in 1883, Hart taught at Harvard, where he was professor of history, 1897–1910, and of government, 1910–26. He edited the "American Nation" series, published in 28 volumes, 1904–18, for which he wrote *Slavery and Abolition* (1906) and *National Ideals Historically Traced* (1907).

Of particular note are his studies of U.S. foreign policy: *The Monroe Doctrine: an Interpretation* (1917), and *The Foundations of American Foreign Policy* (1901). In addition, he wrote several biographies, among them *Salmon Portland Chase* (1899), *Abraham Lincoln* (1914) and *George Washington* (1927). Hart also edited numerous collections of documents giving contemporary data on historical events; they include *American History told by Contemporaries*, 5 vol. (1897–1929); *American Patriots and Statesmen from Washington to Lincoln, Revealed in . . . Letters, Addresses, State Papers*, 5 vol. (1916); and *Source Book of American History* (1899, frequently revised). These, along with his *Introduction to the Study of Federal Government* (1891), were widely used as college texts, as was *Formation of the Union, 1750–1829* (1892). Beginning in 1925 Hart edited the *American Year Book*. He participated in numerous studies and committees on reform in government and was historian from 1926 of the U.S. commission for the celebration (1932) of the 200th anniversary of the birth of George Washington. He served as president of the American Historical association (1909) and of the American Political Science association (1912). He died June 16, 1943.

HART, CHARLES (d. 1683), English actor, grandson of Shakespeare's sister Joan, is first heard of as playing women's parts at Blackfriars theatre, London, as an apprentice of the actor Richard Robinson. In the Civil War he was a lieutenant of horse in Prince Rupert's regiment, and after the king's defeat he played surreptitiously at the Cockpit and at Holland House and other noblemen's residences. After the Restoration he is known to have been in 1660 the original Dorante in *The Mistaken Beauty*, adapted from Corneille's *Le Menteur*. In 1663 he went to the Theatre Royal in Thomas Killigrew's company, with which he remained until 1682, taking leading parts in plays by Dryden, Jonson, Beaumont and Fletcher. He is highly spoken of by contemporaries in such Shakespearean parts as Othello and Brutus. He is often mentioned by Samuel Pepys. Thomas Betterton praised him, and would not himself play the part of Hotspur until after Hart's retirement. Hart is said to have been the first lover of Nell Gwyn (*q.v.*) and to have trained her for the stage. He died at Stanmore, Middlesex, in Aug. 1683.

HART, HEINRICH (1855–1906) and **JULIUS** (1859–1930), brothers, who collaborated in critical work leading to the development of naturalism in German literature. Heinrich was born on Dec. 30, 1855, in Wesel, studied history, philosophy and modern languages at the universities of Halle, Munich and Münster, and died at Tecklenburg, Westphalia, on June 11, 1906. His brother Julius was born at Münster on April 9, 1859, studied law at the university of Berlin, and died in Berlin on July 7, 1930. Heinrich, in collaboration with his brother, edited a number of short-lived periodicals (*Deutsche Monatsblätter*, 1878 *et seq.*, *Deutscher Literatur-Kalender*, 1879–82), which were followed by his *Kritische Waffengänge* (1882–84). The publication of this last periodical created a sensation and started the new literary movement of naturalism. Gerhart Hauptmann and Arno Holz, in particular, were indebted to the Harts' critical work. The brothers had poems published in *Moderne Dichtercharaktere*, an anthology of lyrical poetry introducing social themes which was published by W. Arent in 1884. Later both brothers were active as theatre critics, but after the death of Heinrich, Julius opposed the literary trends he had helped to initiate and adopted a pantheistic philosophy.

See L. H. Wolf, *Die Kritische Waffengänge der Brüder Hart* (1922); K. Tillmann, *Die Zeitschriften der Gebrüder Hart* (1923). (W. I. L.)

HART, MOSS (1904–1961), playwright and stage director whose own life was a rags-to-riches drama, was born Oct. 24, 1904, in a New York city tenement. At the age of 17 he obtained a job as office boy for the theatrical producer Augustus Pitou. He wrote his first play at 18, and the critics found in it approximately that degree of maturity. He then worked as director of amateur theatre groups, spending his summers as entertainment director of vacation resorts in the Catskills that were known to the theatrical world as "the borscht circuit." In 1929 he wrote the first draft of *Once in a Lifetime*, a satire on Hollywood that became a hit the following year after its exuberant humour had been tempered by the sardonic skill of George S. Kaufman. He then wrote books for musicals for Irving Berlin and Cole Porter, but until 1941 he continued to work with Kaufman, a collaboration that produced such popular comedies as *You Can't Take It With You* and *The Man Who Came to Dinner*. His affinity for success continued with his musical play *Lady in the Dark*, which he himself directed in 1941. Among the plays he directed was *My Fair Lady*. In 1959 he published *Act One*, the story of his theatrical apprenticeship. He died at Palm Springs, Calif., Dec. 20, 1961. (J. Ay.)

HART, THOMAS CHARLES (1877–), U.S. naval officer of World War II, was born at Davidson, Mich., June 12, 1877, and graduated from the United States Naval academy in 1897. He became a rear admiral in 1929 and between that year and 1931 commanded the submarine force. Hart was superintendent of the Naval academy, 1931–34, a cruiser commander, 1934–36, and from 1936 to 1939 served as a member of the general board of the navy. Appointed commander in chief of the Asiatic fleet, with rank of admiral, in July 1939, he served in that post, acting for a brief period also as commander of the Allied naval forces in the far east, until June 1942, when he was retired. He was immediately recalled to active service, however, to serve again on the general board, from which he finally was relieved in 1945. Appointed U.S. senator from Connecticut, he served until Dec. 1946, and was not a candidate for election. (J. B. HN.)

HART, WILLIAM S. (1870–1946), U.S. film and stage actor, the greatest of the early "western" heroes, was born Dec. 6, 1870, in Newburgh, N.Y., and was brought up in the Dakotas, where he lived until he was 16. He first appeared on the stage in 1889, and in 1905 his role in the play *The Squaw Man* made him a western hero. After playing in *The Virginian* and *The Trail of the Lonesome Pine* he went to Hollywood, where his portrayals of stern, taciturn westerners became enormously successful. Among his many films were *The Passing of Two-Gun Hicks*, *Hell's Hinds*, *The Captive God*, *The Dawnmaker*, *Truthful Tulliver*, *The Gunfighter*, *The Square Deal Man*, *Tumbleweeds* and *Desert Dust*. In 1923, after two years of retirement, he made nine pictures, including *Wild Bill Hickok*, *Singer McKee* and *A Lighter of Flames*. Later Hart turned to writing, producing several volumes of fiction and an autobiography, *My Life East and West* (1929). He died in Newhall, Calif., June 24, 1946. (M. S. BY.)

HARTE, BRET (FRANCIS BRETT HARTE) (1836–1902), U.S. author, was the creator of a new genre in the short story and a new movement in American literature—the local colour school. Originally named Francis Brett Harte, he was born in Albany, N.Y., on Aug. 25, 1836. His paternal grandfather was Jewish; his father was Roman Catholic; and his mother, low-church Episcopalian. The family lived a somewhat nomadic life until the death of the elder Harte in 1845, after which they settled in New York and Brooklyn. The education of young Frank, as he was then known, was spotty and irregular, but he inherited a love of books and

managed to get some juvenile verses published at the age of 11. Two years later he was forced to leave school and seek work.

In 1854 Harte left for California, where the previous year his mother had remarried. He taught one year in a rural school, made a brief trip into the mining country which legend has expanded into a lengthy participation in and intimate knowledge of camp life, and worked for a few days or weeks as a Wells Fargo expressman. In 1857 he went to Union, Calif., on Humbolt bay, where for two years he was employed by the *Northern Californian*, a weekly paper. There his support of minority groups, particularly Indians and Mexicans, proved unpopular; and after the massacre of Indians at Mad river, Feb. 26, 1860, which he editorially deplored, he found it advisable to leave town.

Returning to San Francisco, he married, worked in the office of the surveyor general, and began to write for the *Golden Era*, which soon published the first of his *Condensed Novels*, brilliant parodies of James Fenimore Cooper, Charles Dickens, Victor Hugo and others, which revealed him as one of the masters of that form. He then became clerk to the superintendent of the U.S. branch mint, a position which permitted a certain freedom to pursue his literary interests, including the editorship of the *Californian*, for which he engaged Mark Twain to write an article a week.

In 1868, after having written a series of Spanish legends like those used by Washington Irving in *The Alhambra*, he was virtually pushed into his rightful field when Anton Roman named him as first editor of the *Overland Monthly* and charged him with working up a group of local sketches. He wrote "The Luck of Roaring Camp," followed it with "The Outcasts of Poker Flat," and, like one of his idols, Byron, awoke one day to find himself world famous. His brisk reportorial style, his mastery of picturesque narrative, and his shrewd understanding of the universal appeal of an artful blending of sentiment and wit, proved to be a combination of qualities that won immediate praise. A further fillip was given to his reputation by "Plain Language From Truthful James" (better known as "The Heathen Chinee"), a poem which attracted national attention.

Eastern publishers began to bid against one another for the literary services of the brilliant meteor out of the west, and, flushed with success, Harte signed a contract with the *Atlantic Monthly* calling for 12 monthly contributions at a stipend of $10,000, the highest figure until then ever offered an American writer. Resigning a professorship at the newly founded University of California, Harte left for the east, never to return. In New England he was greeted as an equal by Henry Wadsworth Longfellow, James Russell Lowell, Oliver Wendell Holmes and William Dean Howells, and in the best social circles he was lionized and toasted to the point of spiritual and moral breakdown. Moreover, he was soon to learn that the vein he had discovered was a shallow one. It was with difficulty that he tardily fulfilled his contract, which was not renewed. Personality difficulties developed, the domestic scene was not quiet, and his work slumped further. After several years of indifferent success on the lecture circuit, Harte took the advice of friends and in 1878 accepted a consulship in Crefeld, Ger. Two years later he was moved to Glasgow, Scot., where he served as consul for five years. In 1885 he retired to London, where he continued to live for 17 busy but uneventful writing years. His wife and family, whom he always supported generously, joined him for reunions at wide intervals, but he never returned to the U.S. Harte died on May 5, 1902.

During his London years Bret Harte was something of an anachronism, telling and retelling stories of a California which did not then exist and which perhaps had never existed. But he found in England a ready audience long after American readers had tired of his formula. It is inaccurate, however, to say that Harte burned himself out in a few sensational years and did no first-rate work thereafter. His "An Ingénue of the Sierras" and "A Protégée of Jack Hamlin's," both written in 1893, are perhaps better than his earlier stories, for they are dryly and ironically humorous, avoiding the emotional dilution and the sentimentality that mar so many of his more familiar stories.

Harte was driven all his life by hard economic necessity and never had the leisure to do the work of which he was capable. This is unfortunate because his talent, though limited in range, was susceptible of high artistic polish. He had a remarkably discerning journalistic eye for mannerisms and a usually reliable ear for habits of speech, and he was clever enough to pour old wine into new bottles, to take conventional story formulas and give them the aura of novelty that goes with an unusual setting. He was a master of small effects in narrative technique; his style, richly humorous, is ever graceful, ever charming. If his world is a fairyland of make-believe, the illusion is well sustained.

Harte's most successful books were *The Luck of Roaring Camp, and Other Sketches* (1870) and *Tales of the Argonauts* (1875). His best play was *Ah Sin* (1877), which was written in collaboration with Mark Twain, and was based on his famous poem, "Plain Language From Truthful James" (1870).

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HARTEBEEST, the name for large South African antelopes of the genus *Alcelaphus*, characterized by reddish colour, a long face with naked muzzle and sharply angulated lyre-shaped horns, present in both sexes. These graceful animals, among the swiftest of African antelopes, but grotesque appearing, formerly occurred in great herds from Cape of Good Hope province to Rhodesia but are now more restricted in range. Hartebeests stand about four feet high at the withers, with heavy forequarters, which are much higher than the narrow and drooping hindquarters. The term "bastard hartebeest" is generally given to members of the genus *Damaliscus*, species of which are known by other names. *See* ANTELOPE.

HARTFORD, a city and the capital of Connecticut, U.S., in Hartford county is a port of entry at the head of navigation on the Connecticut river, 38 mi. from Long Island sound and 100 mi. N.E. of New York city. Pop. (1960) 162,178; standard metropolitan statistical area (parts of Hartford, Middlesex and Tolland counties), 525,207. (For comparative population figures *see* table in CONNECTICUT: *Population.*)

The city is well-planned with many parks and squares, and a planning commission has functioned since 1907. The state capitol, which stands on a hill in centrally located Bushnell park, is a handsome building of marble and granite, designed by R. M. Upjohn. Completed in 1879, it contains many objects of historic interest, including the tombstone of Israel Putnam and a carved chair made for the senate chamber from wood of the Charter Oak (*see* below). In the park is the Corning Memorial fountain (1899), designed by J. Massey Rhind, and the memorial arch and bridge erected by the city in 1884 in tribute to the Civil War dead. Facing the capitol on the south is the supreme court and state library building (1910), and across the west lawn is the state armoury and arsenal, and Bushnell Memorial hall. Between the capitol and the Connecticut river stands the old three-story brick statehouse (1796), a gem of colonial architecture, designed by Charles Bulfinch. This was turned over to the city, and for a generation was used as a city hall, but after 1915 it was restored as a historic shrine. The city stands at 40 ft. above sea level, and an extensive system of dikes along the lower meadows forms a protection against flood hazards.

Insurance, the outstanding business of Hartford and an outgrowth of its banks, dates from Feb. 8, 1794, when the first fire insurance policy was issued. Principal industries are the manufacture of brushes, mechanical counters, electrical equipment, tools, automatic machines, automobile parts, precision machines, chucks, firearms, plastics, marine engines, typewriters and glass-making machinery.

Hartford is the seat of Trinity college (Episcopalian) founded in 1823 as Washington college, and the Hartford Seminary foundation (Congregational), founded at East Windsor Hill in 1834 and moved to Hartford in 1865. Also located in the city are La Salette Missionary college and St. Mary's seminary (Roman Catholic), the University of Connecticut's schools of law, social work and college of insurance and the University of Hartford (Hartford Art school, Hartt College of Music and Hillyer college). The *Hartford Courant*, established in 1764, is one of the oldest surviving

newspapers published in the United States. The *Hartford Times*, edited by Gideon Welles from 1826 to 1836, was once one of the nation's most influential Democratic newspapers. The city has many literary associations, such as those with Lemuel Hopkins, John Trumbull, Timothy Dwight, Joel Barlow and David Humphreys, known as the Hartford Wits (*see* AMERICAN LITERATURE: *Eighteenth Century*). It is the birthplace of Noah Webster and was at one time the home of Harriet Beecher Stowe, Charles Dudley Warner and Samuel L. Clemens (Mark Twain).

History.—The first settlement was made by Dutch from New Amsterdam, who built a fort in 1633 at the mouth of Park river, a narrow and muddy branch of the Connecticut, which they held until 1654. In 1635, 60 English settlers came from New Towne (now Cambridge), Massachusetts. In 1636 the First Church of Christ (Centre Congregational), which was organized in New Towne (1632), moved to Hartford with most of its congregation under the leadership of Thomas Hooker (*q.v.*) and Samuel Stone. (The present building [1807] stands near the site of the original meetinghouse and adjoins the graveyard where Hooker, William Leete, John Haynes and their contemporaries were buried.) In 1637 the settlement adopted its present name from Hertford, England, the birthplace of Stone.

Of interest is the monument marking the site of an oak tree on Charter Oak avenue, where, according to tradition, Capt. Joseph Wadsworth secreted the royal charter when New England colonial Gov. Sir Edmund Andros attempted to seize it in 1687. The city was chartered in 1784 and the town and city were consolidated in 1881. Hartford was the scene of the famous convention of 1814–15 called by New England Federalists to protest against the war policies of Pres. James Madison. (*See* UNITED STATES [OF AMERICA]: *History*.) Shipping reached a peak in the 18th century but never recovered from the depression caused by the War of 1812. After the American Civil War the city prospered through better transport facilities, and industries rapidly developed in the late 19th century.

Hartford adopted a council-manager form of government in 1948. By the 1960s the city had become the focus of a growing metropolitan area, surrounded by suburbs and an even larger urbanized area. The chaos in local government produced by this development is suggested by the fact that there are more than 30 local governments in the metropolitan area. (E. E. SR.)

HARTLEBEN, OTTO ERICH (1864–1905), German poet, dramatist and short-story writer, was born at Clausthal in the Harz mountains on June 3, 1864. After studying law at Berlin, Tübingen and Leipzig he held some minor judicial appointments, but from 1890 on lived a bohemian life as a free-lance writer in Berlin and Italy. He died at Salò on Lake Garda on Feb. 11, 1905.

Social criticism in his works soon yielded to anecdote, satire and an eroticism reminiscent of Guy de Maupassant, as in the tales *Vom gastfreien Pastor* (1895). The dramas mock the *bourgeoisie* or sentimentalize social problems, the most popular being *Rosenmontag* (1900; Eng. trans., "Love's Carnival," 1904), the tragedy of an officer in love with a working-class girl. His poems, collected in *Meine Verse* (1905), are formally graceful if superficial. His *Gesammelte Werke* (3 vol., ed. by F. Heitmüller) appeared in 1908.

See H. Lücke, *O. E. Hartleben* (1941). (G. T. HU.)

HARTLEPOOL, a municipal borough in the Hartlepools parliamentary division of County Durham, Eng., on a peninsula at the northern point of Hartlepool bay, 2 mi. N.N.W. of West Hartlepool and 18 mi. E.S.E. of Durham by road. Pop. (1961) 17,674. This ancient market town and port, to which John gave a charter in 1201, is now an industrial centre, mainly for shipbuilding, marine engineering and fishing, and also a residential and seaside resort town with a promenade, marine drive and miles of sandy beach. On Heugh point is a lighthouse and along the coast to the northwest is a lifeboat station. The large parish church of St. Hilda was begun in the late 12th century and restored in 1925–30.

HARTLEY, DAVID (1705–1757), English physician and philosopher, known for his advocacy of a physiological psychology in place of a psychology based on the concept of a soul, was born in June of 1705. Educated at Bradford grammar school and Jesus college, Cambridge, he practised medicine at Newark, London and Bath, where he died on Aug. 28, 1757.

Hartley's chief work, *Observations on Man, His Frame, His Duty, and His Expectations* (2 vol., 1749), aimed to overcome "the great difficulty of supposing that the Soul, an immaterial Substance, exerts and receives a physical influence upon and from the Body." The preface states that he had been "informed that the Rev. Mr. Gay had asserted the possibility of deducing our intellectual pleasures and pains from Association." From Isaac Newton's *Opticks* (1704) he derived the idea that sensory stimuli might operate by producing "vibrations," propagated through the nerves, like "the trembling of particles in sounding bodies": in the brain the occurrence of vibrations in a certain order sets up a readiness for similar vibrations to recur in the same order. Part II explains how more complex processes—imagining, remembering, reasoning—may thus be analyzed into clusters or sequences of elementary sense impressions formed by individual experience, so that all psychological acts can be explained by a single law of association. Part III discusses the growth of God concepts in human thinking. However, Hartley's theory, developed in his *Theory of the Human Mind* (1775), had little influence until taken up and elaborated by James Mill and other members of the associationist school.

BIBLIOGRAPHY.—The *Observations* were published by his son with a life of Hartley, 3 vol. (1801). *See* also G. S. Bower, *Hartley and James Mill* (1881); B. Schönlank, *Hartley und Priestley die Begründer des Assoziationismus in England* (1882); S. J. Kunitz and H. Haycraft (eds.), *British Authors Before 1800* (1952). (CY. B.)

HARTLEY, DAVID, the younger (1731–1813), English parliamentarian, pamphleteer and inventor, son of the philosopher David Hartley, was born at Bath in 1731. He was a fellow of Merton college, Oxford, and member of parliament for Hull, 1774–80 and 1782–84. He gained fame about 1776 by a discovery intended to protect buildings against fire, and attracted gatherings to his experimental house on Putney common where an obelisk stands in his honour. He was the friend and correspondent of Benjamin Franklin, with whom he shared many interests; he devoted a great part of his political career to opposing the American Revolutionary War, speaking frequently in the commons and publishing in 1778 his vigorous *Letters on the American War*. He was appointed by the Fox-North ministry as plenipotentiary to treat with the Americans in 1783 and signed the definitive treaty in Paris. Hartley died at Bath on Dec. 19, 1813.

See G. H. Guttridge, *David Hartley, M.P.*, with bibliography (1926).

HARTLIB, SAMUEL (*c.* 1599–*c.* 1662), educational reformer and agriculturalist, was born at Elbing (then a Hanseatic city under Polish protection). His father was a refugee merchant from Poland, but his mother was English. He was at Cambridge before 1625, and when in 1628 he settled in England he associated himself with the reforming ideas of John Dury. He was an admirer of J. A. Comenius, many of whose works he translated, including *A Reformation of Schools* (1642). He wrote more than 30 tracts and treatises among which were *Macaria* (1641), a description of the ideal state, and *A True and Readie Way to Learn the Latine Tongue* (1654). In 1651, in *An Essay for Advancement of Husbandry-Learning*, he advocated the foundation of an agricultural college. Milton dedicated his tractate *On Education* to Hartlib. He was also concerned with the educational legislation of the Long parliament and the visit to England of Comenius (1641). For his services Cromwell awarded him a pension of £300 a year which ended with the Restoration. It is supposed that Hartlib died in poverty and, according to J. W. Adamson, was buried at St. Martin-in-the-Fields, London, on March 12, 1662.

BIBLIOGRAPHY.—H. A. Dircks, *Biographical Memoir of Samuel Hartlib* (1865); J. W. Adamson, *Pioneers of Modern Education 1600–1700* (reprint, 1921); G. H. Turnbull, *Hartlib, Dury and Comenius* (1947); W. A. L. Vincent, *The State and School Education, 1640–1660* (1950); S. J. Curtis and M. E. A. Boultwood, *A Short History of Educational Ideas*, 2nd ed. (1956). (S. J. C.)

HARTMANN, KARL ROBERT EDUARD VON (1842–1906), German philosopher who based his metaphysical system on the unconscious, was born at Berlin on Feb. 23, 1842. Educated for the army, he turned to philosophy after an injury to his knee in 1865. In 1867 the University of Rostock conferred on him the degree of Ph.D. He subsequently returned to Berlin and died at Grosslichterfelde on June 5, 1906.

Eduard von Hartmann's reputation was established by his second book, *Die Philosophie des Unbewussten*, three volumes (1869; 12th ed., with supplementary texts, 1923; Eng. trans., *The Philosophy of the Unconscious*, 1884). Its success was due to the diversity of its contents (Hartmann professing to obtain his speculative results by the methods of inductive science and using many concrete illustrations), to its apparent pessimism and to the vigour and lucidity of its style. The unconscious is both reason and will and the absolute all-embracing ground of all existence, the spiritual principle required by nature. At the fall of man, will and reason were separated, and the former, as blind impulse, determines the melancholy career of the unconscious in the world process. Reason is in constant strife against will; and only when it is emancipated from this strife in the conscious reason of the enlightened pessimist can the world be redeemed. When the greater part of the will in existence is so far enlightened by reason as to perceive the inevitable misery of existence, a collective effort to will nonexistence will be made, and the world will relapse into nothingness, the unconscious into quiescence. Civilization, like the happiness of the individual, means the annulment of the will to live and the gradual releasing of the unconscious from its sufferings. Meanwhile mankind must provisionally affirm life and devote itself to social evolution, instead of striving after a happiness which is impossible; in so doing man will find that morality renders life less unhappy. Suicide, and all other forms of selfishness, are highly reprehensible.

BIBLIOGRAPHY.—Eduard von Hartmann's numerous other works include *Neukantianismus, Schopenhauerianismus und Hegelianismus* (1877); *Phänomenologie des sittlichen Bewusstseins* (1879); *Zur Geschichte und Begründung des Pessimismus* (1880); *Das religiöse Bewusstsein der Menschheit* (1882); *Moderne Probleme* (1886); *Zwei Jahrzehnte deutscher Politik* (1889); *Das Grundproblem der Erkenntnistheorie* (1889); *Die soziale Kernfragen* (1894); *Kants Erkenntnistheorie und Metaphysik* (1894); *Kategorienlehre* (1896); *Geschichte der Metaphysik*, 2 vol. (1899–1900); *Die moderne Psychologie* (1901); *Das Problem des Lebens* (1906); and *System der Philosophie im Grundriss*, 8 vol. (1906–09). Under the pseudonym Karl Robert he published *Dramatische Dichtungen: Tristan und Isolde, David und Bathseba* (1871).

HARTMANN, NICOLAI (1882–1950), one of the dominant figures of German philosophy between World Wars I and II, was born in Riga, Latvia, on Feb. 20, 1882. Educated at St. Petersburg, Dorpat and Marburg, he served in World War I and was successively appointed professor at Marburg (1920), at Cologne (1925), at Berlin (1931) and at Göttingen (1945), where he died on Oct. 9, 1950.

Originally a disciple of Marburg Neo-Kantianism, Hartmann reversed the Kantian conception of the object as a construct of the mind and developed what he himself called "a new ontology" (*cf.* his *Neue Wege der Ontologie*, 1942; Eng. trans. by R. C. Kuhn, *New Ways of Ontology*, 1953), a theory of unitary though diversified being which *is* in and by itself. Intelligent beings have the privilege of taking cognizance, within the narrow compass of their faculties, of things existing. But this awareness of reality must in its turn be regarded primarily as forming part and parcel of reality, as an event among other events, and by no means as fundamental to being or to reality as such. According to Hartmann it is an error to hold that the basic forms of human thought, the "subjective categories," are identical with the basic structure of reality, the "objective categories." All that scientists or philosophers can hope to achieve is a partial assimilation of their subjective categories to those of the object. The element of the irrational will always loom large in their field of vision, and the restricted circle of light in which they move will be forever encompassed by the vast expanse of unobjectifiable being.

In conceiving his realist ontology Hartmann was influenced by Edmund Husserl's phenomenology, but whereas Husserl supplemented the intuitive grasp of essential forms by a reflexive study of the mental acts which give rise to the realm of intuited essences, Hartmann insisted on viewing philosophy as an object-centred research, a prolongation, as it were, of the scientist's approach to reality.

Reality, for him, revealed a hierarchy of layers, each of them structured in accordance with certain regional "categories," the bottom layer, the region of inanimate matter, supporting the rest, the top layer, the mind, forming a superstructure in no way anticipated by realities further below. Hartmann's conception of the scale of being differed radically from the hierarchical vision of classical metaphysics. He adopted Max Scheler's thesis of the relative weakness of the higher categories. Reality, though orderly and partly rational, is for him void of meaning, and man has to perform the heroic feat of living a human life in a world entirely alien from his human aspirations. In this he is assisted by an intuition of values which are believed to form an imposing firmament of ideal entities. In developing this "material" ethics, so styled in contradistinction to Kant's formalism, Hartmann again followed Scheler's example.

His work, remarkable for its scope and for the consistency with which ontological principles are brought to bear upon all areas of philosophical thought, shows a genius for systematic synopsis rather than for original vision or for disclosure of hidden traits of reality.

BIBLIOGRAPHY.—Hartmann's chief writings are *Grundzüge einer Metaphysik der Erkenntnis* (1921; 2nd ed., 1925); *Die Philosophie des deutschen Idealismus*, 2 vol. (1923–29); *Ethik* (1926; 2nd ed., 1935; Eng. trans., *Ethics*, 3 vol., 1932); *Zur Grundlegung der Ontologie* (1935); *Möglichkeit und Wirklichkeit* (1938); *Der Aufbau der realen Welt* (1940); *Philosophie und Natur* (1950); *Asthetik* (1953). *See* further *Nicolai Hartmann, der Denker und das Werk*, ed. by H. Heimsoeth and R. Heiss (1952); H. Kuhn, "Nicolai Hartmann's Ontology," *The Philosophical Quarterly*, vol. i, iv (1951); O. Samuels, *Foundation of Ontology: A Critical Analysis of Nicolai Hartmann*, Eng. trans. (1954). (HT. K.)

HARTMANN VON AUE (*fl.* 1190–1210), Middle High German poet, was one of the masters of the courtly epic. There are no documentary references to him, but it emerges from his works that he received a learned education at a monastery school, that he was a *ministerialis* at a Swabian court and that he took part in Henry VI's ill-fated crusade of 1197. There are in existence by Hartmann four extended narrative poems (*Erec*, *Gregorius*, *Der arme Heinrich*, *Iwein*), two shorter allegorical love poems (*Büchlein I* and *II*) and 16 lyrics (13 love songs and three crusading songs). The lyrical poems and the two *Büchlein* appear to have been written first, followed by the narrative poems—his most important works—in the above order. *Gregorius* and *Der arme Heinrich* are religious works with an openly didactic purpose. The former is a version of the Oedipan legend of Pope Gregory, a popular medieval theme. The latter, Hartmann's most perfect poem, tells the story of a leper who is healed by the readiness of a pure young girl to sacrifice her life for him. The two secular epics *Erec* and *Iwein*, both based on works by Chrétien de Troyes and belonging to the Arthurian cycle, enshrine Hartmann's ethical ideal of restraint and moderation (*mâze*) in human conduct, and are complementary in that they depict the return to grace of knights who have defected from this ideal—Erec by subordinating the duties of the man of action to those of the chivalrous servant of woman, Iwein by neglecting the claims of family life for the pursuit of heroism and adventure.

Hartmann regarded his works as instruments of a moral purpose. Edifying content mattered more to him than elegance of style, and his narratives are characterized by clarity and directness, and by the avoidance of rhetorical devices and displays of poetic virtuosity.

The best short account of Hartmann and his works is in the introduction to F. Neumann's edition of *Der arme Heinrich* and *Gregorius* (1958). *See* also G. Ehrismann, *Geschichte der deutschen Literatur bis zum Ausgang des Mittelalters* II, 2, 1, pp. 141–212 (1954), which contains detailed bibliographies on specific topics. (RD. J. T.)

HART'S-TONGUE is the common name given to a genus (*Phyllitis*) of ferns. This genus was formerly known as *Scolopendrium*, meaning "like a centipede," from the numerous lines of fruit dots (*sori*) on the leaves. Representative is *P. scolopendrium* (*S. vulgare*), common in Europe, including Great Britain, and in eastern Asia. Variety *americana* grows in the U.S. and southern Canada but is very rare, occurring only locally in central New York, Tennessee, Ontario and New Brunswick; variety *Lindeni* grows in Chiapas, Mex. The thick, leathery, glossy fronds reach a length of 18 in. There are eight species of *Phyllitis*, mainly tropical and subtropical. *See* also FERN.

HARTY, SIR (HERBERT) HAMILTON (1879–1941), Irish conductor and composer, was born at Hillsborough, Northern Ireland, on Dec. 4, 1879. He was an organist in Belfast and in Dublin before going (1900) to London where he gained a reputation as a fine accompanist and skilful composer. In 1904 he married the soprano Agnes Nicholls (1877–1959), with whom he gave many recitals and who sang the solo part in his *Ode to a Nightingale* at the Cardiff festival in 1907. He began to make his mark as a conductor in concerts with the London Symphony orchestra, and from 1920 to 1933 he was conductor of the Hallé orchestra in Manchester, where his performances of works by Berlioz were specially admired. He was knighted in 1925. After leaving Manchester he frequently conducted in London and also toured Australia and the U.S.

His compositions include a violin concerto, a tone poem *With the Wild Geese, The Mystic Trumpeter* for voices and orchestra, *Irish Symphony*, songs and orchestral arrangements of pieces by Handel and John Field. He died at Hove, Sussex, on Feb. 19, 1941.
(H. Ru.)

HARTZENBUSCH, JUAN EUGENIO (1806–1880), one of the most successful of the Spanish romantic dramatists, editor of standard editions of Spanish classics and author of fanciful poetry in a traditional style, was born in Madrid, Sept. 6, 1806, the son of a German cabinetmaker. Early tribulations ended with the production of *Los amantes de Teruel* (1837), a vivid dramatization of a legend, followed by successes with *comedias de magia* (*e.g., Los polvos de la madre Celestina,* 1840) and adaptations of Golden Age plays. He entered the Spanish Academy (1847) and became director of the national library (1862). He died in Madrid, Aug. 2, 1880. (R. F. B.)

HARUN AL-RASHID (766–809), fifth Abbasid caliph, who reigned from 786 to 809, when the caliphate (*q.v.*) was at its zenith. Son of the caliph al-Mahdi and the princess Khaizuran, he was born at Ray (beside modern Teheran) in Feb. 766. From the age of 14 he was given military commands, subject to the advice of his guardian, Yahya the Barmecide, in the wars against the Byzantine empire. His efficiency in these gained him the honorific name of al-Rashid, "the rightly guided," and nomination as second in succession to the throne. After his father's death in 785 his brother al-Hadi tried to alter the succession, to the dismay of Yahya the Barmecide and Khaizuran, but in Sept. 786, before he had taken any definite steps, al-Hadi died under suspicious circumstances and Harun was at once proclaimed caliph. Frankish historians say that he and his contemporary Charlemagne were on friendly terms and exchanged embassies on several occasions. His reign marked the flowering of culture in the new social and political structure created by the Abbasids. The merging of Arab and non-Arab elements and the consequent growth of industry and commerce set free some of the energies of the caliphate for the pursuit of intellectual culture, and Harun proved an enthusiastic and discerning patron. *The Arabian Nights* (*see* Thousand and One Nights) gives impressions, perhaps somewhat romanticized, of the brilliance of the court at Baghdad at that period. Despite expenditure on luxury, however, the affairs of the caliphate were prudently administered by Harun's viziers, Yahya the Barmecide and his son Fadl, who greatly increased administrative efficiency. Nevertheless the strains of the vast empire were not eliminated. It was probably the rivalry of different groups at court supporting different policies that led to the fall of the Barmecides (*q.v.*) in 803; but a change of administration did not improve matters, and troubles increased during the remainder of Harun's reign. He died at Tus (near modern Meshed) on March 24, 809, on his way to quell a rebellion in Transoxiana. The war between his sons, which broke out in 811, is an indication of the strength of the unresolved tensions. *See* also Caliphate.

Bibliography.—F. W. Buckler, *Harunu 'l-Rashid and Charles the Great* (1931); Nabia Abbott, *Two Queens of Baghdad, Mother and Wife of Harun al-Rashid* (1946). (W. M. Wt.)

HARUSPICES, ancient Etruscan diviners, "entrail observers" whose art (*disciplina*) consisted especially in deducing the will of the gods from the appearance presented by the entrails of the slain victim. They also interpreted all portents or unusual phenomena of nature, especially thunder and lightning, and prescribed the expiatory ceremonies after such events. This formed a most complicated pseudo science, in sharp contrast to native Italian divination, which consisted of asking the approval of the gods for a proposed action and deducing a "yes" or "no" from such omens as the flight of birds (*see* Augur; Divination; Oracle) and in simple inspection of the entrails of a victim to see if the beast were normal and therefore acceptable. The Etruscans were said to have learned it from a being named Tages (*q.v.*). Instructions were contained in certain books called *libri haruspicini fulgurales, rituales.* The art was practised in Rome chiefly by Etruscans, occasionally by native-born Romans who had studied in the priestly schools of Etruria. Though of great importance under the early republic, it never became a part of the state religion. In this respect the haruspices contrast with the augurs, who were an ancient and purely Roman institution, and were a most important element in the political organization of the city. In later times the art fell into disrepute. Under the empire, however, there existed a collegium of 60 haruspices; however, it was never a state priesthood but a body of salaried expert advisers.

HARVARD UNIVERSITY, the oldest and one of the foremost U.S. educational institutions, situated chiefly in Cambridge, Mass., but also in Boston and other places. Of its student body, drawn from all parts of the United States and from many other countries, somewhat less than one-half are undergraduates in Harvard college; the rest study in the graduate schools of arts and sciences (which includes engineering and applied physics), business administration, dental medicine, design, divinity, education, law, medicine, public administration and public health.

In 1636 the general court of the Massachusetts Bay colony voted £400 toward "a schoale or colledge," which in the next year was ordered to be at "Newetowne." In memory of the English university where many (probably about 70) of the leading men of the colony had been educated, the township was named Cambridge in 1638. In the same year John Harvard (1607–38), an immigrant Puritan minister to America, a bachelor and master of arts of Emmanuel college, Cambridge, dying in Charlestown, Mass., bequeathed to the wilderness seminary £780 (half his estate) and 260 books; and the college, until then unorganized, was named Harvard college (1639) in his honour.

The history of Harvard is unbroken from 1640, and its first commencement was held in 1642. The spirit of the founders is beautifully expressed in the words taken from *New England's First Fruits* (1643) and carved on the college gates: "After God had carried us safe to *New-England,* and wee had builded our houses, provided necessaries for our liveli-hood, rear'd convenient places for Gods worship and settled the Civill Government; One of the next things we longed for, and looked after was to advance *Learning* and perpetuate it to Posterity; dreading to leave an illiterate Ministry to the Churches, when our present Ministers shall lie in the Dust." The charter of 1650 dedicated the college to "the advancement of all good literature, arts, and sciences," and "the education of the English and Indian youth . . . in knowledge and godlynes." The second building (1654) on the college grounds was called the "Indian College." In it was set up the college press, which since 1638 had been in the president's house, and there, it is believed, was printed the translation of the Bible (1661–63) by John Eliot into the language of the natives, with his primer, catechisms, grammars, tracts, etc. A fair number of Indians were students, but only one, Caleb Cheeshahteaumuck, took a bachelor's degree (1665). By generous aid received from abroad for this special object, the college was greatly helped in its infancy.

The charter of 1650 has been in the main, and uninterruptedly since 1707, the fundamental source of authority in administration. It created a self-perpetuating corporation consisting of the president, the treasurer and five fellows, who formally initiate administrative measures, control the college funds, and appoint officers of instruction and government, subject, however, to confirmation by the board of overseers (established in 1642), which has a revisory power over all acts of the corporation. Circumstances gradually necessitated ordinary government by the resident teachers; and today the various faculties, elaborately organized, exercise

immediate government and discipline over all the students. The board of overseers was at first jointly representative of state and church. The former, as founder and patron, long regarded Harvard as a state institution; but the controversies and embarrassments incident to legislative action proved prejudicial to the best interests of the college, and an act of 1865 severed the connection with the state. Financial aid and practical dependence had ceased some time earlier; indeed, from the very beginning, and with steadily increasing preponderance, Harvard has been sustained and fostered by private munificence. The last direct subsidy from the state terminated in 1824, although state aid was afterward given to the Agassiz museum, later united with the university.

The church was naturally sponsor for the early college. The changing composition of its board of overseers marked its liberation first from clerical and later from political control; since 1865 the board has been chosen by the alumni who therefore really control the university. When in the first half of the 17th century the unity of Puritanism, in religion and in politics, gave way to a variety of intense sectarianisms, this, as also the incoming of Anglican churchmen, made the old faith of the college insecure. The conservatives, who clung to pristine and undiluted Calvinism, sought to entrench themselves in the board of overseers. The history of the college from about 1673 to 1725 was exceedingly troubled. One episode in the struggle was the foundation of Yale college by the conservatives of New England as a truer "school of the prophets" after they had failed to secure control of the government of Harvard. In 1792 the first layman was chosen to the corporation; in 1805 a Unitarian became professor of theology; in 1843 the board of overseers was opened to clergymen of all denominations; in 1886 attendance on prayers ceased to be compulsory. Thus Harvard, in response to changing conditions, grew away from the ideas of its founders.

Harvard and its alumni and faculty have been closely associated with the intellectual development of the United States in many spheres. Especially in the field of letters, its influence was felt in colonial times through Increase Mather, Cotton Mather, Samuel Sewall and others, and in the revolutionary and early national epoch through men such as the Adamses and Robert Treat Paine. Henry Wadsworth Longfellow taught there and the graduates included such men as Ralph Waldo Emerson, Oliver Wendell Holmes, Henry Thoreau, James Russell Lowell, Henry James, Henry Adams, and, later, Robert Frost (who was a special student for two years and taught at Harvard, 1939–43), T. S. Eliot, E. A. Robinson, Walter Lippmann and J. P. Marquand.

The first course in American history was introduced in 1838 by Jared Sparks. The writing of history, given impetus by George Bancroft, William Prescott, John L. Motley, Francis Parkman, John Fiske and others, continued through the works of such teachers and graduates as Albert B. Hart, James Ford Rhodes, Theodore Roosevelt, Frederick J. Turner and Vernon L. Parrington. By the 1960s, Harvard had provided six presidents of the United States—John Adams, John Quincy Adams, Rutherford B. Hayes, Theodore Roosevelt, Franklin D. Roosevelt and John F. Kennedy—and a number of justices, cabinet officers and congressional leaders, as well as business and financial figures of importance. Science was taught at Harvard in the 18th century (astronomy almost from the beginning of the college) but the modern growth of investigation was led by such men as Benjamin Pierce in astronomy, Wolcott Gibbs and Theodore W. Richards in chemistry and Nathaniel S. Shaler in geology. In the debate of the 1860s over Darwin's theories, the botanist Asa Gray was ranged against the anti-Darwinian naturalist Louis Agassiz. At Harvard, William James introduced the experimental study of psychology into the United States in the 1870s. In other fields, too—the ministry, the law, medicine, music, philosophy—Harvard teachers and graduates took a leading role.

In organization and scope of effort Harvard became, especially after 1869, in the highest sense a university; but the "college" proper, whose end is the liberal culture of undergraduates, continues to be the centre of university life, as it is the embodiment of university traditions. In this period of development the university was led by three outstanding presidents—Charles W. Eliot (1869–1909), A. Lawrence Lowell (1909–1933) and James B. Conant (1933–1953). Another forceful leader, Nathan M. Pusey, became president in 1953. The medical school (in Boston) dates from 1782, the law school from 1817, the divinity school (although instruction in theology was of course given from the foundation of the college) from 1819; but in all of these schools the selection and instruction of students had been lax. Under Eliot these schools were raised to the graduate level in admissions and instruction, the laboratory investigation of disease was added to the clinical practice of medicine, the historical study of religions was provided for the ministry, and the case method of studying the law was introduced. (The graduate school of business administration was formed in 1908, and after 1920 teaching by discussion of actual cases was applied to training for business as well.) The graduate school of arts and sciences was formed in 1872. After 1949 it included the fields of engineering and applied physics, which had first been offered in 1847 in the Lawrence scientific school, and later in a school of engineering. Graduate schools also were developed in dental medicine, design, education, public administration and public health. In addition to its laboratories, museums and research groups in Cambridge and Boston, such as the Museum of Comparative Zoology founded by Louis Agassiz in 1859, the Gray herbarium (1864), the Peabody Museum of Archaeology and Ethnology (1866), the Arnold arboretum (1872), the Semitic museum (1889), the William Hayes Fogg Art museum (1895) and the Busch-Reisinger Museum of Germanic Culture (1902), the university maintained several institutions distant from Cambridge. These included an institute of Italian art and culture at the villa I Tatti in Florence; the Dumbarton Oaks Research library and collection in Byzantine and medieval humanities at Washington, D.C.; astronomical and seismographic observatories at Harvard, Mass. and an additional radio telescope at Ft. Davis, Tex. The Harvard forest of about 2,300 ac. is at Petersham, Mass., and the Black Rock forest of 3,700 ac. at Cornwall, N.Y.

At the outset, Harvard students were given the classical tongues —Greek, Latin and Hebrew. In the early 19th century, a young graduate, George Ticknor, returned from Germany to urge the modern languages, and after 1825 instruction was offered in French, Spanish, German and Italian. Longfellow was the first Smith professor of French and Spanish languages, and he was followed by James Russell Lowell. Other languages were added from time to time—Russian in 1896, for instance, and in the 20th century Chinese, Japanese and the Indic languages. After World War II research centres on various regions of the world were established. Combining language skills and social science methods, they included the Russian research centre (1948), the centre for middle eastern studies (1954) and the centre for east Asian studies (1955). In the law school, where international law had been taught for several decades, an international legal studies program was also established after World War II. In addition, the university created a centre for international affairs (1957).

Harvard's library is the largest university library in the United States, if not in the world. Among all libraries of the United States it is the oldest and one of the foremost. Three adjoining buildings house nearly half the collection: advanced study and research centres in the Harry Elkins Widener Memorial library (1915); rare books and manuscripts are kept in the Houghton library (1942); and the Lamont library (1949) serves undergraduates. The New England Deposit library in Boston provides storage for little-used materials. The other half of the university's books are in scores of departmental and special libraries, of which the most outstanding are those covering law, business, biological sciences, Chinese and Japanese, astronomy, anthropology and ethnology. The Houghton library houses remarkable collections of books and manuscripts by John Keats and Emily Dickinson, Emerson, Lowell, Holmes and others; the Theatre collection is unique in 18th- and 19th-century British and American materials. In Widener there is a special Theodore Roosevelt collection, and other particularly strong areas include the Italian Risorgimento, Celtic, the fine arts, the French Revolution, Hebraica, linguistics, and Portuguese language and literature. The university publishes, mainly through the Harvard University Press, a distinguished series

of scholarly studies and journals in a variety of fields.

The central faculty of arts and sciences and seven separate professional faculties control admissions, set curricula and prescribe educational policy. Teaching fellows, instructors and assistant professors are appointed for a term, but associate professors and professors are appointed for life. To assure the highest quality in these posts, a system of *ad hoc* committees was instituted in 1941 with, typically, a special committee of scholars drawn both from Harvard and from other institutions, led by the president, sitting to review each appointment. The office of university professor was created in 1935 to free a few outstanding scholars for work "on the frontiers of knowledge" without commitment to any single school or faculty.

Among the students are a number of mature men established in their careers who come to the university for background study under programs developed since 1935—the Littauer fellows in public administration, the Nieman fellows in journalism, fellows in international affairs, post-doctoral fellows in the sciences, medicine, dental medicine and public health, conservation fellows, members of the trade union program, and the advanced management group (about 140 business executives twice yearly). Beginning in 1933 the Society of Fellows provided an opportunity for a limited number of outstanding young scholars, on three-year appointment as junior fellows, to pursue research and study in fields of their own choosing without academic limitations. Women students, who were first admitted to the school of education in 1920, by the mid-1950s were accepted in all divisions of the university not provided through Radcliffe college.

A strong development toward the university ideal marked the last half of the 19th century, especially in the widening of courses, the betterment of instruction and the progress of university freedom; and this was consolidated in the 20th century, bringing Harvard to the forefront among higher institutions of learning. This had its effect on the undergraduate college as well as in the developing graduate schools, and Harvard became a leader both in setting high standards for admission and in seeking change in the rigid, traditional curriculum. In the search for a college curriculum to meet the needs both of general education and specialized learning, Harvard has been bold in experiment and innovation. The ideas of recognizing special students and introducing the elective system were suggested in 1824, attaining establishment even for freshmen by 1885, the movement characterizing particularly the years 1865–85. The basis of the elective system is freedom in choice of studies within liberal limits. This freedom was modified in 1910 by requiring each student to choose enough courses in one field to enable him to gain considerable knowledge of that subject, and by distributing a certain number of courses among other fundamental subjects to round out his view of the world. Dissatisfaction with the distribution requirement as a means to a well-rounded education, however, led in 1946 to the report of a special faculty committee, under the chairmanship of Paul H. Buck, on "General Education in a Free Society." After several years of trial the general education program was put into full effect in the fall of 1951. This provided that each student should take, during his first two years, one course in each of the three great fields of learning—the natural sciences, the social sciences and the humanities. Rather than offer a single "core" course, however, the faculty gave the student a choice among four or five offerings in each of these fields, each prepared by outstanding scholars especially for the instruction of nonspecialists. Optional advanced courses also were offered under the same program. In this way, it was felt, all students would gain a common appreciation of the western heritage. In 1910 the degree with distinction was established for high attainment in general, coupled with distinguished success in the subject to which the student had given most attention. Beginning with 1916, general final examinations on the student's field of concentration were introduced; the plan was later extended to almost all departments.

In the years following 1916 a system of tutors was developed to direct the private reading of the students. The tutor met his men individually each week and advised as to their private study. In later years, especially after World War II, this tutoring became limited in the larger departments to the abler students. Feeling that tutorial instruction had value for all students, the faculty introduced in the fall of 1952 a system of tutoring in groups of six or less to cover all students in these larger departments, while continuing individual tutoring as before. First-year students in Harvard college live in dormitories in the Harvard Yard, and since 1931 students in the three upper classes have lived under the house plan. The several houses, each with about 400 students with tutors, a senior tutor and a master, became the centres of undergraduate life, each house having its own library, common rooms, social and intellectual activities and athletic teams. It is believed that in this way any advantage that a small college may have is united with those of the university college. In 1950 a somewhat similar arrangement for communal living was provided for graduate students in Cambridge.

With an increase in the number of persons of college age and an increasing demand for college and university education in the United States after mid-century, Harvard sought to make its special contribution by maintaining quality and by providing increasing numbers of well-equipped college and university teachers in several fields through its graduate programs.

RADCLIFFE COLLEGE, an institution of higher education for women, dates from the beginning of instruction of women by members of the Harvard faculty in 1879, the Society for the Collegiate Instruction of Women being formally organized in 1882. The present name was adopted in 1894 in honour of Ann Radcliffe, Lady Mowlson (d. *c.* 1661), widow of Sir Thomas Mowlson, alderman and (1634) lord mayor of London. She was the founder (1643) of the first scholarship in Harvard college. From 1894 also dates the present official connection of Radcliffe with Harvard. The requirements for admission and for degrees are the same as in Harvard, and all diplomas are countersigned by an authorized official of Harvard and bear the university seal. Instruction has always been given by members of the Harvard faculty, and after World War II Radcliffe students were introduced into Harvard classes. Although instruction was joined, Radcliffe maintained its own deans and administration, continued its own student activities and maintained its own library, recreational facilities and tutorial hall. Radcliffe, with the Harvard graduate school of business administration, maintains a one-year graduate management training program for women intending a career in business.

See also references under "Harvard University" in the Index volume.

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HARVEST BUG: *see* CHIGGER.

HARVESTER (HARVEST SPIDER OR HARVESTMAN): *see* DADDY LONGLEGS.

HARVESTING MACHINERY. Each machine on the farm has its important purpose, but harvesting machines have a special place in the over-all picture because the farmer depends upon them to get his crops safely in after they have survived the hazards of drought, flood, hail, frost and pests. For the history of harvesting machinery, *see* FARM MACHINERY. For other types of agricultural machinery, *see* PLANTING MACHINERY; TILLAGE MACHINERY; CROP-PROCESSING MACHINERY. *See* also CROP DRYING AND PROCESSING.

Haymaking Machinery.—The variety of machines used is limited only by the diversity of crops grown, but many farmers grow some hay and this is usually the first harvest of the season. The first operation in making hay is to cut the grass (or legume) close to the ground, usually with a mower. The grass is then made

into hay by drying so it will keep for many months without spoiling.

The Mower.—The cutting mechanism consists of a cutter bar, a long flat bar of strong steel to which slotted fingers or guards are attached to point forward, and a reciprocating knife, a thin strip of steel to which triangular steel blades or knife sections are riveted. The cutter bar runs close to the ground and the guards comb through the grass, which is cut off by the knife sections working against ledger (*i.e.*, stationary) plates mounted in the guards. The action is very similar to having many pairs of scissors mounted along the front of the cutter bar. The guards provide the scissors' action with the reciprocating knife sections and they also give some protection to the knife against stones.

The cutter bar is fastened to a frame which may be carried directly on a tractor or may be mounted on wheels and pulled by a tractor or by horses, mules, oxen or water buffalo. The reciprocating knife is usually driven by a crank and connecting rod (pitman). The crank of a horse-drawn mower is normally driven through gears from the wheels, but tractor mowers are driven by the tractor engine through a flexible drive system which permits the mower to follow the ground independently of the tractor. This drive is more satisfactory than one through the wheels, because there is no slippage and cutting can be done more rapidly.

The width of cut for horse mowers may vary from three and one-half to five feet while tractor mowers are usually six or seven feet except for a few narrower ones designed for very small tractors. As the crop is cut by the mower, it falls in a continuous swath on the ground, where it is usually left to cure until dry enough to rake for stacking or baling.

Dump Rake.—The next machine to be used depends upon whether the hay is to be stored as loose hay in a stack, stored in a haymow as loose chopped hay, or baled. If to be stacked as loose hay, the grass will be allowed to dry almost to the safe storage point in the swath and then it will be raked into windrows and bunches with a dump rake. This machine consists of a number of long, semicircular spring teeth spaced across the entire machine. They are carried at the upper end in a beam which, in turn, is supported by a wheel at each end. The teeth form a basket into which the hay is raked by the forward motion of the machine and which can be dumped by rotating the beam which carries the teeth.

Hay Chopper.—If the hay is to be stored loose for mow curing, the grass is raked into windrows and then picked up and chopped by a hay chopper soon after cutting. The advantage of this system is that a very fine quality hay is secured by avoiding the loss of leaves and certain food elements through field drying. The hay chopper is a form of forage harvester which will be described later under forage harvesting machines.

Side-Delivery Rake.—Often hay is baled to make it more compact and economical to handle. When this is to be done, the hay is raked from the swath into a windrow by a side-delivery rake while the moisture content is still quite high so that the leaves will not fall off too badly. The windrow is kept sufficiently loose for air circulation to continue the drying process to the point where the hay can be baled safely.

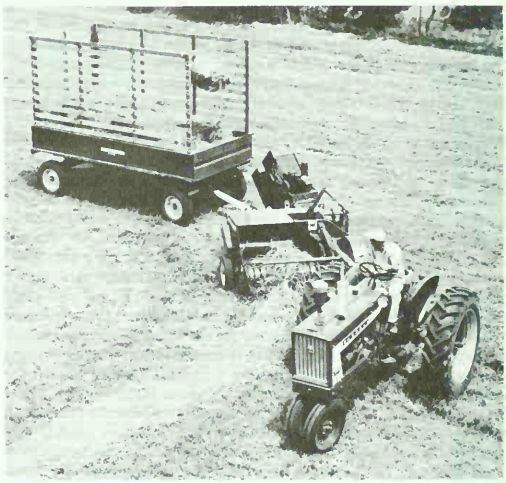
The side-delivery rake consists essentially of a rotating cylinder with spring teeth which, because of the oblique position of the cylinder in relation to the direction of travel, rakes or rolls the hay forward and laterally until it escapes from the rake to form a windrow. The cylinder is counterbalanced so that it can follow the contour of the ground.

Sweep Rake.—For loose hay, side-delivery rakes together with sweep rakes are sometimes used. The latter are used to gather up the windrowed hay and carry it to the stacker. The sweep rake consists essentially of a number of wooden teeth, several feet long, carried at the rear on wheels or directly by a tractor or truck. As the rake moves forward, the hay slides back onto, and collects on, the teeth, which are then lifted at the front for transport to the stack when the rake is full.

Loaders and Stackers.—For handling loose hay, loaders and stackers are also used. By means of toothed pick-up cylinders, the loader picks up the hay from the windrow and delivers it to the wagon or truck body by means of a slat-and-rope carrier or a raker-bar mechanism. Most stackers are of the overshot type. The hay is placed by a sweep rake onto a large "floor" of wooden teeth mounted on the end of a boom which is pivoted at the opposite end. A winch rotates the boom and its load of hay upward, past the vertical, and "shoots" the hay over onto the stack. The boom is then returned to its position flat on the ground for the next load.

Hay Conditioners.—These are used to accelerate the rate of drying when field curing. The machines consist of pairs of smooth rolls which may be of steel or rubber (to split the stems) or meshing fluted rolls (to crimp the stems) between which the swath of cut crop is passed. Splitting or breaking stems of leguminous crops allows moisture to escape quickly so that leaves and stems dry at more nearly the same rate, and drying time is cut by about half.

Pick-Up Balers.—Used to bale hay directly from the windrow in the field when it has been allowed to dry to safe storage moisture content, the baler has a rotary toothed pick-up mechanism. This lifts the windrow and delivers it to an auger or other feeding device which, with the help of packer fingers or a "wadboard packer," places a charge of hay in the bale chamber on each stroke of the compressing plunger. Two twines or wires are automatically tied around a length of hay compressed into the bale chamber to form a bale. The density and length of the bale can be adjusted. Some balers are driven by a power-take-off (PTO) shaft while those of greater capacity, used for custom baling, are usually driven by a gasoline engine mounted on the baler. Twine is tied in a conventional knot. "Wire-tie" machines usually twist the ends of the wires together, but both twine and wire are joined mechanically and automatically.



BY COURTESY OF INTERNATIONAL HARVESTER COMPANY

PICK-UP HAY BALER WITH THROWER ATTACHMENT TOSSES COMPLETED BALES INTO TRAILER

Hay Pelleters.—The next step beyond hay baling is hay pelleting in which the hay is compacted approximately eight times in place of about two and one-half times as in baling. In the 1960s this system offered promise from the standpoint of feeding and handling efficiency but only stationary machines for the commercial pelleting of ground alfalfa were generally available.

Forage Harvesting Machines.—Grass, legumes, corn (maize) and other crops are often ensiled to keep them in a succulent and fermented state rather than in the dry condition in which they are called hay. To make silage, they must be cut up so as to permit packing in the silo sufficiently well to expel most of the air and so produce anaerobic fermentation and prevent mold formation. (*See* ENSILAGE.)

BY COURTESY OF INTERNATIONAL HARVESTER COMPANY

TRACTOR-DRAWN FIELD HARVESTER USED FOR FORAGE CROPS. CHOPPER BLADES CAN BE ADAPTED TO CUT (LEFT) GREEN FEED OR (RIGHT) CORN INTO PROPER CONSISTENCY FOR SILAGE

Almost all silage crops are now cut in the field with a forage harvester which cuts the crop and chops it immediately or picks up and chops a windrow which has been cut and raked earlier. Forage harvesters have a basic cutting or chopping unit consisting of rotating knives which shear the crop against a cutter bar or shear plate. The length of cut is adjusted by varying the feed speed or by changing the number of knives. The knife holder, whether it be flywheel or cylinder type, includes impeller devices which fling the chopped hay through a pipe into a wagon hauled behind the machine. In some cases the knives are shaped so as to provide the impelling action to transport the chopped material. These machines, like balers, may have a separate engine or be driven by a tractor through a PTO shaft. They usually handle one row of corn or up to seven feet of grass or legume crop.

Forage harvesters can be equipped with alternate attachments. They may have a cutter bar similar to that of a mower or combine, in which case the crop is chopped immediately. They may be equipped with a pick-up mechanism like that of a baler. This is used where it is wished to allow the crop to wilt or dry a little before it is chopped for ensilage or placement in the mow for curing as hay. The third attachment is a row-crop device making it suitable for harvesting corn for silage. A knife cuts the stalks close to the ground while gathering chains grasp them and carry them to the feed rolls or apron which delivers the material to the cutter wheel and meters it.

So-called economy-type forage harvesters which perform both the cutting and chopping operations are also used where acreages to be harvested are small. They consist of a stalk beater or shredder to which is fitted a blower to deliver the chopped fodder to a wagon. Beaters which have their axis of rotation parallel to the ground often use an auger to collect the chopped material from the rotor knives or hammers and carry it to the blower.

Grain Harvesting Machinery.—Grain or cereal crops are harvested when their seeds have reached maturity and have dried to some degree. The crop may be threshed as it is harvested (by a combine or reaper-thresher), in which case the grain is usually allowed to dry to a safe storage level of moisture before harvesting. If the crop is not threshed as cut it is harvested with a grain binder and left to dry in bundles, with a windrower or swather, in which case it is dried in the windrow, or with a mower with dropper or buncher attachment, to be dried in hand-tied bundles.

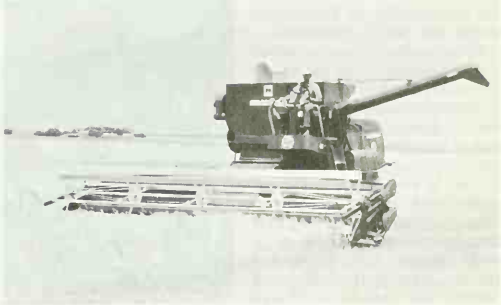
Grain Binder.—This is used to harvest small grains in localities where the combine harvester-thresher is unsuitable or not available. It cuts the grain, binds it and drops the bundles or sheaves on the ground singly or in bunches to be shocked or hauled for stacking or storing in the barn until threshing. The cutting mechanism is very similar to that of the mower. A slatted cylindrical reel mounted parallel to and above the knife pushes the cut grain back onto a canvas conveyer which moves it laterally to and between a pair of counterrotating inclined canvas conveyers or elevators. These deliver the grain to the binding deck where a butter evens the butts of the cut straw, and a set of packer fingers in the binding attachment compresses the straw to form a bundle of the required size and density. A trip mechanism engages the power to operate the binding attachment and the knotter ties a loop of twine around the bundle before it is ejected.

When pulled by horses or other draft animals, binders secure their mechanical motions and power from a large lugged traction wheel, and cut a swath from four and one-half to eight feet wide. When pulled by tractors, they are usually PTO driven and cut up to ten feet. Binders with special drive wheels are sometimes used for rice harvesting but have been largely replaced by combines.

Buncher.—On very small farms, grain may be harvested with a mower using a dropper attachment or buncher, a slat device mounted behind the cutter bar and permitting the operator to collect the grain in bunches for later hand tying.

Combine.—As early as 1950 practically all of the small grains, soybeans and similar crops in the western hemisphere and Great Britain were harvested by means of the combine or combined harvester-thresher. This machine cuts, threshes and cleans the grain as it moves over the field. In design, it is essentially a regular binder-type cutting device with a gathering-conveying mechanism that delivers the cut grain to a conventional thresher that has been modified to make it work satisfactorily when in motion over the fields. In combine harvesting the aim is usually to take the heads of grain with a minimum of straw. Hence, the cutting-gathering device is sometimes called the header. However, if the crop is lodged, that is, bent down, or if the straw is to be saved, the crop is cut close to the ground.

From the threshing cylinder, which rubs the grain out of the heads against a curved "concave," some of the grain and chaff goes directly to the cleaning "shoe" where sieves and a blast of air are used to separate and clean the grain. Some of the grain and chaff go with the straw to the straw deck or to walkers which serve to shake the grain from the straw. This grain too is delivered to the cleaning shoe and thence, after passing through the air blast, it drops into the clean-grain auger which conveys it to an elevator and on into the storage tank or to the bags as the case may be. The straw drops out the back of the machine and is left



BY COURTESY OF INTERNATIONAL HARVESTER COMPANY

COMBINE WITH 20-FOOT CUTTING BLADES HARVESTS, THRESHES AND CLEANS THE GRAIN

in a windrow for later baling, is baled directly by a baling attachment or press, or is scattered over the ground by means of a fan-like straw spreader.

While combines were used as early as about 1875 in California and the Pacific northwest of the United States, it was not really until the 1920s and 1930s that they made themselves generally felt. They were then shown to be the only practical way to harvest soybeans and this impetus together with the introduction of the small (five- and six-foot cut) PTO-driven combine made them popular throughout almost the entire United States. The self-propelled combine, introduced in 1940, with its own traction power made the large combine a much more flexible unit and for large farms this machine became standard equipment. Combines became established in Great Britain during World War II when labour shortage forced their adoption and justified the auxiliary drying equipment needed in that climate. After World War II, several European combines were produced to embody cleaning and separating principles peculiar to those countries and, above all, to provide means for saving the straw, which is valued highly.

Power-take-off-driven combines cut from 5 to 7 ft. wide while self-propelled and pull-type machines with auxiliary engine range in size from 8 to 18 ft. On self-propelled and other large models the cut grain is gathered behind the cutter bar by a large auger which replaces the canvas conveyer used on earlier models. A chain-type conveyer carries the grain to the threshing cylinder except on some "straight-through" pull-type combines where a canvas conveyer moves the material directly from cutter bar to cylinder. V-belt and roller-chain drives are used to power the various elements of the machine and a generous use of sealed-for-life ball bearings on models appearing by the late 1950s typified the trend of the farm machinery industry toward higher standards of materials and workmanship. Combines are made with means for regulating the speed of the threshing cylinder to suit the various crops to be harvested, and self-propelled machines are usually equipped with means for fine adjustment of the travel speed to suit field and crop conditions.

Hillside combines of the self-propelled type are available for use on steeply rolling land. The body of the machine is supported in the frame by hydraulic cylinders which are automatically adjusted to keep the body level.

Pick-Up Attachments.—Combines may be fitted with pick-up attachments that mount ahead of the cutter bar. These are used to pick up, for threshing, windrows of grain that have been cut and allowed to dry for several days.

Windrow-Harvesters, Windrowers or Swathers.—These are used in some sections of the U.S. and Canada where weather and crop conditions at harvest time are unfavourable for direct combining of the grain. Uneven ripening of the grain, and heavy, green weed conditions both favour windrow harvesting. Green patches and green weeds both dry out in the windrow and permit satisfactory threshing; if left standing until green spots and weeds were ripe, the crop might all be lost by storms and windy conditions.

Windrowers.—These consist essentially of a cutter bar with a canvas-type conveyer behind it to move the cut grain to one point and to deposit it gently on the top of the stubble so the air can circulate beneath and through it. A reel is used to push the cut grain back onto the canvas. Most windrowers are pulled by a tractor, cut a swath width up to 16 ft. and are PTO driven, but in the second half of the 20th century there appeared to be an increasing preference for self-propelled models.

Pick-Up Reels.—Used on combines and windrowers when the crop is very badly lodged or flattened by wind or due to straw weakness, these reels have rows of spring teeth in place of the usual bats. The teeth are eccentrically controlled to get under and lift the crop before it is cut, but to retract smoothly after the grain is into the header. This action is necessary to prevent the straw from wrapping on the reel.

Combines may also be fitted with corn harvesting attachments (*see* below).

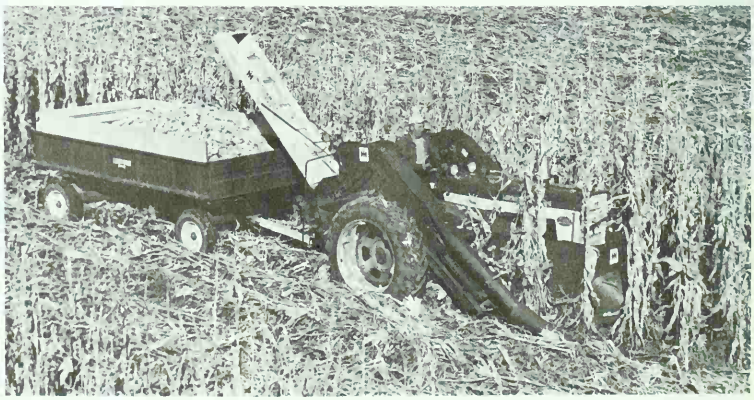
Corn (Maize) Harvesting Machinery.—When corn is grown for grain it may be cut with a corn binder and stored in shocks while the grain dries to shelling and storing moisture. However, the usual practice is to use a mechanical corn picker which jerks or "snaps" the ears from the stalks so that only the grain and cobs are harvested. The standing stalks are guided by two shields or snouts to pass between two counterrotating rollers which pull the stalks down and through very sharply. The ears strike either a snapping bar located above the rolls or the rolls themselves and this breaks the shanks which attach the ears to the stalk. The ears then travel by means of an elevator to the husking mechanism, consisting of closely spaced, counterrotating rollers which tear the husks away. The ears are carried by means of a chain-type elevator to a trailed wagon.

Some pickers are pulled behind a tractor and are PTO driven, but most are mounted directly on a tractor, one unit on each side, to form a two-row harvester.

Picker-Shellers.—Pickers may be fitted with shelling units (*see* FARM MACHINERY) and are then known as picker-shellers. By shelling the corn as it is harvested, a separate operation is eliminated. Cob hauling and storage are avoided with considerable saving and the corn may be harvested early to reduce field losses. Similar advantages can be secured by equipping a combine with a corn attachment. In this case, the combine shells and cleans the corn. The attachment consists of a two-row snapping unit similar to a picker, or of a two-row cut-off and conveying unit which delivers the whole corn plant to the combine. *See* also CORN.

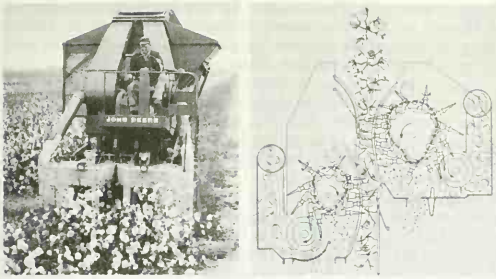
Mechanical Cotton Harvesters.—The hand harvesting of cotton is an excessively laborious operation, which has stimulated the development of many patents on machines to do the job. In the U.S. more and more cotton was being picked mechanically in the second half of the 20th century.

Regular open-boll cotton is commonly harvested by machines which utilize rotating moistened spindles. The plants are guided between banks or drums of rapidly rotating, automatically cleaned and dampened spindles. The cotton is wrapped around the moistened spindles, to which the fibres tend to adhere, and then doffed or stripped by a special device. When barbed spindles are used a doffing wheel unrolls the cotton to get it free of the spindle. From



BY COURTESY OF INTERNATIONAL HARVESTER COMPANY

CORN PICKER SEPARATES EARS FROM THE STALKS, REMOVES HUSKS AND DEPOSITS CLEAN EARS IN THE TRAILER. AN ATTACHMENT CAN ALSO BE USED TO SHELL THE CORN AS IT IS PICKED



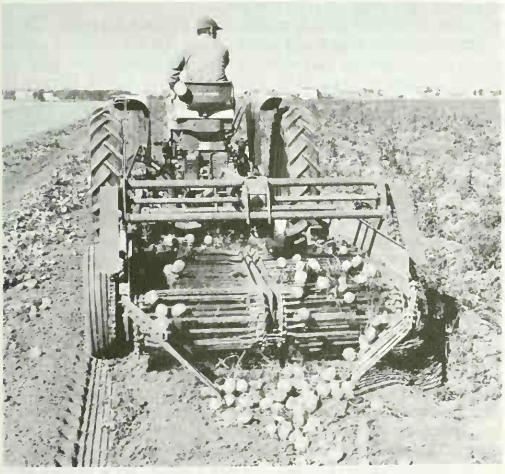
BY COURTESY OF JOHN DEERE, MOLINE, ILLINOIS

(LEFT) SELF-PROPELLED COTTON PICKER HARVESTING OPEN-BOLL COTTON; (RIGHT) DRAWING OF PICKER MECHANISMS VIEWED FROM THE TOP

the strippers or doffers the cotton is delivered by conveyer or suction to a large basket carried above the machine.

In some areas such as the high plains of Texas a stormproof cotton, in which the cotton is kept close within the protective boll, is grown. Strippers are used to harvest this type of cotton. The plants pass between stationary strippers or counterrotating rollers or brushes which tear the bolls from the stalks. Both cotton strippers and pickers are usually mounted on tractors. A few are self-propelled. (*See* also COTTON: *Culture.*)

Potato Harvesting Machinery.—One of the simplest mechanical devices for lifting potatoes is the potato plow provided with



BY COURTESY OF JOHN DEERE, MOLINE, ILLINOIS

AGITATING ROD-LINK CONVEYER OF ELEVATOR-TYPE POTATO HARVESTER SEPARATES TUBERS FROM THE SOIL AND DEPOSITS THEM IN ROWS FOR BAGGING

a share to which are attached a series of rods for raising the tubers as the implement is drawn through the ground. A middle buster, or double plow with right- and left-hand bottom mounted back to back, fitted with rods as above is another simple device for this purpose. Still another consists of a flat diamond-shaped plow, for lifting the potatoes, and an agitated pivoted grate, actuated by a small star wheel underneath, which shakes off most of the earth, leaving clean potatoes lying on the surface of the ground.

More elaborate machines, designed to both raise and separate the tubers from the soil, are of two distinct types, the spinner and the elevator. The spinner type is carried on two wheels and has a broad scoop share which runs under the ridge and loosens the earth around the tubers. Immediately behind the share is the spinner, consisting of a series of forks rotating at right angles to the path of the machine. The forks, set to work at about the same depths as the share, throw the potatoes to one side, leaving them more or less in compact rows. This type is commonly used in Great Britain and Europe.

The elevator type comprises a broad share with an agitating rod-link conveyer directly behind it to carry the earth and potatoes upward and backward. As they are moved the agitation shakes a large part of the earth free and it drops through the conveyer. At the end of this conveyer the potatoes may be dropped off onto the ground. In some they are delivered to cleaning devices and sorting tables. In these more complicated machines various mechanisms are used to prepare the potatoes for direct sacking. Rods and deflectors are used to separate the vines. Rollers may be used to move the potatoes and remove earth and small stones. Finally the potatoes move onto moving picking tables where men, riding on the machine, pick out rocks and other foreign objects before the potatoes are delivered to bags or bulk transportation. Most diggers are PTO driven and are made in one- and two-row models. The digging depth is regulated from a forward truck or gauge wheel that runs on the row.

Beet Harvesting Machinery.—In sugar-beet harvesting the object is to lift the whole root from the ground, clean the earth off it and deliver it to a wagon accompanying the machine. In the process the tops, together with a small portion of the root itself, must be removed and separated from the root as it travels to the wagon. Some machines have stationary blades that lift the beets together with some earth onto a kicker-wheel cleaner-conveyer; others perform the lifting by means of two tilted wheels whose action, rolling together, lifts the beets out of the soil. In these machines the beets are first topped by a revolving inclined disk, the cutting height of which is regulated by a finder wheel or shoe. These machines are semi-mounted on a tractor and lift one row at a time. Other types of beet harvesters top the beets after they have been lifted. One of these actually lifts the beets by their tops. The second type employs a two-blade lifter to do the lifting. At the same time a large spiked wheel rolling over the beets impales them on the spikes and subsequently elevates them to a rod-chain conveyer. They are removed from the spikes by strippers after being topped by rotary disk-type knives. A part of the U.S. beet crop and much in other beet-growing countries is lifted by hand after mechanical loosening. A subsoiler type of standard with a blade or small share projecting under the row is sometimes used. Others employ the two-blade design which straddles and lifts the beet, the device used on some complete harvesters. Some are single-row units drawn by horses; others drawn by tractors loosen several rows at a time. *See* also BEET.

BY COURTESY OF INTERNATIONAL HARVESTER COMPANY

PRONGS ON THE CONVEYER BELT OF A BEET HARVESTER SEPARATE BEETS FROM SOD AND DEPOSIT THEM IN THE TANK. TRACTOR-DRAWN HARVESTER LIFTS TWO ROWS OF SUGAR BEETS AT A TIME

Peanut Harvesting Machines.—Peanuts are an important crop and mechanical harvesting is considered essential. The tubers are usually lifted and allowed to dry for three to ten days before picking or removal from the vines. They are lifted, vines and all, with units similar to potato diggers. Side-delivery rakes may be used to windrow the vines for drying, but special shaker-windrowers that clean and windrow the vines more loosely and gently are more generally used. After drying, the threshing is done with a combine or a special peanut harvester. These employ intermeshing spike tooth cylinders or similar devices to comb the peanuts out of the vines. All peanut harvesters require stemmer saws to remove the piece of stem that remains on the peanut when it is broken from the vine. *See* also PEANUT.

Sugar-Cane Harvesting Machinery.—Sugar cane is harvested by hand in those parts of the world where labour costs are very low, but in the mainland U.S. and Hawaii it has been necessary to mechanize. Harvest of the one-year cane grown in Louisiana is not excessively difficult. The specially designed cane harvester which straddles one row cuts the cane off close to the ground, removes the useless leafy top and conveys the cut stalk or cane to an accompanying truck or wagon.

The much heavier two-year cane grown in Hawaii is far more difficult to handle mechanically since at harvest time it is completely lodged and tangled. Although much effort was made in the late 1950s to develop harvesters to cut, detrash and deliver two-year cane to an accompanying truck, most such cane was harvested by means of push rakes mounted on crawler tractors which push the cane into piles to be grab-loaded onto trucks for hauling to the mill. In being pushed into piles many canes are torn up by the roots, necessitating replanting for the following crop. Much of the balance of Hawaiian cane is grab harvested. A grab, similar to a clamshell bucket, is used literally to tear the cane loose from the ground, two or three tons at a time, and load it directly into trucks. This method, too, damages the stools, or stumps, badly. Some unirrigated cane, which therefore does not grow in furrows, is harvested with a V-cutter which consists of a modified snow plow having sharp knives along the lower edges to shear off the cane, which is then pushed into windrows and bunched for grab loading. *See* GRASSLAND; SUGAR; *see* also references under "Harvesting Machinery" in the Index volume.

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HARVEY, GABRIEL (1550?–1630), English writer and a friend of Edmund Spenser, was the eldest son of John Harvey, a yeoman of considerable means and a ropemaker. In 1566 Harvey matriculated at Christ's college, Cambridge, and in 1570 received his B.A. and became, through the influence of Sir Thomas Smith, a fellow of Pembroke hall (later Pembroke college). When in 1573 he was ready to take his M.A., some students protested that he was arrogant, overcritical and inclined to defend paradoxes. The degree was conferred only after the intervention of John Young, master of Pembroke hall. The next year Harvey was appointed praelector or professor of rhetoric, and in this capacity delivered annual lectures, two of which were published, *Ciceronianus* (1577) and *Rhetor* (1577). Both works revealed the scope of Harvey's learning, his thorough knowledge of classical authors and his admiration of writings in the vernacular. On the death of Sir Thomas Smith in 1577, Harvey composed a series of Latin elegies, published as *Smithus: vel Musarum lachrymae* (1578). On July 26, 1578, Harvey disputed before Queen Elizabeth I when she visited at Audley End, Essex. There is a biased but entertaining account of this in Thomas Nashe's *Have With You to Saffron-Walden* (1596). Harvey himself celebrated this significant event in his career with another collection of facile Latin verse, *Gratulationes Valdinenses* (1578). His fellowship at Pembroke was not renewed, but he was elected on Dec. 18, 1578, to a new fellowship at Trinity hall, Cambridge, where he began the study of civil law.

At Pembroke Harvey had become an intimate friend of Edmund Spenser. Spenser celebrated this friendship in *The Shepheards Calender* (1579) through the characters of Colin Clout (Spenser) and Hobbinol (Harvey). The June eclogue in particular expresses the deep affection between them. In 1580 appeared *Three Proper, and Wittie, Familiar Letters* containing two letters by Spenser and three by Harvey. The letters revealed that Spenser had temporarily succumbed to Harvey's advocacy of classical metres, but that authorship was not Harvey's main aim. Unfortunately for Harvey's ambitious plans, his epistles caused trouble. Cambridge demanded and received a retraction of the criticism that the university failed to honour learning and granted preferential treatment to wealthy students. Edward de Vere, earl of Oxford, at the instigation of John Lyly, interpreted personally Harvey's satire of an Italianate Englishman in "Speculum Tuscanismi." Harvey denied that the poem was an attack upon the earl, and that he went, as Nashe alleged, to the Fleet prison. Further humiliation was heaped on Harvey in the Latin comedy *Pedantius*, performed at Trinity college in 1581, which satirized him as, in Nashe's words, "the concise and firking finicaldo fine Schoole-master."

In 1585 he failed to be elected master of Trinity hall, and though he had completed his study of civil law, he was not admitted to the doctor's degree. In 1585, however, he became doctor of civil law at Oxford. Except for Lyly's criticism in *Pap With a Hatchet* (1589), nothing is known of Harvey's activities until 1592, when he published *Foure Letters, and Certaine Sonnets*. This pamphlet detailed accurately, but mercilessly, the pathetic death of Robert Greene and replied to the indictment of himself and his brothers John and Richard in Greene's *A Quip for an Upstart Courtier* (1592) and Nashe's *Pierce Penilesse* (1592). The origins of this dispute are hidden in mysterious animosities, undoubtedly including the attack on "Speculum Tuscanismi" and the personal associations of the antagonists at Cambridge. Richard Harvey in *Lamb of God* (1590) had abused Nashe as a "piperly makeplay or makebate," but unaccountably the latter did not reply for two years. Then Harvey and he carried on a lengthy fliting, in Nashe's *Strange Newes* (1592) and *Have With You to Saffron-Walden* and in Harvey's *Pierces Supererogation* (1593) to which he appended a reply to Lyly written four years earlier. Both writers were evidently at the time in the employ of stationers, Nashe with John Danter and Harvey with John Wolfe; and since neither appeared enthusiastic to prolong the feud, it is plausible that the controversy was artificially stimulated by printers interested in sales. It was officially terminated in 1599 when the archbishop of Canterbury ordered the satires of the two men burned.

In 1598 Harvey petitioned Sir Robert Cecil to be elected master of Trinity hall; once again he was not appointed. About this time, or earlier, he retired to Saffron Walden. In 1608 his sister, Mary Collins, instituted a legal suit against him. On his mother's death in 1613 he evidently succeeded to his inheritance, and died in Saffron Walden in 1630. The picture posterity has of Harvey is based on Nashe's devastating burlesque, and on his malicious account of Greene's death. Though Harvey was sometimes tasteless and certainly pompous, he should be judged neither by his books, since he came into print reluctantly, nor by his desire to introduce hexameters into English. His marginalia in the books he read, many of which are extant, demonstrate that rather than a pedant, he was, like Francis Bacon, a man who made all learning his province.

Harvey's English works were edited by A. B. Grosart (1884–85); *Ciceronianus* was edited by H. S. Wilson and translated by C. A. Forbes (1945). Autobiographical material appears in *The Letter Book of Gabriel Harvey*, edited by E. J. L. Scott (1884), and Harvey's *Marginalia*, edited by G. C. Moore Smith (1913), which also contains the best biography. (E. H. MR.)

HARVEY, SIR JOHN MARTIN (1863–1944), English actor, producer and theatre manager, who came to be associated with his outstanding success as Sydney Carton in *The Only Way* (an adaptation of Charles Dickens' *A Tale of Two Cities*), was born at Wivenhoe, Essex, on June 22, 1863. He was educated at King's College school, London, and was intended for a naval architect. However, he chose the stage, making his first public appearance at the Court theatre, London, in 1881, while still a boy. He joined Sir Henry Irving's Lyceum company in 1882 and remained there for 14 years. He married Angelita Helena de Silva, who became his leading lady when he entered management.

A man of scholarly refinement, and an actor of power and sensitivity, Harvey maintained the Irving standard and method. His finest performance was as Oedipus Rex in Max Reinhardt's production of that play at Covent Garden theatre, London, in 1912. Martin Harvey was knighted in 1921 and was made an honorary LL.D. of Glasgow university in 1938.

He died on May 14, 1944.

See *The Autobiography of J.M.H.* (1933) and M. Willson Disher, *The Last Romantic* (1948). (W. J. M.-P.)

HARVEY, WILLIAM (1578–1657), English physician, the discoverer of the circulation of the blood, was born at Folkestone, Kent, on April 1, 1578. He was educated at Caius college, Cam-

bridge, and then proceeded to Padua to study medicine under Hieronymus Fabricius ab Aquapendente and became doctor of medicine in April 1602. Returning to England, he settled in London. He was admitted (June 1607) fellow of the Royal College of Physicians, and in 1609 obtained the reversion of the post of physician to St. Bartholomew's hospital, and in the same year he succeeded to the post.

In 1616 he began a course of lectures at the College of Physicians in which he first brought forward his views upon the movements of the heart and blood. Meantime his practice increased, and he had the lord chancellor, Francis Bacon, and the earl of Arundel among his patients. He was physician extraordinary to James I and physician in ordinary to Charles I. In 1628 he published the *Exercitatio anatomica de motu cordis et sanguinis in animalibus*, in which he announced his discovery of the circulation of the blood. Between 1629 and 1632 he traveled on the continent, principally in Italy with James Stuart, afterward duke of Richmond. Four years later he accompanied the earl of Arundel on his embassy to the emperor Ferdinand II. He returned to his practice in London at the close of the year 1636, and accompanied Charles I in one of his journeys to Scotland (1639 or 1641), and was in attendance on the king at the battle of Edgehill (Oct. 1642), and then followed Charles I to Oxford.

While with the king at Oxford he was made warden of Merton college, but a year later, in 1646, that city surrendered to Lord Fairfax, and Harvey returned to London. He was now 68 years old, and, having resigned his appointments and relinquished the cares of practice, lived in learned retirement with one or other of his brothers. The work on which he had been chiefly engaged at Oxford, and indeed since the publication of his treatise on the circulation in 1628, was an investigation into the subject of generation. Charles I had put the royal deer parks at Windsor and Hampton Court at Harvey's disposal, and had watched his demonstration of the growth of the chick with no less interest than he had watched the movements of the living heart. Harvey had collected a large number of observations, and George Ent succeeded in obtaining the manuscripts, with authority to print them or not. The result was the publication of the *Exercitationes de generatione animalium* (1651).

This was the last of Harvey's labours. He had now reached the age of 73. His theory of the circulation was generally accepted by the most eminent anatomists both in his own country and abroad, and he was known and honoured throughout Europe. In 1654 he was elected president of the College of Physicians but declined the honour, though he enriched the college with many gifts.

Harvey died in London on June 3, 1657, and was buried at Hempstead, Essex; in 1883 his remains were placed in the Harvey chapel in the church there.

John Aubrey says: "In person he was not tall, but of the lowest stature; round faced, olivaster complexion, little eyes, round, very black, full of spirits; his hair black as a raven, but quite white 20 years before he died." The best-known portrait of him extant is by Cornelius Jansen in the library of the College of Physicians.

Harvey's Work on the Circulation.—In estimating the character and value of the discovery announced in the *Exercitatio anatomica de motu cordis et sanguinis in animalibus*, it is necessary to bear in mind the previous state of knowledge. Aristotle taught that the blood was elaborated from the food in the liver, thence carried to the heart, and sent through the veins over the body. The Alexandrian physicians Erasistratus and Herophilus taught that, while the veins carried blood from the heart to the members, the arteries carried a subtle kind of air or spirit. Galen discovered that the arteries were not, as their name implies, mere air pipes, but that they contained blood as well as vital air or spirit, and he believed that the nerves arose from the brain and conveyed "animal spirits" to the body. The views of Galen remained current till the 16th century. The physicians of that period had developed certain doctrines concerning the vascular system which may be summarized thus: (1) The blood is not stagnant, but moves in the body. But no one had a conception of a continuous stream returning to its source (a circulation in the true sense of the word) either in the system or in the lungs. If they used the word *circulatio*, as did Andreas Caesalpinus, it was used vaguely. The movements of the blood were in fact thought to be slow and irregular in direction as well as in speed. (2) They supposed that one kind of blood flowed from the liver to the right ventricle of the heart, and thence to the lungs and the general system by the veins, and that another flowed from the left ventricle to the general system by the arteries. (3) They supposed that the septum of the heart was pervious and allowed blood to pass directly from the right to the left ventricle. (4) They had no conception of the functions of the heart as the source of motor power of the movement of the blood. They doubted whether its substance was muscular; they supposed its pulsation, like that of the arteries, to be due to expansion of the contained vital spirits.

Of the great anatomists of the 16th century, Andreas Vesalius in 1543 ascertained that the septum between the right and left ventricles is complete, though he could not bring himself to deny the invisible pores which Galen's system demanded. Michael Servetus, in his *Christianismi restitutio* (1553), went somewhat farther, and, from the anatomical fact of the complete septum and the large size of the pulmonary arteries he concluded that there is a communication in the lungs by which blood passes from the pulmonary artery to the pulmonary vein. It seems doubtful whether even Servetus rightly conceived of the entire mass of the blood passing through the pulmonary artery and the lungs. Indeed, a true conception of the lesser circulation as a transference of the whole blood of the right side to the left was impossible until the corresponding transference in the greater or systemic circulation was discovered. Lastly, the system of valves in the veins had been elaborately set forth and illustrated by Fabricius, Harvey's own teacher. The way then to Harvey's great work had been paved by the discovery of the valves in the veins, and by that of the lesser circulation, but the significance of the valves was unsuspected and the fact of even the pulmonary circulation was not generally admitted.

In his treatise Harvey proved (1) that it is the contraction, not the dilatation, of the heart which coincides with the pulse, and that the ventricles, as true muscular sacs, squeeze the blood which they contain into the aorta and pulmonary artery; (2) that the pulse is produced by the arteries being filled with blood; (3) that there are no pores in the septum of the heart, so that the whole blood in the right ventricle is sent to the lungs and round by the pulmonary veins to the left ventricle, and also that the whole blood in the left ventricle is again sent into the arteries, round by the smaller veins into the *venae cavae*, and by them to the right ventricle again—thus making a complete circulation; (4) that the blood in the arteries and that in the veins is the same blood; (5) that the action of the right and left sides of the heart, auricles, ventricles and valves, is the same, the mechanism in both being for reception and propulsion of liquid and not of air; (6) that the blood propelled through the arteries to the tissues is not all used, but that most of it runs through into the veins; (7) that there is no to-and-fro undulation in the veins, but a constant stream from the distant parts toward the heart; (8) that the dynamic starting point of the blood is the heart and not the liver.

The method by which Harvey arrived at his solution of the most fundamental and difficult problem in physiology is well worthy of attention. He had not only furnished himself with all the knowledge that books and the instructions of the best anatomists of Italy could give, but, by a long series of dissections, had gained a far more complete knowledge of the comparative anatomy of the heart and vessels than any contemporary had. Thus equipped, he began his investigations into the movements of the heart and blood by seeing their action in living animals. He minutely describes what he saw in dogs, pigs, serpents, frogs and fishes, and even in slugs, oysters, lobsters and insects, in the transparent shrimp, and lastly in the chick while still in the shell. He particularly describes his observations and experiments on the ventricles, the auricles, the arteries and the veins. He shows how the arrangement of the vessels in the fetus supports his theory. He adduces facts observed in disease as well as in health to prove the rapidity

of the circulation. He explains how the mechanism of the valves in the veins is adapted to favour the flow of the blood to the heart. He estimates the capacity of each ventricle, and reckons the rate at which the whole mass of blood passes through it. He elaborately and clearly demonstrates the effect of obstruction of the bloodstream in arteries or in veins, by the forceps in the case of a snake, by a ligature on the arm of a man, and illustrates his argument by figures. These results can be explained only by the constant circulation of the same blood. Lastly, in the 15th, 16th and 17th chapters of his great work, he adds certain confirmatory evidence as to the effect of position on the circulation, the absorption of animal poisons and of medicines applied externally, the muscular structure of the heart and the necessary working of its valves. The whole treatise, which occupies only 52 pages of print, is a model of accurate observation, patient accumulation of facts, ingenious experimentation, cautious hypothesis and logical deduction.

In one point only was the demonstration of the circulation incomplete. Harvey did not see the capillary channels by which the blood passes from the arteries to the veins. This gap in the circulation was filled 30 years later by the great anatomist Marcello Malpighi, who described the capillary circulation four years after Harvey's death. But the existence of the channels first seen by Malpighi was already clearly pointed to by Harvey's reasoning.

Harvey's Work on Generation.—The *Exercitationes de generatione animalium* is between five and six times as long as the work on circulation, and is followed by excursus *De partu, de uteri membranis, de conceptione;* but, though the fruit of observations as patient and extensive, its value is far inferior. The subject was more abstruse, and was inaccessible to proper investigation without the aid of the microscope. Hieronymus Fabricius, Harvey's master, in his work *De formatione ovi et pulli* (1621), and another pupil of Fabricius, Volcher Coiter of Nürnberg, were among the few in modern times who had preceded Harvey in this study. The 72 chapters which form Harvey's book lack the co-ordination so conspicuous in the earlier treatise, and some of them seem almost like detached chapters of a system which was never completed or finally revised.

Aristotle had believed that the male parent determined the form of the future embryo, while the female only nourished and nursed the seed. Galen taught that each parent contributes seeds, the union of which produced the young animal. Harvey, after speaking with due honour of Aristotle and Fabricius, begins *ab ovo,* for he says, "almost all animals, even those which bring forth their young alive, and man himself, are produced from eggs." This dictum, usually quoted as *omne vivum ex ovo,* was a prevision of genius, and was not proved until K. E. von Baer discovered the mammalian ovum in 1827. Harvey proceeds with a careful anatomical description of the ovary and oviduct of the hen, describes the new-laid egg, and then gives an account of the appearance seen on the successive days of incubation. Commenting on Aristotle and Fabricius, he declares against spontaneous generation, proves that there is no *semen foemineum,* that the chalazas of the hen's eggs are not the *semen galli,* and that both parents contribute to the formation of the egg. He describes accurately the first appearance of the ovarian ova as mere specks, their assumption of yolk and afterward of albumen. He describes two methods of production of the embryo from the ovum; one is metamorphosis, or the direct transformation of pre-existing material, as a worm from an egg, or a butterfly from an aurelia (chrysalis); the other is epigenesis, or development with addition of parts, the true generation observed in all higher animals. Chapters xlvi–l are devoted to the abstruse question of the efficient cause of generation, which, after much discussion of the opinions of Aristotle and of Sennertus, Harvey refers to the action of both parents as the efficient instruments of the first great cause.

He then goes on to describe the order in which the several parts appear in the chick. He states that the fetal heart is the first organ to be seen, and explains that the nutrition of the chick is effected not only by yolk conveyed directly into the midgut, as Aristotle taught, but also by absorption from yolk and white by the umbilical veins; on the fourth day of incubation appear two masses (which he oddly names *vermiculus*), one of which develops into three vesicles, to form the cerebrum, cerebellum and eyes, the other into the breastbone and thorax; on the sixth or seventh day come the viscera; and lastly the feathers and other external parts.

Harvey points out how nearly this order of development in the chick agrees with what he had observed in mammalian and particularly in human embryos. He notes the bifid apex of the fetal heart in man and the equal thickness of the ventricles, the soft cartilages which represent the future bones, the large amount of amniotic fluid and absence of placenta which characterize the fetus in the third month; in the fourth the position of the testes in the abdomen, and the uterus with its Fallopian tubes resembling the bicornuate uterus of the sheep; the large thymus; the caecum, small as in the adult, not forming a second stomach as in the pig, the horse and the hare; the lobulated kidneys, like those of the seal and porpoise, and the large suprarenal veins, not much smaller than those of the kidneys. He failed, however, to trace the connection of the urachus with the bladder. In the following chapters he describes the process of generation in the fallow deer or the roe. Much of Harvey's work on generation was superseded during the next 25 years by that of Malpighi. The remaining writings of Harvey are unimportant.

Harvey as Physician.—Of Harvey as a practising physician very little is known. Aubrey says that "he paid his visits on horseback with a footcloth, his man following on foot, as the fashion then was." He adds, "Though all of his profession would allow him to be an excellent anatomist, I never heard any that admired his therapeutic way. I knew several practitioners that would not have given threepence for one of his bills" (the apothecaries used to collect physicians' prescriptions and sell or publish them to their own profit), "and that a man could hardly tell by his bill what he did aim at." However this may have been, and rational therapeutics was impossible when the foundation stone of physiology had only just been laid, Harvey was an active practitioner, performing such important surgical operations as the removal of a breast, and he turned his obstetric experience to account in his book on generation. Some good practical precepts as to the conduct of labour are quoted by Percivall Willughby (1596–1685). He also took notes of the anatomy of disease, which unfortunately perished with his other manuscripts. He may be regarded as a forerunner of G. B. Morgagni (*q.v.*), for Harvey saw that pathology is but a branch of physiology, and like it must depend on accurate anatomy. The only remaining specimen of his observations in morbid anatomy is his account of the post-mortem examination made by order of the king on the body of the famous Thomas Parr, who died in 1635, at the reputed age of 152. Harvey insists on the value of physiological truths for their own sake, independent of their immediate utility, but he himself provides an interesting example of the practical application of his theory of the circulation, in the cure of a large tumour by tying the arteries which supplied it with blood.

The following is believed to be a complete list of all the known writings of Harvey, published and unpublished: *Exercitatio anatomica de motu cordis et sanguinis in animalibus* (1628); *Exercitatio anatomica de circulatione sanguinis: ad Johannem Riolanum* (1649); *Exercitationes de generatione animalium* (1651); *Anatomia Thomae Parr,* first published in the treatise of John Betts, *De ortu et natura sanguinis* (1669). Letters: to Caspar Hoffmann of Nürnberg, May 1636; to Schlegel of Hamburg, April 1651; three to Giovanni Nardi of Florence, July 1651, Dec. 1653 and Nov. 1655; two to Morison of Paris, May 1652; two to Horst of Darmstadt, Feb. 1654–55 and July 1655; to Vlackveld of Haarlem, May 1657. His letters to Hoffmann and Schlegel are on the circulation; those to Morison, Horst and Vlackveld refer to the discovery of the lacteals; the two to Nardi are short letters of friendship. All these letters were published by Sir George Ent in his collected works (1687). Of two manuscript letters, one on official business to the secretary, Dorchester, was printed by Aveling, with a facsimile of the crabbed handwriting (*Memorials of Harvey,* 1875), and the other, about a patient, appears in Robert Willis' *Life of Harvey* (1878). *Praelectiones anatomiae universalis* (1616)

—manuscript notes of his Lumleian lectures in Latin—are in the British museum library; an autotype reproduction was issued by the College of Physicians in 1886. An account of a second manuscript in the British museum, entitled *Gulielmus Harveius de musculis, motu locali,* etc., was published by Sir G. E. Paget (*Notice of an Unpublished Manuscript of Harvey,* 1850).

The following treatises, or notes toward them, were lost either in the pillaging of Harvey's house, or perhaps in the Great Fire of London, which destroyed the old College of Physicians: *A Treatise on Respiration,* promised and probably at least in part completed (pp. 82, 550, ed. 1766); *Observationes de usu lienis; Observationes de motu locali,* perhaps identical with the above-mentioned manuscript; *Tractatum physiologicum; Anatomia medicalis* (apparently notes of morbid anatomy); *De generatione insectorum.*

The fine edition of Harvey's works published by the Royal College of Physicians in 1766 was superintended by Mark Akenside; it contains the two treatises, the account of the post-mortem examination of old Parr, and the six letters enumerated above. A translation of this volume by Robert Willis, with Harvey's will, was published by the Sydenham society (1847).

There is a convenient photographic facsimile of the work on the circulation issued by G. Moreton (1894). The standard translation of his collected works is still that of Robert Willis (1847). A convenient reprint of the translation by Willis of the work on the circulation is available (1906).

Bibliography.—The literature that has arisen on Harvey and his great discovery would fill a library. A bibliography by Geoffrey Keynes was published (1928), and a further account of the works of Harvey on the occasion of the celebration of the tercentenary of the publication of the work on the circulation by the Royal College of Physicians, London (1928). Of later writings on Harvey mention may be made of the biography by D'Arcy Power (1897); the facsimile of Harvey's Paduan diploma issued by the Royal College of Physicians, with pamphlet by J. F. Payne (1908); the volume of *Portraits of Dr. William Harvey* published by the Historical section of the Royal Society of Medicine (1913).

The Harveian oration at the Royal College of Physicians is devoted to an annual exposition of some part of his work. Among the orations are those by W. Osler, *The Growth of Truth as Illustrated in the Discovery of the Circulation of the Blood* (1906); H. R. Spencer, *William Harvey, Obstetric Physician and Gynaecologist* (1921); A. Chaplin, *Medicine in the Century Before Harvey* (1922); C. Singer, *The Discovery of the Circulation of the Blood* (1922) gives an exposition of the history of this event. (P. H. P.-S.; C. St.)

HARVEY, a city of Cook county, Ill., U.S., is 20 mi. S. of the Chicago loop. The city was from the first both an industrial and a residential suburb of Chicago. The area was originally platted as South Lawn by a syndicate of land speculators in 1873. Rapid growth began in 1889 when Turlington W. Harvey, a Chicago capitalist, purchased some of the land, which was then swamp and prairie. The following year he organized the Harvey Land association. The population, negligible when the settlement was incorporated as a village in 1891, had increased to 5,000 by 1895 when Harvey was organized as a city. Engineering, machine-shop and metalworking industries were attracted there in the 1890s and have since dominated the industrial life of the community. For comparative population figures *see* table in Illinois: *Population.* (S. L. J.)

HARWICH, a municipal borough and seaport in Essex, Eng., lies on the extremity of a small peninsula projecting into the estuary of the Stour and Orwell, 70 mi. N.E. of London by road. Pop. (1961) 13,569.

Harwich (Herewica, Herewyck) formed part of the manor of Dovercourt. King Alfred in 885 defeated 16 Danish ships in the harbour. It became a borough in 1319 by a charter of Edward II. In 1604 James I gave it a charter which provided a new constitution, and from this date began regular parliamentary representation, though two burgesses had attended parliament in 1344. Until 1867 Harwich returned two members but in that year this was reduced to one. In 1885 the borough constituency was merged with a larger area in Essex and became the North-Eastern or Harwich division of the county. Town wall defenses were begun in 1337 and finished after a French raid in 1450. In the 14th century merchants came from as far away as Spain and there was much trade in wheat and wool with Flanders; the passenger traffic appears to have been relatively as important then as it is now. In 1578 Sir Martin Frobisher embarked at Harwich on his arctic expedition. Shipbuilding was significant in the 17th century and Harwich was an important naval base in World War I.

The town occupies an elevated situation, and a wide view is obtained from Beacon hill at the southern end of the esplanade. Many of the streets are ancient and there are several old houses. The nave of All Saints church is of the 12th century and the chancel is of the 14th century. The harbour is one of the best on the east coast of England, and in stormy weather is often used for shelter; the minimum water alongside Parkeston quay at dead low water is 17 ft. A breakwater and sea wall prevent the blocking of the harbour entrance and encroachments of the sea; and there is another breakwater at Landguard point on the opposite (Suffolk) shore of the estuary. A varied assortment of goods is exported, and imports include dairy produce from Denmark, vegetables from the Netherlands and fruit from Italy. Harwich is one of the principal English ports for continental passenger traffic, steamers providing a regular all the year round service to the Hook of Holland and Esbjerg. A train ferry to Zeebrugge was inaugurated in 1924. The continental trains of the Eastern region railway run to Parkeston quay, 1 mi. from Harwich up the Stour, where the passenger steamers start. Besides shipping, the chief industries are tailoring, light engineering and fishing. The southwestern suburb of Dovercourt, a popular seaside resort, is within the municipal borough of Harwich. A depot of Trinity House, the lighthouse and pilotage authority, was opened in 1953.

HARZ MOUNTAINS, the most northerly highland block of Germany, situated between the Weser and Elbe rivers. Their greatest length extends in a southeast and northwest direction for 60 mi., and their maximum breadth is about 20 mi. An irregular series of terraced plateaus rises here and there into rounded summits, and is intersected by narrow, deep valleys. The northwestern and higher part is known as Ober or Upper Harz; the southeastern and more extensive part, Unter or Lower Harz; while the northwest and southwest slopes of the Upper Harz form the Vorharz. The Brocken group, dividing the Upper and Lower Harz, is generally classed with the Upper. The Upper Harz includes the Brocken (3,747 ft.), the Heinrichshöhe (3,425 ft.), the Königsberg (3,379 ft.) and the Wurmberg (3,186 ft.). The Lower Harz includes the Josephshöhe (1,900 ft.) in the Auerberg group and the Viktorshöhe (1,909 ft.) in the Ramberg.

The Middle and Oberharz are the true Harz. They form a rolling plateau, 3,300 ft. high in the west and 1,600 ft. high in the centre. Above this plateau rises the Brocken (*q.v.*). The northern border is a deeply dissected fault zone. There is a less abrupt drop to the Thuringian lowland to the south. The Brocken is celebrated in legends immortalized in Goethe's *Faust.* The finest valley is the rocky Bodethal, with the Rosstrappe, the Hexentanzplatz, the Baumannshöhle and the Bielshöhle.

The Harz is a mass of Paleozoic rock rising through the Mesozoic strata of north Germany, and bounded on all sides by faults. Slates, schists, quartzites and limestones form the greater part but the Brocken and Viktorshöhe are intrusive granite, and diabases and diabase tuffs are interstratified with sediments. Silurian, Devonian and Carboniferous are represented—the Silurian and Devonian forming the greater part of the hills southeast of a line drawn from Lauterberg to Wernigerode, while northwest of this line the Lower Carboniferous predominates. A few patches of Upper Carboniferous on the borders of the hills near Ilfeld, Ballenstedt, etc., are unconformable upon the Devonian. The general strike of the folds, especially in Oberharz is about northeast. The folding took place at the close of the Paleozoic; but the faulting to which they owe their present position was probably Tertiary. Metalliferous veins are common, among the best known being the silver-bearing lead veins of Klausthal, which occur in the Culm or Lower Carboniferous.

Because of its position as the first range which the northerly winds strike after crossing the north German plain, the climate on the summit of the Harz is generally raw and damp, even in summer. In contrast, the lower slopes have a more moderate climate, and sheltered valleys enjoy congenial summer conditions. Pleas-

ant weather, the scenery, forests and legendary and romantic associations make the Harz a favourite summer resort area. Among the more popular resorts are Harzburg, Thale and the Bodethal; Blankenburg, with the Teufelsmauer and the Hermannshöhle, Wernigerode, Ilsenburg, Grund, Lauterberg, Hubertusbad, Alexisbad and Suderode. Some places also have mineral springs and baths, pine-needle baths, etc. The Harz is penetrated by several railways, among them a mountain railway up the Brocken, opened in 1898. Many resorts are also visited in winter and skiing takes place from December to March.

The highest summits are bare, but the lower slopes of the Upper Harz are rich in spruce and firs. Between the forests stretch numerous peat mosses, the spongy reservoirs of which are sources of many small streams. On the Brocken are found one or two arctic and several alpine plants. In the eastern Harz the forests contain a great variety of timber. The beech attains unusual size and beauty, and the walnut tree grows in the eastern districts. The last bear was killed in the Harz in 1705, and the last lynx in 1817, and since then the wolf has become extinct; but deer, foxes, wild cats and badgers are still found.

Mining has been carried on since the middle of the 10th century, and more than 30 places owe their origin to mining and smelting which was locally important from the 13th to the 16th century. Rich argentiferous lead was chiefly extracted, also small quantities of gold; copper, iron, sulfur, alum and arsenic were also found. Mining is now of little importance, though marble, granite and gypsum are worked, and vitriol is manufactured. Much wood is exported for building and other purposes, and it is used locally as fuel. Forestry, tourism and the harnessing of water power are the main occupations. Agriculture is practised chiefly on the plateaus of the Lower Harz, and there is good pasturage both in the north and in the south. As in Switzerland, the cows, which carry bells, are driven up into the heights in early summer, returning to the sheltered areas in late autumn.

Upper and Lower Saxon, Thuringian and Frankish stocks have all contributed to form the present people, and their influence is still to be traced in the varieties of dialect. The boundary line between High and Low German passes through the Harz. The Harz was the last stronghold of paganism in Germany, and to that fact are due its legends and fanciful names. (R. E. Di.)

HASA, AL (Arabic Al Ahsa'), the eastern province of Saudi Arabia, is bounded north by the Kuwait neutral zone, east by the Persian gulf, south by Ar Rab' Al Khali (Empty quarter) and west by the Dahna sand belt. The area is about 41,200 sq.mi. Its low coastal strip is separated by a thick belt of heavy sand dunes from the steppe-desert of the interior. It derives its name from the large oasis in its centre where about 30,000 ac. of palm groves and other crops are irrigated by flow from 60 or more artesian springs of varying degrees of temperatures, some of them 35.56° C. (96° F.), which are estimated to discharge 150,000 gal. a minute. The Khalas date is especially famous among the 36 varieties grown. The oasis population is about 180,000, of whom about 20,000 are nomads, while 152,000 are congregated in the three large towns of Al Hufuf (82,600), Ad Dammam (30,600) and Al Mubarraz (39,000), the rest being distributed among about 50 villages. The principal Hasa tribes are Al 'Ajman, Bani Khalid and Ahl Murra. They are of the Sunni sect, as also are 45% of the settled folk, while 55% of the latter are Shi'ah.

Little is known of the early history of Hasa; but during the 10th century A.D. it was a stronghold of the Carmathian movement. In later centuries it enjoyed a status of virtual independence under the Bani Khalid dynasty of 'Urair until the middle of the 18th century, when the Wahhabis (*q.v.*) conquered the province. On their defeat by the Egyptians under Ibrahim Pasha in 1818, Al Hasa came under loose Turco-Egyptian sovereignty, interrupted by periodic returns of Wahhabi control under the Saudi imams, Turki and Faisal. Then about 1873 Turkish sovereignty was reimposed on the province by Midhat Pasha: to last till 1913, when the province was wrested from the Turks by 'Abdul-'Aziz ibn Sa'ud, who thus re-established Wahhabi control on the coast of the Persian gulf, including the ports of Al Qatif, Jubail (Al Jubayl), Al 'Uqayr and Ad Dammam, all of which had memories of Carmathian and later Portuguese occupation. Incidentally it was the richest province of his realm from the revenue point of view; and remained so until the Wahhabi capture of the Hejaz (*q.v.*) in 1925.

But primacy soon returned to it with the discovery of rich oil deposits near Ad Dammam (1933–36) and the consequent grant of an oil concession in 1933 to the California Standard Oil company, whose subsidiary Aramco (Arabian American Oil company) was producing more than 1,000,000 barrels of crude oil a day by the early 1960s. The resulting wealth has transformed Saudi Arabia out of all recognition. Al Hufuf (*see* Hufuf, Al) has ceased to be the provincial capital, which is now Ad Dammam (*see* Dammam, Ad) on the coast, the principal commercial port of Saudi Arabia, whence after 1950 there was railway connection with Riyadh via the great oil centres of Dhahran and Abqaiq. In addition, the main port for oil export is at Ras Tanura, 25 mi. N. of Dhahran; and the Trans-Arabian pipeline (TAP-line) after 1951 carried vast quantities of Hasa oil to its Mediterranean terminal near Sidon (Lebanon). With the Americans and the great number of Arabs and others employed in their operations, the population of the whole province was about 500,000 in 1961.

See F. S. Vidal, *The Oasis of al-Hasa*, Aramco (1955); and the *Annual Reports* of Aramco. (H. St. J. B. P.)

HASAKEH (Hasakah; Haseke; Haseje; Fr. Hassetché), a *muhafaza* (governorate) of northeast Syria. Pop. of the *muhafaza* 351,661 (1960). The district was formerly known as Qamishliye (Qamishli, Fr. Kamechlié). The administrative centre is Al Hasakah. Until World War II the arid steppe-land to the south of the region was to a large extent uncultivated, but as a result of improved irrigation it has been intensively developed, and with the region to the north of Al Hasakah town yields the bulk of the Syrian wheat. The northern area has always been more fertile and has a higher rainfall.

Al Hasakah town lies on the Khabur river (a tributary of the Euphrates) about 85 mi. N.N.E. of Dayr az Zawr (Deir ez Zor). Pop. (1960) 17,944. Its modern buildings include schools, hospitals, factories and cinemas, and there is a small garrison. It is an important road junction, linked south with Dayr az Zawr and north with Al Qamishli and Nisibin (Nusaybin), which lie on the Turkish border where the Baghdad-Mosul-Aleppo railway and the Baghdad-Mosul-Urfa road enter Turkey.

There appears to be little evidence of prehistoric settlement there, but the place had become fairly important by the 1st millennium B.C. To the Assyrians it was known as Sha-Dikannu and paid tribute to Tukulti-Ninurta II (889–884 B.C.). It was called Sakane by the classical writers and medieval Arab geographers knew it as Hashashak. Under the Ottoman empire, it lost its importance, but revived during the French mandate of Syria after 1932 with the settlement there of Assyrian refugees from Iraq. (M. V. S.-W.)

HASAN, AL- (al-Hasan ibn Abi al-Hasan al-Basri) (642–728), Arabian theologian, highly influential in the development of Sufism (*q.v.*) and the Mu'tazila school, was born at Medina, the son of a freedman. He became a teacher at Basra and founded a school there, among his pupils being Wasil ibn 'Ata', founder of the Mu'tazilites. Hasan, who was noted for his eloquence, learning, piety and asceticism, was a great supporter of orthodoxy. With him fear is the basis of morality, and sadness is characteristic of his religion. In politics he adhered to the earliest principles of Islam, being strictly opposed to the inherited caliphate of the Omayyads and a believer in the election of the caliph. He died at Basra on Oct. 10, 728.

See H. A. R. Gibb and J. H. Kramers (eds.), *Shorter Encyclopaedia of Islam*, p. 136 (1953), with bibliography.

HASAN AND HUSAIN (called al-Hasanan, "the two Hasans"), sons of the fourth Muslim caliph, 'Ali, by his wife Fatima, daughter of Mohammed. On 'Ali's death Hasan, the elder son, was proclaimed caliph; but the strength of Mu'awiya, who had rebelled against 'Ali, was such that Hasan resigned his claim on condition that he should have the disposal of the treasure stored at Kufa, with the revenues of Darabjird. This secret negotiation came to the ears of Hasan's supporters, a mutiny

broke out and Hasan was wounded. He retired to Medina where he died about 669. The story that he was poisoned at Mu'awiya's instigation is generally discredited. Subsequently his younger brother Husain revolted against Mu'awiya's successor, Yazid, but was defeated and killed at Karbala (Iraq) on Oct. 10, 680. Husain is the hero of the religious drama performed annually (*e.g.*, at Karbala) on the anniversary of his death by the Shi'ites of Persia and India, to whom the family of 'Ali are the only true heirs of Mohammed (*see* SHI'ISM).

See Sir W. Muir, *The Caliphate*, rev. ed. (1915); Sir Lewis Pelly, *The Miracle Play of Hasan and Husain* (1879); D. M. Donaldson, The Shi'ite Religion (1933).

HASDAI IBN SHAPRUT (HASDAI ABU YUSUF BEN ISAAC BEN EZRA IBN SHAPRUT) (915–975), a central Jewish figure during the brilliant reign of the Omayyad caliph Abd-al-Rahman (*q.v.*) III of Córdoba and of his son and successor al-Hakam II (*see* CÓRDOBA, CALIPHATE OF). Hasdai gained eminence in the Arab world and in the domain of Jewish culture. Though he was officially a court physician, his linguistic talents and persuasive personality were utilized for delicate diplomatic missions as intermediary between Muslim and Christian rulers: he arranged treaties between the caliph and the Byzantine emperor, and between the representative of Islam and the Christian kings of Spain and Germany. Hasdai also showed adeptness in state finances and in translating scientific works into Arabic. He helped inaugurate the golden age of Spanish Judaism, gathering under his patronage literary personalities who became the founders of neo-Hebrew poetry, biblical exegesis and scientific Hebrew grammar. Hasdai fostered talmudic study and Jewish law, making Spanish Jewry relatively independent of the eastern academies, a policy pleasing to the Córdoba caliphate.

Hasdai's correspondence (penned by Menahem Saruk, his literary secretary) with a Jewish Khazar king, Joseph, is noteworthy, revealing the statesman enthralled by the vision of a Jewish king ruling over an independent kingdom (*see* KHAZARS). This letter and the king's response led a shadowy existence till their unexpected publication in the 16th century. After much controversy, the authenticity of both letters and the accuracy of their information seem well established.

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HASDEU, BOGDAN PETRICEICU (1836–1907), Rumanian philologist, who was a pioneer in many branches of Rumanian philology and history, was born at Khotin, Bessarabia, on Feb. 16, 1836, and studied at the University of Kharkov. At Iaşi he started his *Archiva historica a Romaniei* (1865–67), in which a large number of old documents in Slavonic and Rumanian were published for the first time. In 1870 he inaugurated *Columna lui Traian*, the best philological review of the time in Rumania. In his *Cuvente den Bătrâni* (2 vol., 1878–81) he was the first to contribute to the history of apocryphal literature in Rumania. His *Historia critica a Romanilor* (1875), though incomplete, marks the beginning of critical investigation into the history of Rumania. Hasdeu edited the ancient Psalter of Coresi of 1577 (*Psaltirea lui Coresi*, 1881). In 1876 he was appointed director of the state archives in Bucharest and in 1878 professor of philology at the University of Bucharest. His works include one drama. After the death of his only child, Julia, in 1888 Hasdeu became a mystic and a strong believer in spiritualism. He died at Campina on Aug. 25, 1907. (M. G.)

HASDRUBAL, the name of several Carthaginian generals, the most important being:

1. The son-in-law of Hamilcar Barca (*q.v.*), whom he followed in his campaign against the governing aristocracy at Carthage at the close of the First Punic War and in his subsequent wars in Spain. After Hamilcar's death (winter 229/228 B.C.), Hasdrubal, who succeeded him in the command, extended the new province by diplomacy and consolidated it by the foundation of New Carthage (Cartagena) as its capital and by a treaty with Rome in *c.* 226/225 B.C. which fixed the frontier on the Ebro river. In 221 he was killed by an assassin.

2. The second son of Hamilcar Barca (d. 207 B.C.). Left in command of Spain when his brother Hannibal went to Italy (218 B.C.), he fought for seven years against Publius Cornelius Scipio and his brother Gnaeus. A defeat on the Ebro in 215 prevented him from joining Hannibal in Italy at a critical moment, but in 211 he completely routed his opponents. He was subsequently outgeneraled at Baecula by the younger P. Cornelius Scipio (208). Nevertheless, by a retreat he evaded Scipio and broke into central Italy to join Hannibal. He was ultimately defeated in 207 on the banks of the Metauro river, his head being thrown into Hannibal's camp by order of the Roman general Gaius Claudius Nero.

3. Hasdrubal, son of Gisco, commanded Carthaginian armies in Spain (214–206 B.C.) along with Mago but was defeated in 206 at Ilipa (mod. Alcalá del Río) by Scipio Africanus. Hasdrubal continued operations against Scipio in Africa during 205–203 in alliance with Syphax, king of the Massaesyli, to whom Hasdrubal's daughter Sophonisba was married. Accused of treason, he committed suicide before the battle of Zama. (*See* HANNIBAL.)

4. Another Hasdrubal commanded the Carthaginian armies against Masinissa and was defeated by him in 150 B.C. He was condemned to death but was reinstated in command at the outbreak of the Second Punic War. He led the siege of Carthage against Scipio Aemilianus in 148 and surrendered to him in 146.

See works listed in bibliographies of HANNIBAL; PUNIC WARS; *see* also B. H. Warmington, *Carthage* (1960). (WM. C.)

HASHEMITE KINGDOM OF JORDAN: *see* JORDAN.

HASHEMITES, the Arab descendants, either direct or collateral, of the prophet Mohammed, from among whom came the family who created the 20th-century Hashemite dynasty. Mohammed himself was a member of the house of Hashem (Hashim), a subdivision of the Kuraish (Quraish, Koreish) tribe. The most revered line of Hashemites passed through Hasan, son of the prophet's daughter Fatima and her husband, 'Ali, the fourth caliph. Hasan was the last of this line to hold the caliphate, but his progeny eventually established themselves as hereditary amirs of Mecca, the role continuing under Turkish rule. Of such stock were Husain ibn Ali (*q.v.*), amir of Mecca and king of Hejaz from 1916 to 1924, and his sons Faisal (*see* FAISAL I) and Abdullah (*see* ABDULLAH IBN HUSAIN), who became kings of Iraq and Jordan respectively, thus founding the modern Hashemite dynasty. King Husain of Jordan (*see* HUSAIN IBN TALAL) is the grandson of Abdullah.

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HASHISH (HASHEESH), the Arabic name, meaning literally "dried herb," for the various preparations of the true hemp plant (*Cannabis sativa*) used as a narcotic or intoxicant in the east, and either smoked, chewed or drunk. From the Arabic *hashishin*, *i.e.*, "hemp-eaters," comes the English "assassin" (*see* ASSASSIN).

See HEMP: *Hemp as a Drug Plant*.

HASIDISM refers to the pietist movement in Judaism that rose in the southeastern districts of Poland (Volhynia, Podolia) in the 18th century. In character it was not unlike the contemporary pietist movements in Protestantism—both Jewish and Protestant pietists were reacting against an orthodox system that had become rigidly legalistic and in which the spiritual yearnings of the common people were lost.

Origins and Early Development.—The Hebrew word *Hasidim* ("the pious," "the devout") had been used to designate other extremely devout groups—notably the Assideans or Hasideans of the 3rd and 2nd centuries B.C., who were the philosophical ancestors of the Pharisees (*see* JEWISH SECTS DURING THE SECOND COMMONWEALTH); and the mystics of 12th- and 13th-century German Jewry of whom Samuel the Hasid, Judah the Hasid and Eleazar of Worms are the best known (*see* CABALA: *The Hasidim of Medieval Germany*). The modern Hasidist movement, which amounted to a spiritual revolution among the Jews of eastern Europe, was founded by Israel ben Eliezer (*c.* 1700–60), called the Baal Shem-Tob ("Master of the Holy Name"), or BeShT,

who was born in Okopy, Podolia, and was active especially in Miedzyhorz. This simple, contemplative, mystically inclined youth became steadily more dissatisfied with the rigid, rationalist orthodoxy of the time, and his saintliness, his dedication to the spiritual needs of the common man, his Cabalistic "unifications" and his repeated cures of the sick earned him the name of a miracle worker. His beautiful parables and mystic expositions of Scripture attracted a group of followers that formed the nucleus of the Hasidist movement.

Many of the Baal Shem's teachings were developments of the doctrines of earlier mystical movements in Judaism. He taught that true religion is manifest not in the traditional rabbinic scholarship or in ascetic withdrawal from the world but in the knowledge of the immanence of God in all existence. Awareness of this fact leads to ever greater communion with God, mainly through prayer, though true worship relates to all the activities of life, including such pursuits as the partaking of food. Evil is the base of good; the "evil urge" within man may be transmuted into passionate striving for good. There is an interrelationship between heaven and earth, the "upper" and the "lower" worlds; all of man's actions have cosmic significance. The service of God, rendered in a joyous mood, restores harmony to the disunited world and facilitates the flow of saving grace. Routine, formalism and moral complacency are harmful; a trusting heart and enthusiasm (*hitlahuvut*) are virtues. Yet, facing God, the *Hasid* is to be indifferent to his environment. Israel is conceived as a cosmic factor; it is the focal point of creation.

Hasidism developed under the guidance of the Baal Shem's successors, Jacob Joseph (d. *c.* 1782) of Polnoye (Polonnoje) and, especially, Dov Baer (*c.* 1704–72), the "Great Preacher" of Mezhiritch, the actual founder of the hasidic community. Unlike his master, Dov Baer was a talmudic scholar, and he was therefore able to promote Hasidism in Lithuania, a centre of rabbinic learning. His doctrine generalized the Baal Shem-Tob's concept of his own cosmic role, assigning immense importance to the leader of the hasidic community, the *rebbe* (rabbi) or *zaddik* ("the righteous one"), and thus making possible the existence of many hasidic societies, each clustering around a different *zaddik*. In deviation from classical Jewish thinking, the *zaddik* was conceived as an intermediary between man and God, with the power of intercession on behalf of his flock. Popular trust in the superhuman faculties of the *zaddikim* was a powerful factor in the spread of hasidic communities, as was the dissolution by governmental authorities in 1764 of the central Jewish authority and over-all communal organization in eastern Europe, known as the "Council of the Four Lands." By the end of the 18th century multitudes of Jews in the Polish lands and in some sections of White Russia and Lithuania were following the hasidic doctrine. Special houses of prayer served the pietist groups, and the Sephardic (Spanish) liturgic ritual was taken over by the *Hasidim* from the Lurianic mystics. The *zaddik*'s home became a religious centre for the faithful. Dancing, religious song, ritual ablutions and the sacred communal meal in the presence of the *zaddik* played an important part in the life of the *Hasid*.

Opposition.—The hostility of the learned Talmudists toward the hasidic sectarians led to a series of steps outlawing the movement. The first of such measures by the *Mithnagdim* ("opponents") was a ban of excommunication, pronounced by Elijah ben Solomon, the Vilna *gaon*, in 1772. The opposition of the *Mithnagdim* was based to a large extent on the similarities they observed between the practices of the *Hasidim* and those of the Sabbatians and Frankists (*see* FRANK, JAKOB; SABBATAI ZEBI). They protested against the excessive veneration of the *zaddik*, the pantheistic emphasis and the preoccupation of the early *Hasidim* with the more esoteric teachings of Cabala.

Development of Hasidic Doctrine.—Among the followers of the Baal Shem and the "Great Preacher" who were instrumental in establishing the authoritative hasidic schools were Elimelekh (d. 1787) of Lizhensk (Lezajsk), Galicia; Jacob Isaac (d. 1815), "the Seer" of Lublin, Pol.; Nahum (1730–98) of Chernobyl; Levi Isaac (1740–1809) of Berdichev; and Shneur Zalman (*c.* 1748–1813) of Ladi. Elimelekh of Lizhensk, a former mystic from the school of Isaac Luria (*q.v.*) and an ascetic, through his belief that the charismatic powers of the *zaddik* pass to his son helped to foster the dynastic principle of hasidic leadership. Jacob Isaac of Lublin, a disciple of both the "Great Preacher" and of Elimelekh of Lizhensk, popularly believed to enjoy the gift of clairvoyance, emphasized the need for humility and for overcoming melancholy, in which "the evil spirit" dwells. He interpreted the Napoleonic Wars as the eschatological war of Gog and Magog that was to precede the messianic redemption, and he was prepared to employ magic to "hasten the end." In this he was opposed by his disciple, Jacob Isaac (d. 1814) of Pzhysha (Przysucha), called "the holy Jew," who believed in the patient, gradual, ethico-religious preparation for the Messiah.

Nahum of Chernobyl, a disciple of the Baal Shem, taught that all things created are but symbols of the divine reality. Levi Isaac of Berdichev, a disciple of the "Great Preacher," was the author of *Qedushat Levi* ("The Holiness of Levi," 1798), a commentary on the Pentateuch in which he expounded, in agreement with his master, the divine aspect of man, God as both unfathomable and close to man, love as man's basic attitude toward the world, the election of Israel and the ultimate unity of mankind. Another follower of the "Great Preacher," Menahem Mendel of Vitebsk, migrated in 1777 to Palestine, leading a group of 300 *Hasidim* who hoped to hasten the advent of the Messiah by prayer and penitence in the Holy Land.

A grandson of the Baal Shem, Baruch (*c.* 1757–1811) of Miedzyborz, preached asceticism and penance; since, however, the character of the *zaddik* could not be grasped by ordinary categories, Baruch himself lived in luxury and arrogance. The chief hasidic leader in White Russia was Shneur Zalman of Ladi, author of *Tanya* (1795). His doctrine, known as HaBaD (*Hokhmah-Binah-Daat*, Wisdom-Understanding-Knowledge), combines mystical piety with rationalism and rabbinic learning. Despite this adjustment to the established tradition, arrived at by other hasidic leaders as well, the opposition of the *Mithnagdim* continued.

Decline.—From the beginning of the 19th century, the original conceptions of Hasidism gradually declined. The *zaddikim* gained excessive power; the dynastic principle proved detrimental; elaborate "courts" replaced the simplicity of the original mystical brotherhood. Nahman (1771–1810) of Bratslav, a great-grandson of the Baal Shem, struggled against "zaddikism" and attempted to restore Hasidism to its pristine purity of faith.

An incisive criticism of the classical hasidic doctrine was launched by Mendel (1787–1859) of Kotzk, a disciple of Jacob Isaac of Lublin. The Baal Shem and his successors emphasized love, mercy, joy, optimism, consideration for people, and stressed religious fellowship. Mendel pointed to the tragic aspect of existence, to the chaos in man's soul; he demanded solitude, individual striving toward perfection and the discipline of learning; and he rejected compromise. However, the "dynasties" continued to flourish. In eastern Europe before World War II, the *Hasidim* were a numerically strong group within Orthodoxy.

Outstanding among the hasidic "dynasties" were those founded by Nahum of Chernobyl; by Israel (d. 1850) of Ruzhin, Ukraine, and later of Sadgora, Bukovina; and by Shneur Zalman of Ladi (Zalman's descendants moved to Lubavitch, the name of which came to designate this dynasty). From its native lands, Hasidism spread to Rumania, Hungary and Palestine. In the second half of the 19th century the dynasty of Ger (Gora Kalwaria, near Warsaw), established by Isaac Meir ben Israel, rose to a central position. Occasionally a woman was elected to the position of hasidic leadership, notably Hannah Rachel (b. 1815), "The Maid of Ludomir."

After World War II.—World War II destroyed the massive base of the movement; among those that survived the war, the Lubavitch, Skvir and Satmar groups emerged as the most active; from their new centres in Brooklyn, New Square (for New Skvir) and Williamsburg, New York city, they initiated a revival of Hasidism in the new world.

In Israel the Satmar group supports the *Neturei Karta* ("Watchmen of the City") in Jerusalem, militant opponents of the secular Jewish state; the Lubavitch movement maintains a

network of religious schools and a youth village in Israel (Kfar Habad, near Lydda). Other hasidic groups that migrated to Israel co-operate with Agudat Israel, the Orthodox political party. In the early 1960s there were an estimated 200,000 Hasidim in the world.

See CABALA; *see* also references under "Hasidism" in the Index volume.

BIBLIOGRAPHY.—The first presentation of hasidic thought, in the form of sermons, was *Toledot Yaakov Yosef* ("The Generations of Jacob Joseph"; 1782) by Jacob Joseph of Polnoye. The legends that grew up around the founder and his circle were first published in 1815 as *Shibhe ha-Besht* ("The Praise of the Baal Shem"); an edition by S. A. Horodezky was published in 1922. *See* also M. Buber, *Tales of the Hasidim*, 2 vol. (1947–48), and *Hasidism* (1936), which gave rise to a "neohasidic" trend among western and Israeli intellectuals; S. Dubnow, *Geschichte des Chassidismus*, 2 vol. (1931); L. I. Newman and S. Spitz, *The Hasidic Anthology* (1934); G. G. Sholem, "Hasidism: the Latest Phase," in *Major Trends in Jewish Mysticism* (1946); M. S. Geshuri, *La-Hasidim Mizmor* ("The Song of the Hasidim," 1936), which deals with hasidic melody; Yitzhak Werfel, *Sefer ha-Hasidut* ("Book of Hasidism"), in effect a lexicon of Hasidism. (N. N. G.)

HASKOVO, Bulgaria: *see* KHASKOVO.

HASLEMERE, an urban district (1933) of Surrey, Eng., lies 42 mi. S.W. of London by road in an elevated valley between the ridge of Hindhead (Gibbet hill, 895 ft.) and Blackdown (918 ft.). Pop. (1961) 12,528. Both hill areas, covered with open heath and self-sown conifers, are National trust property. On the eastern slope of Blackdown stands Aldworth house, built for Alfred, Lord Tennyson, who died there in 1892. The Dolmetsch family settled in Haslemere in 1925 (*see* DOLMETSCH, ARNOLD); the musical instruments made there are used at the annual Dolmetsch festival of early music and exported all over the world. The manor of Haslemere was formerly part of the royal manor of Godalming; the urban district council is now the owner of the manorial rights and deeds. Haslemere was a borough from 1596 to 1832. The Educational and Natural History museum was founded in 1895 by Sir Jonathan Hutchinson. Gen. James Edward Oglethorpe, founder of the state of Georgia, was member for parliament for Haslemere. The town is residential, with many houses dating from the 15th century. There is easy access to London by road and rail. (G. R. Ro.)

HASLINGDEN, a market town and municipal borough (1891) in the Rossendale parliamentary division of Lancashire, Eng., 17 mi. N.N.W. of Manchester by road. Pop. (1961) 14,370. The old town stood on a slope on the border of the ancient Rossendale forest, but the modern part has extended about its base. The parish church of St. James (rebuilt 1780) retains a 16th-century tower. Woolen manufactures have largely given place to the making of cotton goods, rubber, footwear, poultry equipment (pedigree poultry are bred), chemicals and engineering; stone is quarried nearby. There is a weekly cattle market. To the northwest is Haslingden moor and Thirteen Stones hill, once an ancient stone circle.

HASMONAEANS: *see* MACCABEES.

HASSAM, (FREDERICK) CHILDE (1859–1935), U.S. painter and etcher, an important exponent of Impressionism in American art, was born in Dorchester, now part of the city of Boston, Mass., on Oct. 17, 1859, and studied in Boston and Paris. He soon fell under the influence of the Impressionists, and took to painting in a style of his own, in brilliant colour, with effective touches of pure pigment. He settled in New York city on his return from Paris, where he became a member of the group of U.S. Impressionists known as the Ten American Painters. Scenes of New York life remained his favourite subject matter, though he also did New England and rural New York landscapes. Hassam received many medals and awards. He died on Aug. 27, 1935.

HASSAN, a town and district in Mysore state, India. The town, 60 mi. N.W. of Mysore city by rail, is an important trading centre and the district headquarters. Pop. (1961) 32,172. The town, which dates from the 12th century, was in the Balam province and was annexed to Mysore in 1690. Standing 3,084 ft. above sea level, it has a cool and humid climate with an average annual rainfall of 38 in. There are a degree college affiliated to Mysore university, a government implement factory, several rice mills and engineering and cement works. It is served by a line of the Southern railway, which runs from Arsikere to Mysore.

HASSAN DISTRICT is situated in the western part of Mysore state. Area 2,638 sq.mi. Pop. (1961) 895,847. It is divided into the western hill region (Malnad) and the eastern plateau region (Maidan) and is drained by the Hemavati river, an important tributary of the Cauvery. It consists of eight *talukas*, that of Manjarabad being covered with evergreen tropical forests. The minerals are chromite, gypsum, kaolin and magnesite. Coffee and cardamom are the plantation crops in the wet parts of the west, while in the Maidan zone dry crops such as millets and oilseeds are grown. Halebid, now a village in the Belur *taluka*, marks the site of the ancient city of Dorasamudra, the wealthy capital of the Hoysala dynasty (11th–14th century). Another remarkable monument is the Sravana Belgola with a famous Jain temple.

(G. K. GH.)

HASSAN IBN THABIT (*c.* 563–*c.* 674), Arab poet, best known for his poems in defense of Mohammed. He was born in Medina, a member of the tribe of Khazraj. In his youth he traveled to Hira and Damascus, then settled in Medina, where, after the advent of Mohammed, he accepted Islam and became the new religion's first poet, using in his verse many phrases from the Koran. He is said to have lived to be over 110 years old. He was an able satirist, but his poetry is regarded as lacking in distinction. His works were edited by H. Hirschfeld, with introduction (1910).

HASSE, JOHANN ADOLPH (1699–1783), German composer famous for his operas. Born at Bergedorf near Hamburg on March 25, 1699, he began his career as a singer and made his debut as a composer at Brunswick in 1721 with the opera *Antioco*. He went to Italy to complete his studies with N. A. Porpora and, later, with Alessandro Scarlatti, to whom he owed his first Italian commission, a serenade, which was performed by two of the greatest singers in Italy, Vittoria Tesi and Farinelli. In 1726 his *opera seria*, *Sesostrate*, written for the royal opera at Naples, made him famous throughout Italy as "Il Sassone" ("the Saxon"). He spent several years in Venice, where he married the singer Faustina Bordoni (1700–81), with whom he was invited to Dresden by the elector of Saxony. Hasse later lived in Dresden from 1739 until 1763, when he and his wife retired from court service. They then went to Vienna, where Hasse wrote several more operas. His last stage work was *Ruggiero* (1771), written for the wedding of the archduke Ferdinand at Milan. Hasse died in Venice on Dec. 16, 1783.

Hasse's compositions include 56 operas, as well as oratorios, masses and instrumental works. The popularity of his music during his lifetime was enormous. The two airs that Farinelli (*q.v.*) sang every evening for ten years to the melancholy king Philip V of Spain were both by Hasse. The chief characteristics of Hasse's music were melodic beauty and formal balance. His operatic overtures had a considerable influence upon the development of the symphony, especially in north Germany. Several of his flute concertos have been reprinted; his opera *Arminio* has been published in *Das Erbe deutscher Musik*, vol. xxvii (1957), and the oratorio *La Conversione di S. Agostino* appears in *Denkmäler deutscher Tonkunst*, vol. xx (1904).

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HASSELT, ANDRÉ HENRI CONSTANT VAN (1806–1874), Belgian romantic poet who exercised a strong influence on French literature in Belgium before the revival inspired by the founding of the literary periodical *La Jeune Belgique* (1881). He was born in Maastricht, Holland, on Jan. 5, 1806, and obtained Belgian nationality in 1833, settling in Brussels, where he was employed at the Bibliothèque de Bourgogne before becoming an inspector of schools. He knew Victor Hugo, Alexandre Dumas and other French romantic writers, but was also influenced by the German lyric poets. His first book of poems, *Primevères* (1834), was followed by the patriotic *La Belgique* (1842) and by poems on a variety of themes. His chief work, *Les Quatre Incar-*

nations du Christ, appeared first in 1863, and was augmented in 1867 and re-edited in 1908. He also wrote novels for young people, and a few historical studies. He died in Brussels, Dec. 1, 1874.

In spite of imperfections of form and a declamatory style, Van Hasselt's work remains one of the highest achievements in Belgian poetry during the greater part of the 19th century. Romantic in conception and austerely spiritual, it displays great literary beauty. His chief contribution, however, consists in his introduction into French prosody of rhythms and metrical devices from German poetry, which he knew by heart.

Van Hasselt's masterpiece is his epic, *Les Quatre Incarnations du Christ*, in which he presents great historical events as marking the progress of society under the influence of Christianity toward a final establishment of Christ's kingdom upon earth. The poem is admirably constructed and is often extremely moving.

His works were published in ten volumes (1876–77).

See M. Reichert, *Les Sources Allemandes des oeuvres poétiques d'André van Hasselt* (1933). (J.-E.-M.-G. D.)

HASSELT, the capital of the Belgian province of Limburg, lies on the Demer river, 39 km. (24 mi.) N.W. of Liège by road. Pop. (1961) 36,618. The principal buildings include the largely 14th- and 15th-century church of St. Quentin and an 18th-century Béguine house (now a museum), and there is a monument to the peasants whose uprising was crushed by French troops in 1798. It was at Hasselt on Aug. 6, 1831, that the Dutch obtained their chief success over the Belgian nationalists during the war of independence. A septennial fete is held on the day of Assumption, Aug. 15, in honour of the Virgin under the name of Virga Jesse; the figure of a giant (the "long man") is paraded on this occasion.

Hasselt was for centuries a centre of administration, market town and home of distilleries, and the gin called Hasselt spirit is still produced. Since the extraction of coal began in the Campine to the north, it has grown as an important centre of industry, trade and education. It stands on the Albert canal and at the junction of several important roads (from Liège, Maastricht, Eindhoven, Brussels, Namur) and railways. (Ca. S.)

HASSENPFLUG, HANS DANIEL LUDWIG FRIEDRICH (1794–1862), Hessian statesman whose attempts to promote ultrareactionary government in Germany won him the nickname of "Hessenfluch" (Curse of Hesse), was born at Hanau on Feb. 26, 1794. Graduating in law at Göttingen (1816), he became an assessor in the judicial chamber of the Hesse-Kassel board of government, to which his father Johann Hassenpflug also belonged. Appointed minister of justice and then minister of the interior in 1832, he set to work to undo the liberal constitution of 1831 (*see* HESSE), but was dismissed in 1837. He then went to serve as head of the administration of Hohenzollern-Sigmaringen (1838–39), as civil governor of Luxembourg (1839–40) and in the Prussian judicial service (1841–50). A conviction for peculation was reversed on appeal.

Recalled to Hesse-Kassel by the elector Frederick William I, Hassenpflug resumed his struggle against the constitution. Opposed by all classes and even by the army, he resolved to rely on support from Austria, which was working to restore the state of affairs overthrown by the revolution of 1848 (*see* GERMANY: *History*). Having persuaded the elector to secede from the Prussian-sponsored Erfurt union, he fled with him to Frankfurt where, on Sept. 21, 1850, they induced the *Bundestag* (German federal diet) to decree armed intervention against the Hessian liberals. The Austro-Bavarian execution of the decree nearly led to war with Prussia, which sent troops into Hesse, but the situation was resolved by the Olmütz agreement (Nov. 1850), whereby the Prussian troops were withdrawn.

Returning to Hesse, Hassenpflug in 1852 introduced a new constitution (bicameral). The elector's son-in-law Maximilian, Graf von Isenburg-Wächtersbach, publicly horsewhipped him (Nov. 1853) but was pronounced insane, so that Hassenpflug's resignation was not accepted. Hassenpflug, however, was at last dismissed on Oct. 16, 1855. He died at Marburg on Oct. 10, 1862, a few months after the constitution of 1831 had been largely restored (June 21).

See P. Losch, article in *Zeitschrift des Vereins für hessische Geschichte*, vol. 63 (1940).

HASSLER, HANS LEO (1564–1612), the most famous German composer of his day, was born in Nürnberg on Oct. 26, 1564. He presumably studied music with his father, the organist Isaak Hassler (d. 1591). After mastering the imitative techniques of Orlando di Lasso and the fashionable polychoral style of the Venetians, he traveled to Venice in 1584 to study with Andrea Gabrieli, in whose nephew and pupil Giovanni Gabrieli he found a close friend. The light, elegant secular music of O. Vecchi, B. Donato and G. Gastoldi and the keyboard works of the Venetian school soon attracted him. In 1585 he returned to Germany as organist to the Augsburg banking family of Fugger. By 1591 he enjoyed the favour of the emperor, Rudolph II, who later ennobled him. In 1600 he was appointed director of music for Augsburg city, moving to a similar post in Nürnberg in 1601. In 1608 he became organist to the elector of Saxony. He died in Frankfurt on Aug. 19, 1612.

Hassler's style is a remarkable fusion of German counterpoint and Italian form. His *Madrigali* (1596), though avoiding the harmonic experiments of L. Marenzio, are among the finest of their time. His instrumental compositions and his church music—Protestant and Roman Catholic—were widely imitated. His German songs owe much to the homophonic dance rhythms of Gastoldi; the best-known collection was the *Lustgarten* (1601), which contains the charming "Mein gmüth ist mir verwirret." This tune reappears in Bach's *St. Matthew Passion* under the title "O Haupt voll Blut und Wunden."

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HASTINAPUR, an ancient, ruined city of India, in the Meerut district of Uttar Pradesh, lying on the banks of a former bed of the Ganges, 22 mi. (35 km.) N.E. of Meerut. It formed the capital of the great Pandava kingdom, celebrated in the *Mahabharata*, and probably one of the earliest Aryan settlements outside the geographical area of the Punjab. Tradition points to a group of shapeless mounds as the residence of the Lunar princes of the house of Bharata whose deeds are commemorated in the great national epic. The town was swept away by a flood of the Ganges, and the capital was transferred to Kausambi (modern Kosam).

HASTINGS, the name of a famous English family. SIR HENRY DE HASTINGES (d. 1269) was the son of Sir Henry de Hastinges (d. *c.* 1250) and of Ada, 4th daughter of David, earl of Huntingdon, younger brother of the Scottish king William the Lion. He was summoned to parliament (1264) as a baron by Simon de Montfort, whose party he supported throughout the Barons' War of 1263–67. He was at the battles of Lewes (1264) and Evesham (1265) and defended Kenilworth castle against Henry III (June–Dec. 1266). His son JOHN (d. 1313) unsuccessfully claimed, through his grandmother, a third of the kingdom of Scotland after the throne fell vacant on the death (1290) of Margaret, the maid of Norway. He served Edward I in Wales and Scotland and was twice seneschal of Gascony. LAWRENCE (d. 1348), grandson of John, was created earl of Pembroke (1339). On the death (1389) without issue of JOHN, grandson of Lawrence, the earldom reverted to the crown and the barony of Hastings became dormant.

SIR WILLIAM HASTINGS, summoned to parliament by writ as Lord Hastings of Hastings (1461) and executed (1483) by order of Richard III, belonged to an early cadet branch of the family. His grandson GEORGE (d. 1544) was created earl of Huntingdon (1529) and his descendants held that title (*see* HUNTINGDON, EARLS OF) until the death (1789) of FRANCIS HASTINGS, 10th earl. The barony passed to his sister, ELIZABETH (d. 1808), countess of Moira; her son was Francis Rawdon-Hastings (1754–1826), created Viscount Loudoun, earl of Rawdon and marquess of Hastings (1817).

HASTINGS, FRANCIS RAWDON-HASTINGS, 1ST MARQUESS OF (1754–1826), British soldier and colonial administrator, chiefly notable for his services in India, was born on Dec. 9,

1754. He was the son of Sir John Rawdon of Moira, County Down, Ire., 4th baronet, who was created Baron Rawdon of Moira and afterward earl of Moira, in the Irish peerage. He was educated at Harrow and Oxford and joined the army in 1771 as ensign in the 15th foot. His life may be divided into four periods: from 1775 to 1781 he was engaged with much distinction in the American Revolutionary War; from 1783 to 1813 he held various high appointments at home, took an active part in the business of the house of lords and belonged to the circle of the prince of Wales (later George IV); from 1813 to 1823 was the period of his labours in India; the final years of his life were spent as governor of Malta (1824–26). He was created an English peer, Baron Rawdon, in 1783 and succeeded his father as earl of Moira in 1793.

In 1812 Moira was appointed governor general of Bengal and commander in chief of the forces in India. He landed at Calcutta and assumed office in Oct. 1813. One of the first questions awaiting him was that of relations with the Gurkha state of Nepal. Moira, after studying the question, declared war in Nov. 1814. Though heavily outnumbered, the Gurkhas made a valiant resistance along their 600-mi. frontier. In 1816 they abandoned the disputed districts, ceded some territory to the British and agreed to receive a British resident. For this success Lord Moira was made marquess of Hastings in 1817. He had now to deal with a combination of Maratha powers. In 1816 the Pindaris entered British territory in the northern Circars, where they destroyed 339 villages. Hastings drew up a comprehensive plan; toward the end of 1817 he offered the Maratha powers the choice of co-operation against the Pindaris, or war. The peshwa, the raja of Nagpur and the Holkar army successively chose war and were successively defeated. The Pindari bands were finally broken up and the way was open for a comprehensive settlement. The peshwa's territories were annexed; the Rajput princes, freed from the Marathas, accepted British supremacy.

Hastings obtained the cession by purchase of the island of Singapore in 1819. In internal affairs he proved himself to be a successful administrator as well as a skilful general. During his many tours he observed the ruined state of the countryside and he took the first steps toward rehabilitation. He began the repair of the Mogul canal system; he encouraged education in Bengal; he began the process of "indianization" by raising the status and powers of subordinate Indian judges; and he took the first measures for the revenue settlement of the extensive "conquered and ceded" provinces of the northwest. In his last years he became entangled in the commercial affairs of William Palmer and company, who had obtained a financial stranglehold over the state of Hyderabad, in consequence of which Hastings left India on Jan. 1, 1823.

In 1824 Hastings received the comparatively minor post of governor of Malta. He died on Nov. 28, 1826.

See M. S. Mehta, *Lord Hastings and the Indian States* (1930).
(T. G. P. S.)

HASTINGS, FRANK ABNEY (1794–1828), British sailor, son of Lieut. Gen. Sir Charles Hastings, was the first commander to employ in a naval action a vessel with auxiliary steam power and carrying heavy guns. A boy at the battle of Trafalgar, he was dismissed from the Royal Navy in 1820 for a breach of discipline. An intrepid sailor and admirer of Lord Byron, he joined the insurgent Greeks in April 1822. A few months' service in the "Themistocles" (he later fought on land in Argolis and Crete) convinced him of the inadequacy of the small Greek naval vessels. Early in 1824 he persuaded the Greek government to buy two steamships, a plan he had earlier suggested to Byron, and promised to contribute £5,000 himself. On arriving in England in Oct. 1824 to make arrangements, he learned that the London-Greek committee was negotiating for Lord Thomas Cochrane's services. He persuaded the committee to stake £160,000, part of which was intended for a military expedition, on six steamships for Cochrane. Mismanagement (for which Hastings was not responsible) led to delays and the four vessels eventually completed had serious defects. Only the "Perseverance" ("Karteria"), a vessel of 400 tons, with two 42-h.p. engines and four 68-pounder guns, saw enough action to demonstrate the value of Hastings' ideas. She arrived in Greece in Sept. 1826 and, with Hastings in command, was employed effectively against ships protected by shore batteries, firing with rapidity shells heated in the furnaces and slung into the breeches by a mechanical device. While fighting in her launches in support of Gen. Sir Richard Church's attack on Anatoliko on May 25, 1828, Hastings was wounded. He died at Zante on June 1, 1828.

See D. Dakin, *British and American Philhellenes, 1821–33* (1955).
(D. Dn.)

HASTINGS, WARREN (1732–1818), the first and most famous of the governors general of India, dominated Indian affairs from 1772 to 1785 and was impeached on his return to England. He was born on Dec. 6, 1732, in the hamlet of Churchill, near Daylesford, of an old Oxfordshire family which had fallen into poverty. His father Pynaston, vicar of Bledington, drifted away to the West Indies to die obscurely in the winter of 1743–44. Warren was taken in charge by his uncle in London, Howard Hastings, who held a post in the customs, and eventually was sent to Westminster school, where Elijah Impey, William Petty Fitzmaurice (later earl of Shelburne), William Cowper and Edward Gibbon were among his contemporaries. His uncle died in 1749 leaving him to the care of a distant kinsman, Joseph Creswicke, who forthwith arranged for his nomination as a writer in the East India company's service.

Early Years, 1750–72.—Hastings was assigned to Bengal and arrived on Oct. 9, 1750. He was then somewhat older than the usual company recruit of that time and had the advantage of a good classical grounding at Westminster; but he was without friends or influence and had to make his own way. Hastings found himself in a society of mercantile Englishmen, young in age because of the ravages of tropical disease, in close contact with Indian merchants and in constant dispute with the local Indian administration. They were devoted to money-making, not only in the company's interests; they were expected to augment their nominal salaries by private trading on their own account. At first Hastings followed the usual pattern. He was sent to Kasimbazar in 1753 where he laid the foundations of his knowledge of Indian character and oriental languages. He was a member of the council there in 1756 when the Indian conflict occurred, which changed the fortunes of the British in India and of India itself. Siraj-ud-Daula, the nawab of Bengal, the most prosperous and orderly part of the then surviving Mogul empire, attacked Calcutta because the governor would not halt the building of fortifications. There followed the siege and fall of Calcutta, the Black Hole incident, the flight of the fugitives to Falta, the recovery of Calcutta by Robert Clive and Adm. Charles Watson in Jan. 1757, and the overthrow of Siraj-ud-Daula at the battle of Plassey on June 23, 1757.

When war broke out Hastings was taken prisoner but was well treated and acted as intermediary for the prisoners from Calcutta. In Oct. 1756 he joined the fugitives at Falta and thence returned with Clive's force to Calcutta. He had no share in the overthrow of Siraj-ud-Daula, but was then appointed resident at Murshidabad (Aug. 1758) where, under Clive's direction, he had to deal with the new nawab, Mir Jafar. This was his apprenticeship in the diplomacy at which he later excelled. He joined the Calcutta council in Aug. 1761, where he supported Clive's successor, Henry Vansittart, against the majority in his attempts to reach a working arrangement with the next nawab, Mir Kasim. In this stand he braved great unpopularity while receiving little credit from the directors in England. This was his apprenticeship in official controversy and marked his development into a man of resolution and integrity. It may well have sown the first seeds of his later distrust of the directors. Disgusted with the actions of the majority of the council, Hastings retired in 1764 with what he thought to be a small fortune. This he dissipated and was compelled to seek re-employment. He was appointed second-in-council at Madras in 1769 and he was made governor of Fort William in Bengal in 1772, after the loss of Vansittart and two other supervisors at sea.

Thus began, inauspiciously and almost accidentally, the longest and most eventful governorship in the history of British India. Hastings owed his appointment to a change in the constantly shift-

ing fortunes of the factions which controlled the company; he was saddled with a large council and had no casting vote; he had to deal with resentful merchant-officials who feared regulation and the clipping of their fortunes. On the other hand he was armed with authority by the directors. "We now arm you with full powers," they wrote, "to make a complete reformation." He was not quite 40, in the full vigour of his powers and still buoyant with hope and resolution.

Governor and Governor General, 1772–85.—The first period of his rule lasted for two and a half years, and was its most placid and constructive phase. He was adroit and conciliatory as well as determined; the company's servants were resigned to some restraint and preferred it to come from one of themselves. He first dealt with the *diwani*, or revenue administration. The deputies who had collected the revenue on behalf of the company in Bengal and Bihar were deposed and the company became its own collector; each district had an English collector and a revenue settlement was made for five years. Hastings never perfected these arrangements but this step marked the beginning of the elaborate land revenue organization of British India. As civil justice was involved with the revenue, a network of civil courts was established with an appeal court in Calcutta. The treasury was then transferred from Murshidabad to Calcutta, where it could be properly supervised; the nominal nawab's household was reorganized and his allowance reduced from 32 to 15 lakhs of rupees a year. Hastings' management was such that the nawab actually had more for his personal expenses than before. Finally came the commercial reforms. *Dastaks* or free passes through customs houses for the private merchandise of company servants were finally abolished in March 1773. The customs houses themselves were centralized at five main places. Except for the monopolies of salt, betel nut and tobacco, a uniform duty of 2½% was charged on Europeans and Indians alike, very much on the lines agreed by Vansittart and Mir Kasim 11 years before. By these means conditions were stabilized and trade encouraged.

The second phase of Hastings' rule commenced with the arrival of three councilors appointed under the Regulating act of 1773. In 1772 the company had been driven to ask Lord North's government for a loan of £1,000,000 to avert bankruptcy. The consequent appointment of parliamentary committees of inquiry and their hostile reports led to the passing of this act, the first of several compromises between government and company control. The act created a governor general of Fort William, with a council of four, all named in the act to hold office for five years. The governor general was given a general superintendence over the other two presidencies of Bombay and Madras, but had only a casting vote in his own council. In addition, the crown was empowered to set up a supreme court of justice in Calcutta which would administer English law. The first chief justice was Hastings' former school fellow, Sir Elijah Impey. In London the power of the stockholders to influence Indian policy was restrained by raising the qualification for a vote in the proprietors' court from £500 to £1,000 of company stock, and replacing the annual elections of 24 directors for one year by the annual election of 6 directors for four-year terms.

The new councilors arrived in Oct. 1774. Three of them, Gen. Sir John Clavering, Col. George Monson and Philip Francis (*see* FRANCIS, SIR PHILIP), were English public men. They were dominated by Francis, who hoped to succeed Hastings as governor general and in Lord Macaulay's words was "a man prone to the error of mistaking his malevolence for public virtue." There followed the famous contest of Hastings with the majority which coloured the whole course of his life. For two years he was consistently outvoted in council. A lesser man would have given up but Hastings held on grimly. Then Monson died in Sept. 1776 and Hastings could use his casting vote. The next year Hastings' London agent mistakenly resigned on his behalf but the supreme court supported his repudiation and prevented Clavering from succeeding. Clavering himself died in Aug. 1777. Francis was thus isolated and, after a duel with Hastings, left India in 1780 to pursue his vendetta in England. For the last five years of his rule Hastings was unchallenged, but the strain of the struggle soured his temper and blunted his susceptibilities. This goes far to explain the more questionable acts of his government and the tone of his attitude to all criticism in his later years.

Hastings' major work was the defense of the company's dominions from concerted attack by Indian powers at a time when Britain, engaged in the American Revolutionary War and threatened by a hostile European coalition, was unable to give sustained help. His first care was the northwest where the buffer state of Oudh adjoined the company's province of Bihar. The Maratha power revived about 1770 and the emperor Shah Alam returned to Delhi under their auspices in 1772. Hastings occupied Allahabad and Kora when the emperor, after his return to Delhi, was constrained to promise them to the Marathas. In 1773, by the treaty of Benares, he handed them to the nawab of Oudh on the payment of £500,000. The state of Oudh was thus strengthened and the Maratha menace kept from the company's borders. The nawab then persuaded Hastings to lend him a brigade of company troops to subdue the Rohillas, a warlike and restless Afghan tribe recently settled to the west of his dominions between the rivers Ganges and Jumna. The Rohillas were overthrown and the nawab strengthened; the Maratha danger was removed to the Jumna area. But the company's troops had been used in an Indian war and this fact was later seized on by Hastings' critics. The next crisis was none of Hastings' making. In western India the head of the Maratha power at Poona became involved in disputes over the succession to the peshwaship after the young peshwa had been murdered in 1773. His ambitious uncle and guardian, Raghunath Rao, driven away by the supporters of the peshwa's posthumous son led by Nana Fadnavis, turned to the company's Bombay government for help. This was given without consulting Hastings, who overruled the treaty of Surat (1775) with that of Purandhar in 1776, by which he abandoned Raghunath. Then London intervened and support for Raghunath was revived. Hastings sent a force which, under Col. Thomas Goddard, made a brilliant march across central India to Surat. It arrived to find that the Bombay army had capitulated at Wadgaon while attempting to march on Poona. The war dragged on inconclusively until Hastings, having divided the Maratha chiefs, concluded the peace of Salbai, in 1782, by which Raghunath Rao was given a pension and all occupied Maratha lands were restored.

Crises, 1780–84.—The supreme crisis of Hastings' career occurred in 1780. When the news reached India, in 1778, of Gen. John Burgoyne's surrender at Saratoga (1777), Hastings wrote "if it be really true that the British arms and influence have suffered so severe a check in the western world, it is the more incumbent upon those who are charged with the interest of Great Britain in the east to exert themselves for the retrieval of the national honour." But worse was to follow. For many years Madras had been in a chronic state of misgovernment. The governor, Lord Pigot, had been imprisoned by the majority of his own council for attempting to enforce the company's orders. The folly of the Madras government allowed the nizam of Hyderabad, the Marathas and the able Haidar Ali of Mysore, normally in mutual hostility, to form a coalition against the British. At the same time the company had neglected its own means of defense. Haidar Ali overran the whole Carnatic in 1780, took the capital, Arcot, destroyed Col. William Baillie's brigade and compelled Gen. Sir Hector Munro of Bengal fame to retreat with ignominy. Hastings was undaunted. He suspended the governor of Madras, sent the veteran Sir Eyre Coote (then commander in chief in Bengal) to Madras and drained Bengal of men and money to sustain him. Hastings detached the whole Maratha confederacy from the coalition in 1782, while Coote restored the situation in the Carnatic by a series of pitched battles. The crisis was over when Haidar died at the end of 1782, though the war was prolonged by the arrival of Bailli de Suffren's French fleet which captured the harbour of Trincomalee and landed French troops in Feb. 1782. The great French general Charles de Bussy arrived too late in April 1783 to affect the issue and peace was finally concluded with Haidar's son and successor, Tipu Sultan, at Mangalore in March 1784, on the basis of mutual restoration of conquests. This episode was the crowning triumph of Hastings' spirit, which remained as unshaken amid

follies and blunders, defeats and isolation from Britain as it had done during the internal struggle with the council majority.

But the tenseness of the situation and the dire peril of the company's position in India help to explain some of the highhanded actions which were later so bitterly assailed. The principal dubious actions were the Rohilla War and the cases of Nandkumar, Chait Singh of Benares and the begums of Oudh. Nandkumar was a prominent Calcutta merchant who, at the height of the council struggle in March 1775, accused Hastings of bribery, to the delight of the majority. Hastings replied with a charge of conspiracy. But before the case came on Nandkumar was accused of forgery by an Indian merchant. The case came before Sir Elijah Impey in the supreme court, where Nandkumar was found guilty and executed. The case created a sensation because the sentence of death for forgery was an English penalty unknown to Hindu law. Hastings was accused of complicity with the judges, but no convincing proof has ever been adduced. He certainly did not reprieve Nandkumar; but in the circumstances the failure of the council majority to vote a reprieve was much more remarkable. Raja Chait Singh was the zamindar of Benares whom Hastings dunned repeatedly for money until the raja rose in revolt in 1781 and was dispossessed. These events occurred while Hastings was beset by the Maratha and south Indian coalition. The begums, or princesses, of Oudh were the mother and grandmother of the nawab who held large estates. Here again there was a disregard of engagements; relentless pressure on the nawab and the begums, combined with ill-treatment of the begums' agents, eventually produced about £1,000,000 which tided Hastings over the worst of his financial difficulties.

Hastings' government was by no means all diplomacy, war and dissension. His administration was the most effective since the battle of Plassey, if by no means perfect. It may be described as a more efficient version of the Mogul pattern of corruption, kept within bounds. His system was considered too strict by the men of the 1760s and too lax by the reformers of the 1780s. But in assessing him as an administrator it must be remembered that throughout his government his position was the target of factions at home, so that he had to think continually of conciliating enemies and rewarding friends. In the cultural sphere he continued the Mogul tradition of the patronage of learning. He himself knew Persian, the language of diplomacy and high society, as well as Bengali, Urdu and some Arabic. He encouraged Nathaniel Halhed in his work on Hindu law and William Wilkins in his Sanskrit studies. He supported Sir William Jones, judge and Sanskrit scholar, in the foundation of the Asiatic society of Bengal in 1784, and founded a college of Arabic studies in 1781. He also sent two expeditions to Tibet.

Impeachment and Last Years, 1785–1818.—Hastings returned to England in 1785 after the passing of Pitt's India act in 1784 had convinced him that there was no future for him in Bengal. At first the prime minister, William Pitt, the younger, was friendly. But the Whigs, led by Edmund Burke and egged on by Francis, decided to attempt an impeachment. Pitt turned against Hastings on the Chait Singh issue, after supporting him on the Rohilla War. The proceedings commenced in Westminster hall in Feb. 1788 amid great excitement and dragged on for seven years to end in acquittal on all counts in April 1795. Though acquitted Hastings was financially crippled and denied further public office. The penalty was in glaring disproportion to the magnitude of his services. But as the representative of a system of high politics without sufficient scruple and administration without sufficient integrity, there was a certain rough and rather brutal justice in the episode. A system rather than a man was arraigned; British standards (such as they were) were to be enforced overseas as well as at home.

On his return Hastings purchased his ancestral home at Daylesford in Oxfordshire, where he lived in dignified retirement until his death on Aug. 22, 1818. When he appeared before the house of commons in 1813 to give evidence on Indian affairs the whole house rose in his honour and in 1814 he was made a privy councilor. Hastings married first Mrs. John Buchanan, widow of an officer at Falta, in 1756. She died in 1759 and their two children both died young. His second marriage was to Marian, Baroness Imhoff, after her German divorce in 1777. This proved to be a union of kindred spirits and they were inseparable companions for life.

While Hastings had many shortcomings he still stands out as the preserver and second founder of British rule in India. His capacious mind, his large views, his courage and constancy weigh down the scale against his highhandedness and occasional unscrupulousness, his toleration of corruption, his later speciousness and lack of candour. Many of these traits were the unhappy result of the years of bitter struggle with his colleagues. Nevertheless, though Hastings remains an enigma, he was undoubtedly the greatest figure in the list of British leaders in India. *See* INDIA-PAKISTAN, SUBCONTINENT OF: *History*.

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HASTINGS, a municipal, county and parliamentary borough and seaside resort of Sussex, Eng., one of the Cinque Ports, 64 mi. S.S.E. of London by road. Pop. (1961) 66,478. Hastings stands where an outlier of the chalk downs reaches the coast, and the shore line is backed by cliffs. Two converging valleys running seaward contain much of the town, which has spread up the steep slopes as well as westward along the shore at the foot of the cliffs, and since 1872 the borough has included the town of St. Leonards, built (1828) by James Burton, father of the more famous Decimus. At the eastward end of the foreshore is the old fishing village. Hastings has some light industries, but its main occupation is catering for visitors who, because of its genial climate and sandy beaches, are attracted the year round. Romantically placed on the cliff overlooking the old town are the ruins of Hastings castle, and below it are the remains of a harbour begun in 1893 but never finished.

Rock shelters on Castle hill and numerous flint implements suggest an extensive early population, and there are earthworks and a promontory camp probably of the early Iron Age or Romano-British date. In 700, the name tells us, it was the residence of the Haestingas tribe (*i.e.*, "Haesta's people"). Hastings was not a Roman settlement, but it was a place of some importance in the Anglo-Saxon period. In the reign of Aethelstan (928) it was important enough to have a mint. The battle of Hastings (*see* below) in 1066 was fought near the small town of Battle (*q.v.*), about 6 mi. N.W. After the Conquest, William I made the earthworks of the castle and by 1086 Hastings had given its name to the rape (*q.v.*) of Sussex in which it lay. The town at that time had a harbour and a market but although it became the chief town of the Cinque Ports (*q.v.*) it was not mentioned in Domesday Book. Its charter shows, however, that it had greater liberties than Dover in return for the same services. It was represented in the parliament of 1265 and was incorporated by Elizabeth I in a charter of 1588.

The fragments of the castle stand on the brink of the West cliff, together with the ruins, excavated in 1824, of the castle chapel, a transitional Norman structure 110 ft. long, with a nave, chancel and aisles. Besides the chapel there was formerly a college, both being under the control of a dean and secular canons. The deanery was held by Thomas Becket, and one of the canonries by William of Wykeham. Titus Oates, whose father was rector of the parish, was baptized in 1649 in the church of All Saints, a 15th-century Perpendicular building. The parish church of St. Clement replaced (about 1380) an earlier structure which in turn had replaced a church washed away by the sea. (X.)

The Battle of Hastings (1066).—The battle of Hastings (Oct. 14, 1066) between Harold, king of England, and William, duke of Normandy, was "one of those battles which at rare intervals have decided the fate of nations" (Sir F. M. Stenton, *Anglo-Saxon England*, Oxford University Press). By 1066 William controlled, directly or by alliance, every harbour from the Scheldt

to Brest; his wife's father, Baldwin of Flanders, was regent of France, and the count of Anjou, his only other dangerous neighbour, was distracted by rebellion. With a solemn papal blessing and the emperor's approval, William prepared to enforce his claim to the English crown. He persuaded the Norman barons to promise support, and recruited thousands of volunteers from Brittany, Maine, France, Flanders, Spain and Italy, mostly adventurers attracted by prospects of conquest. The organization of supplies and transport for this miscellaneous host of about 5,000 knights, and the imposition of disciplined Norman cohesion upon them, were probably William's supreme military achievements.

Harold mobilized his fleet and army in May, repelled his outlawed brother Tostig's raids on the south and east coasts, and concentrated his large fleet off Spithead and his militia along the Hampshire, Sussex and Kentish coasts. Ready to move early in August, William's transports were kept in port by north winds for eight weeks, first in the Dives estuary until Sept. 12, then at St. Valéry-sur-Somme. Meanwhile the English militia, short of supplies after four months' fruitless waiting, lost morale and on Sept. 8 were dismissed; the ships were brought back to the Thames, many being lost en route. The channel was thus left open, and the best chance of destroying William's army was lost. About that time Harald III Hardraade, king of Norway, another claimant of the English crown, supported by Tostig, entered the Humber with 300 ships, defeating the forces of Edwin, earl of Mercia, and his brother Morcar, earl of Northumbria, in a heavy battle at Gate Fulford, outside York (Sept. 20). This battle crippled Hardraade's forces, but also left the two earls incapable of raising another army that year. King Harold, hearing of this invasion, left London immediately with his housecarls and such thegns and shire militia as he could muster, and by forced marches surprised the invaders at Stamfordbridge on Sept. 25, utterly destroying them and killing Harald and Tostig.

On Sept. 27 the wind changed, and after nightfall William crossed the channel unopposed and disembarked quietly at Pevensey next morning. He quickly transferred his forces to Hastings, built a castle and began to explore and ravage the neighbourhood, determined not to lose touch with his ships until he had defeated Harold's main army. Harold, at York, learned on about Oct. 2 of William's landing, summoned all thegns and shire militia to follow, and set off by forced marches, gathering reinforcements as he went, and by Oct. 13 he was approaching Hastings with about 7,000 men, including his housecarls, some thegns and shire levies and many half-armed, untrained peasants. He had mobilized barely half of England's trained soldiers, yet he advanced against William instead of making William come to meet him in a chosen defensive position, a bad strategical decision probably explained by his eagerness to defend his own men and lands, which William was harrying, and to thrust the Normans back into the sea.

William, warned of Harold's approach, determined to force battle immediately. At dawn on Oct. 14 he advanced, sighting Harold's army on the ridge 10 mi. N.W. of Hastings. William arrayed his army for attack, his archers and crossbowmen in the front line, his heavy infantry in the second, his knights in three divisions in the rear, Normans in the centre, Bretons and French on left and right respectively. The English, lacking archers and cavalry (though they used horses for movement from place to place) could not hamper these maneuvers, but prepared to resist. Their position was not wholly favourable; William's advance was unexpected, and Harold had to fight where he stood or retreat. He placed himself, his housecarls and his other trained troops around his standard at the summit of the ridge (where the high altar of Battle abbey was later placed), grouping his other men along the crest for about 400 yd. westward and about 200 yd. eastward, at which points the slope became steep enough to protect both flanks. The front was too small: some men, finding no fighting room, withdrew; the rest, in too close order, made a perfect target for arrows. In front the easy slope (50 ft. in 400 yd.) allowed William's knights an open approach, against which Harold relied on the close "shield wall" formation of his trained troops to hurl back and dishearten the enemy. The idea that Harold prepared a palisade is incorrect; but the disparity of English and Norman equipment and tactics was smaller than is often supposed. The heavily armoured knight, riding a powerful charger and holding couched a heavy thrusting lance, was still 100 years away; Norman armour was flimsy, the horses light and unprotected, and the knights, using javelins, maces and swords, had to engage hand to hand, where the great two-handed English battle-axes would work terrible havoc. Harold's hopes depended on keeping his line unbroken, his casualties light, and so exhausting and demoralizing the Normans.

William's archers opened at close range, inflicting many casualties but suffering heavily from the English slings and spears; William therefore threw in his cavalry, which was so badly mauled by the English battle-axes that it panicked and fled. William himself checked and turned them, counterattacking a large body of Englishmen who had broken ranks in pursuit. William pressed his cavalry charges throughout the day, interspersing them with flights of arrows, and annihilating considerable numbers of Englishmen whom he drew from their positions by two feigned flights. The defense, hard-pressed, depleted and tiring, was worn down and slowly outnumbered; Harold's brothers, Gyrth and Leofwine, fell, and late in the afternoon a chance arrow killed Harold. The leaderless English fought on till dusk and then broke; a last rally in the gloom caused the Normans further casualties and endangered William himself. But as darkness fell the English scattered, leaving William the winner of one of the most daring gambles in history. (R. F. T.)

HASTINGS, a city in the North Island of New Zealand, is situated in Hawke's Bay land district, 193 mi. N.W. of Wellington by road and 187 mi. by rail. Pop. (1961) 23,383. The principal buildings include the council chambers and theatre (1915) and the war memorial library (1959). Hastings is the commercial centre of a rich agricultural, pastoral and fruit-growing district, and the town has canneries and quick-freezing plants. There are highland games at Easter and a spring blossom festival in September. Formerly known as Heretaunga, and renamed for the British colonial administrator Warren Hastings, it became a borough in 1886 and a city in 1956. (C. G. Cr.)

HASTINGS, a city in Nebraska, U.S., about 90 mi. W. of Lincoln, is the seat of Adams county. It was founded in 1872 as the western terminus of the St. Joseph and Denver railroad on Walter Micklen's homestead and named after a surveyor who graded the final section of the railroad into the village. It was incorporated in 1874.

Located in irrigated farm land it is a wholesale and distributing centre with large grain storage facilities. Its industries include the manufacture of agricultural implements, irrigation equipment, air conditioning machinery, sheet metal and millwork and the processing of food. A natural gas company has its regional headquarters there. Water and electricity plants are municipally owned.

Educational institutions include Hastings college (Presbyterian), founded in 1882; Mary Lanning School of Nursing; and Immaculate Conception monastery. The House of Yesterday, a municipal museum, emphasizes the Great Plains in its historical, geological and biological collections; the J. M. McDonald planetarium is operated in conjunction with the museum. Good Samaritan Village (Lutheran) offers low cost housing and nursing care for the aged. Hastings State hospital and Mary Lanning hospital also serve the community. A nearby artificial lake provides facilities for water sports. For comparative population figures *see* table in Nebraska: *Population.* (R. S. V. M.)

HAT: *see* Hat Manufacture.

HATAY, the southernmost *il* (province) of Turkey, on the Mediterranean coast, is bounded west by the Gulf of Iskenderun (Alexandretta), south and east by Syrian territory. Pop. (1960) 441,198. Area 2,139 sq.mi. Formerly part of the Turkish empire, coextensive with the former sanjak of Alexandretta, Hatay came under French mandatory control after World War I but, after a period from Jan. 1937 as a separate entity under Syrian responsibility, it was returned to Turkey by a Turko-French agreement in June 1939. Between the Amanus mountains or Nur Daglari (6,000 ft.) in the west and the rim of the Syrian plateau

on the eastern border is a large plain watered by the Asi (Orontes) river, partly occupied by a shallow lake. Climate and agriculture are typically Mediterranean. Main roads connect Hatay with Syria and with the rest of Turkey. The chief towns are Antioch (Antakya), the capital, and Iskenderun. *See* also TURKEY: *History.* (N. TU.; S. ER.; E. TU.)

HATCHMENT, a term derived from the word "achievement" and used to describe a heraldic memorial to a deceased person. In England it is diamond-shaped and made of wood or canvas in a black-edged frame. On it are painted the arms of the deceased, and it is placed first over the doorway of the house and later in the church of burial. It is sometimes called a funeral escutcheon.

HATCHMENT OF A MARRIED MAN WHOSE WIFE SURVIVES HIM

Hatchments developed in England particularly from the 17th century onward and declined in the 19th, although they are by no means obsolete. One was hung over the main gate of an Oxford college in 1944. Many old English parish churches contain hatchments, as, for example, Stoke Poges church, Buckinghamshire.

The background of the device is painted black throughout for bachelor, spinster, widower or widow. For a married person with a surviving spouse the part beneath the survivor's arms is painted white. As the arms of men, of unmarried women and of married women differ in form, it follows that it is possible from the colouring of the hatchment's background to tell the marital status of the deceased. In the case of a bishop or other head of a public armigerous corporation, the sinister side, which bears his personal arms, is painted black under the arms, and the dexter side, under the official arms, remains white.

In Scotland, where there is a tendency to have more regard to quarters than in England because of Scotland's closer links with the continent of Europe, the arms often of both parents and sometimes of the grandparents and even of the great-grandparents of the deceased appear on the hatchment.

The parallel continental custom is to make circular plaques of the deceased's arms as well as memorial slabs with the arms of the parents and grandparents engraved upon them. (R. G. G. N.)

HATFIELD, a New Town (*see* NEW TOWNS) and rural district council in Hertfordshire, Eng., 20 mi. N. of Hyde Park corner, London, on the Great North road. Rural district pop. (1961) 39,630. The church of St. Etheldreda contains an Early English round arch; the chancel and transepts are also of the 13th century. In the Salisbury chapel (1618) are monuments to Robert Cecil, 1st earl of Salisbury, and Robert Cecil, the 3rd marquess. Hatfield house stands close to the site of a palace of the bishops of Ely erected in the 15th century; hence the true name of the town, Bishop's Hatfield. Of the red brick palace, built round a large quadrangle, only one side remains, and it contains the banqueting hall, used as a restaurant for visitors.

After the Dissolution Henry VIII kept the palace mainly as a residence for his children, and it was there that Elizabeth I received the news of her accession. James I exchanged Hatfield in 1607 for Theobalds, near Cheshunt, an estate of the 1st earl of Salisbury, who immediately pulled down three sides of the old palace to build the present Hatfield house, which remained in the Cecil family thereafter. It is built in the shape of an E. Large gardens were laid out by James I and altered through the centuries. The west wing was severely damaged by fire in 1835 when the eccentric widow of the 1st marquess of Salisbury was burned. The house was among the first in England to be equipped with electric lighting (1881). During World War II it was used as a hospital. Hatfield house is rich in portraits; there are three of Elizabeth I.

When Hatfield New Town (to cover 3.7 sq.mi. between the Barnet bypass and Hatfield park and adjacent to Welwyn Garden City) was designated in 1948, there was already enough industry in the district to employ nearly all its projected 25,000 inhabitants; the 1961 pop. was 20,504. The aircraft industry is the most important; other industries include general engineering and the making of cardboard boxes. During the 1950s and 1960s a number of schools, including a technical college, were completed.

HATHERLEY, WILLIAM PAGE WOOD, BARON, (1801–1881), lord chancellor of Great Britain, was born in London on Nov. 29, 1801. The son of Sir Matthew Wood, a London alderman and lord mayor who became famous for befriending Queen Caroline and braving George IV, he was educated at Winchester, Geneva university and at Trinity college, Cambridge, of which he became a fellow in 1824. He entered Lincoln's Inn, and was called to the bar in 1824. He practised as an equity draftsman and before parliamentary committees. In 1845 he became queen's counsel, and in 1847 became member of parliament for the city of Oxford. In 1849 he was appointed vice-chancellor of the county palatine of Lancaster, and was solicitor general in 1851–52. When the Liberal party returned to power in 1853, he was raised to the bench as a vice-chancellor.

In 1868 he was made a lord justice of appeal, but before the end of the year was selected by Gladstone to be lord chancellor. He retired in 1872, but sat occasionally as a law lord. He died in London on July 10, 1881.

HATHOR, Egyptian goddess, was originally a personification of the sky, as the meaning of her name, "Castle of (the sky-god) Horus," shows. In the sun temples built by six kings of the 5th dynasty (*c.* 2560–2450 B.C.) near Memphis, her worship was, therefore, associated with that of another sun-god, Ra of Heliopolis. In the old centre of her cult, at Dandarah, in upper Egypt, however, she was considered as the wife of Horus and as the goddess of festivity, dance and love.

From Dandarah her worship spread elsewhere, and she was consequently identified with a number of local tree, lion and cow goddesses, as at Dayr al Bahri. There, however, owing to the proximity of the necropolis of Thebes, she became "Lady of the West" and patroness of the region of the dead, quite contrary to her earlier nature. The Greeks identified Hathor with their Aphrodite. *See* also DANDARAH. (J. CY.)

HATHRAS, a town and *tehsil* in Aligarh district of Agra division, Uttar Pradesh, India. The town lies 85 mi. S.S.E. of Delhi and is a road and railway junction. Pop. (1961) 64,045. It has a college affiliated to Agra university, and the industries are cotton ginning and spinning and the making of tin canisters. Hathras is an important trade centre for cotton, grains (particularly wheat), sugar, oilseeds and ghee. A ruined Jat fort lies 6 mi. to the southwest.

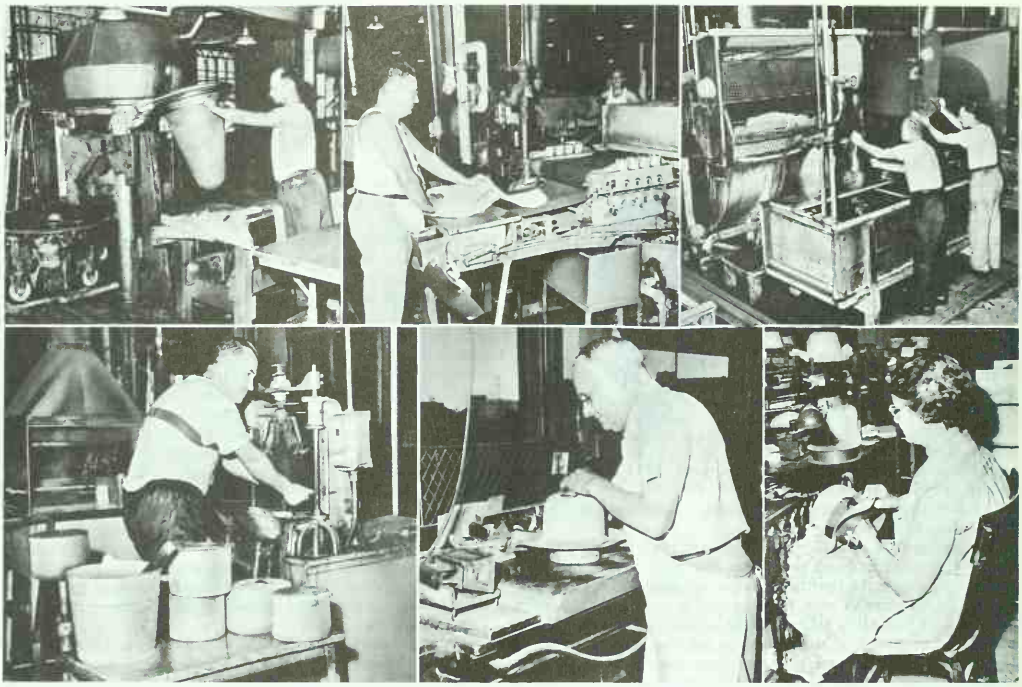
HATHRAS TEHSIL has an area of 291 sq.mi. and a population (1951) of 276,813. (S. S. BH.)

HAT MANUFACTURE. The majority of hats for both men and women are made of felt or straw. This article deals with the manufacture of fur felt hats, wool felt hats, straw hats, silk top hats, military caps and berets. For a description of hats as items of dress *see* DRESS.

Historical Background.—Probably the oldest type of hat was a homemade variety made of plaited straws, rushes or other vegetable fibres. These are associated with the earliest rural traditions of Europe and Asia Minor. Virgil writes in the *Pastorals* of "plaiting of osiers and willows," and an early statue of Mercury shows that the model for the messenger god's hat was a finely plaited straw. In Shakespeare's *The Tempest,* Iris urges: "Your rye straw hats put on."

In classical Athens and Rome, a member of the artisan class usually wore a cap. This cap, known as the *pilos* in Greece and *pilleus* in Rome, was conical, with an egg-shaped crown, and could be pulled over the ears. It was usually made of felt and was equipped with a band near the edge to make it fit closely. The bit of material that protruded below the band evolved into a brim. The Roman *pilleus* was a badge of the plebeian class and was presented to slaves when they were granted their freedom.

Among the upper class it was customary to go hatless except



BY COURTESY OF THE JOHN B STETSON CO.

HAT MANUFACTURING PROCESS: (TOP LEFT) STRIPPING FUR FELT BODY FROM METAL CONE. FORM IS MADE BY ROTATING CONE, DRAWING FUR PARTICLES TOGETHER BY SUCTION. (TOP CENTRE) SHRINKING BODY TO ONE-THIRD ORIGINAL SIZE BY DIPPING IN HOT WATER. (TOP RIGHT) COLOURING BODY BY IMMERSION IN REVOLVING DRUM FOR TWO HOURS. (BOTTOM LEFT) FORMING CROWN AND BRIM BY STRETCHING WET HAT BODY BETWEEN METAL FINGERS. (BOTTOM CENTRE) SMOOTHING FINISH BY APPLYING OIL AND FINE SANDPAPER. (BOTTOM RIGHT) FINISHING HAT BY SEWING ON RIBBON AND OTHER ACCESSORIES

in rough weather or when hunting or traveling. For such occasions a small, round hat with a flat crown was usually worn. This hat, known as the *petasos* in Greece and *petasus* in Rome, was equipped with a chin strap, from which it was frequently allowed to dangle down the wearer's back. Augustus in his old age never went out without a *petasus*, thereby setting a new fashion.

In the early medieval era, hats for city folk were made mostly of cloth. The chaperon, a loose-fitting hood, was worn by both men and women. In the 14th century, beaver hats came into fashion in Flanders, and these were later imported by wealthy Englishmen. In 1641 Samuel Pepys paid £4 5*s*. for a beaver. The manufacture of straw hats was a flourishing industry in Italy in the 16th century and in the 17th century in England, where straws were worn by fashionable ladies affecting a bucolic touch. The sennit straw was made regulation for British sailors by Lord Nelson. The silk hat, originated in Florence about 1760, appeared in England in 1810. The hat known as a bowler in Britain (after its inventor, a London hatter) and as a derby in the United States was introduced in 1850.

Men's hats then became substantially standardized in style. In the early 1960s hat manufacturers in the U.S., Britain and western Europe diversified their lines and made an intensive effort to increase sales to young men. A variety of youthful styles of hats were introduced in both fur and wool felt as well as in cloth and suede leather.

Women's hats were to a considerable extent an item of fashion, with consequent changes in styles from season to season; various materials other than felt and straw were used, especially as trimming.

Fur Felt Hats.—The natural tendency of certain animal fibres to mat, or "felt," together when subjected to heat, moisture and manipulation is utilized in the production of felt (*q.v.*). Two kinds of felt are employed in hat manufacture—fur felt and wool felt.

Fur felt is made of rabbit (cony) and hare fur and—to a much more limited extent—of muskrat, nutria and beaver. The raw animal skins are opened, cleansed and, by pulling and shearing, relieved of long, coarse guard hairs, leaving the soft underfur, each fibre of which has a well-defined surface of scale structure.

The felting properties are improved by treatment with chemical compounds—a process known as carroting because of the colour of the compound originally used. After the fur has been carroted, the skin is shredded away from it by a cutting machine equipped with flailing knives. Only the fur remains, still retaining the shape of the pelt. It is gathered, graded according to whether it came from cheek, flank, centre back or side, and packed in bags. Before felting is undertaken, a blend of the various grades of fur is prepared. For hats of certain weights and finishes, man-made fibres are added to the fur mixture.

The initial process in fur felt manufacture is called forming. A weighed quantity of fur is introduced into a cylindrical chamber and deposited, by means of a suction fan, as a thin uniform film on the surface of a finely perforated metal cone about three feet high. The form is sprayed with hot water to make the fibres cohere and then is removed from the cone. A number of such forms are wrapped in a cloth and the roll is subjected to mild agitation either by machine or by hand to initiate felting. The hat bodies are further shrunk, to a specified size and degree of consolidation or tightness of felt, on a series of roller machines under the combined action of moisture, heat and mechanical manipulation of increasing severity. The heat and moisture are provided

by a spray of either hot water or dilute sulfuric acid solution. Under these conditions, because of the surface scales, the fibres mat together, causing the material to shrink and consolidate into a strong and uniform felt.

A mechanical stretcher, consisting of a ribbed frame and an upper and a lower set of metal fingers, performs the initial shaping operation. The conical hat body is pulled over the frame and the upper mechanical fingers work the tip of the cone and press the felt between the ribs of the frame until a rough crown shape is produced. At the same time, the lower fingers grip the edge of the hood, working and stretching it to a crude brim form.

The hat, thus roughly formed, is given a finished crown shape and true head size by being pulled over a wooden hat block, steamed and ironed. Original or master blocks are made of wood by hand and are then mechanically reproduced. For each shape and style they are made up in sets in the various head sizes. Special and distinctive styles such as bowlers, British policemen's helmets and the gray topper follow the normal fur felt processes but have special finishing processes such as proofing or stiffening with spirit solutions of shellac. For gray toppers a special blend of fur is used.

The brim of the hat is steamed and ironed flat, trimmed to a specified width and placed on a wooden flange having a desired roll or curl. The brim is steamed and ironed again, allowed to dry and, while still on the flange, pressed with a heated sandbag. Excessive nap is sheared away from the hat, which is then sandpapered until a desired surface smoothness is achieved. The brim is given added stiffness by treatment with shellac or a synthetic resinous compound.

Finishing and trimming a man's hat customarily consists of inserting a sweatband and a lining and encircling the exterior of the crown at its base with a ribbon, usually grosgrain, covered at its joining with a tailored bow. If the brim edge is not to be left plain, it may be bound with a ribbon or turned up or under and stitched down in what is termed a welt edge. A finished brim edge may be formed as an integral part of the hat by turning the edge of the conical hat body before it is originally shrunk.

Wool Felt Hats.—In making wool felt, fine, long staple wool fibres are blended to a well-balanced mixture with noils, which are the short fibres combed from wool that is to be spun into worsted yarn. When the wool blend is received at the factory it usually has been cleansed of grease and foreign matter by scouring in warm, mild alkali and soap solutions, followed by rinsing in clean tepid water. If vegetable materials such as seeds and burrs still cling to the wool, they may be removed by carbonization. The vegetable matter is reduced to carbon by treatment with a mild sulfuric acid solution and the application of heat, and the carbon particles, crushed to powder by passing the wool through heavy rollers, are easily removed by a dusting machine.

The cleansed wool is carried through a machine equipped with several cylinders covered with wire card and emerges as a delicate web that is wrapped around a double reciprocating cone. When a predetermined amount of wool has been added, two large fluffy forms about $1\frac{1}{2}$ ft. high and 1 in. thick are obtained by cutting along the middle axis. These forms are consolidated by the hardening process in two stages, tip hardening and flat hardening, which are carried out between vibrating plates in the presence of pressurized steam. The subsequent felting of the hardened wool is achieved by "settling" on multiroller machines, as for fur felt, and is finally brought to the requisite degree of consolidation and strength by being pounded with hammers in a fulling mill. Wool felt hats are given correct shape and size by being stretched and blocked in much the same way as fur felt hats and also are finished and trimmed in a like manner. Both fur and wool felt hats are usually dyed in the body stage; when mixed colours or special effects are desired, the dyeing is done with the raw materials.

Straw Hats.—Included in the category of straw hats are hats made of many types of vegetable fibre, including hemp, raffia, jute, palm leaf, willow shavings, and mixtures of these materials with straw (*q.v.*).

The manufacture of a straw hat usually begins with the making of plaits, widths of braided straw. These are sometimes woven by hand, but usually by machine, and are bleached or dyed. The plaits are sewed together by hand or machine, edge to edge or in overlapping rows. A wooden block is usually used to shape the crown. When the sewing is completed, the hat is dipped in a stiffening solution, blocked, polished and trimmed.

Some types of hat, known in the trade as hoods, are woven in one piece. Panamas and imitation panamas are in this category. Panamas, made in various parts of Central America but named for the country from which they were first shipped north, are made of the grass known as *toquilla*. When this grows to a height of $4\frac{1}{2}$ to 5 ft., it is cut before ripening and sorted for selection of the finest fibres. In some districts the fibres are dampened in order to prepare them for cutting to the desired widths; in others they are boiled. The leaves are then hung in the shade (never in the sun) to dry. They are split before drying completely and are allowed to curl slightly at the edges. They are then bundled in damp cloths.

The weavers begin at the apex of the crown, working to the edge of the brim and then making a double return. For best results in weaving, a humid atmosphere is needed, which has led to the popular misconception that panamas are woven under water. When the weaving is completed, the ends are pared and the hood is pounded with a small wooden mace to smooth it. It is washed and then dried in the sun. Two or three weeks are generally required to make a good panama. One of top quality, calculated for a lifetime of wear, might take as much as two or three months of work.

Other Types of Hat.—In the silk top hat, the tall crown is constructed of cotton fabric, patterned and cut to form the side and top of the hat and varnished to make it stiff. The body of the crown is shaped by winding the cotton sidepiece around a hat block and joining its edges by ironing. The toppiece is set in place and united to the side, also by ironing. The brim consists of three layers of cotton material cemented together. It is passed over the crown and adjusted into position, after which a second sidepiece and another toppiece are added to the structure and cemented in place. The hat body, which is first sized and then varnished, is covered with either black or midnight-blue plush silk. The underside of the brim is covered first, and then the upper side. The silk covering of the crown, consisting of top and side sewed together, is next slipped over the crown, and the entire silk covering of both brim and crown is stretched and ironed until perfectly smooth and wrinkle free. The varnish applied to the hat body softens under the application of heat and produces perfect adhesion between hat body and silk covering. The surface of the hat is dressed by dampening, brushing and ironing and is given a smooth, bright finish by revolving buffers covered with velvet or haircloth.

Simplification of military dress in modern times has resulted in the wide adoption of such uniform caps as the service and the garrison cap. The former consists of a stiff cap frame with a flat-topped covering of woven fabric and a leather visor. The latter is made of a woven material also and in such a manner that it can be folded flat. Some service cap covers are removable so that covers of different colours may be used with a single frame.

The round, flat-topped beret is commonly associated with the Basque country as a point of origin, although it is of ancient and classical ancestry and was introduced to the Basques by Greek and Roman traders. The modern beret began as an oversized hat knitted from wool yarn on special machines. The forms were felted and shrunk in soap solution in fulling mills. In this process the knitted structure gradually disappears and the soft smooth felt produced is shaped on a former, pressed and trimmed with a leather sweat band and lining. Most berets for women are also made of felt, with the underturn finished with a simple binding or band, although berets made of other fabrics and of knit wool are also extensively worn. (E. L. Y.)

HATSHEPSUT (Hatasu, Hatshopsitu, Hashepsowe), an Egyptian queen (18th dynasty) who reigned *c.* 1503–1482 B.C., first as regent for her nephew Thutmose III, and soon with the full powers of a Pharaoh (*see* Egypt: *History*). In contrast with

the warlike temper of the dynasty, she devoted herself to administration and the encouragement of commerce. Her greatest monument is the beautiful terraced temple of Dayr al Bahri in west Thebes. Reliefs there depict the transport of two obelisks from the Aswan quarries to Karnak; a maritime expedition down the Red sea to Punt to bring back incense and other exotic merchandise; religious scenes; and scenes symbolic of the queen's divine birth as child of Amon, emphasizing her right of succession to the throne.

After her death her nephew erased her name, obliterated her figure and smashed her statues, some of which have been reassembled in Cairo and New York. Her long tomb in the Valley of the Tombs of the Kings, constructed in the axis of her temple, was left unfinished. (M. S. Dr.)

HATTA, MOHAMMED (1902–), Indonesian political leader, was born in Bukittinggi, Sumatra, on Aug. 12, 1902. After studying in Europe (1922–32) he became an important leader in the Indonesian nationalist movement, but in Feb. 1934 was arrested by the Dutch authorities and sent to a concentration camp in New Guinea. In 1935 he was exiled to the island of Bandanaira, where he remained until the eve of Japan's invasion. Although he filled advisory positions under the Japanese occupation, he managed to work on behalf of the Indonesian nationalist movement. With Sukarno on Aug. 17, 1945, he proclaimed Indonesia's independence, becoming vice-president and a key leader in the revolutionary government. In Feb. 1948 he became prime minister as well and played the major role in suppressing the Communist rebellion of September–November. Hatta led the Indonesian delegation in the United Nations-sponsored conference at The Hague (Aug. 23–Nov. 2, 1949) which culminated in the Netherlands' relinquishment of sovereignty over Indonesia. During the first seven months of 1950 he was prime minister in the critical period of transition from a federal to a unitary state. He then served as vice-president until Dec. 1956 when, partly because of increasing disagreement with Sukarno, he resigned. Subsequently he became further estranged from Sukarno and a bitter critic of his "guided democracy."

Hatta is one of Indonesia's leading economists and is known as "father of the Indonesian co-operative movement." His writings include: *The Co-operative Movement in Indonesia* (1957); "Indonesia Between the Power Blocs," *Foreign Affairs,* vol. xxxvi (1958); and *Past and Future* (1960).

See G. McT. Kahin, *Nationalism and Revolution in Indonesia* (1952). (G. McT. K.)

HATTIESBURG, a city of southeastern Mississippi, U.S., and the seat of Forrest county, is located on the Leaf and Bowie rivers, 65 mi. from the Gulf of Mexico and about 85 mi. S.E. of Jackson. The town was founded in 1881 by Capt. William Harris Hardy, Confederate soldier, statesman and engineer, and named for his wife. It was incorporated in 1884. Early settlers were attracted to the area by the large acreage of virgin pine timberland which constituted the major source of wealth for many years. Adequately served by an excellent system of highways and railways, and also by a trade area consisting of ten surrounding counties, Hattiesburg is referred to locally as the "Hub of South Mississippi." Industrial plants produce timber products and building materials and a variety of other items, including metal goods, clothing, fertilizers, mattresses, food products, naval stores and boilers.

Hattiesburg is known for its medical and recreational facilities, as well as for its culture and hospitality. It is the seat of Mississippi Southern college (1910), a state institution; and William Carey college (1906), owned and operated by the Mississippi Baptist convention. Camp Shelby, a U.S. army training centre, is nearby.

For comparative population figures *see* table in Mississippi: *Population.* (J. T. D.)

HATTINGEN (Hattingen an der Ruhr), a town of Germany which after partition of the nation following World War II was incorporated in the *Land* (state) of North Rhine-Westphalia in the Federal Republic of Germany. It is situated on the Ruhr river, 33.6 km. (21 mi.) N.E. of Düsseldorf. Pop. (1961) 29,096. The medieval town centre has framework buildings and the old town hall built (1576) in Renaissance style is now the museum. Hattingen, which received civic rights in 1396, was one of the Hanse towns. It declined during the Thirty Years' War and expanded in the 19th century. There are steel works and briquette presses, with coal mining in the neighbourhood.

HATTO I (d. A.D. 913), archbishop of Mainz, was at the turn of the 9th and 10th centuries the most important ecclesiastical prince of the East Frankish kingdom with the exception of Salomon III of Constance. Born into the Swabian nobility, he became abbot of Reichenau in 888, abbot also of Ellwangen in 889 and archbishop of Mainz in Sept. 891. King Arnulf, whom he accompanied to Italy in 894 and in 895–896, held him in high esteem and made him one of the tutors of his son Louis the Child. On Arnulf's death (899), Hatto, without being officially guardian or regent for Louis, came to exercise the most powerful influence in politics, in close association with the Conradines during their bloody feud against the house of Babenberg (*q.v.*). The association was continued when the head of the Conradine family became German king as Conrad I in 911; Hatto supported him against the Saxon duke Henry the Fowler (later German king), who seized the Mainz church property in Thuringia. Both in Mainz and in his abbeys (Lorsch and Wissembourg as well as his earlier possessions), Hatto did good work as a sponsor of new church building. He died on May 15, 913. Popular imagination and malevolent Saxon historiography spread tales about him to which no credence can be given: for instance, that he treacherously lured Adalbert of Babenberg to his death; that he planned to murder Henry the Fowler; and that he himself was eaten by mice in the Mäuseturm at Bingen (this story dates only from the 13th century).

See E. Dümmler, *Geschichte des ostfränkischen Reiches,* vol. iii, 2nd ed. (1888); R. Holtzmann, *Geschichte der sächsischen Kaiserzeit,* 3rd ed. (1955). (T. Sch.)

HATTON, SIR CHRISTOPHER (1540–1591), lord chancellor of England from 1587 to 1591, was a son of William Hatton of Holdenby, Northamptonshire. He was educated at St. Mary hall, Oxford, admitted to the Inner Temple in May 1560 and enrolled as one of the queen's gentleman pensioners in 1564. A handsome and accomplished man and a good dancer, he soon became a prime favourite of Elizabeth I. In 1572 he was made captain of her bodyguard; in Nov. 1577 vice-chamberlain of her household and a privy councilor; and in December of the same year a knight. Regularly elected to parliament from 1571, he soon became a leading government spokesman in the house of commons. In foreign affairs he sided with the earl of Leicester and Sir Francis Walsingham rather than with the more cautious Lord Burghley. He was a promoter of Sir Francis Drake's great voyage (1577–80), and Drake renamed his flagship "Golden Hind" in honour of Hatton, whose cognizance was "a hind statant Or."

At this time Hatton though not himself in favour of the queen's proposed marriage to Francis, duke of Alençon, was active in the prosecution of the Puritan John Stubbe for printing a violent pamphlet against it. Later he took a prominent part in the examinations of various Catholic plotters, notably William Parry (1585) and Anthony Babington (1586). He was a commissioner for the trial of Mary Stuart at Fotheringhay and afterward advised William Davison to dispatch the warrant for her execution. He strongly supported Archbishop John Whitgift's efforts to discipline the Puritans, and this may well explain his appointment as lord chancellor in 1587. He lacked any great knowledge of the law, but seems to have been a sensible and businesslike chancellor. In 1588 he was made knight of the Garter and chancellor of Oxford university. He died in London on Nov. 20, 1591, and was buried in St. Paul's cathedral.

His name is perpetuated in Hatton garden, part of Ely place, Holborn, of which Elizabeth forced the bishop of Ely to grant him the virtual freehold. Hatton also built the magnificent Holdenby (or Holmby) house in Northamptonshire. He wrote the fourth act of a tragedy, *Tancred and Gismund,* and was a patron of men of letters such as Thomas Churchyard, John Dee and Barnaby

Rich. Edmund Spenser addressed a sonnet to him, and William Byrd a musical work, and his death occasioned several panegyrics in both prose and verse.

See E. St. J. Brooks, *Sir Christopher Hatton* (1946); J. E. Neale, *Elizabeth I and Her Parliaments, 1584–1601* (1957). (R. B. Wm.)

HATTON, JOHN LIPTROT (1809–1886), English composer of operas and songs, was born in Liverpool on Oct. 12, 1809. Largely self-taught, he settled in London, where he gained a reputation not only as a theatre composer and conductor but also as an accomplished pianist and singer. His opera *Pascal Bruno* was produced in Vienna in 1844. He toured the U.S. (1848–50) and on his return to England became musical director at the Princess's theatre. His second opera, *Rose, or Love's Ransom,* was given at Covent Garden in 1864. Many of Charles Kean's productions in London had music by Hatton. He died at Margate, Kent, on Sept. 20, 1886.

Of his many tuneful songs, the most popular were "Simon the Cellarer" and "To Anthea." (H. Ru.)

HATZFELDT, MELCHIOR VON (1593–1658), German general in the Holy Roman emperor's service during the Thirty Years' War (*q.v.*), was born on Oct. 10, 1593, at Krottorf in the county of Sayn. Having taken part in the generals' conspiracy against Wallenstein (*q.v.*) in 1634, he was rewarded with the dignity of count (1635; the style Graf zu Gleichen was accorded in 1640) and later with the large Silesian estate of Trachenberg (1641), the erstwhile property of Johann Ulrich Schaffgotsch, who had perished as one of Wallenstein's confidants. Hatzfeldt fought successfully in the secondary Rhenish-Westphalian theatre of war from 1639 to 1643, but was no match for the leading Swedish generals: Johan Banér had defeated him at Wittstock in Brandenburg (1636); and Lennart Torstensson defeated and captured him at Jankov in Bohemia (1645). Hatzfeldt retired in 1646 but was given the command of the imperial army, which in 1657 came to the rescue of Poland against the Swedes. He took Cracow but had to resign because of ill-health and died on Jan. 9, 1658, at Trachenberg.

See J. Krebs, *Aus dem Leben des Grafen M. von Hatzfeldt,* 2 vol. (1910–26). (S. H. S.)

HATZIDAKIS (Chatzidakis), **GEORGE N.** (1848–1941), the first and greatest linguist of modern Greece, who was eminent in studies of ancient, medieval and modern Greek, and the initiator of the *Historical Lexicon of the Greek Language,* was born at Myrthio, Crete, on Nov. 12, 1848. After his classical studies in Athens (1873–77), he devoted himself to comparative linguistics in Germany (1877–81). He obtained his Ph.D. degree in Athens (1883) and taught linguistics there (1885–1923) and in Salonica (1926–28). Hatzidakis was among the first members of the Academy of Athens (1926), and an honorary member of five other European academies. Between 1881 and 1935 he wrote 9 books and nearly 600 other works, mostly on medieval and modern Greek, especially on the origin of its dialects from the *Koinē* (except *Tsakonian*). Adhering to the idea of Greek bilingualism, however, he failed to sense the rise of the new common Greek language even in Athens from *c.* 1835; he supported the lost cause of the puristic language (*katharevousa*) against the popular language as a literary and educational vehicle. Among his works are: *Einleitung in die neugriechische Grammatik* (1892) and *Medieval and Modern Greek* (1905–7), both aggregates of previously published articles. He died in Athens on June 26, 1941.

See *Orbis,* 4:574–576 (1955). (D. J. G.)

HAUCH, JOHANNES CARSTEN (1790–1872), Danish poet, dramatist and novelist, whose works expressed his high moral seriousness and tragic philosophy, was born in Frederikshald, Norway, on May 12, 1790. As a student, he was strongly attracted by romanticism; but after early and unsuccessful literary attempts he turned to natural sciences, particularly zoology. He took his doctorate in 1821 and then studied in Paris and Italy. In 1825 he had a foot amputated and shortly afterward attempted suicide. He emerged from the spiritual crisis which followed with a renewed desire to write. On his return to Denmark, he was successively lecturer in natural sciences at Sorö, professor of Scandinavian literature at Kiel (1846–48) and, following his friend Adam Oehlenschläger, professor of aesthetics at Copenhagen from 1851 until his death in Rome on March 4, 1872.

Hauch was by nature gloomy and brooding, but also of exceptional rectitude and nobility: his works have a tragic quality and express high moral ideals and a belief in universal justice. As a dramatist he modeled himself upon Shakespeare and Oehlenschläger and wrote a number of historical tragedies about men of destiny: *Bajazet, Tiberius* and *Grégor den Syvende* (Pope Gregory VII) (all 1828); and great Danish figures: *Svend Grathe* (1841) and *Marsk Stig* (1850). Later, his historical novels exerted considerable influence: they include *Vilhelm Zabern* (1834); *Guldmageren* ("The Alchemist," 1836), *En polsk Familie* (1839) and *Robert Fulton* (1853). But his greatest success was as a poet, particularly as a writer of odes. One of his most important poetic works was the ballad-cycle *Valdemar Atterdag* (1861).

Hauch's collected poems were published, 2 vol. (1891); his collected novels, 7 vol. (1873–74); his plays, 3 vol. (1852–59); his essays and reflections upon aesthetics, 3 vol. (1855–69). *See* also G. Brandes, "Carsten Hauch," in Brandes' *Samlede Skrifter,* vol. i (1899); K. Rönning, *J. C. Hauch* (1890). (S. M. K.)

HAUFF, WILHELM (1802–1827), German poet and novelist, who belonged to the Biedermeier period between romanticism and realism and who is best known for his fairy stories, was born at Stuttgart on Nov. 29, 1802, the son of a lawyer. After studying at Tübingen university he took up a post as private tutor, which left him time to write. On his return from a tour made to widen his education which took him to Paris, Bremen, Berlin and Dresden he became editor of J. F. Cotta's *Morgenblatt* in Jan. 1827, but he died prematurely at Stuttgart on Nov. 18 the same year.

Hauff had a natural narrative and inventive gift and sense of form; he wrote with graceful ease and excelled in combining narrative themes of others with his own. His work shows a pleasant, often spirited, humour and satirical wit, which was inspired by J. P. F. Richter. There is also a strong influence of E. T. A. Hoffmann, notably in the satirical fantasy *Mitteilungen aus den Memoiren des Satan* (1826–27), in *Phantasien im Bremer Ratskeller* (1827) and of Hoffmann and Ludwig Tieck in his short stories, such as *Die Bettlerin vom Pont des Arts* (1827). His novel *Der Mann im Monde* (1826), a parody of H. Clauren (pseudonym of Karl Heun), resulted in an action for damages, which Hauff bitingly commented on in his *Kontroverspredigt* . . . (1827). The historical romance *Lichtenstein* (1826), which deals with Württemberg history of the early 16th century, was one of the first imitations of Walter Scott. Some of Hauff's fairy stories published in his *Märchenalmanach auf das Jahr 1826* (followed by similar volumes in 1827 and 1828) have retained their popularity.

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HAUGE, HANS NIELSEN (1771–1824), Norwegian lay preacher and founder of Norwegian Pietism, was born of a peasant family near Smaalenene, Norway, April 3, 1771. From 1797 he journeyed through Norway preaching repentance at a time when the clergy were influenced by the rationalist theology he attacked. He was the leading Norwegian representative of Pietism (*q.v.*). In addition, however, he sought to raise the living standards of the people by improved methods in agriculture and by peasant industries. For violating the ecclesiastical law of 1741 against religious dissent he was imprisoned, 1804–11. He died near Christiania (Oslo) March 29, 1824. Hauge's many writings had a wide influence in Norway and Denmark, bringing renewed spiritual life to the church, from which his followers, called *Haugianer* or *Leser* ("readers"), did not formally separate.

See N. Sivertsen, *Hans Nielsen Hauge og renesamfunnet* (1946). (B. H.)

HAUGHTON, WILLIAM (*c.* 1575–1605), English playwright whom Henslowe's *Diary* shows to have collaborated in plays for the Admiral's company from 1597 to 1602. Philip Henslowe first mentions "yonge Horton" on Nov. 5, 1597, and on March 10, 1600, he lent him ten shillings "to release him out of the Clink." With Thomas Dekker and Henry Chettle, Haughton wrote *The*

Pleasant Comodie of Patient Grissill (1603), and he collaborated with many other playwrights including John Day and Richard Hathway. *English-Men For My Money* (1616) is ascribed to his sole authorship.

For a list of Haughton's lost and doubtful plays, *see* E. K. Chambers, *The Elizabethan Stage*, vol. iii (1923). *See* also *English-Men For My Money*, ed. by A. C. Baugh (1917); W. J. Lawrence, "Englishmen for My Money," *Review of English Studies*, I (1925).

HAUGWITZ, CHRISTIAN, Graf von (1752–1832), Prussian statesman whose vacillation between war and alliance with Napoleon was held by the patriotic party to have contributed to the catastrophe of 1806, was born at Peuke-bei-Öls, in Silesia, on June 11, 1752. After studies at Halle and at Göttingen, he traveled in Switzerland, in Germany and in Italy. Essentially a rationalist, Haugwitz was for a time inclined to Pietism under the influence of the house of Stolberg, but later joined the Rosicrucians, among whom he made the acquaintance of J. R. von Bischoffwerder, the influential adviser of Frederick William II of Prussia. Bischoffwerder soon opened a diplomatic career for Haugwitz, who was sent as Prussian minister to Vienna in 1791 and became a minister of the Prussian cabinet as early as 1792. Behind Austria's back he reached an agreement with Russia over the second partition of Poland (1793); and in 1795 he concluded the peace of Basel, which extricated Prussia from the War of the First Coalition against France (*see* French Revolutionary Wars).

Haugwitz, who early recognized the danger threatening from Napoleon, wanted to make Prussia participate in the War of the Second Coalition in 1799, but he could not overcome Frederick William III's pacific intentions. For a short time in 1804 he withdrew from office; but in the autumn of 1805, during the War of the Third Coalition, he undertook the delivery of a Prussian ultimatum to Napoleon. Inspired by the Russian emperor Alexander I, the ultimatum threatened a declaration of war if Napoleon should refuse Prussia's services as a mediator. In view of Napoleon's unfavourable military position in Nov. 1805 this diplomatic move might have had far-reaching consequences, but Haugwitz, probably acting under verbal instructions from Frederick William III to preserve the peace at all costs, delayed the delivery of the ultimatum until Napoleon had won the decisive victory over the Russians and the Austrians at Austerlitz (Dec. 2, 1805). Napoleon then compelled Haugwitz to sign the treaties of Schönbrunn (Dec. 15, 1805) and Paris (Feb. 15, 1806), which virtually made Prussia a French satellite. Under fierce attack from Prussian public opinion, Haugwitz then drove Frederick William III into the War of the Fourth Coalition, in which Prussia, quite inadequately prepared, suffered fearful defeats in the battles of Jena and Auerstädt (Oct. 14, 1806). (*See* Napoleonic Wars.) Soon afterward Haugwitz was dismissed at K. A. von Hardenberg's instigation. He later retired to Italy, where he wrote *Fragment de mémoires inédits* (published 1837) and died in Venice on Feb. 9, 1832. (H. Re.)

HAUPTMANN, GERHART JOHANN ROBERT (1862–1946), one of the most important and prolific German writers of his time, and winner of the Nobel prize in literature in 1912. He was born in Ober-Salzbrunn, Silesia, on Nov. 15, 1862. From 1880 to 1882 he studied sculpture at the art school in Breslau. After studying science and philosophy at Jena (1882–83), working as a sculptor in Rome (1883–84) and further study in Berlin (1884–85), he settled in Erkner, near Berlin (1885–89), and devoted himself entirely to writing. Although his social drama *Vor Sonnenaufgang* (1889) shocked the theatrical public, it was his first success. In 1891 he returned to Silesia and until his death his work was closely connected with its landscape, people, dialect and culture. He lived in Schreiberhau until 1893 and in 1901 settled in Agnetendorf but spent parts of the year on the Baltic island of Hiddensee or abroad, often in Italy or the Ticino. He died in Agnetendorf on June 6, 1946.

Hauptmann's work is exceptionally rich in material, styles and forms, and in German literature is comparable only to Goethe's in its profusion and variety. Although his epic poems are equally important, his fame rests chiefly on his plays. Following on from Ibsen and the Naturalist movement, he began with social themes and in 1892 reached the first peak of his achievement with *Die Weber*. This play depicts the rise of a mass movement in the unsuccessful weavers' revolt of 1844. Masterpieces like *Fuhrmann Henschel* (1899) and *Rose Bernd* (1903), in which the heroes become the victims of their environment, show, however, that what was important to Hauptmann was not social ideologies but the fate of the suffering individual. He also assumed a primary position in German poetic comedy with *Der Biberpelz* (1893); a thieves' comedy, *Schluck und Jau* (1900), in the Shakespearean tradition; and the verse comedy of a *Minnesinger Ulrich von Lichtenstein* (1939). Although he helped to establish naturalism in Germany, as early as 1894, with the dramatic dream poem *Hanneles Himmelfahrt*, Hauptmann himself passed the limits of naturalism's creative principles. In his later plays, fairytale and saga elements mingle with mystical and mythical symbolism (*Und Pippa Tanzt!* 1906; *Indipohdi*, 1920; *Veland*, 1925). The portrayal of the primordial forces of the human soul in a historical setting (*Kaiser Karls Geisel*, 1908) stands beside naturalistic studies of the destinies of contemporary people (*Dorothea Angermann*, 1926). The culmination of the final phase in Hauptmann's dramatic work is the Atrides cycle (*Die Atriden-Tetralogie*, 1941 *et seq.*), which expresses through the tragic Greek material Hauptmann's horror of the cruelty of his own time and his painfully disappointed longing for peace and the brotherhood of man.

The stories, novels and epic poems are as varied as the dramatic work and are often thematically interwoven with it as well as with one another; for in spite of its variety, his poetry has, as a whole, the inner unity of an individually created world. His *Novelle Bahnwärter Thiel* (1888) is a masterpiece of naturalistic narrative. The novel *Der Narr in Christo Emanuel Quint* (1910) depicts, in a modern parallel to the life of Christ, the passion of a Silesian carpenter's son, possessed by pietistic ecstasy. A contrasted figure is the apostate priest in his most famous story, *Der Ketzer von Soana* (1918), who surrenders himself to a pagan cult of Eros. Erotic mysticism and nature worship also inform the sparkling irony of the novel *Die Insel der Grossen Mutter* (1924). The epic in hexameters, *Till Eulenspiegel* (1928), is one of the crowning achievements of Hauptmann's work and of 20th-century German poetry. In it various levels of reality—politics and mythology, actuality and fantasy, the evocation of the historical past and dreams from the depths of the unconscious—are combined in a great poetic phantasmagoria of the modern consciousness. The terzina epic *Der Grosse Traum* (1942) and the novel-fragment *Der Neue Christophorus* (1943) contain the ripest wisdom of Hauptmann's old age, his final religious and philosophical thinking expressed in poetic symbol. His work is for the most part the artistic expression of the personal experience which he presents directly in many autobiographical works (*e.g. Das Abenteuer meiner Jugend*, 1937).

The naturalism of Hauptmann's early period cannot be fitted into a literary doctrine; it was an investigation of the basic nature of men and women in reaction against the conventional spirit of society and literature at that time. Similarly, the symbolic drama and mythical poetry of his late period were created from the immediate experience of reality suffused with spirit, as opposed to the intellectual abstractions of modern artistic expression. Hauptmann depicts the archetypal images of the soul, using dreams and fantasy as his organs of perception. He was a new imitator of nature, who set up in the face of a degenerate world an elemental creation of the spirit formed from experience and memory and from the forces of erotic love and longing.

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Translations: Many of Hauptmann's works have been translated into English. *See* his *Dramatic Works*, trans. by L. Lewisohn, 9 vol. (1912–29); *And Pippa Dances*, trans. by M. Harned (1907); *The As-*

sumption of Hannele, trans. by G. S. Bryan (1909); *The Fool in Christ*, trans. by T. Seltzer (1911); *The Heretic of Soana*, trans. by B. Q. Morgan (1923); *The Island of the Great Mother*, trans. by W. and E. Muir (1925). (H.-E. Ha.)

HAUSA, a Negro people found chiefly in northern Nigeria and the region immediately to the north in Niger. They numbered about 5,780,000 (1960) and comprised the single most numerous ethnic group in northern Nigeria. The Hausa have a sense of ethnic unity based on common language, similarity of customs and a tradition of common origin. According to a widely known legend, a man named Bayajida, having fled from Baghdad, his place of origin, arrived ultimately in Daura, at present a minor Hausa kingdom in the north. There, as a reward for his valour in killing a snake in the town well which was terrorizing the local population, he married the queen. His son, Bawo, is the reputed progenitor of six sons who founded the Hausa states of Gobir, Katsina, Kano, Zaria, Biram and Rano, which, together with Daura itself, form the original seven Hausa states. In addition, the states of Zanfara, Kebbi, Nupe, Gwari, Yauri, Bauchi and Kororofa are traditionally called the "illegitimate seven," since they arose out of the assimilation of populations of non-Hausa origin. A reckoning based on the Kano Chronicle, a main source of indigenous history, would place the beginning of the rule of Bagauda, the first king of Kano and the grandson of Bayajida, in A.D. 999.

The early rulers of the Hausa states were pagans. Islam was introduced in the latter part of the 14th century by a delegation of learned Muslims from the Negro kingdom of Mali, at the bend of the Niger river. It gradually spread among the Hausa, profoundly influencing their traditional beliefs and customs. A small minority of pagan Hausa, called Maguzawa, persists in some rural areas.

With the destruction of the vast Songhai empire with its capital at Timbuktu at the end of the 16th century, the important trans-Saharan caravan trade largely moved eastward to the Hausa cities of Katsina and Kano, which became flourishing centres of trade and Muslim culture.

Fulani and British Rule.—At the beginning of the 19th century the Fulani (*q.v.*), a largely pastoral people, originally from Senegal, who had settled in considerable numbers in Hausa country and were thoroughly Islamic, waged a holy war against the native Hausa rulers who were accused of religious laxity. Under the leadership of Usuman dan Fodio, the Fulani succeeded in conquering virtually all of the Hausa states and establishing an empire with its capital at Sokoto. After the death of the founder, the empire was divided and administered from two theoretically equal centres, Sokoto for the east and Gwando for the west. The individual states under their emirs, however, retained considerable autonomy, conducting independent wars and slave expeditions and even engaging in internecine warfare. The Fulani empire was on the verge of dissolution at the time of the advent of the British under the leadership of Lord Lugard in 1907. Under British administration the Fulani continued as the ruling class. The policy of indirect rule, by which indigenous political forms were as far as possible preserved and adapted to modern conditions, was first formulated by Lord Lugard in northern Nigeria as the result of his contact with the highly organized Hausa emirates and subsequently applied in other British territories in Africa. Slave-raiding and the legal status of slavery were abolished under British rule.

Political and Economic Organization.—In the pre-British period, the Hausa states were organized on a feudal basis, the emir being surrounded by a number of titled officeholders who held as fiefs various villages from which their agents collected taxes. In addition to the Fulani nobility and the free Hausa farmers and artisans there were large numbers of slaves obtained in warfare and slave-trading, some of whom were individually owned, in which case they were treated as members of the household. Others worked on the estates of the officeholders or of the king. A few royal slaves held important positions of authority. The children of those born in slavery held a special position and might not be sold.

The economy rested on the intensive cultivation of sorghum, maize, millet and other food plants. The principles of crop rotation and mixed farming based on the use of manure from the Fulani cattle were utilized; the plow was unknown. The existence of part-time specialists in leather, metalwork, weaving, dyeing and other crafts, professional traders, the use of cowrie shell currency and permanent markets in the larger cities, all testified to the vigour of the Hausa economy.

The chief political and commercial centres were large walled cities with mud-brick architecture, whose style and construction were probably borrowed from the Negro Muslim centres of the Niger bend and ultimately from north Africa.

Language and Literature.—The Hausa language belongs to the Chad group of Hamito-Semitic languages (*see* AFRICAN LANGUAGES). As a result of Islamic influence, numerous Arabic words have been borrowed, particularly in the spheres of religion and technology. The number of people who speak Hausa as a second language is difficult to estimate, but is considerable, and the language has become the general lingua franca in northern Nigeria, where it enjoys official status. Many Fulani speak it as a mother tongue.

Hausa is traditionally written in an orthography based on the Arabic alphabet, and an indigenous literature both in poetry and prose exists. The poetry employs quantitative metres of Arabic origin. The Muslim literati, however, more often use Arabic in their writings, which thus holds a position analogous to that of Latin in Europe in the middle ages. After the establishment of the British protectorate, an orthography based on the Latin alphabet came into widespread use and by the middle of the 20th century appeared likely to displace the older system. The standard literary dialect was that of the important commercial centre of Kano, the largest Hausa city. Dialect differences were considerable, that of Sokoto and the northwest being, in general, the most divergent from the standard form. These differences, however, were not sufficiently serious to interfere with mutual intelligibility.

See also NIGERIA; AFRICA: *Ethnography* (*Anthropology*): *West Africa.*

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HAUSER, KASPAR (1812?–1833), a German youth around whom grew up one of the most celebrated mysteries of the 19th century. On May 26, 1828, this youth was brought before the authorities in Nürnberg, apparently bewildered and unable to speak coherently. With him he had a letter purporting to be written by a labourer, into whose custody, it stated, the boy had been delivered on Oct. 7, 1812, with the proviso that he should be instructed in reading, writing and the Christian religion but kept in close confinement. Enclosed with this letter was one purporting to be written by the boy's mother, giving his name as Kaspar and his birthday as April 30, 1812, and stating that he was the son of a cavalry officer who had died. At first detained as a vagrant, the boy was later taken under the care of the educationist Georg Daumer. On Oct. 17, 1829, he was wounded—by an unidentified assailant according to his own account. Next the 4th Earl Stanhope took the boy under his protection (1832) and sent him to Ansbach, where he became a clerk in the office of the president of the court of appeal, Anselm von Feuerbach. The youth died in Ansbach on Dec. 17, 1833, from a wound that was either self-inflicted or, as he claimed, dealt by a stranger.

From the beginning, Hauser's case was much publicized, but little light has been shed on it. It was early alleged that he was the hereditary prince of Baden, son of the grand duke Charles Louis by his wife Stéphanie de Beauharnais; and that the grand duke Charles Frederick's widow, Luise Geyer von Geyersberg, Gräfin von Hochberg, had suppressed him in the hope of securing the succession for her own offspring. The German emperor William I, however, in 1875, caused the publication, in the *Augsburg Allgemeine Zeitung*, of the official record of the post-mortem and burial of the hereditary prince, who had died on Oct. 16, 1812. Papers relating to the case, in the Munich public record office, fill 49 folio volumes.

The case has inspired a great output of imaginative literature,

most of it worthless. A play by Anicet Bourgeois and Dennery (Adolphe Philippe) appeared as early as 1838. Paul Verlaine's poem in *Sagesse* (1881), the novels by Jacob Wassermann (1908), Sophie Hoechstetter (1925) and Otto Flake (1950) and the play by Erich Ebermayer (1928) deserve mention.

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HAUSHOFER, KARL (1869–1946), German political geographer and popularizer of geopolitics (*q.v.*), a theory of organic national development, was born in Munich on Aug. 27, 1869. The son of a professor at the University of Munich, he followed a military career until the end of World War I, attaining the rank of general. He acquired his first taste of the world-wide problems of political geography during an extended stay in Japan (1908–10). He was fascinated by Japan's expansionist ambition to become the leading power of Asia, and several of his books, including his most ambitious study in political geography, *Geopolitik des Pazifischen Ozeans* (1924), dealt with the role of Japan in 20th-century politics. In 1924 Haushofer founded the *Zeitschrift für Geopolitik*, which greatly influenced the new elite of Germany in the 1920s and '30s, augmented by Haushofer's teachings at the Institute of Geopolitics which he directed at the University of Munich. Compounded of sound observations and hazy theories, Haushofer's concept of the dominant role of the vast spaces was based upon Friedrich Ratzel's theories of space and nation and Rudolf Kjellén's conception of the state as a biological organism; his vision of the future role of Russia led him to adopt wholeheartedly the "heartland" idea of Sir Halford J. Mackinder (*q.v.*).

Haushofer's influence was considerable in military circles, but his impact upon the Nazi leadership was probably less significant than was assumed during World War II when the German pseudo science of geopolitics was identified in the United States with the Nazi doctrine of world domination. During the war Haushofer continued his efforts to justify the drives of Germany and Japan for world power, although his cultural background and his marriage to a woman of Jewish extraction must have made this task increasingly distasteful to him. When, after Germany's collapse, he was investigated as an alleged war criminal, he and his wife ended their lives, March 13, 1946.

His son Albrecht, who held a chair in geopolitics in the University of Berlin, had been executed as a resistance fighter against the Hitler regime. (H. W. WT.)

HAUSSMANN, GEORGES EUGÈNE, BARON (1809–1891). French administrator responsible for the transformation of Paris from its ancient character to the one which it still largely preserves, was born in Paris on March 27, 1809, the grandson on his father's side of a member of the Convention and, on his mother's, of a Napoleonic general. He studied law in Paris and entered the civil service in 1831 as the secretary-general of a prefecture, rising to be subprefect (1832–48), prefect in the provinces (1848–53) and finally prefect of the Seine *département* (1853–70).

In this last office he embarked on an enormous program of public works: he cut large straight avenues through the chaotic mass of small streets of which Paris was then composed and so made rapid and easy movement across it possible for the first time; he created new systems of water supply and of drainage and so removed the foul odours; he opened up parks on the English model both in the centre and at Boulogne and Vincennes; he demolished most of the private buildings on the Île de la Cité and gave it its official character; he built the Opéra and the markets known as Les Halles. Many of the ideas for these changes came from Napoleon III, but it was owing to Haussmann's exceptional capacity for work that schemes which might have remained idle dreams were carried out so expeditiously. Haussmann's success was favoured also by the autocratic nature of the regime under which he served, for this allowed him to raise enormous long-term loans and to use them almost without parliamentary or other control. His handling of public money, however, roused increasing criticism among the liberal opposition; and the advent to power of Émile Ollivier's liberal government in 1870 resulted in his dismissal. Haussmann was Bonapartist member for Corsica in the national assembly from 1877 to 1881, but took little active part in parliamentary work. He died in Paris on Jan. 11, 1891. He left an important autobiography, *Mémoires*, 3 vol. (1890–93).

Though the aesthetic merits of his creations are open to dispute, there is no doubt that as a town planner he exerted great influence on cities all over the world. *See* also PARIS.

See J. M. and B. Chapman, *The Life and Times of Baron Haussmann* (1957); D. H. Pinkney, *Napoleon III and the Rebuilding of Paris* (1958). (T. ZE.)

HAUTE-GARONNE, a *département* of southwestern France, was formed in 1790 from portions of the ancient provinces of Languedoc (parts of Lauragais and Toulousain) and Gascony (parts of Comminges and Nebouzan). Area 2,458 sq.mi. Pop. (1962) 594,633. It extends from the low-lying country around Toulouse to the central Pyrenees, which rise above 10,000 ft. along the Spanish frontier. The Garonne flows through the *département* in a northerly direction. After receiving the Salat tributary and crossing the outer Pyrenean range (Petites Pyrénées) it flows in a wide valley across the fertile lowlands of the northern part of the *département*. There are extensive cornlands (maize and wheat) and vineyards, with market gardening important on the valley floor near Toulouse. In the Pyrenees cultivation is much more restricted to the valley lands, and the mountainsides, largely deforested, have suffered severe soil erosion and gullying. There are modern hydroelectric power stations on the headstreams of the Garonne, and a large cellulose factory has been established at St. Gaudens. The mineral springs of Bagnères-de-Luchon, Barbazan and Salies-du-Salat are well known, and the tourist industry is developing. In the mountains there are some scattered ore deposits, but of much greater importance is the natural gas that was discovered in 1939 at St. Marcet, 7 mi. N. of St. Gaudens. Besides supplying Toulouse, the gas serves as the basis of chemical industries, and there are fertilizer plants at Lannemezan and Pierrefitte.

Toulouse (*q.v.*) on the Garonne and the Canal du Midi, which crosses the *département* from the gap of Naurouze to the Garonne valley, is the metropolitan centre of a large part of southwestern France, and naturally serves the *département* as its administrative capital and ecclesiastical, educational and judicial centre. There are two *arrondissements*, Toulouse and St. Gaudens. (AR. E. S.)

HAUTE-LOIRE, a *département* of central France, was formed in 1790 of Velay and other districts of ancient Languedoc (*q.v.*), together with some adjacent portions of Lyonnais and Auvergne. Area 1,931 sq.mi. Pop. (1962) 211,036. Haute-Loire is bounded north by Puy-de-Dôme and Loire, east and southeast by Ardèche and southwest and west by Lozère and Cantal. It consists of some of the highest parts of the Massif Central in the upper basins of the rivers Loire and Allier, which drain it northward. The uptilted crystalline plateau surface rises above 5,000 ft. both in the Vivarais highlands on the southeastern border of the *département*, and west of the river Allier in the granite highlands of Margeride. Below the general plateau surface are downsunk basins such as those of Langeac and Brioude, connected by the Allier, and that of Le Puy, which lies about 2,000 ft. above sea level in the heart of Velay. Large areas of Velay are covered with lava, and other remains of geologically recent volcanic activity are widespread. The winters are severe and long, but there are considerable contrasts between the exposed plateaus and the sheltered basins and valleys, which are much drier and milder. In fertility there are great differences between the cold, acid soils of the granite and schist areas and the rich soils of the basalt country. Whereas the former were traditionally poor rye lands, wheat has for centuries been widely grown in Velay. Corn occupies nearly half the arable land there, and elsewhere potatoes are widely grown; but fodder crops are increasingly predominant, and young cattle are the chief farm product. The vine makes only sporadic appearances in some of the lowest and most sheltered valleys.

Great areas of the high plateau surface are occupied by heaths (*chaumes*), which provide only extensive summer grazing.

Small pockets of coal in the Allier valley are worked and there has been development of hydroelectric power, notably on the Loire; but large-scale industry is not represented in the *département*. For many decades rural depopulation has been acute and widespread and the population of the *département* has fallen steadily. The domestic manufacture of lace is widespread, especially in and around the great pilgrimage centre of Le Puy, where the adornment of religious objects fostered its development. The cult of the Black Virgin has for centuries brought pilgrims to Le Puy, which has developed as an important tourist centre. Set in a fertile basin, of which it is the market town, Le Puy is dominated by a volcanic hill, the Rocher Corneille. From the modern statue of Notre Dame, which surmounts the summit, a magnificent panorama may be obtained of the surrounding bizarre landscape, bristling with volcanic rocks that are crowned with castles and churches. Among them Polignac preserves the fine keep of its medieval castle. The crater lake of Le Bouchet and the spectacular basalt columns, known as the Orgues d'Espaly, are other features of tourist attraction near Le Puy, and the *département* elsewhere has several fine Romanesque churches, including that at Brioude.

Le Puy, ancient capital of Velay, is the *préfecture* (capital), and other small market towns, Brioude and Yssingeaux, are centres of *arrondissements*. The *département* forms the bishopric of Le Puy in the archepiscopal province of Bourges, and it comes under the *académie* of Clermont-Ferrand for educational administration and under the court of appeal at Riom. (Ar. E. S.)

HAUTE-MARNE, a *département* of northeastern France, consisting of some districts of the ancient province of Champagne (*q.v.*; Bassigny, Perthois, Vallage) with smaller portions of Lorraine and Burgundy and some fragments of Franche-Comté (*qq.v.*). Area 2,416 sq.mi. Pop. (1962) 208,446. It is bounded northeast by Meuse, east by Vosges, southeast by Haute-Saône, southwest by Côte-d'Or, west and northwest by Aube and Marne. In the south the plateau of Langres, rising above 1,500 ft., forms the watershed between the Rhône-Saône and Seine drainage basins. The Marne valley, traversing the *département* from south to north, crosses successively the arcuate outcrops of alternating limestones and clays of Jurassic and Cretaceous age which form the southeastern part of the Paris basin. Crossing the limestone highlands, the river has a trenchlike valley with steep walls, but it opens out more widely in the clay belts. In the west of the *département* headstreams of the Aube traverse the same belts, and in the extreme east a 30-mi. stretch of the Meuse river, traversing Lias clay country, falls within the *département*. The limestone platforms have stony, permeable and infertile soils and a climate with severe wet winters, especially on the plateau of Langres. Settlement is sparse, largely confined to the valleys, and much land is left as forest and rough grazing. There is extensive evidence of the reversion of the stony arable fields. Sheep farming for wool, once a leading pursuit, has become much less important, and on the reduced farmland cattle have increased in numbers and the crops grown are mainly for their support. On the richer pastures and mixed farms of the clay country, cattle have also become the mainstay. Iron ore has been extensively worked in the past, and charcoal smelting of iron was a widespread activity which persisted well into the 19th century. The engineering and hardware industries at St. Dizier, Wassy and Joinville are modern outgrowths. The chief mineral worked is limestone.

The Marne valley, followed by railway and the Marne-Saône canal, is the axis of the *département*, with the chief towns, St. Dizier, Chaumont (*q.v.*) and Langres (*q.v.*), strung out along it. These towns are the centres of the three *arrondissements*. Thanks to its industrial growth, St. Dizier (33,511 in 1962) is the largest, but Chaumont (21,462) is the *préfecture* (capital) and the old fortress city of Langres (7,648), controlling one of the approaches to the centre of the Paris basin from the Rhône corridor and the gate of Belfort, is the centre of the bishopric. Both for the administration of education and justice Haute-Marne comes under Dijon. (Ar. E. S.)

HAUTES-ALPES, a *département* of southeast France, was formed in 1790 out of the southern portion of the old province of Dauphiné (*q.v.*), together with a small part of Provence (*q.v.*). It is bounded north by Savoie, west by Drôme and Isère, south and southeast by Basses-Alpes, and extends east to the Italian frontier, occupying the upper basin of the Durance river in the heart of the southern French Alps south of the Pelvoux massif. In the northwest it extends over the Col Bayard north of Gap to include the upper basin of the Drac. Area 2,179 sq.mi. Pop. (1962) 87,436.

The *département* consists of a complex tangle of high mountains, mainly limestone in the west, with overthrust sheets of diverse sedimentary and metamorphic rocks in the east. The sheltered valleys are remarkably dry and sunny, and vegetation limits are high, with patches of cultivation above 6,000 ft. Irrigated meadows, cornfields, orchards and vineyards occupy the valley floors and lower slopes, with a sparse cover of scrub and degraded woodland above. There is little forest of commercial value and the bare mountain slopes have been extensively gullied by torrents. Sheep rather than cattle are the basis of the livestock farming, but the *département* is no longer visited by transhumant flocks from Provence, which in the past played an important part in the destruction of its woodlands. Stone buildings, with tiled roofs, are characteristic of this *département* in contrast with the lavish use of timber for construction in the northern Alps.

Hydroelectric power is much less important than farther north and although there are scattered workings of anthracite, little industry is carried on in the *département*. Floss silk, however, is made at Briançon. The isolation of the high Alpine valleys has been reduced by the modern development of motor roads. Two important roads traverse the *département* from north to south, the Route Napoléon in the west by Gap, and the Route des Grandes Alpes nearer the Italian frontier, using high passes above 6,000 ft. Since the middle of the 19th century depopulation has been intense and still continues in spite of the developing tourist industry.

The *département* is divided into the two *arrondissements* of Gap and Briançon. Briançon, at the foot of the Col de Genèvre crossing into Italy, is an old fortress town with a modern extension by the railhead in the Durance valley. Gap (*q.v.*), the largest town and *préfecture* (capital), is also the centre of the diocese. For the administration of education and justice the *département* comes under the academy and court of appeal at Grenoble. (Ar. E. S.)

HAUTE-SAÔNE, a *département* of eastern France, was formed in 1790 from the northern part of Franche-Comté (*q.v.*). It lies astride the upper course of the Saône river, and is bounded north by Vosges, east by Belfort and Haut-Rhin, south by Doubs and Jura, and west by Côte-d'Or and Haute-Marne. Area 2,075 sq.mi. Pop. (1962) 208,440. The *département* includes much of the plain of the upper Saône basin north of the Ognon tributary and extends east into the gate of Burgundy and north to the margins of the Langres and Lorraine plateaus. Although the climate of the surrounding uplands is wet, with severe winters, the sheltered Saône valley is much drier and has warm, sunny summers. The soils are generally fertile and well cultivated with corn, sugar beet and fodder crops, but there are some badly drained areas, and also stretches of infertile sands that still carry forest. Fruit trees are widespread, and the district is reputed for its kirsch, an alcoholic beverage made from the morello cherry. The vine is cultivated, chiefly in the west around Champlitte. There is a small coal field at Ronchamp. The canalized Saône is connected with the Meuse and Moselle rivers by the southern branch of the Canal de l'Est at Corre. Metalworking and engineering industries and textile mills are represented in the *département*, especially in the northeast toward Belfort, but the *département* is not heavily urbanized, its capital and largest town, Vesoul, having only 10,794 inhabitants. Luxeuil-les-Bains, a well-known spa, Gray and Lure are the other chief towns, each with a population of about 7,000. Vesoul and Lure are the centres of the two *arrondissements* into which Haute-Saône is divided. It is part of the bishopric, educational division and appeal court area of Besançon. (Ar. E. S.)

HAUTE-SAVOIE, a *département* on the eastern frontier of France, was formed from the old provinces of Genevois, Chablais and Faucigny in the duchy of Savoy. It is bounded north by the canton of Geneva and east by the canton of Valais in Switzerland,

southeast by the Italian frontier in the Mont Blanc massif, and south and west by the *départements* of Savoie and Ain. Area 1,775 sq.mi. Pop. (1962) 329,230.

Consisting of the northernmost part of the French Alps, with some of the foreland, the *département* varies in height from 15,771 ft. at the summit of Mont Blanc in the southeast to less than 1,000 ft. along the Rhône river and on the shores of the Lake of Geneva in the northwest. Most of the *département* is occupied by the prealpine massifs of Chablais, Bornes and Bauges which, apart from some overthrust sheets in the Chablais, consist largely of autochthonous folds of limestone. The great transverse breaches of the Arve valley (Faucigny) and Annecy (partly occupied by the lake) separate the individual massifs of the Préalpes and form routes into the high Alps. In front of the high, heavily glaciated, crystalline massifs of Beaufortin, Mont Blanc and Aiguilles Rouges is the complicated relief of the northern end of the great Alpine furrow, drained mainly by the Arve.

The closed subsistence economy that formerly prevailed in the Alps has given way to specialized cattle farming, with most of the remaining plowland devoted to fodder crops, and gruyère cheese is an especially important product. Some vineyards remain in climatically favoured spots. Fine forests are supported below about 6,000 ft. on the high Alps and the wet and exposed Préalpes, and there are important sawmilling and paper industries. Apart from some production of asphalt at Lovagne near Annecy, some small anthracite workings and stone quarrying, minerals are not important, but there are cement works in the accessible gaps of the Préalpes. Annecy also has engineering industries and the famous bell foundry of Annecy-le-Vieux. Watchmaking, with the manufacture of other precision instruments, has spread from Switzerland into Faucigny and is carried on especially at Cluses on the Arve. Since the 19th century the tourist industry has greatly developed and the communications provided for it have opened up the valleys in the Mont Blanc massif, where Chamonix, in its magnificent setting of mountain peaks and great glaciers, has become an important centre for climbing, winter sports and less active sight-seeing. The construction of the aerial cable car of the Aiguille du Midi after World War II promoted a remarkable further development of skiing and sight-seeing.

The chief towns, Annecy, Bonneville and Thonon, situated near the mouths of Alpine valleys, are the centres of the three *arrondissements* into which the *département* is divided. Annecy (*q.v.*), the largest town and capital, is also the centre of the diocese formed by the *département*, which comes under the *académie* of Grenoble and the court of appeal at Chambéry. (Ar. E. S.)

HAUTES-PYRÉNÉES, a frontier *département* of southern France, was formed in 1790 from Bigorre and parts of Gascony (*q.v.*). Area 1,751 sq.mi. Pop. (1962) 211,433. Most of the *département* lies in the central Pyrenees, north of the wall-like crest line which forms the Franco-Spanish frontier. The crystalline core of the Pyrenees forms massive mountains that rise to 10,000 ft., the Vignemale (10,820 ft.) being the highest peak in the French Pyrenees. They have been heavily sculptured by glaciation, and deep, troughlike valleys extend into the heart of the mountains, ending in great amphitheatres, such as the Cirque de Gavarnie. The passes into Spain are high and difficult and there is little development of longitudinal valleys to facilitate west-east movement. The mountains are drained northward by a number of independent streams, the Gave de Pau, the Adour and the Neste headstream of the Garonne. The relations of each valley are much easier with the plains into which they open northward than with neighbouring valleys.

A pastoral economy prevails in the higher valleys, where possibilities of agriculture are severely limited. Small patches of hay meadow and potatoes surround the highest permanent settlements, above which are extensive summer pastures, with seasonal cabins. At lower altitudes in the valleys, and in the low-lying northern portion of the *département* around Tarbes, maize is the chief cereal and haricot beans and deciduous fruits are important crops. Scattered through the mountains are small deposits of metal ores, including manganese, lead and zinc. Quarrying of slates is carried on at Labassère. The mineral springs have long been well known, and the growing tourist industry has invigorated spa towns such as Cauterets (*q.v.*) and Bagnères-de-Bigorre. Since the middle of the 19th century the old fortress town of Lourdes (*q.v.*) has become the most frequented pilgrimage centre in the world. Hydroelectric power is an important modern resource, and installations are strung out especially along the Gave-de-Pau above Lourdes. The great new station at Pragnères came into operation in 1954.

The *département* consists of three *arrondissements:* Tarbes, Bagnères-de-Bigorre and Argelès-Gazost. The town of Tarbes (*q.v.*), the capital, is also the centre of the bishopric, and the *département* is in the *académie* (educational division) of Toulouse and is attached to the appeal court at Pau. (Ar. E. S.)

HAUTE-VIENNE, a *département* of west central France, was formed in 1790 from portions of Limousin, Marche, Poitou (*qq.v.*) and Berry. Area 2,145 sq.mi. Pop. (1962) 332,514. It is bounded north by Indre, east by Creuse, southeast by Corrèze, southwest by Dordogne, west by Charente and northwest by Vienne. The *département* is situated in the northwestern part of the Massif Central, in the upper basins of the Vienne river and the Gartempe tributary of the Cher river. From the highest ground in the southeast, the Plateau de Millevaches above 2,500 ft., the headstreams of the Vienne flow across the lower plateau surfaces that form the northwestern fringe of the Massif Central. Granite and other crystalline rocks prevail, forming monotonous rolling uplands, impermeable surfaces abounding in watercourses and with boggy hollows. Agricultural possibilities are limited by the poor, acid soils and the inclement climate. In the valleys and on the lower plateau surfaces the cultivation of cereals has been largely replaced by fodder crops. The chestnut, once a mainstay of the rural economy, has declined. Irrigated meadows are extensive, and an intensive pastoral economy has been developed by smallholders concerned mainly with the rearing of cattle. Afforestation has made piecemeal progress, but considerable tracts of moorland remain. In places granite is quarried, but the most important mineral is kaolin, quarried near St. Yrieix and elsewhere for the porcelain industry there and especially at Limoges. Limoges has important manufactures of footwear, and St. Junien is also a centre of leather industries. The railway from Orléans to the southwest traverses the *département* and at Limoges intersects the only important east-west route across the Massif Central, from Lyons.

Limoges is the *préfecture* (capital) of the *département*, which is divided into the *arrondissements* of Limoges, Bellac and Rochechouart. Limoges (*q.v.*) is a large provincial city, the seat of a bishopric and court of appeal, and serves a wide district. The *département* belongs to the *académie* (educational division) of Poitiers. There are some fine Romanesque churches in the *département*, notably those at St. Junien and Solignac, and the cathedral and episcopal palace at Limoges are noteworthy buildings. The latter now houses the Limousin museum of history and art. Limoges also has a remarkable museum of ceramics. (Ar. E. S.)

HAUTE-VOLTA, RÉPUBLIQUE DE: *see* Upper Volta, Republic of.

HAUT-RHIN, a frontier *département* of eastern France, formed in 1790 from the southern portion of Alsace (*q.v.*). In 1870 it was incorporated into the German empire, but was restored to France in 1919 by the treaty of Versailles. It is bounded north by Bas-Rhin, west by Vosges, south by Switzerland and east across the Rhine river, by Baden in Germany. Area 1,363 sq.mi. Pop. (1962) 547,920. The *département* occupies the southern portion of the Rhine rift valley, between the Rhine below Basel and the flanking Vosges highlands. Forming the western part of the *département*, the eastern face of these granite highlands falls steeply from rounded summits that exceed 4,000 ft. to the flat plain of the Rhine, at about 700 ft. It is gashed by the narrow, steep-sided valleys of many torrents that are collected and carried to the Rhine by its tributary the Ill. The plain, despite its lack of relief, shows sharp contrasts in surface character between the Ill and Rhine flood plains, which are marshy strips (*ried*) in part reclaimed for lush meadows, and the flanking dry gravel terraces. The superficial covering of fertile

loess, combined with a favourably dry climate, with warm, sunny summers, if rather cold winters, is responsible for the richness of the farming. Extensive cornfields, orchards and vineyards extend along the foot of the Vosges and up their sheltered valleys. In parts, however, the coarse gravels of the plain carry extensive forests. Among the farmlands are numerous village clusters and market towns, the latter situated especially where valleys debouch from the Vosges and along the Ill. Old established settlements are strikingly absent from the Rhine flood plain, which is still only partly reclaimed.

Large deposits of potash that underlie the Nonnenbruch forest north of Mulhouse are an important developed resource. Brick and tile works are numerous. The active cotton manufacturing industry, developed from earlier woolen and linen textile industries, has depended for its modern growth upon the soft water and water power of the Vosgian torrents and coal brought by the Rhine. Its main centre is Mulhouse, but it is widespread in the small towns of the plain and has spread up the valleys of the Vosges. Silk and new man-made fibres are also important. The *département* is served by the Rhône-Rhine canal and by the railway from Strasbourg to Basel through Colmar and Mulhouse. Colmar is the *préfecture* (capital) of the *département* and the centres of its constituent *arrondissements* are Colmar, Altkirch, Mulhouse, Thann, Guebwiller and Ribeauville. Haut-Rhin forms part of the bishopric of Strasbourg, and is under the *académie* there, but for the administration of justice it comes under the court of appeal at Besançon. (Ar. E. S.)

HAUTS-DE-SEINE, a *département* of France formed in 1964 from the western part of the former *département* of Seine, together with Sèvres and Rueil-Malmaison from the former *département* of Seine-et-Oise. Lying on the west side of Paris, it is bounded east by the *départements* of Seine-Saint-Denis, Ville de Paris, and Val-de-Marne, south by Essonne, north by Val-d'Oise, and west by Yvelines. It comprises the westward and southwestward extensions of Paris outside the line of the last fortifications of 1841–45. In the south is hilly country, reaching 500 ft. (150 m.) and consisting of a limestone base with discontinuous cappings of sand and sandstone that form ridges aligned from southeast to northwest, dissected by left-bank tributaries of the Seine River. The northern part of the *département* consists of the peninsulas that lie within the first two great meander loops of the river below Paris, except for the Bois de Boulogne, which is an annex of Paris *ville*. Adjacent to the Bois de Boulogne are residential areas in Neuilly and Boulogne; the low-lying ground at the tip of the peninsula, where former islands have been attached to the river bank, is the industrial quarter of Billancourt. The Renault automobile works were established there in 1933 on the Île Séguin after it had been raised to reduce flood risk. On the opposite bank is Sèvres, famous for its porcelain, a collection of which is on display at the ceramic museum. Downstream from Le Pecq bridge the new western motorway out of Paris tunnels for half a mile through the steep valley side below the old royal park of Saint-Cloud (*q.v.*), which is especially noteworthy for its water spectacles. At Saint-Cloud also is the Montretout reservoir, which receives an important contribution to Paris' water supply, derived from the Avre tributary of the River Eure.

Quays and port installations, gas and electricity works, and factories line the river banks in the *département,* and more factories, producing a great variety of goods, are closely intermingled with housing in the communes of Levallois-Perret, Clichy, and Saint-Ouen that lie between the boundary of Paris and the river. On the left bank are other industrial suburbs at Suresnes, Puteaux, Courbevoie, and Asnières, but back from the river the interior of the peninsula has become a mass of housing, traversed by the roads leading out from Paris to the west and northwest. Dormitory suburbs such as La Garenne-Colombes and Nanterre, where the *préfecture* has been established, have sprung up on what were gravelly heaths. In the northern part of the peninsula, however, there are still extensive market gardens and nurseries, fertilized since 1869 with treated sewage from Paris. On the Seine, Gennevilliers is a major annex of the port of Paris, with large gas works and an oil refinery alongside. Farther downstream at Colombes is the famous sports stadium.

Beyond the drab, crowded 19th century suburbs, Issy-les-Moulineaux, Vanves, Malakoff, and Montrouge, which girdle Paris on its south side, considerable tracts of forest break up the residential suburbs that are steadily spreading southward on hilly country. Among them Sceaux, served by its suburban railway, is an elegant suburb, which has developed from the town adjacent to the park that once belonged to Colbert. Nearby is the postwar garden city of Butte Rouge. Farther west are Villacoublay Airport and the French nuclear research centre at Saclay, on the plateau between the Bièvre and Yvette valleys. (Ar. E. S.)

HAÜY, RENÉ JUST (1743–1822), French mineralogist, one of the founders of the science of crystallography, was born at St. Just, Oise, on Feb. 28, 1743. An accident directed his attention to crystallography. Happening to let a specimen of calcite fall, he was led by examination of the fragments to make experiments which resulted in the statement of the geometrical law of crystallization according to which the secondary faces on a crystal are related to the primitive form, or cleavage nucleus, by a law of whole numbers, and the angles between them can be arrived at by mathematical calculation. Haüy's name is also known for the observations he made in pyroelectricity, the property of certain crystals, *e.g.,* tourmaline, of developing electric charges on heating or cooling. In 1802, under Napoleon Bonaparte, he became professor of mineralogy at the museum of natural history, but he was deprived of his appointment after the Restoration (1814). He died in Paris on June 3, 1822.

Among his numerous works may be mentioned *Traité de minéralogie* (4 vol., 1801) and *Traité de cristallographie* (2 vol., 1822). He also contributed papers to various scientific journals.

HAVANA (La Habana), a province in middle western Cuba, between Pinar del Rio and Matanzas provinces. Although the smallest province in area (3,174 sq.mi.), including the Isle of Pines, it is densely populated (1962 est., 1,955,440) because of the great concentration in and near the city of Havana. It consists mostly of hilly belts near the northern coast and in the centre, and a gently sloping plain in the south bordered by a swampy coast of mangrove forests. The northern coast is high and is characterized by an abundance of terraces, sandy beaches and the beautiful Bay of Havana. (*See* Pines, Isle of.)

The fertile soils of the province, especially in the Red plain of the south, yield considerable quantities of sugar cane, excellent quality cigar-wrapper tobacco, fruits, vegetables and milk for the urban market of Havana. Güines, in the southeastern section of the province, has been traditionally the supplier of agricultural products for Havana, using irrigation facilities of the Mayabeque river. The province has excellent communications, including a good network of modern highways, railways and airways. Many industrial plants are located around as well as in Havana. (D. R. D.)

HAVANA (La Habana), capital, commercial metropolis and major port of the republic of Cuba, the largest city of the West Indies and one of the leading tropical cities in the new world, lies on the northern coast of the island, toward the western end. Its location on one of the fine harbours of the hemisphere made it commercially and militarily important from colonial times and is a major factor in accounting for its steady growth in population from 235,981 in 1899 to 978,382 (est.) in 1962. Other factors in its growth have been its salubrious climate, picturesque location and, before the advent to power of Fidel Castro in 1959, gay entertainment which made it a mecca for tourists. The mean annual temperature varies only about 10° F. (about 5° C.), averaging 76° F. (about 24° C.). Rain falls throughout the year, the wet season being from May to November.

The city has three sections: the old city; the new, densely settled subdivisions; and the suburbs. Old Havana is located on the peninsula between the harbour channel and the bay; the newer section of Vedado extends along the coast to the Almendares river; a little farther out are the residential and industrial suburbs of Guanabacoa and Marianao. The aspect of Havana from the sea is picturesque. Although the country clubs and many of the fashion-

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PORTION OF MODERN HAVANA SKYLINE

able residential suburbs along the coast were expropriated by the Castro government, from a physical standpoint the view remains no less impressive. On the left of the entrance to the harbour rises the Morro castle and lighthouse. On the right La Punta fortress appears and beyond it the Prado, or Paseo de Martí, the main avenue leading to the heart of the city. Lining the Prado are buildings constructed of West Indian white coral limestone.

The entrance-strait to the harbour, about 300 yd. wide and 1,750 yd. long, leads to the inner harbour, which lies east and south of the city. The water front in the older sections is lined with wharves and docks. There are three distinct arms of the inner bay, called respectively, Ensenada de Marimalena, Guanabacoa bay and the Ensenada de Atarés.

Streets and Buildings.—From well out toward the western suburbs, the Malecón, or sea wall, a wide boulevard which skirts the sea and city, furnishes a colourful foreground which is extended along inside the harbour (on reclaimed ground which covers the shallows of the harbour entrance) and creates wide parks and valuable commercial lands. The Malecón merges at the Prado into the Avenida del Puerto, which, with a width varying from 50 to 125 ft., connects this outer drive to the old narrow streets of the business section. This entrance to the old business thoroughfares Calles O'Reilly and Obispo, and Calle de Oficios eased much of the old downtown congestion. Most of the old streets of Havana, originally laid out to furnish shade along their narrow drives and walks and to carry only a few dozen Cuban coaches (*quitrines* or *volantas*), were converted into one-way streets to accommodate motor vehicles, thus giving a more ordered control of the traffic problem.

Many public buildings were built along the Malecón and the Avenida del Puerto, including the Capitania, or office of the captain of the port. The newer section has also a number of fine parks, notably the Parque del Maine, with its monument by Félix Cabarrocas dedicated to the U.S. battleship "Maine," which was blown up in Havana harbour on Feb. 15, 1898. In 1960, in an angry gesture against the United States, Fidel Castro had the eagle atop the monument removed by a wrecking crane, resulting in the partial destruction of the main shaft of the monument as well. The announced intention was to replace the eagle with the "dove of peace." The Presidential palace, the residence of the chief executive, is at the head of the Avenida de las Misiones, a wide thoroughfare; this avenue leads from Avenida del Puerto inland and was designed to be lined for its short length with the embassies and legations of foreign governments.

Historic Landmarks.—Of the older landmarks, one of the most important is the old palace of the Spanish governors, now the city hall and office of the Ayuntamiento or city government; this fine old pile stands on the site of the original parish church on the eastern side of the Plaza de Armas, the old centre of the colonial city. The palace was erected in 1773–92 and remodeled in 1835 and 1851. It was the scene of the surrender by the Spaniards of the sovereignty of the island to the United States at the close of the Spanish-American War and the scene, too, of the transfer of its sovereignty from the United States to the first president of Cuba, Tomás Estrada Palma, on May 20, 1902.

Havana was once the most strongly fortified city in Spanish America and many of its old forts built to withstand attacks from pirates are still standing. The most precious of these old historical landmarks is the ancient stronghold La Fuerza, or more properly, El Castillo de la Real Fuerza, begun in 1565 and completed in 1583, standing on the site of the yet older fortress built by order of Hernando de Soto in 1538, but destroyed by the French pirate Jacques de Sores. The later fortress was the home of the governors general and the citadel and refuge of the populace in times of danger from 1584 until the middle of the 18th century. Crowning the old watchtower of La Fuerza is a weather vane formed in the shape of an Indian maiden, called "La Habana." The two 16th-century fortresses, Morro castle or El Castillo de los Tres Reyes del Morro (castle of the three kings of the headland) and La Punta, on either side of the harbour entrance, are perhaps the best-known Cuban landmarks. La Cabaña, behind and above Morro castle, is the largest fort in Havana and was completed in 1774.

Another old building (restored and used by the senate) is of elaborate 18th-century Spanish baroque architecture. The old city also contains the post office (the church of San Francisco), begun in 1575 and rebuilt in 1731–37; also the old municipal jail, a typical Spanish fortress on the Prado, and the Castillo del Príncipe, now the penitentiary. In this section also is the National library, the Maestranza, formerly the navy yard and the headquarters of the artillery. The old city abounds in ancient private residences. Before the Castro revolution many of them had been acquired by the government and patriotic societies in order to restore and preserve them.

Many of the public buildings were formerly churches, and indeed churches of the colonial epoch are still among the most interesting and carefully preserved relics of the older days. The convent of Santa Clara, built in 1644, was bought by the government at a substantial price in 1928 and converted into the ministry of public works; in the large patio of this old building are still preserved the first houses and streets built in Havana, which were enclosed in the old church and monastery by its builders in the 17th century. The cathedral is the most noteworthy, architecturally, of the city's churches; it was originally the Jesuit church, erected between 1656 and 1724, although the interior decorations date only from 1790–1820. One of the tombs of Columbus is marked there; the remains of the discoverer were removed, according to certain claimants, from Santo Domingo (Dominican Republic) in 1796, and lay there until carried to Spain in 1898. (*See* COLUMBUS.)

Parks and Suburbs.—Havana has been famous since the days of the Spaniards for its parks and drives. The harbour's edge on the east is traversed in part by the old Paseo or Alameda de Paula, originally laid out in 1772, and by the Avenida del Puerto, the latter a portion of the elaborate modern reconstruction of Havana (including the opening of the Avenida de las Misiones and the beautification of the Prado), designed and carried out under Carlos Manuel de Céspedes while minister of public works under Pres. Gerardo Machado. The Malecón or sea-wall drive, extended around the harbour entrance as the Avenida del Puerto, traverses the edge of the city along the sea for several miles, a beautiful drive and promenade. The Prado, rechristened the Paseo de Martí in honour of the "Apostle of Cuban independence," follows the line of the old city wall. The lower Prado is lined with residences and clubs, but the so-called upper Prado leads to the Parque Central on one side of which was built the pretentious and costly capitol, begun by Pres. José Miguel Gómez about 1910 and completed under Pres. Gerardo Machado in 1929. The Prado continues to the Plaza de la Fraternidad, formerly Parque de Colón or Campo de Marte, curving in its course and furnishing a highway into the heart of the old city, although its formal climax is the Parque de Colón where stand handsome monuments to José Martí and other Cubans notable in history and science. This park is surrounded by handsome offices, hotels and clubs, among them the elaborate and costly Centro Asturiano, which with the Casino

Español is one of the two large Spanish clubs. In this section were some of the handsomely equipped hotels that made Havana an important winter resort.

From Plaza de la Fraternidad, the Avenida de Simón Bolívar, formerly Calzada de la Reina, reaches the Paseo de Carlos III and the Paseo de Tacón, passing westward through the city to the botanical gardens and the Quinta de los Molinos to the old citadel of El Príncipe, begun in 1774 and finished 20 years later. Los Molinos was once the summer palace of the Spanish governors general and adjoins the gardens of the university. Near El Príncipe is the Colón cemetery, with many historic monuments and mausoleums. Another famous promenade and drive is the Avenida de Menocal, at the west end of the new city; the Cerro, in the southwest, is a residence quarter.

Suburban growth in Havana was rapid and extensive. The whole territory now tributary to the capital covers a large area. On the south and west the city is surrounded by a range of hills, with the conspicuous fortifications of Castillo del Príncipe on the west. Lower down on the hills are the suburbs of Vedado, Jesús del Monte and Luyanó; besides these, Puentes Grandes, old Marianao and Guanabacoa are populous suburbs.

Education.—In the upheaval of revolution and the establishment of the Castro regime, the Universidad de La Habana—the national university established in 1728—suffered catastrophic damage. Shorn of its traditional autonomy and made subservient to the regime, two-thirds of its faculty were forced out and most of them went into exile. The Catholic university in the suburb of Marianao was closed, as were the once excellent secondary schools previously maintained under Protestant, Catholic and nonsectarian auspices. All private schools were outlawed.

Although it was the avowed aim of Castro's 26th of July movement to extend educational facilities to all Cubans, it was not known in the early 1960s to what degree that objective had been fulfilled. The content of instruction in the schools was being changed to support the political orientation of the Castro regime.

Among the libraries are those of the Sociedad Económica de Amigos del País founded in 1793, and the Biblioteca Nacional (National library). The only newspapers allowed by the Castro government were those under strict government control—*Revolucion, Hoy* and a few others. The venerable and internationally respected *Diario de la Marina*, established in 1838, and all other private newspapers were suppressed.

Population and Health.—Havana had 51,307 people in 1791; 96,304 in 1811; 94,023 in 1817; 184,508 in 1841; 235,981 in 1899, the year following independence; 360,517 in 1919; 432,353 in 1925; 542,522 in 1931; 659,883 in 1943; and 785,455 in 1953, while the suburbs aggregated another 432,219; in 1961 the estimate was 897,042. The population is mainly native-born and predominantly Afro-European. The European element is, of course, primarily Iberian and representative chiefly of northern and northwestern Spain. The knowledge of English became widespread in Havana because of the impact of American tourists and the advent of motion pictures, radio and television.

The workers' residence portion of the city is congested, and before the U.S. occupation (*see* CUBA: *History*), health conditions were notoriously bad and deaths from epidemics, including periodic scourges of yellow fever, rose to high figures. One of the worst of the yellow-fever epidemics broke out in 1900, immediately following the War of Independence, and concomitant with a heavy immigration from Spain. Stringent sanitary regulations failed to stop the epidemic until a commission of U.S. army surgeons led by Walter Reed (*q.v.*) definitely established in a series of experiments that the fever was transmitted by the mosquito known as *Stegomyia fasciata*, later classified as the *Aëdes aegypti*. Immediately after Reed's findings (which corroborated a discarded hypothesis of Carlos J. Finlay, the noted Cuban physician and biologist) were announced, the campaign against the disease began. Maj. William C. Gorgas (*q.v.*), later the sanitary officer who cleaned up the Panama Canal Zone, led the fight that practically exterminated the mosquitoes of Havana and ended yellow-fever epidemics.

Havana became one of the most carefully protected ports in the world, so far as sanitary measures were concerned, and its death rate was reduced to normal proportions. Changes in the water system, with additions of new reservoirs, brought the excellent water from the hills into the capital and the fetid Havana of the colonial period became a memory only.

Transportation and Communication.—Havana is the hub of Cuba's transportation system. In its earlier history the commercial and military importance of Havana was derived from its location on its fine natural harbour, which is completely protected and accessible to ships of almost any draft. It was linked by coastwise navigation with various ports of the Caribbean.

To the importance of water transportation must be added the fact that Havana is the terminus for the chief railways and is therefore linked with all the major communities of the island. The coming of the automobile created new problems as well as new opportunities in transportation. The elongated shape of Cuba made highway communication difficult and costly until the completion of the paved central highway. Havana, quite naturally, is the focal point on this highway which feeds its heavy traffic into the city from both east and west. Havana is also the terminus of airlines; the airport serving both domestic and international airlines is about 8 mi. from the centre of the city at Rancho Boyeros.

Commerce and Industry.—About three-quarters of the imports and a large portion of the exports of the island pass through Havana, which is a world shipping centre.

The principal industrial activity is based on sugar and its by-products. Next to sugar, tobacco is probably the most important product, and Havana cigars are considered by general opinion to be the finest in the world. There are also textile mills, meat-packing plants, chemical factories and perfume plants.

History.—Havana was founded in 1514 as San Cristóbal de la Habana by Diego Velásquez de León on an unhealthful site probably where the town of Batabanó now stands, but was early removed to its present location and rapidly assumed an increasing importance in the Spanish colonies of the new world and was used as a base for Spanish exploring expeditions. In 1634 its important strategic position was recognized by a royal decree declaring it to be the *Llave del Nuevo Mundo y Antemural de las Indias Occidentales* ("Key of the New World and Bulwark of the West Indies"), and the arms of the modern city carry the symbolic key.

The town was the object of numerous attacks by English, French and Dutch pirates. In 1537 it was sacked and burned, in 1555 it was plundered by French buccaneers and in 1586 Sir Francis Drake threatened it; but in 1589 Philip II of Spain ordered the erection of La Punta and the Morro castle, the ancient defenses, and the residence of the governor of the island was removed from Santiago de Cuba to Havana, which gained the rank of a city in 1592.

The estimated population of the city was about 3,000 by 1600 but had doubled by 1655, when many Spaniards fled there from Jamaica after the capture of that island by the English. During the 17th century Havana became the port of rendezvous of the east-bound fleets of Spanish galleons and was thus the object of many attacks by the English, Dutch and French. The port was blockaded four times by the Dutch in the first half of the 17th century and in 1671 the city walls were begun, being completed in 1702.

The European wars of the 17th and 18th centuries were marked by various incidents in local history. After the end of the War of the Spanish Succession (1713) came a period of comparative prosperity in slave-trading and general commerce. The creation, in 1740, of a monopolistic trading company was an event of importance in the history of the island. English squadrons threatened the city several times in the first half of the 18th century, but it was not until 1762 that an investment, made by Adm. Sir George Pocock and the earl of Albermarle, was successful. The siege lasted from June to August and was attended by heavy losses on both sides. The British commanders wrung great sums from the church and the city as prize of war and price of good order. By the treaty of Feb. 10, 1763, at the close of the Seven Years' War, Havana was restored to Spain in exchange for the Floridas.

The English turned over the control of the city on July 6. Their occupation greatly stimulated trade, and from it dates the modern

history of the city and of the island. The gradual removal of obstacles from the commerce of the island from 1766 to 1818 particularly benefited Havana. At the end of the 18th century the city was one of the seven or eight great commercial centres of the world, and in the first quarter of the 19th century was a rival, in population and in trade, of Rio de Janeiro, Buenos Aires and New York.

In general, the history of Havana under the Spaniards, and since independence, has been the history of Cuba. Various pirate raids, the slave traffic in the 18th and 19th centuries, filibustering expeditions in the 19th century, the war between Spain and the United States in 1898–99 and tension between the U.S. and Castro governments all had direct bearing on the history of Havana and the city suffered and triumphed with them.

The overthrow of the Batista government by Fidel Castro in Jan. 1959 brought profound and drastic changes in the life of Havana—and Cuba. Foreign-owned land, sugar factories, ranches, corporations and banks were an immediate target for expropriation or, indeed, confiscation. Property of wealthy Cubans, particularly those who were considered supporters of Batista, was likewise taken over by the government.

There followed also the development of close commercial and trade relations with the Soviet Union and other "iron curtain" countries. Meanwhile, continued hostility toward the United States by Castro led to the cancellation of the traditional sugar purchases by the United States. This was a major source of foreign exchange for Cuba, since the island for many years had been allowed a quota in the United States market of about one-third of the U.S. total consumption and for which a premium price was paid. The loss of that market was partially replaced by purchases by the Communist governments on a barter basis, but it was a severe blow to the economy of the island.

Equally severe was the impact of the revolution and its violent aftermath upon the tourist traffic. Tourism had long been of great importance to Havana, and during the 1950s it vastly increased. New luxury hotels and gambling casinos were constructed largely by U.S. capital. The estimated value to Cuba of tourism in 1958—the last year before Castro—was about $60,000,000. Castro at first made a strong effort to attract tourists after he rose to power, and he employed an American advertising firm to promote his campaign. But the news from Havana of unrest, coupled with the stream of government anti-United States propaganda, discouraged prospective visitors. Soon the cruise ships were canceling stops at Havana, and U.S. citizens began to look elsewhere for their vacations. Finally, on Jan. 3, 1961, came the official break in diplomatic relations between the United States and Cuba and, on Jan. 16, an announcement by the U.S. department of state that all United States citizens desiring to visit Cuba must obtain passports specifically endorsed for such travel. Tourism from the United States thereafter was negligible.

See CUBA: *History*. (W. THO.; C. E. MC.; L. NN.)

HAVANT AND WATERLOO, an urban district (1932) in Hampshire, Eng., that includes Havant, Waterlooville and neighbourhood, Bedhampton, Emsworth and Hayling Island. Pop. (1961) 74,564. Havant is 11 mi. N.E. of Portsmouth by road. Of the medieval town, largely burned down in 1760, the 12th-century church survives. Waterlooville became the name of a township that grew up within an area locally known as Waterloo because Wellington's troops, returning from the battle, were said to have passed through the neighbourhood. Many great documents were inscribed on Havant parchment, famous since the middle ages, until production ceased in 1936. Manufactures include electronic and hydraulic equipment, sheet metal, motor vehicles and coachwork, pharmaceutical products, toys, gasoline pumps and plastic goods. Agriculture and the tourist industry, especially yachting, are also important.

HAVASUPAI, abbreviated to Supai, a group of Indians speaking a Yuman (*q.v.*) language who live on a small reservation on Cataract creek in the western edge of Grand Canyon National park, Ariz. In 1776, Father Garces, their first European visitor, found them scattered over canyon and plateau east of the Walapai, from whom they can hardly be distinguished. Their indifferent agriculture supplemented by the natural resources of some 4,000 sq.mi. provided a relative abundance for this group of 300. Men hunted game with bow and arrow, clubs, snares and traps. Women made twined baskets to harvest wild seeds and for transportation, storage and cooking. Red ochre, mined for face paint, was still widely traded in the second half of the 20th century. The Havasupai camped in brush shelters or, in winter, in dirt-covered conical wooden huts. Wherever in the canyon there was level land, and springs made irrigation possible, they planted corn, beans, squash and sunflowers for food and cotton for tinder. There they gathered in late summer for sports, games and gambling. A head chief and a council offered prayers and advice. After a feast and circle dance for visitors they stored the harvest in caves and moved back to the plateau.

They had medicine men, or shamans, to control weather, game, snakes and disease. Only rich men had two wives. Warfare was insignificant. After death the body and all personal property were burned. Sons of the Havasupai inherited agricultural land if they could use it.

About 1870 manufactured goods replaced pottery and skin clothing, and decorated coiled basketry was developed for trade. In the 20th century they raised peaches, alfalfa, horses and cattle, but the reservation (518 ac.) was inadequate when it was established in 1882 and the fields periodically eroded.

See Leslie Spier, "Havasupai Ethnography," American Museum of Natural History *Anthropological Papers*, vol. 29, part iii (1928); Joseph Wampler, *Havasu Canyon* (1959). (A. F. W.)

HAVEL, a river of the German Democratic Republic, rises at a height of 223 ft. on the Mecklenburg plateau, 4.34 km. (7 mi.) N.W. of Neustrelitz, and after threading several lakes flows south as far as Spandau, where it is joined by the Spree. Thence it curves southwest, past Potsdam and Brandenburg, traversing another chain of lakes, and finally continues northwest until it joins the Elbe several miles above Wittenberg after a total course of 213 mi. and a total fall of only 158 ft. Its banks are mostly marshy or sandy, and the stream is navigable from the Mecklenburg lakes downward. The river basin covers about 9,400 sq.mi. The Elbe-Havel canal (34 mi.) runs from Brandenburg to the Elbe, linking with the Mittelland canal. The Havel canal (22 mi.) starts north of Spandau and rejoins the Havel below Rathenow. The Oder-Havel canal (46 mi.) runs from Berlin to Oranienburg and thence east to the Oder. (R. E. DI.)

HAVELOCK, SIR HENRY (1795–1857), British soldier, a hero of the Indian mutiny (*q.v.*), was born at Ford hall, Bishop-Wearmouth, Sunderland, on April 5, 1795. Educated at Charterhouse he first trained for the law but in 1815 abandoned his studies and took a commission in the 95th foot, the rifle brigade. Lacking influence and money he sought promotion by exchange into the 13th light infantry bound for India. He served with distinction in the First Burmese War (1824–26) but in 1838 was still only a captain, "purchased over by two fools and three sots."

In the First Afghan War (1838–42) he proved himself a gallant and conspicuously successful officer. He was made a companion of the Bath but received no military promotion: that came only when, as interpreter to Sir Hugh Gough, he personally distinguished himself in the 1843 Gwalior campaign.

In 1849, burdened by ill-health and the debts of his headstrong eldest son and of his brother, he took two years home leave. After his return the commander in chief, Lord Hardinge, remembering the part played by Havelock in the First Sikh War (1845–46), appointed him quartermaster general (1854) and adjutant general, queen's troops, India (1855).

After sharing in Sir James Outram's Persian expedition of 1857 Havelock returned to India, after the outbreak of the mutiny, to command a mobile column. Though too late to save Cawnpore (Kanpur) and too weakened by casualties and cholera to relieve Lucknow, his series of victories in July and August, the first British triumphs, made his name a household word in England. In Sept. 1857, reinforced by Outram, he won through to the residency at Lucknow. On Nov. 17 Sir Colin Campbell relieved the city bringing Havelock news of the knighthood (Order of the Bath) and major generalship conferred on him. On Nov. 24, he died of dysentery at Lucknow.

In 1829 he had married the daughter of Joshua Marshman, the Serampur missionary, and had become a Baptist. He made a practice of holding prayer meetings for his troops. By forming temperance societies, regimental coffee rooms and savings banks he did much to improve the conditions of British troops. His victories were particularly acclaimed as those of a Christian soldier.

See J. C. Pollock, *Way to Glory: the Life of Havelock of Lucknow* (1957); L. Cooper, *Havelock* (1957). (J. B. Ha.)

HAVERFORD, a residential suburb of Philadelphia in eastern Pennsylvania, U.S., is situated in Haverford township, Delaware county, and in Lower Merion township, Montgomery county. The community, which has a population of about 10,000, was founded by Welsh settlers in the 1680s. It is the site of Haverford college for men, with an enrollment of about 450, founded by the Quaker Society of Friends in 1833, and one of the leading small colleges of the eastern United States. The income from a large trust fund permits employment of a distinguished faculty and the furnishing of board and lodging for students at less than cost. (R. F. We.)

HAVERFORDWEST (Hwlffordd), chief town of Pembrokeshire, South Wales, a municipal borough and a county of itself, in the Pembroke parliamentary division, 7 mi. N.N.E. of Milford Haven. Pop. (1961) 8,892. Situated at the highest navigable point on the Western Cleddau, where the river is also bridgeable, it is a focus of routes from St. David's, Fishguard and Goodwick, Cardigan, Carmarthen, Pembroke and Milford Haven. Haverfordwest is a market town, with traces of its medieval walls and fortifications, and streets that are steep because the houses cluster round the castle on a hillock. Large numbers of Flemings were permitted by Henry I to settle in the hundred (subdivision) of Roos or Rhos in the years 1106–08, 1111 and 1156. The castle, though first mentioned in 1214, is believed to have been built in 1120 by Gilbert de Clare, first earl of Pembroke, to keep an important road to Ireland open and to protect the English and Flemish colonists. It was garrisoned for the king in the Civil War but was captured by parliament in 1644–45 and afterward partly demolished. The church of St. Mary has splendid 13th-century arches in the chancel, a carved 15th-century oak ceiling and many interesting memorials. The church of St. Thomas has a 15th-century tower, and St. Martin's dates from the 14th century. By the river are ruins of an Augustinian priory founded by Robert de Hwlford *c.* 1200. The earliest charter known is one from the reign of Henry I; further charters were granted up to 1695. During the palatinate the town was granted a lord lieutenant, being the only British town to be so favoured. In 1536 Haverfordwest was declared to be a town and county of itself and was further empowered to send representatives to parliament. It remained prosperous through maritime commerce during the 17th and 18th centuries, but with the rise of Milford Haven and the coming of the railways its trade declined. The town came to rely on the marketing of agricultural produce, but still retained an importance out of proportion to its modern significance. A special feature of such towns is the large number of charities which, in Haverfordwest, include John Perrot's bequest (1579) for the improvement of the town and Tasker's charity school founded in 1684. The people of Haverfordwest, like those in the surrounding districts in the southern part of the county of Pembroke, are almost entirely English-speaking.

HAVERHILL, a manufacturing city of Essex county in the lower Merrimack river valley of northeastern Massachusetts, U.S., 35 mi. N. of Boston. It was founded by the Rev. John Ward, who named the settlement after his native Haverhill in Suffolk, Eng. John Greenleaf Whittier (*q.v.*), the New England poet, was born there but lived most of his life in nearby Amesbury. Haverhill was incorporated as a town in 1645 and as a city in 1869.

The village was agricultural until the growth of leather tanning and shipbuilding after 1795; later shoe manufacturing and hatmaking became the dominant industries. The city reached a peak population of 53,884 in 1920, after which manufacturing in Merrimack valley towns declined. Pop. (1960) 46,346; Lawrence-Haverhill standard metropolitan statistical area (two cities and seven towns in Essex county, Mass., and three towns in Rockingham county, N.H.), 197,880. (For comparative population figures *see* table in Massachusetts: *Population.*) Leather and shoes, coin-operated machines, paper boxboard and electric coils are produced. Bradford, annexed in 1897, is the seat of Bradford Junior college, founded 1803, one of the oldest upper schools for girls in New England. (G. K. L.)

HAVERING, one of the 32 London boroughs that came into existence on April 1, 1965, under the provisions of the London Government Act 1963 which reorganized local government in the metropolis and the area around it. These 32 London boroughs constitute Greater London (*see* London). Havering, in the east, is composed of areas that were previously in Essex: the former municipal borough of Romford and the former urban district of Hornchurch. *See* Hornchurch; Romford.

HAVRE, LE, the second seaport of France and capital of an *arrondissement* in the *département* of Seine-Maritime, stands on the estuary of the Seine, 226 km. (140 mi.) W.N.W. of Paris and 86 km. (53 mi.) W. of Rouen by road. Pop. (1962) 182,504.

Until 1516 Le Havre was only a fishing village possessing a chapel dedicated to Notre-Dame-de-Grâce, to which it owes the name, Le Havre ("the harbour") de Grâce, given to it by Francis I. The town was delivered over in 1562 to the keeping of Queen Elizabeth I by Louis I, prince of Condé, leader of the Huguenots, but the English were expelled in 1563. Defenses and harbour works were continued under Cardinal Richelieu and completed by the engineer S. le P. de Vauban. Le Havre was a port of considerable importance as early as 1572 and dispatched vessels to the whale and cod fishing at Spitsbergen and Newfoundland. In 1672 it became the entrepôt of the French East India company and afterward of the Senegal and Guinea companies. Napoleon I made it a naval harbour of the first rank, and under Napoleon III works begun by Louis XVI were completed. During World War I Great Britain and the United States used Le Havre as a base and point of landing for troops and stores, and after the fall of Antwerp and Ostend the Belgian government was transferred there. During World War II the city, which was the target of more than 170 bombings, suffered severe damage, seven buildings out of eight being destroyed. It was captured by the Germans in June 1940 and liberated in Sept. 1944.

Reconstruction, characterized by open spaces, began in 1945 when the architect Auguste Perret was appointed by the French government to design it. The greater part of the town stands on level ground but an eminence, la Côte, rises on the north. A road tunnel links the higher and lower parts. The central point of the town is the Place de l'Hôtel de Ville, where are the public gardens and round which are the *hôtel de ville* and six great buildings. The church of Notre Dame, dating from the 16th and 17th centuries, is a mixture of late Gothic and Renaissance styles of architecture but the tower is older; the carved oak organ case was the gift of Cardinal Richelieu. The museum was totally destroyed during World War II, but its collection of antiquities and paintings had been evacuated, and a modern-style museum was opened in 1961, with a general knowledge section. Le Havre is the seat of a subprefect and a tribunal of first instance, tribunals of commerce and maritime commerce and a board of trade arbitrators, a chamber of commerce and a branch of the Bank of France.

The harbour has 14 basins (the oldest of which dates back to 1669), including the Bassin de l'Eure, which accommodates transatlantic steamers, and more than eight miles of quays. A program of port improvements includes a large graving dock and wharfage in the tidal basin, a floating dock and pontoons, a basin for large oil tankers and reservoirs in the outer harbour, and a wharf and mole for the storage of goods in the northern part of the port. A petroleum pipeline to Paris has been built. Le Havre is the great French port for cotton and coffee and also imports copper and other metals, wool, rum, foreign wines, oilseeds and dyewoods. Its industrial products include rope, timber, wire, machinery, flour, oils and dyes. There is also some spinning and weaving and the manufacture of toys and chemicals is carried on.

HAWAII, nicknamed the "Aloha state," was the 50th state to be admitted (in 1959) to the United States. Geographically Hawaii (the Hawaiian or Sandwich Islands) is a chain of islands

near the centre of the North Pacific ocean, 1,578 mi. from E.S.E. to W.N.W. between 18° 55′ and 28° 25′ N. and 154° 48′ and 178° 25′ W. It consists of the islands ceded by the republic of Hawaii to the U.S. in 1898 and made a territory by congress in 1900, and hence excludes the small coral island, Midway, which was acquired by the U.S. in 1859. Several other small islands are not included in the state. The capital is Honolulu (*q.v.*).

Hawaii, with a total area of 6,424 sq.mi., 9 sq.mi. of which are inland water, ranks 47th among the states in land area. The state tree is the kukui or candlenut (*Aleurites Moluccana*) and the state flower is the red hibiscus. The Hawaiian goose, or *nene*, is the state bird (unofficial). The state flag consists of a field with eight horizontal stripes, from the top down of white, red and blue. A rectangular area containing a device resembling the British union jack extends half way down the hoist. (Although Hawaii was never under British rule, an English sea captain in the 1790s is said to have presented King Kamehameha I with a British jack which he used and whose design was incorporated into the present flag of Hawaii, officially adopted in 1845.) The state motto is *Ua mau ke ea o ka aina i ka pono* ("The life of the land is perpetuated in righteousness"). The state song is *Hawaii Ponoi* ("Hawaii's Own"), written by King Kalakaua.

In addition to the cross references to related articles given under the various headings of this article *see* OCEANIA; PACIFIC ISLANDS; POLYNESIA. *See* also UNITED STATES (OF AMERICA).

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I. GEOGRAPHY

A. PHYSICAL FEATURES

Hawaii, comprising both volcanic and coral islands built up from depths of 15,000 to 18,000 ft., is the northernmost of the Central Pacific island groups. It has the largest area (6,424 sq.mi.) and greatest altitude (13,784 ft.). It is also the most isolated of important land areas.

The nearest important groups to the south are Samoa, 2,263 nautical miles, and Tahiti, 2,390 nautical miles. To the north, Unalaska in the Aleutian Islands is 2,106 mi., and to the west, Guam is 3,337 mi. The distances in nautical miles from Honolulu to principal ports of the Pacific are: San Francisco, 2,100; Los Angeles, 2,226; Seattle, 2,409; Sitka, 2,395; Yokohama, 3,445; Sydney, 4,424; Panamá, 4,665; Manila, 4,778; Hong Kong, 4,961; Valparaiso, 5,916. Cape Horn is 6,488 mi.

The large, high islands, Hawaii (4,021 sq.mi. land area), Maui (728), Molokai (259), Lanai (141), Kahoolawe (45), Oahu (595), Kauai (551) and Niihau (72), together with their near-by small islands, form the east-southeast fourth or about 375 mi. of the chain, extending to 22° 14′ N. and 160° 15′ W.

The islands of the remainder of the chain are so small that their total area is only 3 sq.mi., and yet they afford a rich field for the naturalist. Those in the west half of this part of the chain are coral (mostly sand) islands; those in the other half, forming a transition link with the large inhabited islands, are lava rock. The islands of the entire chain apparently were formed beginning at the westerly and finishing at the easterly end, where there are still active volcanoes.

1. Westerly Islands.—The small westerly islands are remains of larger islands which have mostly eroded. The lava rock islands rest on more or less extensive banks lying at small depths, and the coral ones are sand islands or islets on the rims of large atolls. Those of lava rock are Nihoa or Bird (903 ft. high), Necker Island (276), French Frigate shoals (a rock 120 ft. high and 16 sand islets) and Gardner pinnacles (170); the coral ones, 10–14 ft. high, are Laysan Island, Lisianski Island, Pearl and Hermes reef (12 islets), Midway (Sand Island and Eastern Island) and Kure, or Ocean, Island (Green Island and two islets). None is inhabited except the station at Midway. The Hawaiians anciently visited Nihoa and Necker, not only for fish but also to obtain materials for their famous featherwork. The waters abound in fish and turtles. The islands are most noted, however, for their bird life, and in 1909 all of them, except Midway, were created by the national government into the Hawaiian Islands Bird reservation, to protect them from Japanese poachers who, for the feathers, killed 300,000 birds in one season. Collectively, the islands form the largest and most numerous bird colony in the world. Of the many varieties of sea birds, some are not found elsewhere.

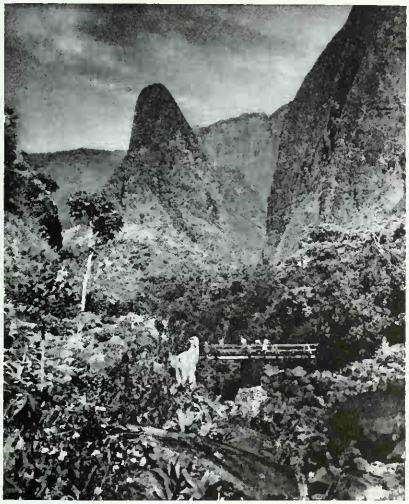
2. Hawaii.—The "Big Island," as it is called, which contains two-thirds of the area of the group, is roughly triangular in shape, with sides of 90, 75 and 60 mi.; it consists of five volcanic mountains about 20 mi. apart, connected by saddles 3,000–7,000 ft. high, formed by overlapping lava flows. Being the newest island, and still in the making by volcanic action, little of its 300 mi. of coast is bordered by coral reefs, and there has been little erosion except along the 60 mi. of the northeast coast from the principal harbour, Hilo, to the north end of the island. There, on the windward side of the older mountains, copious rains and ocean waves and currents have created valleys and cliffs increasing northward in depth and height and culminating in the Waipio and Waimanu valleys, which are several thousand feet deep and recede from coastal cliffs 1,500 ft. high. Throughout the rest of the island there is not a stream except at times of unusual rain—partly because of the porosity of the rocks and soils and, on the leeward side, partly because of insufficiency of rain.

The Kohala mountain or range (5,505 ft.), the oldest, its windward side deeply eroded, its top a water sponge, its leeward side dry, with the higher slopes covered with cinder cones, forms the north angle of the island. Next, southeasterly, is Mauna Kea ("White mountain," so-called from the frequent snow on its summit). This is the highest mountain of the group and one of the highest island mountains in the world (13,784 ft.).

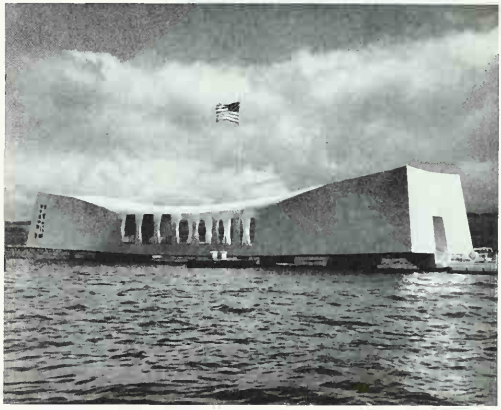
Southwesterly from Mauna Kea is Hualalai (8,251 ft.), whose summit, like that of Mauna Kea, has no great crater and is covered with cinder cones, but, unlike Mauna Kea, has many small pit craters. Its only flow in historic times was in 1801.

Further south is Mauna Loa, "Long mountain," twin of and 104

The windward side of Oahu, seen from Nuuanu Pali, a scenic pass in the Koolau Range, about six miles from Honolulu. In the right background is the town of Kaneohe



The Needle, a volcanic monolith (left), in Iao Valley on the windward side of Maui



The Arizona Monument in Pearl Harbor, Oahu. The concrete monument is built atop the bridge of the USS "Arizona," sunk during the attack of Dec. 7, 1941

SCENES IN HAWAII

Honolulu, the state capital, on Oahu, with Diamond Head crater in the background

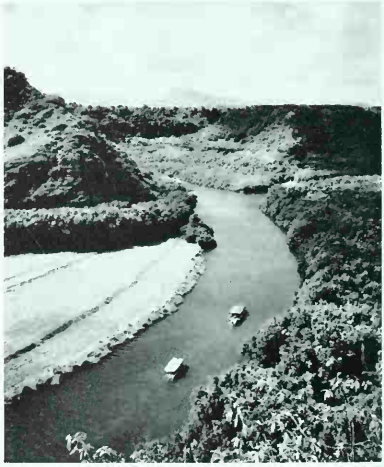
PHOTOGRAPHS, (TOP) NIGEL WATT—PIX FROM PUBLIX, (CENTRE LEFT) WERNER STOY—FPG, (CENTRE RIGHT, BOTTOM) CHARLES GIUGNO—PIX FROM PUBLIX

HAWAII

Akaka Falls near Hilo on Hawaii, largest of the Hawaiian Islands

The rugged volcanic Napali Cliffs on the northwest coast of Kauai, from Kalalau Lookout

Workers bulldozing sugar cane into piles to be shipped to processing plants



Tourist boats on the winding Wailua River, one of the largest rivers on the island of Kauai

SCENES IN THE HAWAIIAN COUNTRYSIDE

Vast pineapple plantations at Wahiawa on the island of Oahu

ft. lower than Mauna Kea. It is an immense lava dome, not only the largest volcano, but the largest mountain in the world in cubic content; it discharges more lava than any other volcano. On the summit is an elongated *caldera* ("caldron"), Mokuaweoweo (3.7 sq.mi.). Eruptions within it occurred in historic times in 1849, 1865, 1903 and 1914; four others were partly on the adjacent rift zones, usually on two lines running northeast and southwest from the summit. Principal flows of the 19th and 20th centuries were in 1843, 1852, 1855–56 (lasting 16 months), 1859 (33 mi. long, 1 mi. wide in places), 1868, 1877 (submarine), 1880–81, 1887, 1899, 1907, 1916, 1919, 1926, 1935–36 (bombed to divert its course), 1942 and 1950 (the most voluminous flow in recorded history: 615,000 cu.yd. in three weeks). In 1955 a violent outbreak in the Puna district south of Hilo lasted for three months and destroyed two villages.

Lastly and easternmost is Kilauea, with the largest and most spectacular of all active craters, an oval pit 4.14 sq.mi. in area, with walls now 500 ft. high—1,000 ft. a century ago. Although an independent volcano and older than Mauna Loa, Kilauea is merely a hole in the side of the latter at an elevation of 4,090 ft.; it is reached by car in an hour, over 30 mi. of concrete road through tropical forests from Hilo.

Kilauea was continuously active for more than 100 years previous to 1924. Most of its activity has been confined to the fire pit of Halemaumau, 3,000 by 3,500 ft. and 470 ft. deep. Operating in cycles, the lava rises until it overflows and breaks through some subterranean passage and drains out, only to begin the cycle again. Just before the last dropout, in 1924, the lake of boiling molten lava covered about 50 ac. In 1954 a spectacular but short-lived eruption flowed on the floor of Kilauea as well as in the fire pit, Halemaumau. The entire town of Kapoho was covered by lava flows from Kilauea in 1960 and more than 1,000 ac. were added to the coast line where lava poured into the ocean. The only two explosive eruptions of historic times have occurred at Kilauea, in 1790 and 1924; the former destroyed a portion of a Hawaiian army. Since that time, almost no loss of human life has been caused by volcanoes in Hawaii.

In 1911 a volcanic observatory was established at Kilauea, and in 1916 Hawaii National park was established, consisting of the Kilauea and Mauna Loa sections (245 sq.mi. together) on Hawaii and the Haleakala section (26 sq.mi.) on Maui. In 1927 a 72-sq.mi. strip was added to connect the first two sections, which were renamed Hawaii Volcanoes National park in 1961 when the third section became the separate Haleakala National park. In the Kilauea section there are, besides the volcano, other pit craters, sulfur banks and sulfur-steam baths, pumice beds, lava tubes and tree molds, stalactites and tropical forests and birds.

Earthquakes have been numerous and tidal waves occasional in Hawaii. On April 1, 1946, the entire Hawaiian chain was struck by a seismic sea wave, or *tsunami*. Two hundred persons were killed and 1,300 rendered homeless. Damage to property was $24,000,000. The water-front area of the city of Hilo was wiped out. Since that time a seismographic warning system alerts residents when waves are expected. In spite of this, 57 lives were lost when a *tsunami* resulting from Chilean earthquakes smashed into Hilo in May 1960; total losses were estimated at $17,700,000.

3. Maui, Molokai, Lanai, Kahoolawe and Molokini (the last two uninhabited), probably once a single island, are now separated by channels 6 to 10 mi. wide and 250 to 600 ft. deep. They are separated from Hawaii by a channel 26 mi. wide and 6,192 ft. deep and from Oahu by one 23 mi. wide and 2,244 ft. deep.

Maui, shaped like the head and bust of a woman, consists of two mountains (East and West Maui) connected by a low isthmus 6 mi. wide. One of these mountains, Haleakala ("House of the Sun," 10,025 ft.), has on its summit the largest of all extinct craters, 20 mi. around and 2,720 ft. deep; on its floor of 19 sq.mi. are 16 reddish cinder cones 400 to 900 ft. high. The view from the summit is the grandest in the region. The windward side, a succession of gorges, rich in waterfalls and verdure, supplies the water for the irrigation of the arid isthmus. It is traversed by a scenic drive. The other mountain, whose highest peak is Puu Kukui (5,788 ft.), being much older, is marked by deep radiating canyons such as the beautiful Iao or Wailuku valley (4,000 ft deep).

Molokai likewise consists of two mountains, Mauna Loa peak (1,381 ft.) at the west end and Kamakou (4,970 ft.) at the east end, connected by a saddle 400 ft. high, both cut off by erosion on the windward side, so that the island, which is 40 mi. long, is narrow and of fairly even width, about 7 mi. The windward side, one of the most scenic coasts of the group, is a precipice, 500 to 4,000 ft. high, sheer from the ocean, the highest part of which is deeply indented by magnificent valleys. On a low peninsula, projecting from the base of the precipice and near its centre, is the site of the leper settlement of Kalawao, which is virtually empty because of the advance of treatment methods.

Lanai (3,370 ft.) and Kahoolawe (1,477 ft.) are single mountains, with cliffs on their southerly coasts exposed to the ocean, their northerly coasts being protected by Maui and Molokai. A pineapple company, having acquired Lanai, constructed a harbour on the south coast and a model village, Lanai City, in the centre of an extensive interior plateau, which has been placed in cultivation. Kahoolawe is uninhabited and for some years has been used as a target area by U.S. armed forces. Molokini is a small, crescent-shaped, barren, rocky island, 160 ft. high, between East Maui and Kahoolawe.

4. Oahu, which is roughly diamond shaped, was once two immense volcanoes; erosion has made of it two rugged, parallel mountain ranges. One range, Koolau (Puu Konahuanui, 3,105 ft.), is twice as long as and older than the other, Waianae (Kaala, 4,025 ft.); the two are connected by a saddle 800–1,200 ft. high. There are many small, recent tuff, ash and lava cone craters, mostly coastal, especially in and about Honolulu, such as Diamond Head and Punchbowl. This island, though third in size and fifth in height, is important agriculturally. It contains the state capital, Honolulu, the landlocked Pearl Harbor (*see* HONOLULU), Diamond Head and Waikiki beach. The picturesque sites of this island are easily accessible; the most noted panoramic view is that of the windward side at the Pali (precipice), the only traversable pass (1,200 ft.), 6 mi. up a beautiful valley back of Honolulu.

5. Kauai, separated from Oahu by a channel 63 mi. wide and 11,232 ft. deep, is roughly circular in form, about 25 mi. across, and consists mainly of one mountain (Waialeale, 5,080 ft.), with marginal lowlands except on the northwest. It is the oldest, most weathered and most verdant of the larger islands, abounding in rivers and waterfalls. Its chief scenic attractions are Waimea canyon (3,000 ft. deep) in the southwest, comparable in vivid coloration and forms to the Grand canyon of the Colorado; the spacious Hanalei valley in the north; and the Napali coast of precipices, 4,000 ft. high, on the northwest.

6. Niihau, separated from Kauai by a channel 15 mi. wide and 3,300 ft. deep, is a small island 17 by 5 mi.; it is privately owned and is operated as a sheep ranch. Lehua Island and Kaula, uninhabited, are crescent-shaped remains of tuff cones, respectively ½ mi. N. and 23 mi. S.W. of Niihau.

B. Climate

The chief determinants of the climate are the prevailing northeast trade winds from over cool ocean currents and the remarkable heights and contours of the land areas. The result is a climate cooler than elsewhere in the same latitude, equable temperatures, abundant sunshine and absence of tropical storms. Mauna Loa on Hawaii and Haleakala on Maui form such barriers to the trade winds that their leeward slopes have regular land and sea breezes. At times, especially in winter, a kona, or southerly wind, brings mugginess and local downpours. The windward slopes are cooler than the leeward, and the temperature falls about 1° F. for each 300 ft. of altitude. The year-round average temperature in the lowlands is about 75° F. There is no distinctly rainy or dry season, but usually more rain falls in winter than in summer. There is wide variation in temperature, rainfall and wind for neighbouring localities.

The record high temperature for the territory was 100° F. at Pahala, Hawaii, in April 1931. Except for the top of Mauna Loa,

the record low of 18° was reached at Haleakala crater in May 1941. The mean annual temperature at the federal building at Honolulu is 75.2°, with a record maximum of 88° and a record minimum of 57°. Usually there is snow on Mauna Kea and Mauna Loa and sometimes on Haleakala. The summit of the island of Kauai has perhaps the greatest average rainfall in the world, 460 in., reaching 624 in. during the year ending in July 1948. The greatest precipitation measured in the islands during a 24-hour period was in the lowlands of Kauai, in Jan. 1956, when more than 46 in. fell. As little as 4 in. a year has been found in the Kona region of Hawaii. At the federal building in Honolulu on leeward Oahu, the average annual rainfall is 24 in., with a record range of from 43.5 to 11.7 in. Four miles distant, at 1,028 ft. in the lee of the mountain ridge, the average is 155 in. The record rainfall for Honolulu in a 24-hour period came in March 1958, with a downpour of more than 18 in.

C. Vegetation

The isolation of Hawaii, its division into islands, the barriers of deep canyons and high precipices and the wide variations in rainfall, temperature, wind, barometric pressure and geologic age of different localities have evolved a flora that not only is exceptionally extensive in the area, but ranks first in the world in percentage of endemic genera and species. There are about 900 species of flowering plants (more than 300 being trees), 140 ferns and also many hundred mosses, lichens, fungi and algae. Attractive forests of tall tree ferns are hung with vines such as the luxuriant ie and the fragrant *maile*, both used as garlands or *leis*. The unique silversword plant is found in both national parks. The forests are tropical and only a few shed their leaves seasonally.

Six botanical regions or zones are commonly treated more or less separately: strand, lowland, lower forest, middle forest, mountain bog and upper forest, with subdivisions of dry and wet, windward and leeward, etc., each having in large measure its distinct flora, but with considerable overlapping. Above 11,000 ft. there is almost no vegetation.

Hundreds of species have been introduced into the islands since their discovery by Europeans and about 25 were introduced anciently by the Hawaiians. Among the ancient introductions are the coconut; breadfruit; ohia or Malay apple (*Jambosa malaccensis*); taro (*Colocasia antiquorum*), used for making a paste (poi), the principal food of the Hawaiians; sweet potato; yam; banana; pia or arrowroot (*Tacca pinnatifida*); sugar cane; gourd; kava and ti (*Piper methysticum* and *Cordyline terminalis*), roots used for making drinks; olona (*Touchardia latifolia*), yielding exceedingly strong and durable fibre for fish nets, etc.; *wauke* (*Broussonetia papyrifera*), fibre used for making kapa or paper cloth; *kukui* or candlenut (*Aleurites moluccana*), useful for candles, oil, dyes, paint, gum, food and medicine; milo (*Thespesia populnea*) and kou (*Cordia subcordata*), now almost extinct, and *kamani* (*Calophyllum inophyllum*), all three yielding beautiful wood valued for making calabashes and other dishes; hau (*Pariti tiliaceum*), useful for making outriggers and rope and training over arbours for shade; *noni* (*Morinda citrifolia*), useful for dyes; and perhaps ginger. Among the more common later introductions are the avocado or alligator pear, mango, pineapple, orange and other citrus fruits, papaya, guava, coffee, grape, fig, poha or Cape gooseberry, litchi, mulberry, tamarind, date, passion fruits, cherimoya, custard apple and macadamia or Australian nut.

D. Animal Life

Isolation and wide variations in local conditions have had much the same effect, though in lesser degree, on the fauna as on the flora, resulting in a high percentage of native species and extreme localization. There is only one certainly indigenous land mammal, a small bat. Dogs, hogs and perhaps rats and mice were introduced anciently by the Hawaiians, and many domestic mammals have been brought in since Captain Cook's discovery; some very early, as goats and English pigs by Cook in 1778, cattle and sheep by George Vancouver in 1793 and horses by R. J. Cleveland in 1803. Axis deer (*Cervus axis*) were introduced in 1867 and the mongoose in 1883, to destroy rats.

There were about 125 species of birds, resident and migrant, of which perhaps a score are now extinct. On the inhabited islands the native birds are disappointingly few, as their habitats are mostly in the forests and on the heights. Most prized for featherwork were the yellow feathers of the now extinct mamo (*Drepanis pacifica*) and nearly extinct o-o (*Moho nobilis*); the vermilion of the iiwi (*Vestiaria coccinea*); and the crimson of the apapane (*Himatione sanguinea*). Very common are the brown *elepaio* (*Chasiempis sandwicensis*); the green and yellow *amakihi* (*Chlorodrepanis* spp.); and the *ou* (*Psittirostra psittacea*), the best Hawaiian songster. A rare wild goose, or *nene*, confines itself to dry areas on the island of Hawaii. The birds most commonly seen on the lower and more open areas are introductions. Chickens were anciently introduced by the natives, and later importations include, besides domestic fowls, the skylark, cardinals, Chinese thrush, myna, turtledove, pigeon, linnet, blue-cheeked parrot, ricebird, English sparrow, pheasant, quail and California partridge.

The only native land reptiles are seven species of small skinks and geckos, commonly called lizards. There are no snakes. Frogs and toads are introductions, including *Bufo marinus*, imported in 1932 to control insects. Although there are several thousand species of indigenous insects, mostly endemic, they are not troublesome or destructive. The noxious forms, which are mostly introductions, include the sugar-cane leafhopper and borer, rice borer, Mediterranean fruit fly, Asiatic fruit fly, melon fly, Japanese beetle, horn fly, cutworms, army worms, termites, fleas and mosquitoes. Perhaps no animal group has contributed more light on the subject of evolution than the 500 species of land and freshwater shells of Hawaii, especially the beautiful tree shells (*Achatinella*). The exceptionally rich marine animal life includes more than 650 species of fish, many of which are fantastic in shape and colour. Among introduced fishes are trout, carp, black bass, catfish, goldfish and top minnows.

E. Geographical Regions

The territory of Hawaii was divided into five counties by the territorial legislature in 1905 and these revisions were retained when the territory became a state in 1959. These are county of Oahu (superseded in 1909 by city and county of Honolulu); county of Maui (including islands of Maui, Molokai—except Kalawao—, Lanai, and Kahoolawe), with county seat at Wailuku; county of Hawaii, with county seat at Hilo; county of Kauai (including the island of Niihau), with county seat at Lihue; and county of Kalawao, the peninsula on Molokai. (For area of city and county of Honolulu, *see* Honolulu.)

II. THE PEOPLE

Hawaii is often called the melting pot of the Pacific, because its population is a mixture of many ancestral stocks who are slowly welding a neo-Hawaiian type combining features from not only Caucasian, European groups but from those of the Pacific islands and the far east as well (see *History*, below).

The descendants of the Polynesians who came to the islands 1,000 years ago are called Hawaiians. They have bronze skin, large dark eyes, heavy features and dark-brown or black hair that may be straight or wavy. The population of about 300,000 found by the discoverers in 1778 shrank until at the beginning of the second half of the 20th century there were only about 12,000 full-blooded Hawaiians in Hawaii—slightly more than 2% of the population. There were, however, about 80,000 part-Hawaiians.

Table I.—*Population by Racial Groups**

Race	1950		1940	
	Number	%	Number	%
Hawaiian	86,091	17.2	64,310	15.2
Caucasian	111,793	23.0	101,701	24.5
Chinese	32,376	6.5	28,774	6.8
Filipino	61,071	12.2	52,509	12.4
Japanese	184,011	36.9	157,905	37.3
Others	20,842	4.2	15,981	3.8
Total	499,794	100.0	423,330	100.0

* Racial data not kept after 1950.

and together the Hawaiians and part-Hawaiians formed the fastest expanding racial group.

People of many other stocks came to the islands or were brought to work on the sugar plantations (see *Population*, below). Most of these folk, enjoying the opportunities provided in Hawaii, successively left the ranks of unskilled labour, and those of Chinese, Japanese, Korean and Filipino ancestry entered all walks of life, including the professions and finance.

After 1950 racial data were not kept because the intermixture of groups made it impossible to list individuals even according to race of father. The oriental component was steadily declining in proportion; the Caucasian group had grown in the first half of the 20th century and the trend was not altered after World War II. Intermarriage of racial groups is very common in Hawaii, and many of the finest physical specimens are of half a dozen stocks. In a schoolroom in the islands, the children may be of 50 different combinations of racial ancestries. There is no segregation of any kind in the islands, and no housing area where there is a barrier to home ownership. Anyone who stirs up racial antagonisms is severely criticized, and Hawaiian or oriental blood is frequently a political asset in the state.

The daily life of the people may vary from the metropolitan existence of Honolulu to the sheltered seclusion of Niihau, an island where Hawaiians speak their own language and do not have telephones, automobiles, motion pictures or liquor stores.

1. Languages.—English is spoken by almost everyone in Hawaii. Hawaiian is one of the two official languages of the government, but except for a number of loan words used daily by the inhabitants, one has to go to some trouble to hear Hawaiian spoken. Many other languages may be heard on the streets, and radio programs in Japanese and several Filipino dialects are popular.

2. Religion.—All the great religions of the world are represented in Hawaii. In 1819 a royal decree ordered the Hawaiians to give up their paganism, and the field was open to the Congregationalist missionaries who arrived from New England in 1820. Roman Catholic missionaries came first in 1827, and Mormons in 1850. (*See* also *History*, below.) Religious tolerance as well as racial tolerance is a part of island life. There are more than 150 churches on Oahu alone. The Roman Catholic and Buddhist religions were the leading faiths in Hawaii at mid-20th century.

3. Customs and Culture.—The spirit of hospitality represented by the welcoming Hawaiian word *aloha* has continued through history to make the stranger feel at home in those islands. Easy informality is found in the customary dress of 20th-century Hawaii. Outside of business offices, people of all races wear both traditional and modern versions of Hawaiian garments. The women at home relax in a *muumuu*, modeled on the Mother Hubbard gowns made for the natives by missionary women. A fitted *muumuu* with a train is called a *holoku*. Men wear *aloha* shirts all year round; these are patterned sport shirts, usually worn with the tail outside the trousers. Flowers are a favourite expression of affection, and on many occasions a *lei*, or wreath, is presented. A *lei* may be formed of flowers or of seeds, coral, shells, nuts, or pieces of ivory, and may be worn not only around the neck but on the head or around a hat.

Foods enjoyed in the islands are as varied as the many nationalities and races represented there. Most people eat foods similar to those consumed in mainland United States, but special dishes of the orient and the Pacific islands are popular. At a *luau* or Hawaiian feast, one might eat poi; *laulau*, a steamed package of chopped taro leaf mixed with fish and pork or chicken; salmon and tomato; *haupia*, a coconut pudding; limu, an edible seaweed; steamed yams, breadfruit and bananas; and pineapples, papayas and mangoes. The main dish is usually a whole roasted pig, cooked by preheated stones in an underground oven or imu.

The mild climate makes Hawaii a recreational paradise all year round. Hotels and vacation resorts provide comfort for visitors on the five largest islands. Water sports are particularly popular, and the ocean temperature varies little from summer to winter.

During the winter months there is skiing on the slopes of Mauna Kea. In addition to the usual U.S. holidays, others are celebrated. These include Chinese New Year's, in January or February; Cherry Blossom festival, in the spring; Lei day, on May 1; Kamehameha day, June 11; and Aloha week, in October or November.

Arts and crafts are popular in Hawaii, reflecting the skill of the ancient Hawaiians in such forms as featherwork, wood carving and mat weaving, examples of which may be seen at the Bishop museum in Honolulu.

Early Hawaiian music was a chant accompanied by simple instruments. Enjoyment in singing hymns introduced by the missionaries led to the development of vocal music, so that today Hawaiian music is heard round the world. The words to the most famous Hawaiian song, "Aloha Oe" ("Love to Thee"), were composed by Queen Liliuokalani. The ukulele was not native to the islands but was developed from a small guitar brought by Portuguese labourers in the latter 19th century. The steel guitar was invented in 1895. The Royal Hawaiian band, formed in 1872, still gives concerts in Honolulu. The Honolulu Symphony orchestra was founded in 1900.

Performances of various forms of hula may be seen in Hawaii, but it is increasingly difficult to find exhibitions of the ancient hula, the sacred dance and chant of prediscovery Hawaii.

The literature of Hawaii both in Hawaiian and English is extensive and still growing. Ancient types, drawn from native memories, include legends, folk tales, epics of heroes and chants. The missionaries early reduced the Hawaiian language to a Roman alphabet, established printing presses and translated many works into both Hawaiian and English. Both the Bible and the Book of Mormon were translated into Hawaiian, along with textbooks and literary works. Many accounts of voyagers, mission workers and travelers are highly readable. Writers associated with the islands include Herman Melville, Mark Twain, Robert Louis Stevenson, Charles Warren Stoddard, Jack London and Genevieve Taggard. A number of 20th-century novelists and other writers have added to the shelf of works using Hawaii as a setting.

III. HISTORY

A. History Before Discovery

Polynesia was probably the last habitable area to be occupied by man. The Polynesians, although of similar features, language, customs, religion and traditions, are not a pure race. They are supposed to be mainly of Caucasian origin, with infusions of other bloods, and to have come from Asia by way of the Malay peninsula and Java, and thence from island to island by various routes in their migrations eastward, northward and southward, and to have reached Hawaii, probably from Tahiti, about A.D. 750, or earlier, in huge sailing canoes. Until about 1300, some Hawaiians voyaged back and forth to Tahiti, more than 2,000 mi. to the south. During this period many chiefs, who intermarried with Hawaiian reigning families, and priests came to Hawaii; both classes became powerful and the severity of taboos and frequency of human sacrifices increased. Then followed a long period of isolation, the last centuries of which were full of wars and rebellions—the result of pressure of population, rapacity of the nobility and dynastic ambitions and jealousies.

Feudalism grew up much as it did in medieval Europe and from much the same causes. The unit of land, the *ahupuaa*, usually extended from the shore to the mountain top, with rights in the adjoining sea waters, so that the occupants had the means of supplying all their wants—the sea for fish, the littoral for coconuts, the valley for taro, their principal food, the lower slopes for sweet potatoes, yams and bananas and the mountain for wood.

The next subdivision was called the *ili*, either subservient to the *ahupuaa* or independent. Within these were small areas, *kuleanas*, occupied by the common people, who also had certain rights of fishery, water and mountain products. Besides open sea fisheries, there were stone-walled fish ponds, some now 1,000 years old, built semicircularly from the shore. Taro was raised in terraces flooded by conduits from streams. Elaborate systems of water rights were evolved. A conqueror or a successor king often redistributed the lands.

The Hawaiians were a brown race, with straight or wavy black

hair, attractive features, large and of fine physique, like the New Zealand Maoris, whose dialect resembled theirs. The ruling classes tended to inbreed. Polygyny and polyandry were practised, especially among the chiefs. Rank descended mainly through the mother.

The language is soft and musical, vowels and liquids predominating. There are only 12 letters, the vowels and *h, k, l, m, n, p* and *w*, (the *l* and *r* and the *k* and *t* being very similar), and, as each syllable consists of only a vowel or a consonant followed by a vowel, there are only 40 syllables to make the more than 20,000 words. The Hawaiians were fond of oratory, poetry, history, storytelling, chants, riddles, conundrums and proverbs, and paid much attention to the proper use and pronunciation of words. Without writing, knowledge of all sorts was preserved and taught to successive generations by persons specially trained for the purpose.

Without metals, pottery or beasts of burden, the people made implements, weapons and utensils of stone, wood, shell, teeth and bone, and great skill was displayed in arts and industries. The featherwork (capes, robes, helmets, *leis*, kahilis) has not been excelled. Houses were of wood frames and thatched, with stone floors covered with mats. Food was cooked in holes in the ground, imus, by means of hot stones, but many foods, including fish, were often eaten raw. Many of the best foods were taboo to women. Men usually wore only a *malo* or girdle and women a skirt of kapa or paper cloth or leaves or fibre, though both sometimes wore mantles thrown over the shoulders. Canoes were outrigger or double, sometimes 100 ft. long. The men have hardly been surpassed as sailors, fishermen or swimmers. They were skilful navigators, knowing stars, winds and currents. Their year began on Nov. 20 and consisted of 12 lunar months with occasionally an intercalary month. They had remarkable knowledge of animals and plants and were great warriors, using spears, javelins, clubs and slings, but no shields or bows, the latter being small and used only for shooting rats and mice for sport.

They excelled in athletics, in which there were frequent contests, even between champions of different islands, in surfboarding on the crests of waves, swimming, wrestling, boxing, spear throwing (at each other), coasting down permanently prepared courses while standing on narrow sleds, bowling, foot racing, etc. Surfing has become a favourite sport for others as well as Hawaiians. They gambled much and made narcotic and fermented drinks of the awa (kava) and ti roots, but not distilled liquors. They were fond of music, vocal and instrumental, and had percussion, string and wind instruments, including a nose flute but no mouth flute. Their dances were largely the hula of many varieties, the better forms of which have become popular with others. They loved flowers, which they wore much in *leis* or wreaths about necks and hats. This has become customary with non-Hawaiians, especially on arrivals and departures of steamers and airplanes and on May day. They tattooed little. Their proverbially courteous, generous, hospitable spirit has affected the remainder of the population.

There were four principal gods, Kane, Kanaloa, Ku and Lono, and innumerable lesser gods and tutelary deities. Animals, plants, places, professions, families, all objects and forces had their gods or spirits. Temples of stone and idols of wood abounded and hardly anything was undertaken without religious ceremonies. On important occasions there were human sacrifices. There was a vague belief in a future state. Priests and sorcerers were potent. There were cities of refuge to which one might flee and be safe. Cannibalism was unknown but infanticide was prevalent. The political and religious systems were closely interwoven.

During the last period before the discovery, although there were occasional bright intervals and notwithstanding that there was much that was praiseworthy, the nobility and priesthood became more and more tyrannical, the common people more and more oppressed; the laws, chief among which were the intricate and oppressive taboos, bore heavily upon the masses, especially the women, and their administration became largely a matter of arbitrariness and favouritism. (*See* also OCEANIA; PACIFIC ISLANDS; POLYNESIA.)

B. History After Discovery

Foreigners other than Polynesians who may have arrived in Hawaii as castaways prior to 1778 did not return to the civilized world. Capt. James Cook (*q.v.*), the English navigator, is regarded as the discoverer. He named the group the Sandwich Islands after his patron, the earl of Sandwich. Cook first landed at Waimea, Kauai Island, on Jan. 20, 1778. The natives thought him the god Lono. On his return the next year, he was killed, after a period of friendly relations with the natives, on Feb. 14, 1779, in an affray at Kealakekua bay, Hawaii, where a monument to him now stands.

Then followed a period of contact with premissionary whites (1778–1820), a period of political consolidation and religious disintegration. Kamehameha I, the most striking figure in Hawaiian history, came to the throne of one of the then four kingdoms in 1782 and, equipping himself better than his foes with vessels, firearms and foreign and native aids, succeeded by 1795 in conquering all the islands except Kauai and Niihau, and in securing these two by cession in 1810. Having effected consolidation, he organized the government, checked oppression, encouraged industry and suppressed crime, until, as it was said, "the old, men and women, and little children could sleep safely in the highways." He thwarted Russian designs upon the island (1815–16) and eliminated Spanish pirates (1818). It was in this period that the sandalwood trade developed. In 1804 an epidemic, probably cholera, destroyed much of the population.

A new period opened after the accession of Kamehameha II (Liholiho) in 1819 and the arrival of the first company of missionaries from New England on March 31, 1820. Fourteen other companies followed during the next 35 years, in all more than 150 men and women—ministers, teachers, physicians, printers, farmers and businessmen. They introduced the church, the school and the press. The Hawaiians were most eager to learn. By Jan. 7, 1822, the missionaries had learned the language, reduced it to writing and begun printing the first textbook. Two months later the first printed law was issued. By 1840, 50 books had been printed. In 1834 two Hawaiian newspapers were published. An English newspaper, founded in 1843, is still published. The New Testament was completed in 1832, the Old in 1839, the dictionary in 1865. Of great assistance was William Ellis, English missionary in Tahiti, who visited Hawaii in 1822. While Christianity soon came to be regarded as the national religion and churches were well attended everywhere, little interest was taken in it as a personal matter until 1829, when there were 185 church members, of whom 117 joined that year.

Interest culminated in the great revival of a decade later, which added one-fifth of the population to church membership. The first convert (1823) was Keopuolani, head queen of Kamehameha, mother of the next two kings and highest chief by blood in the nation. Indeed the chiefs, especially the females, led in embracing and supporting the new religion and learning. Kaahumanu, Kamehameha's favourite queen, was converted in 1825 and was thereafter known as the "New Kaahumanu," as strong for good as she had theretofore been haughty and cruel. Of the ten who joined the church in 1826, nine were chiefs, including Kalanimoku, known as the "Iron Cable." Kamehameha I had appointed Kaahumanu to be his *kuhina nui*, or premier, with power almost equal to that of the king. She acted as regent when the king and queen visited England in 1824, and, they having died there, she continued as regent until her death (1832). Kalanimoku had been prime minister and treasurer to Kamehameha I and continued as such under Kaahumanu until his death in 1827.

The first score or so of years after the arrival of the missionaries was a crucial period, not so much because of the opposition of the Hawaiians as because of the opposition of whites. This opposition came from British, French and U.S. consuls and naval officers. They opposed the laws against licentiousness and drunkenness, slandered the missionaries, made unjust claims against the government, insisted that they were not subject to Hawaiian laws, attacked with arms the homes of missionaries and chiefs and aimed at the overthrow of the government. The British consul claimed that the islands had become British territory.

1. Growth of Government.—This period was not without bright spots in helpful foreign influences both from residents and from such visitors as Lord Byron of the Royal Navy, cousin of the poet, who brought back the bodies of the king and queen in 1825, and Capt. Thomas ap Catesby Jones (1826) and Captain W. B. Finch (1829) of the U.S. navy, the former of whom negotiated the first treaty entered into by Hawaii. Whaling had become active in 1820 and the sugar industry in 1835.

The first Roman Catholic missionaries arrived in 1827, as part of a French settlement scheme. The priests were resented by the Hawaiian chiefs not only as colonizers but for religious reasons, because by this time Protestantism had virtually become the state religion. During the next decade, attempts to set up Catholicism were resisted and some native converts were punished. But in 1840 the cornerstone of a Catholic church was laid in Honolulu and from that time dates the expansion of membership which made Catholicism the most numerous Christian denomination in the islands (*see* also *The People: Religion*, above).

The first mission of the Mormon sect arrived in 1850 from the California gold diggings. Almost at the outset this group learned the Hawaiian language and appointed native converts to various church offices. The Book of Mormon was printed in Hawaiian in 1854. The Mormons continued to be active in mission work, their success being symbolized by their temple, a landmark at Laie on the island of Oahu.

Because of increasing complications with foreigners, growth in liberal and humane sentiments on the part of the chiefs and realization of their natural rights by the common people, a conviction arose of the need of a better defined and more advanced form of government as a condition of peace, progress and independence. After vain attempts to secure teachers of the science of government from New England, the missionaries were induced to detach one of their number, William Richards (1793–1847), U.S. Congregational clergyman, to the service of the Hawaiian government, in 1838. He gave valuable advice to the government as did two other missionaries, G. P. Judd and R. Armstrong, similarly detached later. After hearing a course of lectures on government (1839) delivered to the king, chiefs and leading commoners, Kamehameha III promulgated the Declaration of Rights, called Hawaii's Magna Carta, June 7, 1839, the Edict of Toleration, June 17, 1839, and the first constitution, Oct. 8, 1840. This first written constitution for Hawaii contained several innovations, including a representative body of legislators elected by the people. It also set up a supreme court. The first compilation of laws was published in 1842 and in that year Richards obtained recognition of Hawaiian independence by the United States, which was formalized by U.S. secretary of state Daniel Webster in July 1843; Richards later obtained recognition by Great Britain and France.

Contrary to the usual course of history, in Hawaii democratization evolved from the top downward rather than from the bottom upward.

But troubles with foreigners were not at an end. French naval officers in 1839, 1842, 1849 and 1851 made unjust demands, the first and third times accompanied by force. A British naval officer, Lord George Paulet, took possession of Hawaii in Feb. 1843 and held it until July when independence was restored by Adm. Richard Thomas, commander of the British Pacific squadron. After the ceremonies, the king, addressing his people on the means of preserving independence, used the expression "*Ua mau ke ea o ka aina i ka pono*" ("The life of the land is perpetuated in righteousness"), which became Hawaii's official motto.

Further troubles with foreigners, and especially the outrageous French demands of 1849 and 1851, led to diplomatic missions and, in the latter year, a secret proclamation putting the islands under the protection of the United States. The French, having learned this, retracted and the United States declined the protectorate, but, as a result of further troubles and dangers, within and without, including threatened filibustering from California and the "manifest destiny" sentiment awakened in the United States by the acquisition of the Oregon territory and California, negotiations were opened in 1854 for annexation to the United States. They were terminated by the death of the king.

2. New Codes.—An able lawyer, John Ricord, was appointed attorney general in 1844 and made a famous report to the legislature of 1845, as a result of which he was requested to draft comprehensive organic acts, which were enacted in 1846–47. W. L. Lee was appointed chief justice in 1846. He was chief drafter of the penal code of 1850 and the more modern constitution of 1852 and chief compiler of the civil code of 1859. Most important of these reforms, perhaps, was the Great *Mahele*, or division of lands, which provided a basis for modern land titles in the islands. Action was taken in 1845 and subsequent years by which the old feudal tenures were changed to allodial (absolutely independent), and the interests of government, crown, chiefs and common people were severed and all claims adjudicated by a board of which Lee was chairman. R. C. Wyllie, a Scot, was minister of foreign affairs 1845–65. For able and untiring service, Lee, Wyllie and Ricord are among the outstanding personages in Hawaiian history. A tower of strength was Kekuanaoa (father of Kamehamehas IV and V), governor and judge of Oahu. The long and fruitful reign of the liberal-minded Kamehameha III ended on Dec. 15, 1854. Hawaii had become a civilized and Christianized country with constitutional government, highly creditable legislative, executive and judicial branches, secure personal and property rights, allodial tenures, modern industries, the respect of other nations and assured independence.

The next two kings, high-minded, educated and traveled, Kamehameha IV (1854–63) and V (1863–72), were slightly reactionary and pro-British. The former and his consort, Queen Emma, are remembered for founding the Queen's hospital (1860) and introducing (1862) the Episcopal Church. The U.S. board of missions (Congregational), which had sent out workers since 1820, deeming Hawaii qualified to graduate from the field of Christian missions, in 1863 transferred its work to the Hawaiian board. Kamehameha V, after calling and dismissing a constitutional convention, himself promulgated a new constitution (1864).

With his death ended the beneficent Kamehameha dynasty, and after the brief reign (1873–74) of the liberal, popular, pro-American Lunalilo, elected against Kalakaua, came the decidedly reactionary reign (1874–91) of the latter, elected as pro-American against Queen Emma as pro-British. At first Kalakaua ruled fairly well and was largely instrumental in bringing about the Reciprocity treaty with the United States (1876). The treaty was terminable after seven years on one year's notice. An extension for a like term was obtained in 1887 but only by giving the United States the exclusive right to enter Pearl Harbor and maintain a naval coaling and repair station there.

3. Reaction and Annexation.—There was ever-increasing endeavour by the king to restore the ancient order with its customs and ideas of absolutism and divine right, accompanied by extravagance, corruption, personal interference in politics and fomentation of race feeling, until he was compelled to promulgate (1887) a new constitution providing for responsible ministerial government and other guarantees. The struggle continued, however, not only until the end of his reign (1891), during which there was an armed insurrection (1889) by the opposition, but even more hotly during the reign of his sister, Liliuokalani. She had rare qualities as a poet and musical composer and was interested in welfare work; however, it was deemed necessary to depose her (Jan. 17, 1893) and set up a provisional government, with annexation to the United States as its aim.

This failed for the time being, and a republic was established, July 4, 1894. It continued, disturbed only by an unsuccessful insurrection in 1895, until annexation was accepted by joint resolution of congress in 1898, and further until the territory was established, June 14, 1900.

4. Hawaii, U.S.—In 1900 the people of Hawaii, now American citizens, began striving to earn an honoured place in the nation. Population trebled under U.S. administration. The islands slowly won a niche in the national economy, producing sugar and pineapple products for mainland consumption. In turn, Hawaii as a customer for mainland goods was yearly paying about $400,000,000 for these goods by mid-20th century. The third source of

income in Hawaii was the growing tourist industry, which met the demand for a romantic vacation spot.

Politically, the islanders slowly won maturity in self-government and began the uphill task of earning statehood. The first legislative session under territorial status was dominated by a quarrelsome Home Rule party, but newly formed Republican and Democratic parties on the national pattern soon began competing to supply the needs of citizenship.

Hawaii was converted during this period into the westernmost bastion of American defense. Garrison troops were stationed on Oahu as early as 1898. Schofield barracks, first occupied in 1909, grew to be the largest permanent army post under the flag. The great naval base at Pearl Harbor was authorized by congress in 1908 and construction and maintenance thereafter made the U.S. government one of Hawaii's biggest employers.

Hawaii saw no hostile action in World War I but its people contributed their share in the conflict. Almost 1,000 men served in the U.S. army or navy, and many others did their bit in the Red Cross or other organizations in Europe or Siberia.

In the 20th century, large shipping lines grew up to meet the need for Pacific passenger and freight service. The first cargo to pass through the Panama canal was a bargeload of Hawaiian sugar. The air age likewise arrived in Hawaiian skies, and caused the Honolulu International airport to become the busiest landing field in the entire Pacific. Military aviation started in the islands in 1917. The first flight between California and Oahu was completed by two army lieutenants in 1927. Air passenger service began among the islands in 1929, as well as air freight deliveries. In 1936, regular transpacific clipper flights were started, connecting the U.S. with the orient.

As early as 1903 the territorial legislature had petitioned congress for admission as a state, and many subsequent sessions made the same request without avail. Charges of colonialism and paternalism arose, and fear of carpetbagger rule by nonresidents of the islands was also rife. In 1924 congress passed a law extending to Hawaii the benefits of appropriations for general welfare in the states, but Hawaii was still subject to all taxes imposed on the states, and the cry of "taxation without representation!" was often heard. The Jones-Costigan Sugar Control act of 1934 clearly discriminated against the rights of sugar producers in Hawaii. Territorial delegate Samuel W. King introduced a statehood bill in congress in 1935 and succeeded in getting the house committee on territories to send a subcommittee to visit Hawaii—the first of many such congressional investigations. When a plebiscite on the question "Do you favour statehood?" was held in 1940, despite fears of Japan the people voted 67% in favour (see *Campaign for Statehood*, below).

5. World War II.—On Dec. 7, 1941, the Japanese, while still talking peace in Tokyo and Washington, made a surprise air and submarine attack on Pearl Harbor and the army and navy airfields of Hawaii. Casualties numbered over 3,000, including more than 2,300 killed. The battleship "Arizona," target ship "Utah," destroyers "Cassin," "Downes" and "Shaw" (later salvaged) and the mine layer "Oglala" were lost. The battleship "Oklahoma" also capsized, and other ships were severely damaged. Many planes were destroyed or damaged on the ground, and much other damage was done. No fuel depots were destroyed. Some bombs fell on Honolulu; civilian casualties totaled over 100, including 49 dead, but material damage was slight. The Japanese lost 41 planes and 3 submarines. (*See* also PEARL HARBOR ATTACK; WORLD WAR II.) But a bigger result was the unification of the U.S. people for the war. The slogan "Remember Pearl Harbor" became reminiscent of "Remember the Maine." The attack marked the extension of World War II to the Pacific and between Japan and the United States, which was joined at once by Great Britain, the Netherlands and China. U.S. officers and men individually and collectively exhibited great heroism and resourcefulness during the attack. Japanese submarines later briefly shelled Hilo (Hawaii), Nawiliwili (Kauai) and, twice, Kahului (Maui), without casualties and with negligible damage.

The people of Hawaii earned a proud war record, at home and on various world fronts. Memorable is the achievement of the A.J.A. (Americans of Japanese Ancestry) volunteers who served at Anzio and Cassino in Italy in the 100th infantry battalion, later incorporated into the 442nd regimental combat team. Many men from Hawaii also served as interpreters in the island-hopping campaigns against Japan.

Martial Law.—The governor of Hawaii issued a proclamation suspending the privilege of the writ of habeas corpus and declaring martial law. A military government was set up to exercise executive, judicial and legislative functions. Provost courts, under martial law, supplanted district or police courts throughout the territory.

During the early months of 1942 military precautions were continued. Among them were blackout restrictions which provided that only persons on official business could be on the streets, highways, beaches or parks on foot or in vehicles between 6 P.M. and 6 A.M. Hundreds of thousands of individuals were fingerprinted and an extensive immunization program of the whole population against smallpox and typhoid was completed. The civilian population was supplied with gas masks.

By the following year the danger of invasion or concentrated air attack had apparently passed, and the management of civil affairs was restored to the civil authorities in March 1943. Martial law remained in effect, however, and the writ of habeas corpus continued to be suspended. Members of the bar association of Hawaii strongly opposed the practice of trying civilians in provost courts. In Oct. 1944 Pres. Franklin D. Roosevelt announced the suspension of martial law and the restoration of habeas corpus. Military authority was restricted thereafter to defense measures in the islands. The U.S. supreme court held in 1946 that the military courts which were set up under martial law during the war period had no power to try civilians.

6. Campaign for Statehood.—After the close of World War II Hawaii renewed its efforts to obtain admission to the sisterhood of states. In 1946 Harry Truman became the first president to urge congress to grant statehood to Hawaii, but a house bill passed in 1947 did not pass the senate. In the spring of 1950 Hawaii drafted a state constitution to submit to the congress for ratification. This constitution was prepared at a convention of 63 delegates elected from all the islands and was ratified by the voters in the general election held Nov. 7, 1950.

An enabling act for statehood passed the house in March 1950, for a second time, by a majority of 262 to 110, but four days after the senate committee reported favourably, the Korean War broke out and action was deferred. In the last few weeks of the special session toward the end of 1950, opponents of the bills to grant statehood to both Hawaii and Alaska were able to prevent a vote. In 1952, similar bills for the first time reached the senate floor, but a vote of 45 to 44 sent the Alaska bill back to committee and the Democratic leadership decided not to bring up the Hawaii bill. In 1954 a statehood bill passed the senate for the first time but no final action was taken to combine house and senate versions.

The expectation that Hawaii might always send Republicans to congress was upset when in Feb. 1955, the legislature convened for the first time in the history of the territory with a majority of Democrats in both the senate and the house of representatives. In 1956 and 1958 a Democrat, John A. Burns, was elected as Hawaii's last territorial delegate to congress.

In Nov. 1955, Gov. Samuel W. King, in his capacity as president of the 1950 constitutional convention, called the delegates of that body together to act on the reapportionment provision of the proposed state constitution. The convention passed a resolution reaffirming its desire for statehood and requesting the congress meanwhile to permit reapportionment of the legislature as provided by the state constitution. Congress approved in 1956, and in 1958 the first election was carried out under the new plan, which provided for 25 senators and 51 representatives.

In 1957, statehood failed to pass the congress for the 22nd time since 1903. In 1958, as a result of an active effort, Alaska was granted statehood and in 1959 Hawaii's long campaign met with success when Hawaii became the 50th state.

The enabling act was passed by the U.S. senate on March 11,

1959, by a vote of 76 to 15 and by the house of representatives on the following day by 323 to 89. President Eisenhower signed the act on March 18. Citizens voted for statehood in a plebescite on June 27. (*See* also HONOLULU; PACIFIC ISLANDS.)

IV. POPULATION

The population of Hawaii, according to the 1960 federal census was 632,772, exclusive of armed forces personnel. About half the population lived in the capital, Honolulu, a busy, modern

TABLE II.—*Hawaii: Places of 5,000 or More Population (1960 census)**

Place	Population				
	1960	1950	1940	1920†	1900†
Total state	632,772	499,794	423,330	255,912	154,001
Aiea	11,826	3,714	3,553	—	—
Hilo	25,966	27,198	23,353	10,431	—
Honolulu	294,194	248,034	179,326	83,327	39,306
Kailua-Lanikai	25,622	—‡	970	—	—
Kaneohe	14,414	3,208	1,762	—	—
Lualualei-Maili	5,045	—‡	—§	—	—
Wahiawa	15,512	8,369	5,420	—	—
Waianae-Makaha	6,844	—	—	—	—
Wailuku	6,969	7,424	7,319	—	—

*Populations are reported as constituted at date of each census.
†Returns unavailable for 1920 and 1900 for towns and villages.
‡Not separately returned in 1950.
§Not separately returned in 1940.

city with 294,194 inhabitants. The second city was Hilo (25,966) on the island of Hawaii. The remaining centres were small towns or villages, or else part of the Honolulu standard metropolitan statistical area. Urban population was 76.5%, rural 23.5%; density was 98.5 per square mile.

From the discovery of the island (1778) the population changed from extreme homogeneity to extreme heterogeneity because of the decrease of Hawaiians during the first century and immigration of others during the next century (see *The People*, above). At the time of the discovery the population probably did not exceed 300,000. Their decrease, attributable to many causes, was rapid, but latterly continued at a diminishing rate. The Hawaiians seemed destined to disappear more through intermarriage with other races than through excess of deaths. The part-Hawaiians increased more rapidly than the pure Hawaiians decreased.

1. Characteristics.—In 1823 the missionaries estimated the Hawaiians at 142,050. The first census (1832) showed a total population of 130,313, including the few foreigners. The census of 1872 showed a low ebb in the total, 56,897 (51,531 Hawaiians and part-Hawaiians, or 90.5% of the total). That of 1878, just after the reciprocity treaty with the United States began to stimulate the sugar industry and immigration, showed a total population of 57,985, comprising 47,508 Hawaiians and part-Hawaiians (81.9% of the total) and 10,477 of other races.

The census of 1900, the first taken after Hawaii became a territory, showed a total population of 154,001, comprising 37,656 Hawaiians and part-Hawaiians (24.4% of the total) and 116,345 others, including 28,819 Caucasians, 5,767 Chinese and 61,111 Japanese. In 1920 the total population of the territory was 255,912, of which number 41,750, or 16.3%, were Hawaiians and part-Hawaiians. In 1930 the population was 368,336, of which number 50,860, or 13.8%, were Hawaiians and part-Hawaiians. This census represents the smallest recorded percentage of Hawaiians and part-Hawaiians taken together. In 1940 there were 64,310 Hawaiians and part-Hawaiians, forming 15.2% of the total of 423,330. In 1950 there were 12,245 Hawaiians and 73,846 part-Hawaiians, forming 17.2% of the total population of 499,794. Racial data were not recorded after 1950.

The growth of the population of the territory up to 1930 was rather rapid, with a 43.9% increase registered in the decade ending in 1930. The increase between 1930 and 1940 was only 14.9%, between 1940 and 1950 it was 18.0% and between 1950 and 1960 was 26.6%. The number of males per 100 females reached its highest point, at 223.3, in 1900 and an equal proportion between the sexes was not reached until 1930. The population of Hawaii is predominantly youthful; in 1960, 45% of the residents were under the age of 21.

2. Immigration.—Polynesians from the South Sea Islands were introduced into Hawaii between 1859 and 1885, but the total was less than 2,500 and they proved disappointing both as labourers and prospective citizens, so that most of them were returned to their homes. Nonoriental immigration was encouraged, principally Portuguese. In the latter part of the 19th century, after the reciprocity treaty increased the need for plantation workers, about 11,000 Portuguese were brought from Madeira and the Azores in 1878–90 and 337 more in 1899. They proved to be industrious, thrifty and law abiding. They brought their families and most of them remained and multiplied. In 1906–13, more than 5,000 more were introduced, many from Portugal itself. Other groups were brought—mainland Americans, Norwegians, Germans, Galicians, Russians, Poles, Spaniards from Málaga and Italians. In 1900–01 about 5,000 Puerto Ricans were brought in, and contrary to first expectations, most of them developed well and increased to more than 9,500 by 1950. About 100 Negroes and their families were brought in 1901 and about 500 Hindus (1908–11), most of whom soon left.

To solve the problem of finding a source of willing plantation labour, it was early decided that groups from Asia should be introduced. The Chinese came first (1852–67); then, opposition having arisen, 148 Japanese were brought in 1868. The Japanese government objected, however, and the Chinese continued to come in growing numbers until restrictive measures were applied by the Hawaiian government in 1883 and attention again turned to Japan. Japanese came in large numbers—65,034 during 1885–99, of whom almost 20,000 came in the last year, fearing that such immigration might be prohibited. Upon annexation, the United States laws on Chinese exclusion were extended to Hawaii. After the gentlemen's agreement of 1907 with Japan, arrivals were chiefly women, and a rapid increase continued through births. Opposition on the mainland led to Japanese exclusion in 1924. Koreans to the number of 7,859 came in 1903–05, but there were only 4,533 in 1910, 4,950 in 1920 and 7,030 in 1950.

Finally, largely because of the enactment of federal laws prohibiting assisted immigration from foreign countries, the sugar companies turned to Filipinos as the only available labour source, beginning in 1906, and, although many went on to the mainland, their number grew to 21,031 in 1920 and 63,052 in 1930; they numbered 69,070 in 1960 and constituted the largest racial element on the sugar plantations.

All the various national groups brought into Hawaii prospered. The Puerto Ricans remained United States citizens after arrival. Nearly all the Portuguese became citizens, and after World War II many Filipinos and Chinese took out citizenship papers under laws favouring such action. The Hawaiian-born children of all alien residents are citizens at birth.

V. ADMINISTRATION AND SOCIAL CONDITIONS

1. Government.—From 1900 to 1959 the Hawaiian Islands were a territory, an integral part, not a possession, of the United States, governed under an organic act, effective from June 14, 1900. Having been previously an independent sovereignty, Hawaii was the most highly organized territory created by congress and the only one to which was given the administration and revenue of its public lands. The federal officers were a delegate to congress, elected for two years, who could introduce bills and debate but not vote, two judges of a federal district court and a U.S. attorney and marshal, appointed for six years by the president with the consent of the federal senate, and various officials of the treasury, post office, agriculture, commerce and interior departments. The territorial legislature met for a 60-day term every two years. In 1959 the first session was held under a reapportionment act which provided for 51 members of the house of representatives, elected for two years, and 25 members of the senate, with 12 or 13 elected each two years for four-year terms. This plan anticipated a similar scheme of representation under the state constitution which was ratified by the people of Hawaii in 1950 and went into effect in 1959.

This constitution required that to be eligible for the state senate a candidate must be 30 years old, a resident of the state for not

less than three years and a qualified voter of the senatorial district from which he seeks to be elected. A candidate for the house of representatives must be at least 25, a resident of the state for three years and a qualified voter of the representative district.

Regular sessions of the legislature are held annually, starting on the third Wednesday in February. Regular sessions in odd-numbered years are known as general sessions and run for 60 days; regular sessions in even-numbered years are known as budget sessions. Budget sessions and special sessions are limited to 30 days, but the governor may extend any session for not more than 30 days.

Under the constitution the governor and the lieutenant governor are elected by the voters for four-year terms. All executive and administrative offices and bureaus are allocated by law among not more than 20 principal departments, each headed by a single executive who is appointed by the governor with the advice and consent of the senate. The terms of these executives expire at the end of the governor's term.

Local Government.—Under the state constitution the legislature "shall create counties and may create other political subdivisions within the state, and provide for the government thereof." Each political subdivision has the power to frame and adopt a charter for its own self-government. The taxing power is reserved to the state except so much thereof as may be delegated by the legislature to the various subdivisions.

Qualifications of Voters.—Qualifications for voting include citizenship, registration, residence of one year in the state, age of 20 years and ability to speak, read and write the English or Hawaiian language. Voters do not lose residence through absence in the service of the United States, or while engaged in navigation or studying at any institution of learning. The legislature provides for registration and for absentee voting. General elections are held on the first Tuesday after the first Monday in November in all even-numbered years.

During territorial rule direct primaries were adopted in 1913 and women's suffrage in 1920. Political parties are the Republican and Democratic. During the general election of 1958 the registered voters numbered 175,221, of whom more than 88% voted, usual in Hawaii but much higher than in most other U.S. states.

2. Taxation.—The tax structure under territorial rule comprised an elaborate system of taxes which included every major type of tax found in the states and several others not in general use. Among the latter was a general excise (gross income) tax of $3\frac{1}{2}$% levied against almost all business activities. In 1957 the territorial income tax law was revised to make payments more closely comparable to the system used by the federal government. The rate on homes occupied by owners was lower than that on real estate in most states. The net assessed valuation of real property at the time statehood was achieved in 1959 was more than $1,085,000,000. All federal taxes, including individual income and corporate income taxes, were applicable in the territory and continued to be in the state. The funded debt of the state at any time was set at $60,000,000.

3. Living Conditions.—The cost of living in Hawaii is slightly higher than that of the mainland United States because most of the goods used by the people must come by ship from other places. Per capita personal income when Hawaii was admitted to the union was about $1,700. Wage scales were about the same as on the mainland. Approximately 200,000 persons were employed. The average weekly wage was about $60 for industrial workers covered by employment insurance. Payroll for all industries was more than $711,000,000. The sugar plantation companies paid wages of more than $58,000,000 to an average number of full-time equivalent employees totaling almost 19,000. The pineapple companies paid more than $35,500,000 to employees totaling about 11,000. But the biggest employer, governmental agencies, with a payroll of more than $320,000,000 to territorial, county and federal workers, accounted for 45% of all wages. A lively home-building program was being carried on, despite high costs and relative scarcity of residential land.

4. Welfare Services.—Services in Hawaii parallel those of mainland states. The department of public health is second in importance only to that of education. Physicians are employed or subsidized for the benefit of all, however indigent or remote from population centres. The incidence of Hansen's disease (leprosy) has declined greatly so that only about 150 patients are confined. All cases discovered since 1949 have been confined at Hale Mohalu, Pearl City, Oahu, rather than at Kalawao. Tuberculosis hospitals are found on Oahu, Hawaii, Maui and Kauai. Two hospitals on Oahu care for the mentally handicapped. There is one prison system with three units, two of which are minimum security projects. There is also a correctional school for boys and another for girls. The department of health has allocated in one year more than $1,000,000 to the counties for hospital and medical aid to the indigent. All workers in the islands benefit under the social security act and other federal laws concerning child labour, minimum wages and unemployment insurance. In 1945, the local government extended collective bargaining to agricultural labour. As a state, Hawaii automatically benefits by all federal welfare laws.

5. Justice.—Judicial decisions are made by the United States district court of Hawaii and by the state courts. These consist of one supreme court, circuit courts and such inferior courts as the legislature may establish. The supreme court consists of a chief justice and four associate justices. The justices, as well as judges of the circuit courts, are appointed by the governor with the advice and consent of the state senate, from those persons who have practised law before the supreme court of Hawaii for at least ten years. Justices serve seven years and judges of the circuit courts serve six years. Equity and law are kept distinct but with simplified procedures. Appeals may be taken from the federal district court and, when a federal question or a value in excess of $5,000 is involved, from the state supreme court to the federal circuit court of appeals of the ninth circuit, in San Francisco.

6. Education.—Twelve years after the arrival of the first missionaries in 1820 there were 900 schools with 53,000 pupils (40% of the population, mostly adults); 12 years later about 80% were literate. In 1824 the regent and chiefs prescribed schools and compulsory attendance. In 1831 and 1834 there were founded two higher institutions for training teachers and religious assistants, which were also largely manual and industrial training schools, said to be the first of the kind established in what is now the United States. In the 1830s and 1840s pupils came from Spanish California, Kamchatka and other Pacific islands to attend an English-taught school opened in Honolulu in 1833. At first Hawaiian was the language of public instruction, but in 1854 the change was made to English, and American teachers, textbooks and methods became popular.

When Hawaii became a state the educational system included all grades from kindergarten through university, as well as special classes for physically defective or feeble-minded students. There were many evening classes. Much attention was given to agricultural, trade and industrial vocational work, home economics and medical, dental and nutritional needs. School attendance was compulsory for children 6 through 15 years of age. The public school system was under the territorial government; buildings and other physical equipment were under the local governments. There were about 200 public schools, including kindergartens and grades through 12. The total school enrollment was almost 160,000 or about 27.5% of the population of the territory. Of those enrolled, not quite 30,000 were in private schools. Public school teachers numbered about 5,000; they were all under a standard salary schedule regardless of teaching location.

Under the state constitution, a board of education is appointed by the governor, with the advice and consent of the senate, from panels submitted by local school advisory councils. The superintendent of public instruction is appointed by the board. The education system is state wide rather than local, continuing the centralization found under the monarchy and under territorial rule. The constitution provides that "there shall be no segregation in public educational institutions because of race, religion or ancestry."

Prominent among private schools are Punahou, founded in 1841, which specializes in college preparatory courses; the Kamehameha schools (for those of Hawaiian blood), largely industrial; St. Louis college (Catholic, for all races); and Mid-Pacific institute (for all races).

7. University of Hawaii.—The state-supported University of Hawaii lies at the crossroads of the Pacific. There are more than 7,000 students earning credits. The campus in Honolulu lies in Manoa valley, three miles from the business centre and two miles from Waikiki. It was established by the territorial legislature in 1907 and is a federal land-grant institution. Originally called the College of Agriculture and Mechanic Arts (1907–11) and later the College of Hawaii (1911–20), it became the University of Hawaii in 1920. As a state university it receives a major portion of its financial support from the state legislature. Its colleges include arts and sciences, business administration, engineering, education, agriculture and general studies. In addition to the bachelor degree, the university grants the master's degree in 29 departments and the doctor's in 7. Co-operating institutions include the Pineapple Research Institute of Hawaii; the Hawaiian Sugar Planters' association; Fruit Fly laboratory; the U.S. fish and wildlife service, which established the permanent headquarters of its Pacific oceanic fishery investigations on the university campus; the Bernice P. Bishop museum, which built an extensive Polynesian collection; the Pacific and Asian Affairs council; and the Honolulu Academy of Arts. The Gregg M. Sinclair library of the university contains more than 300,000 bound volumes and is a regional depository for U.S. government publications. It holds extensive collections of works in Chinese and Japanese and also books and periodicals concerning Hawaii and the Pacific. The university operates the aquarium at Waikiki and the Hawaii Marine laboratory with a branch at Coconut Island off the north shore of Oahu. It also operates a junior college at Hilo.

Other collegiate institutions in Hawaii are Chaminade college (founded 1957) and Honolulu Christian college (1953), both in Honolulu, and Church College of Hawaii (1955) at Laie, Oahu, and Maunaolu college, a junior college at Paia, Maui.

8. Armed Forces.—Hawaii is the centre for the unified command of the U.S. armed forces for the entire Pacific area; the admiral in charge is also in command of the Pacific fleet, with headquarters at Pearl Harbor. The army maintains six major posts on the island of Oahu, including Schofield barracks, about 20 mi. from Honolulu. Air defense of the Pacific is a function of the Pacific air force (USAF) with headquarters at Hickam air force base on Oahu. The Hawaii national guard is available for immediate call in time of national emergency and also may be called out by the governor in local emergencies. A national guard fighter squadron is stationed at Hickam air force base.

VI. THE ECONOMY

Hawaii's economy has increasingly expanded in the 20th century because of closer integration into the U.S. national market, and by specializing in four major sources of income, which may then be used to purchase the needs of the population. The four are sugar, pineapples, tourism and government spending. Hawaii grows one-seventh of all the sugar used in the United States, and 75% of all the pineapples marketed in the world. Although Hawaii is predominantly agricultural, the cultivable land is only about 7% of the total area; 40% is suitable only for grazing and another 25% is forest reserves. Three-fourths of the agricultural acres are used for sugar cane, but the entire sugar crop of more than 1,000,000 tons a year is grown on 221,300 acres—an area about the size of New York city. When Hawaii became a state the sugar crop was worth about $147,000,000 annually, and the pineapple crop about $115,000,000. But the largest source of income was federal expenditures, mostly for defense, including payrolls, purchases and contracts, running to more than $385,000,000 annually. Tourism was a growing industry which may compete with agriculture.

Sandalwood was Hawaii's first important commercial product. The industry (1800–30) originated through the discovery of fur traders that the wood was in demand in China. When the trade was at its height during 1810–25, the king and chiefs found it so lucrative that they compelled most of the available population to get the wood from the forests, so that it was soon exhausted. But before that time, whaling (1820–80) began. The vessels usually called twice a year for rest, repairs, supplies, storage or transshipment of oil and whalebone and engagement of Hawaiians as seamen. The annual calls during 1840–60, when the industry was at its height, averaged about 400. Whaling was also carried on locally. The discovery of petroleum (1859) and the destruction of whaling vessels in the American Civil War and by the northern ice pack in 1871 lessened its importance. Hawaiians were excellent seamen; in 1846 about a fifth (3,000) of the young men of 15–30 were so engaged.

A. Production

1. Sugar has long been the chief product of the islands. Small quantities were produced from 1802 to 1835, when the industry really began, and yet the output had increased to only 13,036 short tons by 1876, when there was great impetus from the reciprocity treaty with the United States. It increased to 229,414 tons by 1898, the year of annexation, and to 1,035,548 by 1933, after which there was a reduction of about 9% in output under the national quota system. Tonnage was more than 1,000,000 in the 1950s. Laboursaving devices and improved scientific methods have reduced the working force; in the 1950s the same amount of sugar was produced by one-third the number of employees as in the 1930s. In 40 years tons per employee rose from 12.6 to 56.1. Wages paid these unskilled workers increased to an average of $11.10 daily in the second half of the 20th century. Employment is on a year-round basis. The yield per acre is the highest in any sugar area, averaging 7¼ tons of sugar per acre, with a maximum of 18 tons. The cane requires 14 to 24 months to mature, and two or three crops at different stages grow at the same time. Nowhere have scientific methods been applied in agriculture more than to the sugar and pineapple industries in Hawaii. About half the area is irrigated—by conduits from mountain streams and pumping from artesian and surface wells. The irrigation system of one plantation cost nearly $6,000,000, and supplies amounts of water that would meet the needs of a medium-sized city. Before a field is harvested it is set on fire to burn off the leaves. Conveyance to the mills is by large trucks, flumes and overhead trolleys. The centrifugal drying process for sugar was introduced in Hawaii in 1851. Almost all the sugar is shipped raw, mainly to a co-operative refinery in California. Corporations own the mills and raise most of the cane. In the second half of the 20th century there were 27 sugar plantation companies and some 2,000 independent sugar planters.

2. Pineapple growing, an industry rising in the 20th century, is second only to sugar as a crop. Annual production of all companies increased from 1,893 cases in 1903 to more than 30,000,000 cases of canned fruit and juice in the 1960s. Nine companies dominate the industry, and the working force of about 20,000 persons grows, harvests and processes the fruit. Some of the by-products of processing include citric acid, bran, calcium citrate, alcohol and sugar. Unlike the sugar industry, the pineapple companies have had to create their market.

3. Other Agriculture.—The livestock, coffee and rice industries have successively occupied third place. There are numerous ranches and dairies, many with thoroughbred stock—cattle, sheep, horses, hogs and poultry. Livestock products brought about $30,000,000 a year in the 1960s. More than 30,000,000 quarts of milk are produced annually. The coffee, valued at about $6,000,000 annually, is of superior quality, known as Kona from the district on western Hawaii where most of it is raised. Rice is a waning industry. Hilo on the island of Hawaii is the centre of the flower trade. The banana supply is steady, though not large. Other industries which are still small or have had their day are silk, cotton, tobacco, rubber, vanilla, sisal, potatoes and wheat. New methods have made a future for the growing of macadamia (Australian) nuts. There is much subsistence farming and a wide variety of diversified crops can be grown in the islands, but

for many years the people have found it most economical to grow the two important money crops—sugar and pineapples—by large-scale methods, and to import most of their supplies, chiefly from mainland United States. Purchases by Hawaii from the mainland amount to more than $748,000,000 a year. Little lumber is produced.

4. Fisheries.—Commercial fishermen catch millions of pounds of fish each year, valued at about $3,000,000. Most important commercially are the aku, or ocean bonito, and the *ahi*, or yellow-fin albacore, both of which are canned as tuna. Fishing in island waters, however, does not begin to supply local needs and much frozen fish is imported into Hawaii.

5. Industry.—Although Hawaii is essentially agricultural, the principal industries are such as require much manufacturing directly, as in sugar, pineapple, rice, coffee and fish mills and canneries, and indirectly, as in iron, fertilizer and can works of large size. A petroleum refinery has been erected on Oahu by a large mainland corporation. More than 150 products are made in the islands, from acetylene to zinc sulfate, but all on a small scale. Handicraft items, perfumes, curios, costume jewelry and jams and jellies are exported. Apparel, particularly Hawaiian sportswear, is a growing industry, and annual sales reached more than $10,000,000 in the 1960s.

Practically the only mineral products are building stone, lava aggregates for concrete, lime and salt, but important deposits of bauxite, raw material for aluminum, were identified in the 1950s. There are no local sources of power except a few waterfalls, and most electricity is produced by conversion of imported petroleum.

6. Tourism.—Third largest source of income from industry comes from tourism. In the second half of the 20th century almost 200,000 tourists spent nearly $80,000,000 in the islands annually. The industry has been promoted by the Hawaii Visitors bureau, established in 1903. The tourist income, which unlike sugar and pineapple has no apparent saturation point, may increase greatly and its effects will spread throughout the economy.

B. Trade and Finance

In quantity imports have exceeded exports, approaching a ratio of two to one, but dollar earnings have shown a favourable balance. As indicated above (see *Production*) the major exports are sugar and pineapples, and the tourist trade is the third largest source of income. At the time Hawaii became a state about two-fifths of the total dollar income was based on the export of agricultural products and three-fifths on the sale of services and goods to tourists and to defense agencies and shipping and airlines. Roughly three-fifths of expenditures outside Hawaii were for commodities imported, less than one-fifth for services and other items (like freight and passenger services) and about one-fifth for payments to the federal government.

C. Transport and Communications

The state highway system includes more than 3,000 mi. of concrete and macadam roads. There were more than 200,000 passenger cars in Hawaii by the 1960s. The people are served by many bus lines as well. Most of the heavy hauling is done by trucks, since there are virtually no railway lines. Water and air transport is preferred over road transport in these islands. Shipping lines connect with all the ports of the world. Chief shipping terminals in the islands are Honolulu; Hilo, on Hawaii; Kahului, on Maui; and Port Allen, on Kauai. About 50 shipping companies have representatives in Honolulu. There are about 1,200 ship arrivals annually at Honolulu harbour with incoming freight of almost 3,000,000 tons and outgoing freight of more than 1,000,000 tons. Eleven commercial airports accommodated travelers, flying more than 400,000 individual passenger trips to and from the territory, and 600,000 individual trips between islands. Eight international airlines use the Honolulu airport. Use of jet planes reduced the flying time from San Francisco to Honolulu to about four hours.

There are about 170,000 telephones in use; the dial system may be used even for calling a party on another island. In 1957 a dual trunk line telephone cable connected Honolulu and San Francisco, capable of carrying 34 conversations simultaneously. Hawaii is also connected with the rest of the world by cable, radio, radiotelephone and ship-to-shore radio service. At the time Hawaii was admitted to the union in 1959, there were 16 broadcasting stations in the islands and 6 television stations, of which 3 were in Honolulu.

D. Labour

Unionization in the islands has followed an unusual pattern. Before 1934 there was very little organizing activity by labour unions. Workers were often of different races and tended to be unfamiliar with U.S. labour movements. Union organization was perhaps delayed by certain paternalistic policies of employers who, in the face of prospective organization, voluntarily improved conditions and supplied various benefits such as housing and medical care. There was little labour leadership until after the 1934 waterfront strike in San Francisco. During the two years following, some 500 striking seamen were ashore in Honolulu and built up strong sentiment among the stevedores and other workers. The International Longshoremen's and Warehousemen's union (I.L.W.U.), formed at that time, became Hawaii's most militant union and organized not only the dock workers but workers in the sugar and pineapple fields and later even had some success in organizing retail clerks in competition with A.F.L.–C.I.O. locals. For a considerable period the rivalry of west-coast organizations such as the Sailors' Union of the Pacific under Harry Lundeberg and the I.L.W.U. under Harry Bridges was reflected in union activities in and pertaining to the islands.

During World War II union activities were necessarily restricted in scope. The pressure of wartime duties, the early curfew and blackout and gasoline rationing all impeded activities of labour as well as other organizations. Moreover, under martial law, wage rates were frozen and workers were forbidden to move from one job to another. At the war's end unionization proceeded rapidly. There was a wave of strikes comparable to those on the mainland at that time, reflecting desires to obtain gains in the postwar world and to meet rising living costs. Doubtless here, as elsewhere, resentment over wartime regulation played a role. Late in 1946, the I.L.W.U.–C.I.O. leadership called a strike on 33 plantations involving 28,000 workers. The strike lasted for 75 days, and involved substantial losses to all concerned. An even more important strike occurred in the summer of 1949, the longest major maritime tie-up in U.S. history, when for 178 days shipping between the mainland and Hawaii was suspended. Many persons felt this strike and the territory's means of dealing with it pointed up the need for statehood. That labour controversy had not vanished was evidenced by the sugar strike which began on Feb. 1, 1958, and lasted for 126 days. Its effect on the general economy of the islands was to a substantial extent offset by a continued boom in building construction.

Estimated membership in A.F.L.–C.I.O. locals at mid-century was 10,000, and I.L.W.U. membership at 23,000. There were also four organizations representing federal and territorial employees. Labour union leaders were active politically in the islands and their efforts met with varied success. In the general election of 1946, the political action committee of the C.I.O. endorsed 51 candidates from both parties, of whom 35 were elected. Later attempts in the support of candidates for the legislature met less clear-cut success. In general, but with exceptions, the unions lent their considerable influence to candidates of the Democratic party. To present a united front in respect to labour controversy the Hawaii Employers council was founded in 1943. In the 1960s it represented more than 200 firms, large and small, employing 46,000 persons.

See also references under "Hawaii" in the Index volume.

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Current statistics on production, employment, industry, etc., may be obtained from the pertinent state departments; the principal figures, together with current history, are summarized annually in the *Britannica Book of the Year*, American edition. (A. G. Dy.)

HAWARDEN (Penarlag), a town of Flintshire, Wales, 7 mi. W. of Chester. Pop. (1951) 13,842. Hawarden castle (1752) stands near the 13th-century castle which suffered in Welsh raids and in the Civil War. The modern house passed to W. E. Gladstone, who lived there for 60 years and added a library and study which he called the Temple of Peace. St. Deiniol's library was founded by Gladstone in 1895 and rehoused in 1902. There is also a Gladstone museum. In St. Deiniol's church, an Early English building restored, is a memorial window to Gladstone by Sir E. Burne-Jones. In the town are the William Temple Memorial college for women (1947) and a grammar school (1606).

The Hawarden rural district (pop. [1961] 36,290) comprises the civil parishes of Hawarden, Higher Kinnerton, Hope, Llanfynyd, Marford and Hoseley, East and West Saltney, Sealand and Treuddyn.

HAWES, STEPHEN (fl. 1502–1521), English poet who called John Lydgate (*q.v.*) his master. He was educated at Oxford (according to Anthony à Wood in *Athenae Oxonienses*, 1691) and traveled in England, Scotland and France. The date of his birth cannot be determined, and little is known of his life. He was groom of the chamber to Henry VII by 1502 and was still living in 1521. His main work is *The pastime of pleasure*, several passages of which suggest that he wrote it in early manhood; it was finished in 1506 and printed by Wynkyn de Worde in 1509. It is a long allegorical poem in seven-line stanzas and has as its title in the 1554 edition *The Historie of graunde Amoure and la bell Pucel, . . . conteining the knowlege of the seuen sciences and the course of mans life in this worlde.* Its chief motive is the education of the knight Graunde Amour, based on the *De nuptiis Philologiae et Mercurii* of Martianus Capella (*q.v.*); but its most interesting feature is the treatment of the theme of death, which inspires Hawes's best-known lines:

> For though the day be never so longe
> At last the belles rynge to evensonge.

His other allegory, *The example of virtue* (1504?), is simpler and shorter. Though Hawes shows at times a finer quality of mind than Lydgate he is not even Lydgate's equal in technical accomplishment and little that he wrote is memorable.

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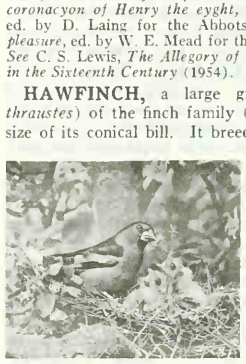
HAWFINCH, a large grosbeak (*Coccothraustes coccothraustes*) of the finch family (Fringillidae), remarkable for the size of its conical bill. It breeds extensively in the British Isles (but not Ireland) and is found over most of Europe and northern Asia south to northern Africa. The plumage, brightest in the male, is mainly brown shading to pink below. The wings are black, with a conspicuous white bar and shoulder patch, and males have black throats. Notably shy, hawfinches are essentially arboreal in habits but often feed on the ground. Their flight is rapid, usually high, and characteristically undulating over short distances. In winter they gather in flocks and courtship begins. The nests are often built in scattered groups. The voice includes loud explosive notes and variations of a simple, hesitating song. (E. R. Be.)



ERIC HOSKING

HAWFINCH (COCCOTHRAUSTES COCCOTHRAUSTES) WITH YOUNG

HAWICK, a small burgh of Roxburghshire, Scot., and one of the chief border towns, lies 51 mi. S.S.E. of Edinburgh by road at the confluence of the Slitrig with the Teviot. Pop. (1961) 16,204. Bridges across the Teviot connect Hawick with the suburb of Wilton where Wilton lodge is now a museum. The first church of St. Mary, believed to have been founded by St. Cuthbert (d. 687), was succeeded by one dedicated in 1214, which was the scene of the seizure of Sir Alexander Ramsay of Dalhousie in 1342 by Sir William Douglas; the present one is the third and was built in 1763. The Buccleuch memorial hall, commemorating the 5th duke of Buccleuch, is used as a technical college and a museum. The Moat or Moot hill at the southern end of the town is an earth mound 30 ft. high and 300 ft. in circumference, possibly the place where the court of the manor formerly met. The Baron's tower, founded in 1155 by the Lovels, lords of Branxholm and Hawick, and afterward the residence of the Douglases of Drumlanrig, is said to have been the only building that was not burned down during the raid of Thomas Radclyffe, earl of Sussex, in 1570. It became an inn in 1773 (now the Tower hotel) and was visited by William Wordsworth, his sister Dorothy and Sir Walter Scott.

In 1537 Hawick received from Sir James Douglas of Drumlanrig a charter which was confirmed by the infant Queen Mary in

1545 and remained in force until 1861, when the corporation was reconstituted by act of parliament. Sir Robert Umfraville (d. 1436), governor of Berwick, burned the town about 1417. In 1514, the year after the battle of Flodden in which Hawick burghers had suffered severely, a number of young men or "callants" routed an English force at Hornshole on the Teviot 2 mi. below the town. This event is celebrated every June in the "Common Riding" ceremony, in which a facsimile of the captured pennon is carried in procession by the "cornet" to the accompaniment of a chorus, "Teribus ye Teri Odin" (or, the other version, "Tyr-ibus ye Tyr Odin"), supposed to be an invocation to Thor and Odin—a survival of Northumbrian paganism. An equestrian statue was erected in 1914 to mark the quatercentenary of the victory. The town's chief industries are the manufacture of hosiery, tweeds and knitwear. Markets for livestock are also important.

Two miles southwest of Hawick is the massive peel of Goldielands—the "watchtower of Branxholm," a typical border stronghold. One mile beyond it is Branxholm castle, the Branksome Hall of *The Lay of the Last Minstrel*, once owned by the Lovels but since the middle of the 15th century the property of the Scotts of Buccleuch. It was destroyed in 1570 and was rebuilt in 1571–76, its tower and south front forming part of the modern mansion.

HAWK, a name applied generally to any diurnal bird of prey belonging to the families Accipitridae—kites, buzzards (*i.e.*, buzzard hawks or buteos) and harriers, excepting the larger species known as eagles and old-world vultures—and Falconidae—falcons and caracaras. The most typical hawks, however, are the goshawks and their relatives in the genus *Accipiter*, with perhaps 44 species, and allied genera in the subfamily Accipitrinae. They are small or moderately large, with short wings, comparatively long legs and tail, beak curved directly from the cere and the upper beak edge wavy but not notched. The young are striped below but barred in the adult, and the female is considerably larger than the male. Most hawks nest in trees, but some, like the marsh hawks (*Circus*), nest on the ground in grassy places, while others nest on cliffs; the small falcons such as the American sparrow hawk, may use holes in trees, in which to breed. Others build crude nests of sticks and lay about three to six brown-spotted eggs.

Hawks pursue their prey by raking, or swiftly following its efforts to escape; occasionally destroying poultry and smaller birds, they usually eat small mammals, reptiles, insects and the like. On the whole, the great majority of hawks are more useful to the farmer than they are harmful, but there still is widespread prejudice against them; many farmers still call all hawks "hen hawks" and kill them without reason. Hawks have long been used in falconry (*q.v.*).

KARL H. MASLOWSKI

COOPER'S HAWK (ACCIPITER COOPERII)

The largest is the goshawk, about two feet long, while some of the smaller sparrow hawks, such as *A. minullus* of Africa and allied birds in South America, are but slightly larger than a thrush. Cooper's hawk (*A. cooperii*), of southern Canada and the United States, length 15–19 in., like the goshawk is well known to poultry raisers, as is the smaller (11–14 in.) sharp-shinned hawk (*A. striatus*), ranging over North America to the Mexican border, with allied races in Cuba, Hispaniola and Puerto Rico. The common Eurasian sparrow hawk (*A. nisus*) breeds from the limit of trees in Europe and Asia south to the Mediterranean and Himalayas. Other species occur in Central and South America, Africa and Madagascar, Asia, Australia, Malay Islands and nearby Pacific and Indian ocean.

See BUZZARD; CARACARA; EAGLE; FALCON; GOSHAWK; HARRIER; KITE; VULTURE. (G. F. Ss.; Ht. Fn.)

HAWKE, EDWARD HAWKE, BARON (1705–1781), British admiral, responsible for the naval victory over the French at Quiberon bay, was born in London in 1705 and entered the navy in 1720, rising to captain in 1734. During the War of the Austrian Succession he commanded the "Berwick" at the battle of Toulon in 1744, where his capture of the "Poder" was the only success in the action. As a result he was promoted to rear admiral and on Oct. 14, 1747, fought a brilliant action off Finistère in Brittany, where six out of eight warships escorting a French convoy were captured. For this action he was knighted.

During the interval before the outbreak of the Seven Years' War he was almost constantly at sea, so that although elected to parliament for Portsmouth from 1747 to 1776, he took little interest in political affairs. In 1756 he commanded the fleet in the channel until he was sent out to relieve Adm. John Byng in the Mediterranean. Hawke commanded the naval force in the unsuccessful expedition to Rochefort in 1757 and he also failed to intercept a French fleet which reached Brest that year. However, in 1759, his command of the channel fleet blockading Brest played a vital part in the conquest of Canada, by preventing reinforcements from reaching the marquis de Montcalm. As a counteroffensive the French determined to invade Great Britain, a force for that purpose being collected at Vannes in Brittany, which was to be escorted by the combined fleets from Toulon and Brest. The French fleet from Toulon was defeated by Adm. Edward Boscawen at Lagos in Portugal in August and the Brest fleet under Adm. H. de Conflans was defeated by Hawke at Quiberon bay on Nov. 20, 1759.

This action was the climax of the long and arduous close blockade of Brest which began in May 1759. Hawke commanded the best-maintained fleet seen before the days of Nelson—a total of some 30 ships being employed to maintain 20 on station. This was because of the amount of fresh food supplied on the advice of Dr. James Lind in order to prevent the usual outbreak of scurvy. In order to keep a close watch on the movements of the enemy, Hawke cruised off Ushant until he was forced into Torbay by southwesterly winds. On such occasions he left a force of frigates under Commodore Robert Duff on the coast to notify him if Conflans escaped before he himself was back on station. On Nov. 9 he was forced by stress of weather to run into Torbay. Before he could return, a French squadron reached Brest to tell Conflans that his way to the Morbihan, where the troops were to embark, was free. Conflans therefore left Brest with 21 ships and 5 frigates on Nov. 14, the same day that Hawke left Torbay. Having heard that the French were on their way south and east, Hawke crowded on all sail and caught up with their rear just as they were about to attack Duff's squadron off the Quiberon peninsula. At 9:45 A.M. on Nov. 20 Hawke gave the signal for a "general chase," to enable the fastest ships to get into action first. At 2:30 P.M., as Conflans was rounding Belle-Île to seek safety in Quiberon bay, Hawke's leading ships opened fire on the French rear. A hard-fought battle followed among the rocks and reefs of the bay until nightfall at 5:30 P.M. By the evening of Nov. 21 three French ships had been sunk, two, including the flagship, were aground and were later burned, seven had escaped over the bar of the Vilaine river, where four broke their backs, and the remainder had fled south. Two English ships were lost in the gale but all fear of invasion was now averted. "Had we had but two hours more daylight, the whole had been totally destroyed or taken," wrote Hawke. It was this battle, the climax of the year of victories, which inspired David Garrick's song "Hearts of Oak." (*See* QUIBERON BAY, BATTLE OF.)

Hawke served no more at sea. He was raised to the peerage in 1776 and was first lord of the admiralty from 1766 to 1771, but he was not a success as an administrator. He died at Sunbury on Oct. 17, 1781. As a tactician he was in the first class. It was he who instituted the system of close blockade and who did much to improve the manners and behaviour of sea officers by his example.

See M. Burrows, *Life of Hawke* (1883); J. S. Corbett, *England in the Seven Years' War* (1907); G. Marcus, *Quiberon Bay* (1960). (C. C. L.)

HAWKE'S BAY, a land district of New Zealand. It comprises the central portion of the east coast of North Island and

lies to the east of the axial mountain ranges. It is one of the finest hill sheep-farming regions of the country, with many prosperous estates running to thousands of acres. Trade and traffic converge on the small lowland on the southern side of Hawke's bay, where the neighbouring cities of Napier and Hastings have a joint population of more than 47,000 (1961). Napier is one of the main exporting ports of New Zealand, and Hastings is an important centre for fruit and vegetable canning, preserving and quick-freezing. (K. B. C.)

HAWKESWORTH, JOHN (*c.* 1715–1773), English writer of little education but considerable talent who succeeded Dr. Johnson in 1744 as compiler of parliamentary debates for the *Gentleman's Magazine*, to which he also contributed poems, and collaborated with him in founding the *Adventurer* (1752), in which he published articles. He was a close imitator of Johnson and joined the Rambler club, but his cocksureness alienated both Johnson and Reynolds. He also published Swift's works (1755), adapted plays for Garrick, wrote *Zimri*, an oratorio (1760), *Edgar and Emmeline*, a fairy play (1761) and *Almoran and Hamet* (1761), an oriental romance. His *An Account of the Voyages Undertaken in the Southern Hemisphere* . . . , chiefly those of Captain Cook (1773), undertaken for the admiralty, was criticized for inaccuracy and for failure to attribute escapes at sea to Providence. He died in London Nov. 16, 1773.

HAWKINS (HAWKYNS), **SIR JOHN** (1532–1595), English admiral, was born at Plymouth, the second son of William Hawkins, mayor of Plymouth, who represented the town in parliament and was a successful merchant in the African trade. John's elder brother, William, was also a merchant seaman and became mayor of Plymouth three times; it was owing to this family that Plymouth became the leading port in the west country. Other members of the family distinguished themselves at sea, notably their kinsman Francis Drake and John's son, Richard (*q.v.*).

John followed his father in the African trade, which he extended to the carrying of slaves between Guinea and Brazil or the West Indies. As the first English slave trader he aroused the hostility of the Portuguese, whose example he was following, and the Spanish, whose trade monopoly he infringed without licence. His first independent voyage to Hispaniola in 1562–63 on behalf of a syndicate of London merchants was so successful that a more important group (including the queen herself, who lent him a ship and permitted him to fly her standard) supported his second voyage in 1564–65. The narrative of this expedition introduced to English readers the potato and tobacco, and included Hawkins' famous advice to his men, "Serve God daily, love one another, preserve your victuals, beware of fire, and keep good company." His success led to the grant of a coat of arms with a "demi-Moor proper, bound" as his crest. His third voyage of 1567–68 ended disastrously. The queen again lent him the "Jesus" and another royal ship, while Drake commanded one of the four other ships. After selling his slaves in the Caribbean, Hawkins was forced by lack of water to take refuge at San Juan de Ulua, the port of Veracruz. After he had gained permission to enter, the Plate fleet arrived unexpectedly, bringing the governor of New Spain. They entered the harbour and made terms with Hawkins, but the Spaniards treacherously attacked the English ships, of which all were captured save two, Hawkins returning home in the "Minion" and Drake in the "Judith." This affair marks the beginning of the long quarrel with Spain which led to open war in 1585.

In 1570, probably at Lord Burghley's instigation, Hawkins offered his services to the king of Spain. Though he was never employed by Spain, he obtained evidence of the complicity of the duke of Norfolk to release Mary, queen of Scots, and overthrow Elizabeth I; he also secured the release of some of the prisoners taken at San Juan de Ulua. In 1571 he became M.P. for Plymouth. After his marriage (in about 1559) to Katherine, daughter of Benjamin Gonson, treasurer of the navy, Hawkins became connected with the administration of the navy board. In 1577 he succeeded his father-in-law as treasurer and in 1589 he also became comptroller, while his brother-in-law was clerk of the ships. He was chiefly responsible for rebuilding the 22 ships inherited by the queen, increasing the fleet to 25 in 1588, rearming it with more guns and encouraging the new and faster type of galleon typified by the "Revenge." He also improved the pay of seamen and was unusually attentive to their health. In 1590 he and Drake founded the Chatham Chest fund, and in 1592 he founded a hospital at Chatham for the relief of sick and aged mariners.

In the Armada campaign he commanded the "Victory" and was knighted by Lord Howard off the Isle of Wight on July 26, 1588. Afterward he was responsible for the only original strategic idea during the remainder of the war, the Azores blockade, by which it was hoped to intercept returning treasure fleets. The idea was in advance of the time and never succeeded in its object, though Hawkins himself sailed with Sir Martin Frobisher on one of the periodic cruises in 1590. In 1591 his first wife died and he married Margaret Vaughan.

His last voyage was in 1595, when he sailed with Drake and 27 ships on a raid on the Spanish West Indies. Their departure was delayed by a Spanish landing at Penzance and by dissensions between the commanders after they had put to sea. Warned of their intentions, the Spanish repulsed their attack on Puerto Rico. On Nov. 12, 1595, the night before the attack, Hawkins died after a short illness.

Hawkins was the leading naval administrator of his age, and though he had his detractors he was as honest as any public servant of that time. In his attacks on the Spanish monopoly he led the way for Drake and others. By his reconstruction of the nation's fleet he was the chief architect of the Elizabethan navy.

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HAWKINS, SIR JOHN (1719–1789), English lawyer and music historian, was born in London on March 30, 1719. He studied law, devoting his leisure to the study of music. A wealthy marriage in 1753 enabled him to indulge his passion for acquiring rare works of music. From 1761 he was a magistrate for Middlesex and was chairman of the quarter sessions from 1763 to 1778; he was knighted for these services in 1772. He died in London on May 21, 1789. Hawkin's great work was *The General History of the Science and Practice of Music* (1776). Its first publication coincided with the appearance of the first volume of Charles Burney's history, and the relative merits of the two works were eagerly contested by contemporary critics. In his own day Burney's work seems to have been favoured, but with the passage of time the two histories came to be seen as complementary sources of information (*see* also BURNEY, CHARLES). Hawkins also wrote a life of Samuel Johnson (like Burney, he was a member of the Johnsonian circle) and published editions of Izaak Walton's *The Compleat Angler*.

See P. A. Scholes, *The Life and Activities of Sir John Hawkins* (1953). (Cs. CH.)

HAWKINS (HAWKYNS), **SIR RICHARD** (*c.* 1560–1622), English seaman, was the only son of Sir John Hawkins (*q.v.*) by his first marriage. In 1582 he sailed with his uncle William to the West Indies, and in 1585 he commanded a ship on Sir Francis Drake's raid on the Spanish Main. In the Armada campaign he was captain of the royal ship "Swallow" and afterward built a ship of about 300 tons named "Repentance," renamed the "Dainty." Not till 1593 was he able to use her for his own purposes on an intended voyage round the world, following the examples of Drake and Thomas Cavendish.

In June 1593 he sailed from Plymouth in her with two smaller vessels which parted company before reaching the Pacific. In Feb. 1594 he sighted what he called Hawkins Maidenland, probably the Falkland Islands, which had been discovered two years previously by John Davis. After burning four ships at Valparaiso, Hawkins continued up the coast until he met six Spanish warships off Callao. He overcame them; but on June 22, when north of Paita, he was wounded and forced to surrender after a fight lasting three days with two more Spanish ships. He was imprisoned at Lima and then from 1597 till 1602 in Spain, at which date his ransom of £3,000 was paid. On his return he was knighted and

elected mayor and M.P. for Plymouth. In 1608, after five years as vice-admiral of Devon, he was arrested and fined for condoning piracy. In 1620 he sailed as second in command of Sir Robert Mansell's ineffective expedition against the Algerine corsairs. He died in London on April 18, 1622.

His *Observations in His Voyage Into the South Sea* was printed that year, having been composed about 1603. This gives the best extant idea of Elizabethan life at sea and was used by Charles Kingsley for *Westward Ho!*

See Richard Hawkins, *Observations . . .*, ed. by C. R. D. Bethune, Hakluyt Society (1847), ed. by C. R. Markham, Hakluyt Society (1878), ed. by J. A. Williamson (1933); *Monson's Tracts*, ed. by M. Oppenheim (1913). (C. C. L.)

HAWKSHAW, SIR JOHN (1811–1891), English consulting engineer among whose most notable works were the Charing Cross and Cannon Street railways, with their bridges over the river Thames, and the East London railway which utilized I. K. Brunel's old Thames tunnel, was born in Yorkshire in 1811. In 1845 he became chief engineer of the Manchester and Leeds railway, and in 1850 he set up as a consulting engineer in London. With Sir J. Wolfe Barry he constructed that section of the underground District railway completing the "inner circle" between the Aldgate and Mansion House stations. He designed the bridge over the river Narmada in India and in 1862 became the engineer for the Amsterdam ship canal. The following year he reported on the site for the Suez canal in favour of Ferdinand Marie de Lesseps' plan. As a member of the international congress in 1879 considering the construction of an interocean canal across central America, he preferred the Nicaraguan route, considering the Panama plan too costly. In 1872 he was appointed consulting engineer for the tunnel under the river Severn, his last great work. Hawkshaw was elected a fellow of the Royal society in 1855 and was knighted in 1873. He died in London on June 2, 1891.

(T. M. S.)

HAWKSMOOR, NICHOLAS (1661–1736), English architect, was the most important pupil of Sir Christopher Wren and with Wren and Sir John Vanbrugh was among the major baroque designers in England. Hawksmoor was born in Nottinghamshire in 1661. He was Wren's personal clerk and later held several official posts under him, including those of draftsman at St. Paul's cathedral, clerk of works at Kensington palace, where King William III's gallery and orangery are attributable to him, and clerk of works (afterward assistant surveyor) at Greenwich hospital, where he designed the greater part of the King William and Queen Anne blocks.

He assisted, and later succeeded, Vanbrugh in designing and supervising the building of Castle Howard (from 1699) and Blenheim palace (from 1705). Easton Neston, Northamptonshire, begun about 1695, his first large independent work, shows a personal, romantic style and an exceptional freedom—but thorough familiarity—with Renaissance vocabulary. As one of the two surveyors to the 1711 commission for new London churches, he realized several of his own designs, notably St. Anne's, Limehouse; Christ church, Spitalfields; and St. George's, Bloomsbury. These show most clearly his variety of invention and his sense of enormous mass and of evocative abstract ornament. He designed the north quadrangle of All Souls, Oxford (with a classical interior), and the towers of Westminster abbey in picturesque Gothic. He was a prolific and sensitive draftsman and an engaging correspondent, notably in the letters concerning his last work, the mausoleum at Castle Howard. Changes in architectural taste, however, allowed him little influence. He died in London on March 25, 1736.

See K. Downes, *Hawksmoor* (1959). (K. Do.)

HAWKWEED, the name given to species of the genus *Hieracium*, of the family Compositae (*q.v.*), containing an enormous number of species inhabiting the northern hemisphere, south Africa and the Andes. The flowering heads, often yellow, are borne, often several at a time, on an elongated axis. Various hawkweeds are serious pests, especially in rundown grasslands.

Hundreds of species occur in the British Isles, and more than 40 are found in North America, including several from the old world. Of the latter, the orange hawkweed or devil's-paintbrush (*H. aurantiacum*) of Europe, the field hawkweed (*H. pratense*), king devil hawkweed (*H. florentinum*) and mouse-ear hawkweed (*H. pilosella*) are pestiferous in pastures and meadows. Once established, the perennials are almost ineradicable, but the annuals can be eliminated by mowing before flowering. (N. Tr.)

HAWKWOOD, SIR JOHN (*c.* 1320–1394), English soldier who became the leading *condottiere* of Italy. Nothing is known for certain of his early circumstances, save that his father, a tanner, lived at Sible Hedingham, Essex. He served in the French wars of Edward III and may have attained knighthood. After the preliminary peace of Brétigny (1360) he became leader of a free company, with which he was campaigning in Italy by late 1363 as captain general of Pisa. Thereafter he fought in the major wars of Italy as a mercenary captain for nearly 30 years. Using methods developed by the English in France, he gained renown especially for the rapidity of his movements, his handling of infantry and the firm discipline and well-maintained equipment of his troops. He served the Visconti of Milan and Pope Gregory XI. From 1378 to 1392 he was at the head of his profession as captain general of Florence, seeking employment elsewhere when the republic did not need his services. Hawkwood received credentials from King Richard II of England as member of a mission to Florence and Naples in 1385. He was paid enormous sums by the Italian powers, but seems to have saved little. He acquired lands in Romagna, but sold them and bought estates near Florence. Florentine citizenship was conferred on him and his male descendants in 1391. When over 70 years of age he decided to return to England and sold his properties, but died at Florence on March 16–17, 1394, before he could accomplish his design. The Florentines accorded him a civic funeral, but in 1395 permitted his body to be taken to England for burial. A large equestrian portrait of Hawkwood, commissioned for the inner façade of the cathedral of Florence, was repainted by Paolo Uccello in 1436.

See J. Temple-Leader and G. Marcotti, *Sir John Hawkwood*, Eng. trans. by L. Scott (1889); F. Gaupp, "The Condottiere John Hawkwood," *History*, new series vol. xxiii (1938–39). (D. M. B. de M.)

HAWORTH, SIR WALTER NORMAN (1883–1950), British organic chemist, sharer with Paul Karrer of the 1937 Nobel prize in chemistry for his work on carbohydrates and vitamin C, was born on March 19, 1883, at Chorley, Lancashire, Eng. A graduate of Owens college, Manchester, he received his Ph.D. at Göttingen. From 1911 to 1948 Haworth held positions at the Imperial college, London, at St. Andrews university, at Kings college, Newcastle (1920–25), and the directorship of the chemistry department at Birmingham university (1925–48). With W. H. Perkin, Jr., and Otto Wallach he investigated terpenes. Associated with T. Purdie and J. C. Irvine at St. Andrews, he turned to carbohydrates. By 1928 he had decided the constitution of maltose, cellobiose, lactose, gentiobiose, melibiose, gentianose, raffinose and the ring structures of glucosides of normal sugars. Examination of polysaccharides settled the basic features of the starch, cellulose, inulin and xylan molecules. In 1932 Haworth developed a method to ascertain the chain lengths in methylated polysaccharides, an important structural problem. In 1934, with E. L. Hirst, Haworth announced the first laboratory synthesis of a vitamin, ascorbic acid, so that less expensive commercial production was made possible. Later work led to further co-ordination of chemistry, physics and biological problems related to bacterial polysaccharides. His book *The Constitution of Sugars* (1929) is a classic. From 1945 he served on the committee for advances in carbohydrate chemistry. He became a fellow of the Royal society in 1928. Recipient of the Longstaff, Davy and royal medals, he was knighted in 1947 after war service as chairman of a general research board. Retired in 1948, he died at Birmingham, March 19, 1950. (V. Bw.)

HAWORTH, a stone-built village of worsted workers and the name of a former urban district in the West Riding of Yorkshire, Eng., lies on the declivity of a moorland salient overlooking the river Worth. The village is now in the borough of Keighley. Ecclesiastically, before 1864 it was a chapelry under Bradford, and to this minor cure in 1820 the Rev. Patrick Brontë brought his wife and six children including Charlotte, Emily and Anne. At the top of the town the church of St. Michael—thrice rebuilt, but with

an old tower—contains memorials to all the family. The adjacent parsonage (1779) was given in 1928 by Sir James Roberts to the Brontë society as a home for the society's museum, established in 1895: the personal and literary relics housed there include the Bonnell collection from the U.S. Among neighbouring places recognizable in the novels are Wuthering Heights (High, or Top, Withens), a derelict farmstead 1,450 ft. up on Haworth moor; Thrushcross Grange (Ponden hall), which now overlooks Ponden reservoir, 1 mi. W.; and Ferndean Manor (Wycoller hall), now maintained by Colne municipal corporation, 2 mi. farther on, beyond the Lancashire boundary.

See also BRONTË, CHARLOTTE, EMILY AND ANNE.

(C. K. C. A.)

HAWTHORN is a shrub or tree of the genus *Crataegus*, of the rose family (Rosaceae; *q.v.*), overwhelmingly North American, but known also in Europe, north Africa and Asia Minor. They are unknown south of the equator. In eastern North America there are over 100 species; some estimate the number as nearer 900.

Hawthorns comprise a prolific group of thorny shrubs and trees with alternate, simple leaves, nearly always toothed or lobed. The flowers are white or pink, usually borne in clusters (corymbs), rarely solitary, and followed by often showy, red, blue or black fruits suggesting a miniature apple, containing bony nutlets or stones. All have hard wood, hence the name *Crataegus*, from the Greek *kratos*, "strong."

The use of the hawthorn as a boundary for fields certainly dates from Roman times, but its use as a pleached hedge appears to have been since about the end of the 17th century. Annual pruning, to which the hawthorn is particularly amenable, is necessary if the hedge is to maintain its compactness and sturdiness. When the lower part shows a tendency to go bare, the strong stems may be split, bent over and pegged to the ground, so that new growths may start.

J. HORACE MCFARLAND CO.

RED HAW (CRATAEGUS MOLLIS)

The tree is particularly suited to the common practice of ditching and hedging as it thrives on the earth thrown up from the ditch. The combination of sturdy twigs, hard wood and many thorns makes a formidable barrier to cattle and hogs. It is seldom used for this purpose in America.

In Great Britain the name hawthorn is confined to two species: *C. oxyacantha* (or *oxyacanthoides*) and *C. monogyna*, both also called may, hedgerow thorn and whitethorn. They differ in that there is only one stone in the fruit of *C. monogyna*, but two in the fruit of *C. oxyacantha*. The fruit of both are commonly known as haws. Often they are not distinguished as different species because their superficial resemblance is striking.

Both have deeply lobed leaves, many thorns, white or pinkish flowers in May and rather persistent and profuse red fruit. Normally they would be medium sized (15–25 ft.), round-headed trees, but their wide use for hedges and frequent pruning make of them close twigged, practically impenetrable barriers, especially *C. monogyna* which is preferred for hedges.

Hawthorn flowers emit the faint odour of decayed fish as a result of the plant's mixture of coumarin and aminoid compound. Many legends among rustics warn against bringing flowering branches of hawthorn into their houses as it was supposed to portend death in the family. More factual is the avoidance of hawthorn by bees and butterflies, so that the plant is pollinated only by flies.

The cultivation of hawthorns for ornament is extensive in the United States, where the finest collections in the world will be found in the Genesee Valley park at Rochester, N.Y., and at the Arnold arboretum of Harvard university at Jamaica Plain, Mass.

The outstanding species for cultivation, outside the English hawthorn, either for their showy flowers or for their spectacular, often persistent, coloured fruit or both, are the following: the Washington thorn (*C. phaenopyrum*), a tree from the southeastern U.S. with red fruit; the pear haw (*C. calpodendron*), a shrub from eastern North America with orange-red fruit; the cockspur thorn (*C. crus-galli*), a shrubby tree of eastern North America with red fruit; *Crataegus lavallei*, a hybrid hawthorn whose brick-red fruits persist throughout the winter; *Crataegus arnoldiana*, a tree up to 30 ft. high with pear-shaped red fruit, native from Massachusetts to New York; and the red haw (*C. mollis*), a tree from the central U.S. with scarlet fruit one inch thick.

(N. TR.)

HAWTHORNE, NATHANIEL (1804–1864), one of the greatest fiction writers in American literature, was born in Salem, Mass., on July 4, 1804. His earliest American ancestor, William Hathorne (the *w* was added by Nathaniel himself when he was in college), came from England to Massachusetts Bay colony with John Winthrop in 1630. Later, as a magistrate in Salem, he ordered the public whipping of a Quakeress. William's son John was one of the three judges (the other two being Samuel Sewall and William Stoughton) in the Salem witch trials in 1692. Nathaniel was sensitively aware of the prominence of these 17th-century ancestors, and wondered if the decline of his family's fortunes (his immediate forebears had followed the sea with indifferent success; his father had died in a faraway port when Nathaniel was four years old) might be a retribution for their crimes. Nathaniel's boyhood was spent in Salem and in Maine, near Lake Sebago, where he enjoyed outdoor sports. He attended Bowdoin college, at Brunswick, Me., and was graduated in the class of 1825. Three fellow collegians became his lifelong friends: Franklin Pierce, 14th president of the United States, belonged to the class just before him; Horatio Bridge, commodore in the United States navy, and Henry Wadsworth Longfellow, the poet, were of his own class.

After college, Hawthorne returned to his mother's home in Salem, and devoted himself closely to mastering the craft of fiction. He read much and wrote much. Being his own severest critic, he destroyed much of what he wrote. After publishing a rather undistinguished "college novel," *Fanshawe* (1828), he happily hit upon the short tale as a distinctive métier.

His tales were published first in various periodicals, and later collected in book form. *Twice-Told Tales*, his first collection, appeared in 1837; a second, enlarged edition appeared in 1842. Since these volumes brought their author more fame than money (the 1842 *Tales* was highly praised by Poe), he held a job in 1839–40 in the Boston customhouse to eke out his income, and for six months in 1841 he was a resident at Brook Farm (*q.v.*). Meanwhile he had met (in 1839) and fallen in love with Sophia Peabody (one of the three famous "Peabody sisters"), and she with him, and after their marriage on July 9, 1842, they went to the "Old Manse" in Concord, Mass., to live. Their life together during the three and one-half years at the Old Manse, as recorded in Hawthorne's *American Notebooks* and his essay "The Old Manse," is a famous marital idyl of American literature.

In Concord, Hawthorne saw a good deal of his neighbours, Ralph Waldo Emerson and Henry David Thoreau; he welcomed their companionship while rejecting their transcendentalism. At the Old Manse, too, he returned to the writing of tales, with the same result as before: literary success, monetary failure. *Mosses From an Old Manse*, a new collection, appeared in 1846. Not being able to pay his rent, however, he with his wife and daughter, late in 1845, had moved to his mother's house in Salem. In 1846 he received from the Polk administration (he had always been a loyal member of the Democratic party and he had pulled all the political strings he possibly could to get this appointment) a position in the Salem customhouse. Three years later he was turned out of office when the Whigs came into power under Zachary Taylor.

Hawthorne was very angry (especially at the local bigwig Charles Wentworth Upham, whom he was to lampoon recognizably in the character of Judge Pyncheon in *The House of the Seven Gables*), and appealed to influential friends in the effort to force his reinstatement, making the point that literary men were traditionally entitled to sinecures from government; but the spoils system was already firmly established. Hawthorne later saw his dismissal as

a great blessing ("Thank God for my enemies," he said), for in the gloom of his disappointment and chagrin he had sat down to write *The Scarlet Letter*. The book, which appeared in 1850, made him famous. It was eventually to be recognized as probably the greatest of American novels.

The sharp local references in "The Custom House," the introductory essay to *The Scarlet Letter*, made Hawthorne *persona non grata* in Salem, and, looking westward for a change of air, he and his family settled in "the little red house" near Lenox, overlooking the Stockbridge Bowl in the Berkshires. There Hawthorne wrote *The House of the Seven Gables*, a sombre study in heredity, which appeared in 1851. And there he enjoyed the stimulating friendship of Herman Melville, who lived in nearby Pittsfield. This relationship was one of the most fortunate in American literature; each encouraged and stimulated the other. Melville wrote an enthusiastic essay, "Hawthorne and His Mosses," in praise of Hawthorne, and was undoubtedly influenced by Hawthorne's work at many points; the similarity between "Ethan Brand" and *Moby Dick* (which appeared in 1851, with a dedication to Hawthorne) is only one instance of Melville's indebtedness. Hawthorne, being 15 years Melville's senior, was less susceptible to influence; but his admiration for Melville and his work was very great.

These two writers at least confirmed each other in the opinion that the romantic, progressive 19th century took much too rose coloured a view of the human condition; that the Emersonian optimism so dominant in the century was premature; that a balanced view of man even in the new world (the essential human condition being indeed the same in the new world as in the old, since the mere expedient of removing to a new continent could hardly be expected to make sinful man sinless) would have to include somewhere along the line something approximating Jonathan Edwards' notion of "original sin." Hawthorne and Melville (patriotic, democratic Americans that they were) would stand together on some such proposition as this in an American world which seemed to believe that Americans could do no wrong.

Late in the autumn of 1851 the Hawthornes—Nathaniel, Sophia, Una (born in 1844), Julian (born in 1846) and Rose (born in 1851)—returned to eastern Massachusetts (Hawthorne had always preferred ocean to mountains), and settled for the winter at West Newton. There Hawthorne wrote *The Blithedale Romance*, a study of a socialist community based upon his residence at Brook Farm. In the spring of 1852 he purchased "The Wayside" in Concord. There, Franklin Pierce having been nominated for the presidency by the Democrats, he loyally wrote a campaign biography, and after Pierce's election he accepted, in 1853, the lucrative appointment, generously bestowed by Pierce, to the consulship at Liverpool.

The Hawthornes were in England from 1853 to 1857, Hawthorne resigning his post at the end of Pierce's administration. He performed his consular duties faithfully and efficiently, and at the same time found leisure for much travel and sight-seeing, the rich record of which can be read in his *English Notebooks*. Nearly two years (1858–59) were spent in Italy—in Rome and in Florence—and there again he recorded in a voluminous journal his acute observations (*see* his *Italian Notebooks*). In the autumn of 1859 the Hawthornes returned to England, where, at Redcar on the German ocean and later at Leamington, Hawthorne wrote *The Marble Faun*, his last completed novel and his most earnest study of the problem of good and evil. The book appeared early in 1860, being published simultaneously in London and in Boston; in London it was given the title *Transformation*, and it has remained so known and referred to among the English. In June of the same year, the Hawthornes returned to America and settled at The Wayside, after an absence of nearly seven years. The residence abroad had been rewarding. Hawthorne had seen the places he had always longed to see; he had studied sympathetically sculpture, painting and architecture; he had stored up impressions. One sorrow, however, darkened both retrospect and prospect: Una had nearly died of the fever in Rome, and though improved, did not completely recover upon her return to America.

Mrs. Hawthorne believed that her husband's failing health, noticeable upon their return, was the result of anxiety for Una, and also of some deep-seated Roman infection which he himself had contracted. Whatever the reason, Hawthorne's health after 1860 failed rapidly and mysteriously. He managed to salvage some of the material of the English journals (he had incorporated a good deal of the Italian journals in *The Marble Faun*) in a series of essays published in the *Atlantic Monthly* and later collected under the nostalgic title *Our Old Home*. But his attempts at imaginative literature proved less successful. He filled hundreds of manuscript pages with drafts of stories, but the old skill seemed to have deserted him. *Septimius Felton* and *Dr. Grimshawe's Secret*, published posthumously, were fragmentary and inferior to their author's best work.

In 1862 Hawthorne visited Washington and the battlefields of northern Virginia, and wrote for the *Atlantic* an article entitled "Chiefly About War Matters," which is remarkable for its contemporary portrait of Lincoln. The dedication of *Our Old Home*, in 1863, to Pierce, who was sympathetic with the Southern side of the war, caused a flurry of protest around Boston. But Hawthorne, while loyal to the North, insisted that the dedication was a fitting and deserved compliment to his friend. "If Pierce is so exceedingly unpopular," he told his publisher, James T. Fields, "there is so much the more need that an old friend should stand by him." He died in his sleep on May 19, 1864, at Plymouth, N.H., where, accompanied by the faithful Pierce, he had stopped overnight, en route to the White mountains. Longfellow's poem "Hawthorne," written soon after the burial in Concord, spoke of his friend's "wand of magic power."

Hawthorne's high rank among American fiction writers, and indeed among the fiction writers of the world, is the result of at least three considerations, which can be particularized with some definiteness.

First, he was a skilful craftsman. He had an architectonic sense, a sense of form. (Henry James was to resemble him in this respect.) The structure of *The Scarlet Letter* is tightly integrated. It has a beginning, middle and end. No chapter, no paragraph, no sentence even, could be omitted without doing violence to the whole. The four characters—Hester Prynne, Arthur Dimmesdale, Roger Chillingworth and little Pearl—are inextricably bound together in the tangled web of a life situation which seems to have no solution. The calculated use of the "scaffold" in three crucial scenes (at the beginning, middle and end) gives unity of place. The tightly woven plot gives unity of action—an action which rises slowly but inexorably to the climactic scene of Arthur's public confession. The same structural virtue is found in Hawthorne's other writings also, especially in the shorter pieces or "tales."

Hawthorne not only had a sense of structure, he had a sense of style. His was the older classic, literary style, but one remarkable nevertheless for its directness, its clarity, its firmness and its sureness of idiom. Fields tells us that when, on occasion, he queried some phrase in a manuscript, Hawthorne could always point to a precedent in the King James Bible. And indeed there is in Hawthorne that infallible rightness of language which is a mark of literary greatness. The great writer must first of all be master of the word, master of *le mot juste*. This is a truth learned later from Henry James and T. S. Eliot, and it is important to give to Hawthorne his rightful place as their predecessor in this tradition.

A second reason for Hawthorne's greatness is his moral insight. He inherited the Puritan tradition of moral earnestness; he was concerned everywhere with what the theologians would call "original sin." But it should be noted that the background of Hawthorne's religious attitudes is not confined to New England Puritanism; it reaches to pre-Reformation times, and can be regarded in certain basic respects as essentially Catholic. As for New England Puritanism, he was critical of its narrowness, intolerance and cruelty. A story like "The Maypole of Merrymount" is just as critical of the bigoted zealots as of the wanton revelers. Hawthorne's general position can more properly be called Christian than Puritan.

Hawthorne was deeply involved in the perennial debate concerning the nature of man. In his own century there was a strong "romantic" current of thought which insisted that man is innately good. This view stemmed from Rousseau, and its chief proponent

in American literature was Emerson. "Trust thyself," proclaimed Emerson. Hawthorne was not unresponsive to the romantic fascination. His treatment of Hester in *The Scarlet Letter* shows a latent sympathy. Hester is a splendid self-reliant heroine. She is never truly repentant for the act of adultery committed with the minister. She never quite understands the minister's agony of conscience. "What we did," she says to Arthur, "had a consecration of its own." When she meets the minister at the brookside, she tears the scarlet letter from the bosom of her dress and casts it on the ground. This casting aside of the letter was Hester's "romantic revolt." The action of the story at this point seems to suggest that there is much to be said for Hester's position. It is the kind of action which might have been applauded by great 19th-century romantics like Byron or Browning.

But there is more to be said, the story seems to say, for the claims of law and conscience. Arthur speaks of "the law we broke." Hester redons the letter, at the insistence of the child Pearl. The lovers do not elope, as Hester planned, but instead Arthur, in the profoundly moving climactic scene, mounts the scaffold, speaks his confession to the assembled parishioners and dies with a smile on his lips and Pearl's hand in his own. There is no "romantic escape" here; rather, a firm and resolute facing (heartily approved, incidentally, by 20th-century psychologists) of the psychological and moral facts of the human condition.

All of Hawthorne's fiction shows pride as the great besetting sin, whether it is the intellectual pride of Ethan Brand or the reforming zeal of Hollingsworth in *The Blithedale Romance* or the arrogation to oneself of godlike power, as in the case of Aylmer in "The Birthmark," or a selfish concern for one's reputation, as with Arthur Dimmesdale who played the hypocrite in his Puritan parish for seven years. Man is a fallible, imperfect being in Hawthorne's stories. He is isolated from his fellows by his endless self-involvement; one of his most memorable tales is appropriately entitled "Egotism, or the Bosom Serpent." Man can be "saved" only through humility, only through the surrender of the proud, stubborn individual will to the divine will. Man finds his life only through losing it. Humility (not the vain-boasting "Trust thyself") is the best solvent, the true equalizer in human relations. The tales and novels of Hawthorne embody these truths in enduring dramatic situations.

A third reason for Hawthorne's eminence is his mastery of allegory and symbolism. The allegorical method was depreciated in Hawthorne's own century, but the critics of the 20th century have recognized its merit. All great fables, in a sense, are allegories. Symbols enlarge and deepen the meaning. Hawthorne's symbolism is especially successful in *The Scarlet Letter*. Places, characters and incidents take on larger meanings. The scaffold stands for punishment at the beginning and for expiation at the end. The forest is a place where one goes morally astray. The scarlet letter itself stands for adultery; but more than that, for any sin; and still further, as its scope enlarges more and more, for all faults and limitations which prevent the happy working of human society. The fall of man in Hawthorne, however, is the "fortunate fall." Through sin and suffering, man achieves a depth and wisdom not otherwise attainable. Adam fell, these remarkable fictions seem to say, that we might ultimately rise to a loftier paradise than his.

The craftsmanship, the moral insight, the intensification of symbol—these have recommended Hawthorne's work with special cogency to readers of the mid-20th century and after. The dangers and tensions of the modern atomic, anxious age seem reflected almost clairvoyantly in his symbolic depths.

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(R. ST.)

HAWTHORNE, an industrial community of Los Angeles county, Calif., U.S., about 10 mi. S.W. of Los Angeles, was founded in 1906 by B. L. Harding and H. D. Lombard and named by the Harding family in honour of Nathaniel Hawthorne. Its earlier economy centred around a series of small factories producing furniture, clothing and leather goods. Hawthorne grew very slowly for 30 years, being incorporated in 1922 and changing to a council–manager government in 1948.

Stimulated by aircraft construction during World War II, the population tripled in the decade ending 1960. This sudden increase in population, of mixed racial and economic status, brought housing and land-use problems, and considerable delinquency. A unique arrangement with school and county officials resulted in establishment of improved recreational facilities. With over half the city budget devoted to improvement of civic and recreational facilities Hawthorne made rapid progress toward developing a balanced industrial and residential city.

For comparative population figures *see* table in CALIFORNIA: *Population*.

(R. C. GM.)

HAXO, FRANÇOIS NICOLAS BENOÎT, BARON (1774–1838), French military engineer of the Revolutionary and Napoleonic wars who lived to win recognition as "the premier engineer of Europe" in Louis Philippe's reign, was born at Lunéville, in Lorraine, on June 24, 1774, the son of a lawyer. In 1793 he passed into the miners, a lesser branch of the French artillery. Made captain of engineers in April 1794, he served before Mainz and Mannheim. Since the regular engineers trained at Mézières could not approve of him, Lazare Carnot sent him in 1796 to a course at the École Polytechnique. In 1800 Haxo gained experience in northern Italy, at Peschiera in particular; and in 1807 he was attached to the mission for the defense of Constantinople and the Dardanelles. In 1808, as chief engineer of one of the new corps for Spain, he took part in the siege of Saragossa, where his activity and talent were seen by leading engineers. The sieges of Lérida and Tortosa increased his reputation, and at last he was made general in June 1810.

Haxo was made aide-de-camp to Napoleon and created a baron in 1811. In 1812 he was chief engineer to L. N. Davout's corps in Russia and, from December, general of division. Sent to study the Bohemian frontier, he was with Gen. D. Vandamme's corps when he was captured in the battle of Kulm (Aug. 30, 1813). He and Vandamme never agreed as to the responsibility for the disaster.

Chief engineer of the army which fought at Waterloo, Haxo was afterward one of the commissioners who tried to obtain terms for the army's submission to Louis XVIII. His service was not interrupted for long after the Bourbon Restoration, and he had many years of responsible duty as inspector general of fortifications. Under Louis Philippe he became Marshal Maurice Gérard's chief engineer in Belgium in Aug. 1831, and his capture of Antwerp citadel in 24 days (Dec. 1832) was a technical achievement which won him a European reputation. He inspired the rejuvenation of the French frontier defenses and the great works at Paris and Lyons, but could not complete them before he died in Paris on June 25, 1838.

(I. D. E.)

HAY, SIR GILBERT (SIR GILBERT [OF] THE HAYE) (fl. 1456), Scottish translator of works from the French whose prose translations are the earliest extant examples of literary Scots prose. He probably belonged to the family of the Hays of Errol, and if he was the "Gylbertus Hay" named in the registers of St. Andrews university in 1418 and 1419, must have been born about 1403. That he received degrees as a master of arts and as bachelor in decrees, that he became a knight and that he was at some time chamberlain to the king of France (Charles VII) are facts known from his own description of himself at the beginning of the manuscript of his prose translations; he is known to have been in France by 1432. By 1456 he had returned to Scotland and had entered the service of the earl of Orkney and Caithness, at whose request

he began in that year the translation of three of the most popular works of the middle ages: Honoré Bonet's *L'Arbre des Batailles* (as *The Buke of the Law of Armys* or *Buke of Bataillis*); *Le Livre de l'ordre de chevalerie*, a French version of Raimon Lull's *Libre de cavayleria* (as *The Buke of the Order of Knichthood*); and *Le Gouvernement des Princes*, a French version of the pseudo-Aristotelian *Secreta secretorum* (as *The Buke of the Governaunce of Princes*). The second of these precedes William Caxton's translation by at least ten years. These remained in manuscript until found in Sir Walter Scott's library at Abbotsford and edited for the Abbotsford club by D. Laing in 1847. An edition for the Scottish Text society (2 vol., 1901–14) by J. H. Stevenson has an introduction containing all that is known of Hay's life.

By 1456 he must have become a priest, for the earl's father-in-law, in a will dated then, left him instructions to say ten psalters for his soul. He was apparently still alive in 1499.

Hay is named as a poet in William Dunbar's *Timor mortis conturbat me* and by Sir David Lyndsay in his *Testament and Complaynt of the Papyngo*. His only extant poetical work, *The Buik of Alexander the Conqueror*, is a translation of the French *Roman d'Alexandre*. It is in heroic couplets and a portion remains in a manuscript copy at Taymouth castle; extracts were printed by A. Herrmann in 1898. This shows interesting differences in treatment from other versions and, like his prose, a thorough knowledge of French, and vigour in the use of his own language.

HAY, JOHN MILTON (1838–1905), U.S. statesman and author best known for his activities as secretary of state under Presidents William McKinley and Theodore Roosevelt, was born at Salem, Ind., on Oct. 8, 1838. He graduated from Brown university in 1858, then studied law in Springfield, Ill., in a law office next to that of Abraham Lincoln, and was admitted to the bar on Feb. 4, 1861. A week later Hay went to Washington with Lincoln as an assistant private secretary. He served in this capacity along with John George Nicolay until President Lincoln's death in 1865.

Hay was secretary of the U.S. legation at Paris in 1865–67, chargé d'affaires at Vienna in 1867–68 and secretary at Madrid in 1869–70. After his return to the United States he was for five years an editorial writer on the *New York Tribune;* in 1879–81 he was in government service again as assistant secretary of state. Upon the inauguration of Pres. William McKinley in 1897 Hay was appointed ambassador to Great Britain, from which post he was transferred in 1898 to that of secretary of state. He remained in this office until his death at Newburg, N.H., on July 1, 1905.

Hay's tenure as secretary of state came at a turning point in the history of American diplomacy—the era when the United States emerged as a great power in the world. He helped negotiate the peace with Spain after the war of 1898, forwarding to the peace conference in Paris the decision of McKinley that the United States would keep the Philippine Islands—the most momentous result of the war. He managed the settlement of difficulties with Germany over Samoa in 1899 and in the same year persuaded McKinley that the United States should champion equal trading rights for all nations in China. Hay's first open-door note of 1899 was followed by a novel proposal (the second open-door note) to the great powers in 1900, in the midst of the Boxer rebellion, that the nations should preserve China's territorial and administrative integrity. Hay in 1903 assisted Pres. Theodore Roosevelt in the diplomatic maneuvers that led to the independence of Panama and the construction of the Panama canal. Previously he had arranged with the British ambassador in Washington, Lord Pauncefote, the Hay-Pauncefote treaty of 1901, which abrogated the Clayton-Bulwer treaty of 1850 and looked toward construction of the canal by the U.S. He arranged an agreement over the Alaska boundary through a joint Anglo-American commission in 1903.

Throughout his life Hay found time for literary composition, and his *Pike County Ballads* (1871) and *The Bread-Winners* (1883) were well received. His *Abraham Lincoln: a History* (1890), written with John G. Nicolay, was for years the standard account of Lincoln's life. The Nicolay and Hay edition of Lincoln's *Complete Works* (1894) has since been superseded by Roy P. Basler's *Collected Works of Abraham Lincoln* (1953).

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HAY, OLIVER PERRY (1846–1930), U.S. paleontologist and author of many valuable works on fossil vertebrates, was born in Saluda, Ind., May 22, 1846. He was graduated from Eureka college, Ill., in 1870 and joined the college faculty as professor of natural sciences in the same year. He held the same position at Oskaloosa college, Ia., from 1874 to 1876 and at Abingdon college, Ill., from 1877 to 1878. In 1879 he became professor of biology and geology at Butler university, Indianapolis, Ind., where he remained until 1892. He served as assistant curator of zoology at the Field Museum of Natural History in Chicago from 1895 to 1897 and subsequently went to the American Museum of Natural History in New York where he worked from 1901 to 1907, serving first as assistant and later as associate curator. He was employed by the Carnegie institution, Washington, D.C., where he did research on the history of the vertebrates of the Pleistocene epoch in North America, from 1912 until his retirement in 1926. He was also employed during his lifetime as assistant in the geological surveys of Arkansas (1884–88), Indiana (1891–94 and 1911–12) and Iowa (1911–13). He died in Washington, D.C., Nov. 2, 1930.

Among Hay's works on various phases of vertebrate paleontology the following are outstanding: *The Bibliography and Catalogue of the Fossil Vertebrata of North America* (1902); *The Fossil Turtles of North America* (1908); *Pleistocene Period in Indiana and its Vertebrates* (1912); *Pleistocene Mammals of Iowa* (1914); and a three-volume study of the vertebrates of the Pleistocene epoch in North America (east of the Mississippi river, 1923; the middle region, 1924; the western region, 1927). In 1929–30 Hay published the two volumes of his *Second Bibliography and Catalogue of the Fossil Vertebrata of North America,* and it is for this work and his earlier bibliography and catalogue that he is most noted.

HAY (Y GELLI), once known as Welsh Hay but now as Hay-on-Wye, is a market town and urban district of Brecknockshire, Wales, 16 mi. N.E. of Brecon by road. Pop. (1961) 1,321. It occupies the slopes of a hill on the south bank of the Wye, which there separates Brecknockshire and Radnorshire and immediately below enters Herefordshire, from which Hay is separated by a small brook. There are scattered remains of the old town walls and, on the summit of the hill, the tower and gateway of the castle, which was probably built in the reign of William Rufus. On the riverside is the Warren, the public park. The town and the magnificent range of the Black mountains behind it to the south form part of the Brecon Beacons National park. Hay lies in rich agricultural land noted for its livestock and particularly for the white-faced Hereford pedigree cattle. The Wye yields a fine stock of salmon annually. At Clyro, 1 mi. N.W. in Radnorshire, the Rev. Francis Kilvert began his *Diary*. (F. W. SE.)

HAY: *see* GRASSLAND.

HAYA, an East African people of the Interlacustrine Bantu group, also known as the Bahaya, Wahaya, Baziba or Waziba, who inhabit the northwestern corner of Tanganyika between the Kagera river and Lake Victoria. Although forming a single modern administrative district (Bukoba) with a single local government, the Haya peoples, whose language is very similar to that of the Nyoro, were traditionally divided among eight small states (Kiamtuara, Ihangiro, Kianja, Karagwe, Maruku, Bugabo, Kiziba, Missenyi), each under a ruler called the *Mukama*. Together they numbered about 300,000 in 1960. The production of coffee, an indigenous crop, was expanded under German and British administration to form the basis for a thriving modern economy; the staple food, however, is the plantain.

As among the Nyoro, there are two main elements in the population: the pastoral Nfula, or Hima (Bahima), and the more agricultural Iru (Bairu). In some of the states, the rulers are apparently Hima, while in others the dynasties are related to the Nilotic Bito (Babito) rulers of the Nyoro. Traditionally, rulers appointed subordinate chiefs and officials from both royal and com-

moner clans. Age groups of boys were brought to the capital for military and character training. Traditional religion resembled that of the Nyoro. *See* also BANTU (INTERLACUSTRINE); NYORO; TANGANYIKA: *The People.*

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HAYA DE LA TORRE, VÍCTOR RAÚL (1895–), Peruvian political theorist, founder and *jefe* (leader) of the Aprista party, Peru's largest, was born on Feb. 22, 1895, in Trujillo. He was educated in Peru and England. As president of the Peruvian federation of students in 1919 he led the students in creating popular universities to educate workers. After leading a mass demonstration May 23, 1923, protesting the dedication of Peru to the Sacred Heart of Jesus he was jailed. When he began a protest hunger strike he was deported.

Haya founded the Alianza Popular Revolucionaria Americana (American Popular Revolutionary Alliance), popularly known as the Aprista movement, or Apra, May 7, 1924, in Mexico. From 1924 to 1931 he traveled through the Americas and Europe, studying, writing and organizing. After Pres. Augusto Bernardino Leguía y Salcedo (1863–1932) was overthrown, Haya returned to Peru in 1931, as the Aprista candidate for president. The consensus is that Haya was elected; nevertheless his opponent, Col. Luis M. Sánchez Cerro (1894–1933), was inaugurated president. Sánchez Cerro imposed a sanguinary dictatorship and jailed Haya. Protests in all parts of the world apparently saved Haya from execution. He was released after Sánchez Cerro's assassination in 1933. From 1934 to 1945 Haya lived in hiding in Peru, becoming a living legend as his underground life and writings became widely known.

In 1945 the Aprista party was legalized and took the name Partido Popular (Popular party). Desiring a transitional administration, the Apristas helped to elect José Luis Bustamante y Rivero president. His conduct in office and refusal to co-operate with the Apristas led to a new dictatorship under Gen. Manuel Odría in 1948.

Following his party's orders Haya took refuge in the Colombian embassy Jan. 3, 1949. His status became a *cause célèbre* as the governments of Peru and Colombia argued about his right to asylum. The case was taken to the International Court of Justice but the court's decisions were never clear. On April 7, 1954, under pressure from the other American republics, Odría permitted Haya to leave Peru and go to Mexico. His asylum case stimulated the American republics to strengthen their treaty regulating political asylum. Haya returned to Peru July 20, 1957, after constitutional government under Manuel Prado had replaced Odría's tyranny. (H. KR.)

In the 1962 Peruvian national elections Haya was the presidential candidate for the Aprista party. His principal opponents were the former dictator Odría and Fernando Belaúnde Terry from the Popular Action party. After a bitter and violent campaign the election took place on June 10. The official results gave Haya 32.97% of the popular vote, Belaúnde Terry 32.13% and Odría 28.45%. Since none of the candidates had received the minimum (one-third of the total vote) required for election, the newly elected congress prepared to choose between the three. Aware that the army firmly opposed him and would try to block his election, Haya negotiated with Odría and seemed ready to give his congressional support to the former dictator. On July 18, 1962, however, the army took over the government. A military junta assumed power and annulled the June election, promising new elections in mid-1963. *See* also PERU: *History.* (X.)

HAYASHI, SENJURO (1876–1943), Japanese army officer and politician, was born on Feb. 23, 1876, in Ishikawa prefecture. Educated and trained at the Military academy and Military Staff college, he held many responsible posts. In 1931, as commander of Japanese troops in Korea, he ordered his forces to march into Manchuria without waiting for permission from Tokyo, an action that had much to do with Japan's success in that territory. Promoted to full general in 1932, he was appointed inspector general of military training, one of the three most important positions in the Japanese peacetime army. In 1934 Hayashi succeeded Gen. Sadao Araki as minister of war. He attempted to purge the army of Araki's supporters, who had strong fascist leanings, and by bold and varied means removed an estimated 5,000 officers from important posts. After his resignation in 1935, he took a position on the supreme war council. However, in Feb. 1936, after the assassination of some of the principal Japanese military leaders, he and the other council members resigned. He became premier in Feb. 1937 but remained in office only a few months; when a general election revealed that he had few supporters, he resigned on May 31. He died in Tokyo on Feb. 4, 1943. (S. L. FK.)

HAYASHI TADASU, COUNT (1850–1913), Japanese diplomat and statesman whose greatest diplomatic triumph was the Anglo-Japanese alliance of 1902, was born in Chiba prefecture on Feb. 22, 1850. Sent to study in England in 1866, he returned home just in time to join Enomoto Buyo in his last-ditch defense of the shogunate against the Meiji emperor's armies. Imprisoned until 1871 by the imperial government, he was then assigned as interpreter to the mission headed by Iwakura Tomomi to the western powers. Thereafter he joined the diplomatic service and also served in other governmental offices. Appointed vice-minister for foreign affairs in 1891, he played a leading role in the renegotiation of the Anglo-Japanese treaty in 1894. In the following year, after participating actively in the conclusion of the treaty of Shimonoseki, ending the Chinese-Japanese war, Hayashi was dispatched as ambassador to China. In 1897 he became minister to Russia and in 1899 was appointed minister to England. There he was to achieve his greatest diplomatic triumph. Alarmed by the expansion of Russian power in the far east, which he viewed both as a threat to his country's security and as an obstacle to the extension of Japanese interests, Hayashi was instrumental in concluding the Anglo-Japanese alliance. Renewed several times, the alliance was a pillar of Japanese foreign policy for the next 20 years (*see* JAPAN). After the Russo-Japanese War he completed his diplomatic career by serving as minister for foreign affairs from 1906 to 1908. Hayashi died in Tokyo on July 10, 1913.

See A. M. Pooley (ed.), *The Secret Memoirs of Count Tadasu Hayashi* (1915). (HS. KN.)

HAYDEN, FERDINAND VANDEVEER (1829–1887), U.S. geologist, a pioneer investigator of the western states who clarified many fundamental geological relationships in the Great Plains and Rocky mountains, laying sound groundwork for subsequent researches, was born at Westfield, Mass., on Sept. 7, 1829. He graduated from Oberlin college in 1850 and Albany medical college in 1853, in which year, with F. B. Meek, he visited the Dakota badlands. Their discoveries reinforced Hayden's interest in the west and thus began scientific explorations prosecuted for three decades. Hayden's industry and contagious enthusiasm becoming legendary. In 1854 and 1855 he explored the upper Missouri country aided by American Fur company employees; from 1856 to 1860 he was attached to military expeditions. During the Civil War, he served the Union army as surgeon of volunteers, being breveted lieutenant colonel for meritorious service. He then became professor of geology at the University of Pennsylvania (1865–1872); he resumed explorations in 1866, and the next year organized the geological and geographical survey of the territories, which continued 12 years and won world-wide acclaim. When federal surveys were consolidated in 1879, he became geologist with the United States geological survey. He played a leading role in the creation of Yellowstone National park, which he had explored, and he popularized western geology throughout the United States. The "Hayden surveys" launched numerous scientists on brilliant careers, and their maps and about 50 published volumes embody scientific information of enduring value. In large measure they laid the foundation for the U.S. geological survey. He died at Philadelphia on Dec. 22, 1887. (F. M. FL.)

HAYDEN, HORACE H. (1769–1844), U.S. dentist, cofounder of the first dental college in the world, was born in Windsor, Conn., Oct. 13, 1769. He was for a time a school teacher and later became an architect, but about 1790 became interested in dentistry. Probably in 1804 he began to practise in

Baltimore, where he remained for most of his lifetime. He participated in the War of 1812 as a surgeon, a profession he had studied at the same time he learned dentistry. He was the founder, with Chapin A. Harris, of the Baltimore College of Dental Surgery, the first school of its kind in the world. It opened in 1840, its charter being dated Feb. 1 of that year, with Hayden as its first president and first professor of dental pathology and physiology, a post he retained until his death. The school continued in existence under its original name until 1923, when it became a part of the University of Maryland. In 1840 Hayden also founded the American Society of Dental Surgery, an organization of which he was the first president. In addition to his interest in dentistry, he was much interested in geology and wrote a number of essays on geological subjects. Haydenite, a form of the mineral chabazite, was named for him. He died in Baltimore, Jan. 26, 1844.

HAYDN, (FRANZ) JOSEPH (1732–1809), one of the greatest composers, perfected the early symphonic form, invented the modern string quartet and was the principal founder of the Viennese classical school.

Haydn's Life.—Born on March 31, or possibly April 1, 1732, at Rohrau, Lower Austria, Haydn was the second child and eldest son of Mathias Haydn and Anna Marie Koller. Most of Haydn's ancestors came from the border state of Burgenland. Though Hungarian, Croatian, German, Austrian and Gypsy elements were spread throughout this state, the research of Ernst Fritz Schmid left little doubt that Haydn's forefathers were German and Austrian peasants and that he was not, as was once believed, of Croatian origin.

Concerning his early years, Haydn wrote in 1776: "My father was a wheelwright by profession, and served Count Harrach [whose country castle was at Rohrau], a great lover of music. [My father] played the harp without knowing a note of music and, as a boy of five, I sang all his simple little pieces correctly: this induced my father to entrust me to the care of my relative, the school rector in Hainburg, in order that I might learn the rudiments of music and other juvenile requirements . . . When I was seven, the late *Kapellmeister* von Reutter [the elder Georg Karl von Reutter, 1708–72] passed through Hainburg and quite by accident heard my weak but pleasant voice. He forthwith took me to the choir house (of St. Stephen's cathedral in Vienna) where, apart from my studies, I learned the art of singing, the harpsichord, and the violin —and from very good masters. Until my 18th year I sang soprano with great success, not only at St. Stephen's but also at court. Finally I lost my voice, and then had to eke out a wretched existence for eight whole years . . . I never would have learned what little I did, had I not, in my zeal for composition, composed well into the night. I wrote diligently, but not quite correctly, until at last I had the good fortune to learn the true fundamentals of composition from the celebrated Herr Porpora [Niccolo Porpora, 1685–1766], who was then in Vienna . . ."

Not many of these "diligent" early compositions have survived, but two masses, the *Missa Brevis* in F and the *Missa brevis alla cappella* "Rorate coeli desuper" (rediscovered by H. C. R. Landon in 1957 at Göttweig abbey), certainly date from the period *c.* 1750; the latter mass also contains sufficient "not quite correct" passages to suggest that it may be Haydn's earliest surviving work. Probably some of the early piano sonatas (no. 1, 2, 7, 8, 9 of the collected edition) were written during these formative years.

About the year 1757, Haydn was invited by an Austrian nobleman, Count Carl Joseph von Fürnberg, to spend the summer in Weinzierl castle, near Melk. On this occasion Haydn wrote his first string quartets, probably those contained in what is known as Opus 1 and four of the six contained in Opus 2. Before this date, he had written a comic opera, *Der krumme Teufel*, for the Viennese comedian and impresario Feliz Kurz-Bernadon. Although the piece was a great success and was played all over Germany, as well as in Prague and Pressburg, the music remains undiscovered.

In 1759 Haydn was engaged as music director to Count Ferdinand Maximilian Morzin, whose summer castle was at Lukavec in Bohemia. There he wrote his first symphony and numerous *divertimenti* for wind band or for wind instruments and strings. When the monastery and castle archives in Czechoslovakia were investigated by Landon in 1959 a number of lost works from the Lukavec period came to light.

Haydn stayed only a short time with the Morzins, for the count fell into financial difficulties and the musicians were dismissed; but while the band was still intact, Prince Paul Anton (Pál Antal) Esterházy seems to have heard Haydn and subsequently invited him to become assistant *Kapellmeister* of the Esterházy court orchestra. He accepted with alacrity, the contract dating from May 1, 1761. On Nov. 26, 1760, he had married Maria Anna Keller, daughter of the wigmaker Johann Peter Keller, who had befriended him ten years before. His childless marriage was most unhappy and Haydn's animosity to his wife increased as the years went by.

The engagement as assistant *Kapellmeister* to the Esterházy court at Eisenstadt and, in the winters, at Vienna proved decisive for Haydn's career. He remained in the family's service till his death. He was in command of a small but brilliant orchestra, a church choir and, at the beginning, a few operatic singers. The instrumentalists and vocalists were supplemented by local musicians from Eisenstadt.

In 1762 Prince Paul Anton died and was succeeded by his brother, Nicolaus Joseph (Miklós József; 1714–90), called "the Magnificent," under whose reign the Esterházys became famous throughout Europe as patrons of the arts. The prince was a passionate lover of music and played the baryton (a bass viol with sympathetic strings), for which Haydn was required to write an enormous number of *divertimenti*. Nicolaus also enlarged the band and the operatic forces, and a regular opera season was soon inaugurated. The singers were mostly Italian and the prince preferred *opera buffa* to all other kinds of opera. At the beginning Haydn's relationship to his patron was one of master and servant but, in the course of years, he managed to turn Nicolaus from a despotic and often ruthless ruler into a kindly and tolerant protector. Haydn's letters to Nicolaus, discovered in 1955, show the composer to have been a born diplomat.

In 1766 Miklós opened an enormous new castle at the south end of the Neusiedler See called Esterháza. It was intended to be a Hungarian Versailles, and it was certainly one of the most luxurious and fantastic aristocratic residences of the 18th century. There was an opera house, seating 500, and strolling players were housed in the castle for several months of the season. When the prince was in residence there was a theatrical performance, a concert, an opera or a marionette performance every night.

During the 1760s Haydn's fame began to spread throughout Europe. The Austrian and Czech monasteries did much to disseminate his church music and also his symphonies, *divertimenti*, sonatas and concertos. Many of Haydn's secular works are preserved only in one or more of the great monastery collections. Aristocratic patrons in south Germany, Italy and the Austro-Hungarian empire also assiduously collected his music and their libraries are among the most important sources for his work. It also spread rapidly to France, where G. B. Venier in Paris published a Haydn symphony as early as 1764 and R. de la Chevardière followed with the first string quartets in the same year. J. J. Hummel of Amsterdam and Berlin and Robert Bremner of London also printed these quartets. Within five or six years a large number of Haydn's instrumental works had been printed, most of them in Paris. It was not until 1774, however, that Haydn himself actually arranged to have any of his works published and not till 1780 that he found a firm, Artaria of Vienna, that was willing to issue all his new music. It is probable that Haydn never knew of the existence of half the music printed under his name in Paris.

Apart from moving from one Esterházy castle to the other, Haydn traveled little. He and the other musicians were obliged to remain available to Prince Esterházy almost without interruption. The story of the "Farewell" Symphony (no. 45, F sharp minor) is associated with the long stays that the prince made in Esterháza. In 1772, the musicians asked Haydn to write a piece of music that would suggest to Nicolaus that they thought it time to return to Vienna and their families. When L. A. Tomasini and Haydn, left alone at the end of the symphony, were blowing out their candles, the prince is reported to have said, "Well, if they go, we might as

well leave, too." Whereupon the court departed the next day. The anecdote shows Haydn's tact in handling his princely patron; but it does not entirely explain the passionate romanticism of the symphony and indeed of all Haydn's music during this period. The "romantic crisis," which begins about 1768 and continues till about the year 1774, inaugurates Haydn's maturity: the music written during these years, from the great *Stabat Mater* (1767) to the large-scale *Missa Sanctae Caeciliae* (*c.* 1773), would be sufficient to place Haydn among the ranks of the great.

The succeeding decade (1774–84) shows a tendency to popularization. After the great quartets of Opus 20, the piano sonata in C minor (no. 20) and the symphonies in minor keys (especially the so-called *Trauer-Symphonie* in E minor, no. 44), the ensuing compositions seem in part pallid. This is not true, however, of the operas produced in this decade. Here, Haydn's swift imagination fills page after page of beautiful music. He wrote about 10 operas and *Singspiele* in this decade, but until this music becomes generally known his importance as an operatic composer must be left undecided. (*Il Mondo della Luna*, 1777, on a text by Carlo Goldoni, was revived in 1959 with great success.)

Toward the end of the 1780s, the composer's letters begin to show restlessness and dissatisfaction. He longed for his Viennese friends, among them Mozart, who in 1785 dedicated to him six of his finest string quartets. Haydn longed, in fact, for artistic freedom. In 1790, just as this situation threatened to become intolerable, Prince Nicolaus died. His successor, Anton (Antal), cared nothing for music, dismissed the whole band and retained only Haydn as nominal *Kapellmeister* and a few musicians for the hunt. The composer was free to go. Meanwhile, Johann Peter Salomon (1745–1815), one of London's leading impresarios, hearing of the death of Prince Nicolaus, hastened to the Austrian capital. He offered Haydn a double contract—one for 12 new pieces of music to be performed at public concerts in the Hanover Square rooms in London, and one from Sir John Gallini for a new Italian opera to be produced at the King's theatre. Haydn needed no persuasion and the two men set off on Dec. 15, 1790, journeying through Munich, Wallerstein, Bonn and Brussels to London.

In his artistic development, Haydn's visits to England were the most important events in his life. Esterháza, beneficial though it was, had outlived its usefulness. It is doubtful that he would have become the great master he did were it not for the enormous stimulation provided by the English public. He was feted, lionized and treated as a genius. The public received his new "overtures" (actually the Salomon and London symphonies) with "shouts of applause." Although his new opera *L'Anima del Filosofo* was completed, court intrigues prevented its being given and it was not performed until 1951 in Florence.

At the end of the first concert season, in June 1791, Salomon persuaded Haydn to stay another year. Salomon's undertaking had of course excited the jealousy of rival organizations, and the "Professional Concerts" engaged Ignaz Pleyel, Haydn's former pupil, to come to London for the 1792 season and to organize a rival concert series. But the excitement soon died down because neither Haydn nor Pleyel would stoop to disfavour the other; both series played to sold-out houses. The strain of producing so many new pieces, of a constant social life and many fashionable pupils rather tired the aging composer, however, and it was with considerable relief that he returned to the continent. En route to Vienna, in the summer of 1792, he stopped again at Bonn, where Beethoven was introduced to him. Haydn accepted the tempestuous young man as his pupil. In a letter of 1793 to Beethoven's patron, the elector of Cologne, Haydn stated that "Beethoven [then aged 23] will one day be considered one of Europe's greatest composers, and I shall be proud to be called his teacher."

Haydn's return to Vienna was scarcely noticed in the Viennese newspapers. "I had to go to England to become famous in my own country," he often bitterly remarked. The curiously cool reception on his return in 1792 may have strengthened his decision to make a second journey to England in Jan. 1794.

The principal compositions of the second London journey were the second set of Salomon symphonies (no. 99–104), and the six string quartets (erroneously known by two different opus numbers, each containing three works, Opus 71 and 74). On his second London visit, Haydn reached even greater heights of inspiration, particularly in the last three symphonies (no. 102–104), of which no. 102, in B flat major, is one of the greatest of all symphonies. The public no longer regarded him as a sensation but as an old and well-loved friend. George III earnestly invited him to stay in England, but Haydn—for reasons that have never been made clear—preferred to return to his native Austria to serve a new Prince Esterházy, Nicolaus II.

Again his arrival in Vienna, in the early autumn of 1795, was greeted with stony silence. Haydn's real success with the Viennese public was first established with the late oratorios, and in the 20th century it is principally *The Creation* and *The Seasons* that endear him to the German-speaking public.

Haydn seems to have received the text of *The Creation* from Baron Gottfried van Swieten while still in England. He began work on it in 1796, and the first performance on April 29 and 30, 1798, at the Schwarzenberg palace in Vienna was an instantaneous success.

Haydn's duties with Prince Nicolaus II, an unpleasant and despotic patron with whom Haydn preserved only a conventional politeness, consisted primarily in writing a yearly mass for the name day of the princess Maria. His last six masses (1796–1802) are his greatest church works and the worthy successors to the London symphonies. They were performed in the Bergkirche at Eisenstadt, where the prince resided when he was not in Vienna.

During this period Haydn composed the six string quartets known as Opus 76, most of which were completed by 1797. He also rewrote the earlier oratorio, *The Seven Words of the Saviour on the Cross* (1785), adding vocal parts, the text of which was also by van Swieten (first performed at Eisenstadt, 1796). Honours were awarded to him in succession from Holland and Sweden, and from Paris and St. Petersburg. Finally Vienna conferred on him the coveted "Salvator" medal and the honorary citizenship of the city.

In 1799 Haydn began *The Seasons*, the text of which van Swieten adapted from George Thomson's poem. "Spring" was finished rapidly and was performed at the Schwarzenberg palace on March 17, 1799; the remaining three parts were not completed until 1801. On April 24 of that year the first semiprivate performance of the complete work took place.

"*The Seasons* broke my back," Haydn is reported to have said; and indeed, apart from the last two masses of 1801 and 1802, he undertook no more large-scale works. During the last years of his life, shadowed by illness and the Napoleonic Wars, Haydn's thoughts were constantly of death; he felt himself incapable of further work, and on his 74th birthday he made the pathetic statement to his biographer, G. A. Griesinger: "Music is boundless, and that which could be done is far greater than that which has hitherto been accomplished; I often have ideas which would increase the boundaries of the art far beyond its present scope, but my physical powers are not equal to the task."

In 1809, Napoleon besieged Vienna and in May entered the city. Haydn refused to leave his house and take refuge in the inner city. Napoleon placed a guard of honour outside Haydn's house, and a few days before he died the enfeebled composer was much touched by the visit of a French hussars' officer who sang "Mit Würd' und Hoheit" from *The Creation*. On May 31, 1809, Haydn died peacefully and was buried two days later. "Not one single Viennese *Kapellmeister* was there to accompany his last journey," a contemporary report acidly notes.

Haydn's Achievement.—Haydn's creative activity spans half a century—50 years that witnessed one of the most profound stylistic revolutions in the history of music. Not only is he the first of the three great names of the Viennese classical style—Haydn, Mozart and Beethoven—but he also was a deciding factor in forming this style. At Haydn's death his achievement was obvious to musicians throughout Europe. But during the 19th century, as fewer and fewer of his early and middle period works were played, his importance became obscured. It was not until the middle of the 20th century that his position again became clear.

His achievement, however, is still considerably confused by the fact that an enormous number of works were wrongly attributed

to him. In the 18th century, publishers and professional music copyists did not hesitate to publish and circulate in manuscript under Haydn's name works by J. B. Vanhal, Carlos d'Ordoñez, Leopold Hofmann, Karl Ditters von Dittersdorf and a score of others. It was not until about 1935 that the research was done by which most of this staggering amount of spurious Haydn could be attributed to correct authors. Just how staggering the numbers are may be seen in one instance: for 107 authentic symphonies, there are nearly 200 spurious. The difficulty in determining the genuine works is, moreover, complicated by the large stylistic gap that Haydn's music bridges, ranging from the outgoing baroque to the advent of romanticism.

Haydn's early style is rooted in the Austrian and south German baroque, to which the Italian *opera buffa* added a stylistic admixture typical of Austrian music about 1750. On the one hand there is in Haydn the strongly baroque *Missa brevis* in F and on the other fresh gaiety, as in the Viennese street serenade or the Divertimento in G for string quintet of *c.* 1754. During the 1760s Haydn began to solidify and deepen his style. The new technique of working with small motifs to tighten the fabric of the sonata form turns the first movement of sonata, quartet and symphony into a little drama. Haydn worked simultaneously at a number of genres—church music, the symphony, the piano sonata, the *divertimento* (in the narrower sense; *i.e.*, music for strings, or wind instruments, or both), the string quartet, the opera, the cantata, the concerto. It is only in the last form that he never displayed much more than a passing interest.

During the romantic crisis between 1768 and 1774 Haydn's music took on a deeper hue; the intellectualization that had steadily increased throughout the 1760s found its natural outlet. An important change in his outlook occurred in 1785. The profound music to the *Seven Words* did much to restore the emotional strength that so much of his work had lost after the outburst of the early 1770s. The Paris symphonies (1785–86) are miracles of beauty and formal perfection combined with great profundity, noticeable especially in the slow movement of no. 86 in D.

The London visits injected a new force in Haydn's music, but side by side with a greatly increased nervous tension his works began to take on an emotional depth often characteristic of the music of an aging composer. Haydn began to explore new harmonic fields, *e.g.*, third-related keys, his interest in new harmonic structures being particularly apparent in the late piano trios. On his return to Vienna, Haydn concentrated almost exclusively on vocal music and the string quartet. The last six masses are pillars of symphonic strength and grandeur, ranging from the brightness of the *Missa in Tempore Belli* to the terse drama of the *Missa in Augustiis* ("Nelson Mass") in D minor. Here the symphonic principles brought to perfection in the London symphonies are brilliantly combined with older contrapuntal forms. Solo voices are blended with vocal quartet and choir; and there is a constant juxtaposition of the available forces. *The Creation* and *The Seasons* may be considered as huge masses for they, too, are songs of praise to the Creator. The same musical principles are employed; but in the purely orchestral passages ("Chaos" at the beginning of *The Creation*), Haydn showed that he was capable of discovering new tonal continents.

Haydn's last instrumental works were the string quartets Opus 76 and 77 (1799) and the unfinished Opus 103. In these works, the art of the quartet was brought to a new pinnacle. 'I never received more pleasure from instrumental music," Charles Burney wrote to the composer about Opus 76 in Aug. 1799. "They are full of invention, fire, good taste, and new effects, and seem the production, not of a sublime genius who has written so much and so well already, but of one of highly-cultivated talents, who had expended none of his fire before."

The full scope of Haydn's achievement only began to emerge as the result of advances in musicology in the first half of the 20th century. Gradually he was seen to be a musical giant whose one hand touches the fading baroque, the world of Bach and Handel, and whose other hand calls to life the evergreen freshness of the young romantic movement at the beginning of the 19th century.

Works.—The collected editions of Haydn's works remain incomplete. They are: *Joseph Haydns Werke*, edited by E. Mandyczewski, H. Schultz and M. Friedlander (1908–32); *Joseph Haydn. The Complete Works*, edited by J. P. Larsen (Haydn Society, 1950–51); *Joseph Haydn's Werke*, edited by J. P. Larsen (Haydn Institute, 1958–). A complete thematic catalogue of Haydn's works was begun by A. van Hoboken (1957–).

The following list is a summary of Haydn's achievement.

Instrumental Music.—One hundred and seven symphonies (one lost); about 50 *divertimenti* for small orchestra; 84 string quartets; about 58 piano sonatas (eight lost); about 40 trios for piano, violin and cello; 126 trios for baryton, viola and cello; about 35 trios for 2 violins and cello; 3 trios for 2 flutes and cello; 6 duets for violin and viola; 1 horn trio; numerous chamber works (duets, cassations, etc.) with baryton.

Concertos: for organ (3); harpsichord (about 7); violin (4, one lost); cello (2, one rediscovered in 1961 in Prague); horn (3; one lost, one doubtful); two horns (1, lost); double bass (1, lost); flute (1, lost; the work played under Haydn's name is by Leopold Hofmann); trumpet (1); two *lyre organizzate*, a type of hurdy-gurdy (5). The concerto for oboe attributed to Haydn is spurious. *Sinfonia Concertante* for oboe, violin, bassoon, cello and orchestra. About 30 *divertimenti* or *concertini* for harpsichord, two violins and bass. Marches, single movements and overtures for orchestra. Minuets and German dances for orchestra and/or piano. Pieces for musical clocks (*Flötenuhr*).

Sacred Music.—Masses (13, one lost); *Stabat Mater; Salve Regina* (two settings); *Te Deum* (two settings); motets, offertoriums, etc.

Cantatas: *Applausus* (festival cantata) for soli, chorus, violin, harpsichord and orchestra; five or six smaller cantatas. Oratorios: *Il Ritorno di Tobia; Die Sieben Worte des Erlösers am Kreuze* ("The Seven Last Words"); *Die Schöpfung* ("The Creation"); *Die Jahreszeiten* ("The Seasons"); *Mare clausum* (unfinished).

Songs.—Numerous lieder, in Italian, German and English. About 450 Scottish, Welsh and Irish songs with piano trio accompaniments; 13 part songs with piano accompaniment.

Operas.—*Der krumme Teufel* (probably identical with *Der neue krumme Teufel*, first performed 1751(?) or 1758(?); *Acide e Galatea* (1763); *La Marchesa Nespola* (1762); *La Vedova* (lost, 1762); *Il dottore* (lost, 1762); *Il Scanarello* (lost, 1762); *La Canterina* (1767); *Le speziale* (1768); *Le pescatrici* (1770); *L'infedeltà delusa* (1773); *Der Götterrat, oder Jupiters Reise auf die Erde* (1773); *Philemon und Baucis* (1773); *Hexenschabbas* (lost, 1773); *L'incontro improvviso* (1775); *Il mondo della luna* (1777); *La vera costanza* (1779); *Dido* (lost, 1776); *Genovevens vierter Theil* (lost, 1777); *Die bestrafte Rachgier* (lost, 1779); *Das abgebrannte Haus; L'isola disabitata* (1779); *La fedeltà premiata* (1780); *Orlando Paladino* (1782); *Armida* (1784); *L'anima del filosofo* (*Orfeo ed Euridice*), first performed, Florence, 1951).

Numerous arias for insertion in the operas of other composers performed at Esterháza; two concert scenes (*Miseri noi* and *Scena di Berenice*); 45 separate canons; a canon cycle, *Die zehn Gebote*.

See also references under "Haydn, (Franz) Joseph" in the Index volume.

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HAYDON, BENJAMIN ROBERT (1786–1846), English historical painter and writer, was born at Plymouth on Jan. 25, 1786, and educated at Plymouth, Honiton and Plympton. In 1804 he went to London and attended the Royal Academy schools,

of which Henry Fuseli was keeper. There began his lifelong friendship with the Scottish painter, David Wilkie.

In 1807 he first exhibited at the Royal Academy, but because of subsequent quarrels most of his later paintings were shown at the British gallery or at private exhibitions. Among his principal paintings "Leigh Hunt" and "Wordsworth Ascending Helvellyn" are at the National Portrait gallery; "The Raising of Lazarus" and "Punch or May-Day" are at the Tate gallery. Others are at the Royal Albert Memorial museum, the Royal hospital, Chelsea, and Buckingham palace. Two of his paintings are in America: "Napoleon Musing at St. Helena" in the Metropolitan Museum of Art, New York city, and "Christ's Entry Into Jerusalem" at Mount St. Mary's seminary, Norwood, O. The latter contains portrait heads of Wordsworth, Hazlitt and Keats.

Haydon's stormy career, down to 1821, is recorded in his superb *Autobiography* (1847). This and his unpublished journals were the basis for Taylor's *Life* and the *Correspondence and Table-Talk* edited by Haydon's son. He was a frequent contributor to periodicals and wrote a number of pamphlets on controversial subjects. His acquaintance among literary people was extensive. His friends included Wordsworth, Coleridge, Scott, Lamb, Hazlitt, Keats, the Hunts, Mary Russell Mitford and Elizabeth Barrett, several of whom composed poems to honour him. Intimate glimpses of persons eminent in literature, art, politics and society enliven his writings, for he had a keen eye for character and a striking gift of phrase.

Haydon's fantastic incompetence in financial matters and the disappointment of his hopes resulted in his ruin. Four times he was confined in King's Bench prison for debt, and on June 22, 1846, he committed suicide in his painting room.

His influence upon art was not great. The day of the Raphaelesque "high art" which he upheld had passed; and his attempts to "improve the public taste" were a failure. As a lecturer and writer, however, he advocated social concepts of art which anticipated those of Ruskin and Morris. Haydon is also remembered for his courageous defense of the Elgin marbles, sculptures from the Parthenon, and was largely responsible for their acquisition in 1816 by the nation.

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(C. O.)

HAYES, HELEN (HELEN HAYES BROWN) (1900–), U.S. actress of stage, screen, radio and television, was born on Oct. 10, 1900, in Washington, D.C., daughter of Francis and Catherine (Hayes) Brown. She first appeared at the age of five with the Columbia Players as Prince Charles in *The Royal Family*. Juvenile successes included *Pollyanna*, *The Prince Chap*, *Little Lord Fauntleroy* and *The Prince and the Pauper*. She graduated from Sacred Heart academy, Washington, in 1917 and not long after began to play adult roles. Some of her successes were *To the Ladies* (1922), *Caesar and Cleopatra* (1925), *Coquette* (1927), *Mary of Scotland* (1933), *Victoria Regina* (1935), *Happy Birthday* (1946) and *Mrs. McThing* (1952). Miss Hayes was awarded the medal of the Drama League of New York for her performance in *Victoria Regina*. In 1955 she played Mrs. Antrobus in the revival of *The Skin of Our Teeth*, presented in Paris, and the same year the Fulton theatre in New York city was renamed the Helen Hayes in her honour. From 1930 she was heard often in radio drama, and when television developed she performed in that medium. She acted in several motion pictures and received an Oscar in 1932 for her performance in *The Sin of Madelon Claudet*. She married the playwright Charles MacArthur (1895–1956) in 1928. (B. HT.)

HAYES, ISAAC ISRAEL (1832–1881), U.S. arctic explorer who discovered and explored Grinnell Land, was born in Chester county, Pa., on March 5, 1832. He was educated at Westtown academy and received his M.D. degree at the University of Pennsylvania, Philadelphia, in 1853. He immediately volunteered to serve as surgeon with Elisha Kent Kane's expedition in search of the missing explorer, Sir John Franklin. The expedition sailed from New York on May 30, 1853, in the ship "Advance." During the winter of 1853–54, the vessel was beset in Kane basin, northwest Greenland. Hayes took part in several expeditions on Ellesmere Island during this period and discovered Grinnell Land on May 28, 1854. When it became obvious that the ship would have to spend a second winter in the ice, Hayes, with nine men, attempted to reach Upernavik on the west coast of Greenland. This attempt failed and the party was forced to turn back, reaching the "Advance" in Dec. 1854. The following summer the entire crew successfully made the same journey, reaching Upernavik in August and New York in October.

Hayes had determined that there must be an open sea about the north pole and that he would discover it. In July 1860, therefore, he sailed from Boston, Mass., in command of the schooner "United States." He wintered somewhat south of the point at which the "Advance" had been frozen in, and in the spring of 1861 began to proceed northward by sledge. Although he thought that he reached latitude 81° 35′ N. and looked upon the open polar sea that he had set out to find, it is almost certain that he actually reached a point only slightly north of 80° and that the "open polar sea" was only Kennedy channel. In July 1861 he sailed for Boston, arriving in October. He gave his ship to the government to use in the prosecution of the Civil War and became an army surgeon. In July 1869 Hayes again traveled to Greenland with the artist William Bradford. Later in his life he was for a number of years a member of the New York state assembly. He died in New York city on Dec. 17, 1881.

Hayes was a careful scientific observer and his first two expeditions made valuable contributions in natural history, meteorology, glaciology and hydrology. The photographs taken on the second expedition were among the first to be taken in the arctic. Hayes was the author of *An Arctic Boat Journey . . .* (1860), *The Open Polar Sea* (1867), *Cast Away in the Cold* (1869) and *The Land of Desolation* (1871). (H. G. KG.)

HAYES, PATRICK JOSEPH (1867–1938), U.S. Roman Catholic archbishop and cardinal, whose most notable achievement was the unification of Catholic welfare activities under a central agency, Catholic Charities, was born in New York city, Nov. 20, 1867. Upon graduation from Manhattan college in 1888, he entered St. Joseph's Provincial seminary, Troy, N.Y., and was ordained a priest in 1892. After graduate courses at the Catholic University of America, he returned to New York city as curate at St. Gabriel's parish. Subsequently secretary (1895) to Bishop (later Archbishop and Cardinal) John Farley, chancellor of the archdiocese (1903), and first president (1903) of Cathedral college, the archdiocesan preparatory seminary, he became bishop auxiliary to Cardinal Farley in 1914. During World War I he served on the executive committee of the National Catholic War council and as first bishop of the armed forces (1917), in charge of all Catholic chaplains in the army and navy. In Sept. 1919 he succeeded to the archbishopric of New York and five years later was named a cardinal. As archbishop he created Catholic Charities (1920), an organization which became a model for other U.S. dioceses. Cardinal Hayes died in Monticello, N.Y., on Sept. 4, 1938.

See J. B. Kelly, *Cardinal Hayes, One of Ourselves* (1940).
(J. A. RS.)

HAYES, RUTHERFORD BIRCHARD (1822–1893), 19th president of the United States, was born in Delaware, O., on Oct. 4, 1822. He came of New England stock several generations removed from old England. His father, Rutherford Hayes, who had settled in Delaware in 1817, died in 1822, two months and two weeks before the birth of his son. Young Rutherford and his sister Fanny were reared by their mother assisted by her brother, Sardis Birchard, a prosperous businessman of Lower Sandusky (later Fremont), O. He attended a private school in Delaware, O., an academy at Norwalk, O., and a preparatory school in Middletown, Conn. In 1842 he was graduated from Kenyon college, Gambier, O., valedictorian of his class. After a year of study in a Columbus law office, he entered Harvard law school and received his degree in Jan. 1845. The same year he began to prac-

tise at Lower Sandusky. Dissatisfied with the opportunities in a small town, he moved to Cincinnati in late 1849 and presently established himself as a successful practising attorney. His humanitarian instincts led him to take several fugitive slave cases and drew him into the Republican party. In 1852 he married Lucy Ware Webb (1831–89).

At the outbreak of the Civil War, Hayes became a major in the 23rd Ohio volunteer infantry. He saw much active service in Virginia, was severely wounded at South mountain, and after successive promotions ended his service as a brevet major general of volunteers. He was elected to congress in 1864 while still with his regiment and was re-elected in 1866. He followed the Republican leadership in supporting radical reconstruction for the south. He was elected governor of Ohio in 1867 by a narrow margin over Allen G. Thurman, although a Negro suffrage amendment which he supported was voted down and a Democratic legislature chosen. He was re-elected over George H. Pendleton in 1869, and the legislature chosen with him ratified the 15th amendment to the U.S. constitution forbidding racial discrimination in voting. At his recommendation the legislature created, under the terms of the Morrill act, the institution that became Ohio State university.

Election of 1876.—In 1875 Hayes was nominated for governor for a third time and defeated the Democratic incumbent in a campaign that attracted national attention because of Hayes's stand in favour of the resumption of specie payments for greenbacks, the paper money authorized during the Civil War. His success made him Ohio's "favourite son" candidate for the Republican presidential nomination. A shrewdly managed preconvention campaign brought him the nomination over James G. Blaine on the seventh ballot.

Exposures of corruption in Ulysses S. Grant's administration, a reaction against radical reconstruction and carpetbag rule in the south, and the hard times following the panic of 1873 worked in favour of the Democratic candidate, Samuel J. Tilden, and on election night early returns indicated a Democratic victory. But the Republican campaign management contested Democratic claims in South Carolina, Florida, Louisiana and Oregon, and two sets of electoral votes were sent to congress from these states. The ultimate solution, without the approval of Hayes, was the creation of an electoral commission of 15 men representing the Republican senate, the Democratic house, and the supreme court to decide which votes should be counted. The commission decided, by a vote of 8 to 7 on key points, in favour of the Hayes electors, and thus made him president with 185 electoral votes to Tilden's 184. Hayes believed that the intimidation of Negro voters by southern whites had reduced the Republican vote in the three states and given the Democrats an unfair advantage. The counting of the electoral votes was not completed until March 2, 1877, and Hayes was inaugurated publicly on Monday, March 5, after privately taking the oath on the night of March 3. (*See* ELECTORAL COMMISSION.)

Presidency.—A secret agreement or bargain between persons close to Hayes and influential southern conservatives helped insure the peaceful acceptance of the decision by Democrats in congress, where a filibuster had been threatened. Pledges were made that federal troops would be withdrawn from South Carolina and Louisiana, thus ending "carpetbag rule" there. The south would be represented in the cabinet and given a larger share of offices and federal appropriations, including aid for a southern Pacific railroad. Southern Negroes would receive fair treatment at the hands of the dominant whites. The Republicans would be permitted to organize the new congress. Not all the conditions of the bargain were carried out, but Hayes did withdraw federal troops, and the south was accorded more appointments to federal offices and more appropriations for internal improvements. But Hayes's conciliatory policy did not appease the more extreme southern Democrats and aroused against him the "Stalwart" faction among the Republicans of the north. His cabinet appointments and his efforts to reform the civil service further antagonized the "Stalwarts," and a bitter struggle developed with Sen. Roscoe Conkling of New York over the removal of Chester A. Arthur and Alonzo B. Cornell from the top positions in the New York customhouse.

The great railroad strikes of 1877 required Hayes to use federal troops, at the request of state governors, to preserve order. Hayes was sympathetic toward labour but believed it was his constitutional duty to intervene, although his intervention caused the strikes to collapse. His secretary of the treasury, John Sherman, brought about the resumption of specie payments for greenbacks on Jan. 1, 1879. Meanwhile, silver advocates in congress had put through the Bland-Allison act of 1878 for a limited coinage of silver dollars, overriding a presidential veto. Hayes also vetoed a bill to restrict Chinese immigration because it violated treaty obligations with China, and this time his veto was upheld. He followed it with negotiations that led to a treaty, ratified in 1881, providing that the United States might regulate, limit or suspend the immigration of Chinese.

Democratic congressional majorities attempted in the latter part of Hayes's term to annul federal election laws by attaching restrictive riders to appropriation bills. He vetoed six bills with riders attached and finally secured the appropriations without the most objectionable restrictions. In so doing he was defending presidential authority against congressional encroachments and won a large measure of public support.

The Democratic house, through the Potter committee's investigation of 1878–79, attempted to show Republican corruption and irregularities in connection with the disputed election of 1876. Its findings reflected on persons close to Hayes, notably John Sherman. They did not involve the president himself except to show that he had rewarded certain carpethag politicians of dubious character with federal positions. The Republican *New York Tribune* in Oct. 1878 published translations of a large number of Democratic telegrams in code, sent when the result of the election of 1876 was still in dispute, revealing that close associates of Tilden were involved in negotiations to bribe election officials. This largely counteracted the Potter committee's exposures and spoiled Democratic plans to capitalize on the fraud issue in 1880.

Hayes's presidency was noted for the banning of alcoholic beverages in the White House. This was attributed to the temperance convictions of Mrs. Hayes—dubbed "Lemonade Lucy" by the scoffers—but Hayes himself took the responsibility and enjoyed some public support for his stand. The aura of middle-class rectitude in the White House was enhanced by the practice of family prayers and Sunday evenings of hymn singing with guests participating. Mrs. Hayes was a staunch Methodist but Hayes never joined a church, although he gave liberally to the Methodist church at Fremont, O.

Hayes had pledged himself to serve only one term as president and held firmly to his pledge. In any case, the dislike of Conkling, Blaine and other practical politicians would probably have made a renomination difficult. He took no part in the campaign of 1880, although he believed that James A. Garfield's nomination was the best possible one. He felt that Republican success was a vindication of his record.

Retirement.—In retirement Hayes was much interested in the cause of education, especially in the south. He served on the boards of trustees of the Peabody Education fund and the John F. Slater fund, the latter for the promotion of the education of southern Negroes. He was a particular advocate of manual training for all children. He was a trustee of three universities—Western Reserve, Ohio Wesleyan and Ohio State. His interest in prison reform led him to accept the presidency of the National Prison association which he held for ten years. His humanitarianism and the writings of Henry George and William Dean Howells, the latter an old friend, led him to fear the growing concentration of wealth in a few hands, and even to express sympathy for socialistic ideas. He believed that the elimination of poverty would solve the problem of crime. His closing years were saddened by the death of his wife in 1889. Hayes died at Fremont after a short illness on Jan. 17, 1893.

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HAYES AND HARLINGTON, an urban district (1940) of Middlesex, Eng., which under the London Government Act 1963 was to be amalgamated on April 1, 1965, with Uxbridge, Ruislip-Northwood, and Yiewsley and West Drayton to form the new London borough of Hillingdon (*see* LONDON). The urban district, 12 mi. W. of Paddington, includes part of London airport across the Bath road. Pop. (1961) 67,912. Area 8.1 sq.mi. It is a parliamentary constituency. Hayes is now industrial (aircraft, electrical and musical instruments), but its church was used by St. Anselm and the Manor house was for a time the home of Archbishop Cranmer. At Harlington, still mainly rural, the composer, William Byrd, lived (1577–92) at Overburgh house.

HAY FEVER is an inflammation of the membranes of the nose and eyes caused by allergy to the pollens of certain plants. It is manifested by sneezing, congestion of the nose, itching and tearing of the eyes, characteristically recurring at the same season each year, when the causative pollen is in the air. Despite the name, fever is not a usual symptom. Irritation of the membranes by allergy to other dusts in the air may cause similar symptoms, called allergic rhinitis, without the typical seasonal pattern of recurrence. The type of allergy causing hay fever is similar to that causing asthma (*q.v.*) and infantile eczema so that persons affected by one of these diseases are particularly susceptible to others of the group. Unless properly treated, about one-third of patients with hay fever later develop asthma. The tendency to develop allergies of this group is apparently hereditary in certain families. If both parents are affected, more than half the children may be expected to develop allergic diseases.

Hay fever is caused chiefly by plants which depend upon the wind to carry pollen to other plants of the same species for cross-fertilization. In order to ensure perpetuation of the species, such plants produce large amounts of light, buoyant pollen which is blown many miles by the wind. Plants with showy blossoms are in general adapted to cross-pollination by insects, and they produce only small amounts of heavy, sticky pollen which does not blow about. Such flowers rarely cause hay fever except on close contact. For this reason, roses and goldenrod, which have often been blamed for hay fever, are actually relatively minor causes.

The incidence and seasons of hay fever vary greatly in different parts of the world according to the vegetation present. In the temperate zones, most species of trees, certain weeds and essentially all grasses produce wind-borne pollen in large amounts. Among these, the pollens of pine trees and related conifers are relatively inert, but practically all others liberated in adequate amounts are potential causes of allergy in susceptible people. In North America and western Europe, various trees are the principal causes of hay fever occurring in the spring, and the grasses are the cause of hay fever in early summer. In the United Kingdom, timothy grass is the main offender. In North America, pollens of weeds, particularly ragweed, cause hay fever in the late summer and early autumn. Throughout central and eastern North America ragweed is by far the commonest cause of hay fever; hence late summer and early autumn is the principal season of the disease. Ragweed does not occur in Europe, and the autumn weeds growing there are relatively unimportant as causes of hay fever; hence in that area the late season is less severe than the spring and early summer. In any locality, the season of pollination of each plant is remarkably constant from year to year, so that hay fever due to any one pollen may be expected to recur in the same weeks each year, and persons familiar with the plants of the area can usually suspect which pollen is the cause from the dates of onset and cessation.

More conclusive proof of the pollens affecting a particular patient is afforded by skin tests, in which minute amounts of extracts of various pollens are scratched or injected into the upper layers of the skin. Extracts of pollens to which the patient is allergic produce local swelling and redness within a few minutes; others produce no reaction. Patients whose symptoms last through several months are usually allergic to several different pollens.

Absorption of pollen into the membrane of a person allergic to it causes release from the tissues of histamine, a substance intensely irritating to the small blood vessels and the glands which secrete mucus. This produces dilation of the vessels and escape of fluid through their walls, causing the membrane to become congested and swollen. The occurrence of the reaction does not depend on the nervous system, but its intensity may be influenced by emotional factors which also affect the blood vessels and mucous glands through the nerves. This aggravation occurs only in persons susceptible because of allergy; typical seasonal hay fever cannot be attributed to purely psychic factors.

Temporary relief of symptoms may be afforded by antihistamine drugs, which block the action of the histamine released in the membrane. Even more effective in temporary relief are the drugs related to cortisone, but these are less often used since they may cause undesirable effects elsewhere in the body. All these drugs serve only to suppress symptoms and do not alter the basic allergy. However, in mild cases they may produce adequate relief. (*See* also ANTIHISTAMINES.)

The most effective treatment over a period of time is desensitization or immunization, in which the allergic reaction is lessened by a series of injections of an extract of the causative pollen. The first dose must be very small, subsequent doses being increased gradually as the patient's tolerance is improved. Ordinarily a course of 15 to 20 injections is given, one or two each week, before the full dose is reached. Treatment therefore should be started three or four months before the onset of the season. Such treatment produces relief in 75% to 80% of patients, but must be repeated each season, or may be carried out continuously with injections every two to four weeks throughout the year. The best results are obtained by the continuous or perennial type of treatment, and it is also believed to offer the best chance of permanent relief after several years of treatment. However, the duration of treatment that will be needed cannot be predicted with certainty. Attempts are being made to shorten the course of treatment by injecting slowly absorbed pollen extracts.

Another measure which may be considered is the avoidance of exposure to a particular pollen by traveling during the season to an area in which it does not exist. Relief may also be obtained by air conditioning or air filtration. Attempts to exterminate ragweed have been made in many areas, but have generally failed to prevent hay fever because of the long distances that the pollen may be carried by wind. *See* also ALLERGY AND ANAPHYLAXIS.

(W. B. SN.)

HAYLEY, WILLIAM (1745–1820), English poet and biographer, patron of William Blake, was born at Chichester, on Oct. 29, 1745, and educated at Eton and at Trinity hall, Cambridge. In 1774 he retired to his estate at Eartham, Sussex, and won wide, though short-lived, fame, first by his verse *Essays and Epistles,* addressed to various contemporaries, and then by a long didactic poem, *The Triumphs of Temper* (1781). In 1792, while at work on his *Life of Milton* (1794), he made friends with the poet William Cowper and used his influence to obtain for him a pension of £300 a year. In 1800 Hayley moved to Felpham in Sussex, and, having been introduced to William Blake by the sculptor John Flaxman, he invited him there to work on the engravings for a *Life of Cowper* (3 vol., 1803–04), which is probably his best-known work. For three years Hayley tried to help and encourage Blake, but he failed to understand the visionary element in his genius. Later Blake turned against his former patron, giving him perhaps his one sure place in English literature in the epigram:

> Thy Friendship oft has made my heart to ache:
> Do be my Enemy for Friendship's sake.

Hayley's *Ballads Founded on Anecdotes Relating to Animals* was published in 1805, with illustrations by Blake, and in 1809 he brought out his *Life of Romney.* He died at Felpham on Nov. 12, 1820.

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HAYNAU, JULIUS JACOB, FREIHERR VON (1786–1853), Austrian general notorious for his brutality, was born at Kassel on Oct. 14, 1786. He entered the Austrian army as an infantry officer in 1801, saw much service in the Napoleonic Wars and reached the

rank of *Feldmarschall-lieutenant* in 1844. A capable officer, but of violent temper, he was employed against the Italian revolutionaries in 1848–49, during which crisis he became notorious for the severity with which he repressed and punished a rising in Brescia. Appointed next to command in Hungary (May 1849), he was successful in the field but was again accused of brutality.

On a visit to London Haynau was attacked and beaten by Barclay and Perkins' draymen when visiting the brewery (1850), and he was saved with difficulty from mob violence in Brussels (1852). Haynau died in Vienna on March 14, 1853.

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HAYNE, PAUL HAMILTON (1830–1886), U.S. poet, best known as a southern literary leader, was born in Charleston, S.C., Jan. 1, 1830, and attended Coates school there. He was graduated from Charleston college in 1850. After practising law for a short time, he worked on the staff of the *Charleston Evening News* and the Richmond *Southern Literary Messenger*, and was associate editor of the weekly *Southern Literary Gazette*. His first collected verses he published at his own expense in 1855. He was co-editor of the influential *Russell's Magazine*, launched under the leadership of William Gilmore Simms, during its three years of publication (1857–60). For a short time during the American Civil War, Hayne was an aide to Gov. Francis Pickens, but had to give up active service because of ill-health. He contributed patriotic verse to the *Southern Illustrated News* of Richmond. After the war, his home burned and his fortune destroyed, Hayne and his family moved to a shanty at "Copse Hill" near Augusta, Ga., where he earned his living writing prose and composed some verse. In 1873 he edited a posthumous edition of Henry Timrod's verse. Hayne died on July 6, 1886.

His published works include: *Poems* (1855), *Sonnets and Other Poems* (1857), *Avolio: a Legend of the Island of Cos* (1860), *Legends and Lyrics* (1872), *The Mountain of the Lovers* (1875), *Lives of Robert Young Hayne and Hugh Swinton Legaré* (1878) and *The Broken Battalions* (1885).

See Kate Harbes Becker, *Paul Hamilton Hayne: Life and Letters* (1951).

HAYNE, ROBERT YOUNG (1791–1839), U.S. political leader and spokesman for the south, was born in St. Paul's parish, Colleton district, S.C., on Nov. 10, 1791. He studied law in the office of Langdon Cheves (1776–1857) in Charleston, S.C., and in Nov. 1812 was admitted to the bar. During the War of 1812 he served briefly as captain in a South Carolina regiment. He was a member of the state legislature from 1814 to 1818 and was attorney general of the state from 1818 to 1822. Entering the U.S. senate in 1823, he soon became prominent as a spokesman for the south and for the doctrine of states' rights. He opposed the protective tariff measures of 1824 and 1828 and defended slavery, which he insisted was a domestic institution that should be dealt with only by the individual states.

Hayne is best remembered for his great debate with Daniel Webster in Jan. 1830. This debate originated during discussion of a resolution introduced by Sen. Samuel A. Foote (1780–1846) of Connecticut, calling for a restriction on the sale of public lands. In an effort to gain western support for southern interests, Hayne joined with Sen. Thomas Hart Benton of Missouri in opposing Foote's resolution. Webster denounced Hayne's states'-rights views and made these the main issue of the debate. Hayne, coached by Vice-Pres. John C. Calhoun, argued eloquently that the federal constitution was a compact among the states, and that any state might nullify a federal law which it considered in violation of the constitutional compact.

In 1832 Hayne helped put this theory in effect, though he was more moderate in his views than many of the nullifiers. A member of the South Carolina nullification convention, he reported the ordinance passed by that body which declared the federal tariff laws null and void in the state. Hayne resigned from the U.S. senate in 1832 in order to serve as governor of South Carolina and prepare the state for resistance to Pres. Andrew Jackson's threatened use of federal troops to enforce the tariff laws. He was mayor of Charleston (1835–37) and, as president of the Louisville, Cincinnati and Charleston railroad (1837–39), devoted himself unsuccessfully to efforts to give Charleston a direct rail connection with the Ohio valley. He died at Asheville, N.C., on Sept. 24, 1839.
(R. N. Ct.)

HAY RIVER, 530 mi. long, rises in the foothills of the Rocky mountains in northern Alberta, Can., makes a bend through British Columbia and descends to Great Slave lake, Northwest Territories. Upper Hay river is quite rapid. From Hay lake (elevation 1,078 ft.) it meanders sluggishly north-northeast through flat muskeg country. A stretch of rapids culminating in the Alexandra falls (106 ft.), 50 mi. from the mouth, is followed by a 46-ft. fall and a 250-ft. deep gorge which opens onto the flat country around Great Slave lake (512 ft.). The Mackenzie highway is parallel to the river, connecting the settlements of Meander River, Alberta and Hay River, on Great Slave lake. (An. Kr.)

HAYTON (Haithon, Hethum), king of Little Armenia or Cilicia from 1226 to 1269, was a traveler in western and central Asia; the narrative of his journey, written by a member of his suite, Kirakos Gandaketsi, is one of the earliest and fullest accounts of Mongolian geography and ethnology. Throughout his reign he followed the policy of friendship and alliance with the overwhelming power of the Mongols. After Mangu's accession in 1251, Hayton was summoned to the court of the new grand khan. Carefully disguised, so as to pass safely through the Turkish states in the interior of eastern Asia Minor (where he was hated as an ally of the Mongols against Islam), Hayton made his way to Kars, the central Mongol camp in Great Armenia, and thence by way of Derbent to the residence of Mangu at or near Karakorum, south of Lake Baikal, where he arrived on Sept. 14(?), 1254. There the king remained till Nov. 1, when he left with diplomas, seals and letters of enfranchisement which promised great things for the Armenian state, church and people. He returned by way of the Urumtsi region, Talas, Samarkand, Merv and Khorasan.

See E. Bretschneider, *Mediaeval Researches From Eastern Asiatic Sources*, i, 164–172, "Trübner's Oriental Series" (1888); C. R. Beazley, *Dawn of Modern Geography*, ii, 381–391 (1901). (Wm. C. B.)

HAYWARD, SIR JOHN (*c.* 1564–1627), English civil lawyer and pioneer of "politic" historiography, was born about 1564 at Felixstowe, Suffolk, and educated at Pembroke college, Cambridge. Like other contemporaries (including Bacon, Raleigh, Samuel Daniel and Fulke Greville) Hayward sought to apply Tacitus' and Machiavelli's political and psychological realism to English history and produced the first example of the new approach, *The First Part of The Life and Raigne of King Henrie the IIII* (1599). Dedicated, at an unfortunate moment, to Essex, the book was censored, then suppressed; Hayward, suspected of treasonous intent, was imprisoned in the Tower (1600–03). Probably because of his political writings, Hayward obtained some favour under James I, becoming, with Thomas Camden, historiographer of Chelsea college (1610) and a member of Doctors' Commons (1616); he was knighted (1619), appointed to the court of high commission (1620, 1625–26) and was an M.P. (1620, 1626). He wrote three popular devotional works and three political pamphlets but his histories are his main achievement. *The Lives of the III Normans* (1613) was his most thorough attempt to subordinate mere chronological narration to critical analysis of political problems, individual characters, and their continual interaction. However in 1613 he also abandoned his unfinished *Annals* of Queen Elizabeth (1636, in part; in full, 1840); his *Edward VI* appeared posthumously in 1630; both show increasing sophistication in handling sources, but are still dominated by his characteristic "politic" approach and his curt, sententious style. He died on June 27, 1627, in London.
(S. L. Go.)

HAYWARD, a city of Alameda county, Calif., U.S., less than 5 mi. from San Francisco bay and 15 mi. from the centre of Oakland in the rapidly growing bay area. This important commercial centre, situated between Oakland and San Jose, is served by two railways, a municipal airport and a superhighway.

The first inhabitants of the site were Indians who gathered shellfish and salt at San Leandro creek. After 1797 the region

was grazed by cattle of the Mission San Jose de Guadalupe. Following the gold rush in 1849, William Hayward purchased land on the Guillerma Castro estate and built the first general store in 1851. The town was incorporated in 1876. Meanwhile the economy of the region shifted from livestock to wheat raising and cherry orchards. After World War II the leading manufactured products were canned fruit, ironwork and electrical equipment.

Pop. (1960) 72,700. For comparative population figures *see* table in CALIFORNIA: *Population.* (R. M. W.)

HAYWOOD, ELIZA (1693?–1756), English writer of sensational romances which made her notorious but prepared the way for later women novelists, was the daughter of a London tradesman. When very young she married Valentine Haywood, a middle-aged clergyman; but she appears to have left him to go on the stage, supporting herself by writing. In 1721 she revised *The Fair Captive,* by a Captain Hurst, for Lincoln's Inn Fields theatre. Two original pieces followed, in one of which she acted herself; but she took a dislike to the stage and instead continued to write, in a light, crisp style, the extravagantly passionate fiction for which there was already a great vogue. She produced a total of 70 novels, writing as many as ten in one year (1724).

She became notorious, however, as an imitator of Mrs. Manley (*q.v.*) in writing novels based on contemporary scandal. To *Memoirs of a certain Island adjacent Utopia . . .* (1725) she appended a key in which society leaders were denoted by initials; the British museum has a copy giving their full names. *The Secret History of the Present Intrigues of the Court of Caramania* (1725) was similarly explained. This infuriated Pope, who attacked her with coarse brutality in *The Dunciad* (II, 11. 149 *et seq.*), imputing to her a personal immorality that her earlier novels certainly do not suggest. Although she attempted to retaliate in *The Female Dunciad* (1729), she almost ceased writing for 16 years Pope's friends attacked her also, Swift calling her a "stupid, infamous, woman." Later she achieved some success with *The Female Spectator* (1744–46; mod. ed. by Mary Priestley, 1929), the first periodical written by a woman, and with her most realistic novel, *The History of Jemmy and Jenny Jessamy* (1753). She died in London on Feb. 25, 1756.

See C. H. Whicher, *Life and Romances of Mrs. Haywood* (1915).

HAZAEL (fl. 9th century B.C.), king of Damascus, whose history is given at length in II Kings viii–xiii. He became king after the death of Benhadad II, under whom he was probably a court official. Benhadad (Bar-Hadad), who was ill, sent Hazael to the prophet Elisha to inquire concerning his chances of recovery. Elisha prophesied that Benhadad would die and that Hazael would succeed him. Hazael, on his return, smothered Benhadad and became king. He ruled for many years, during which time he fought the kings of Judah and Israel with some success, capturing all Israel's possessions east of the Jordan. He was eventually conquered by Shalmaneser III (859–824 B.C.), king of Assyria, who defeated Hazael's forces in battle, the first time taking an enormous toll in lives and equipment and driving Hazael into Damascus and the second time capturing a number of Syrian cities. Damascus itself, though besieged and its oasis devastated, was not conquered.

HAZARA, a people of Mongol descent dwelling in the mountains of central Afghanistan. One group, the Eastern Hazaras, inhabit the Hazarajat, extending southward from the Koh-i-Baba mountains of the Hindu Kush range to Ghazni and a point north of Kandahar, and from about 50 mi. W. of Kabul to, roughly, a line drawn between Daulat Yar and Kandahar. The group includes two tribes, the Yek Aulang and the Sheikh Ali, that live north of the Koh-i-Baba, and there are important Eastern Hazara communities in Afghan Turkestan, between Mazar-i-Sharif and Maimana; in Quetta, Baluchistan (west Pakistan); and in Meshed, Iran. The term Western Hazaras includes two peoples: the Hazaras of Qal'a-i-Nau or Hazari, who dwell in the northern foothills of the Paropamisus mountains; and a group straddling the Afghanistan-Iran border who are known as Hazaras in Iran and as Taimuri or Timuri in Afghanistan.

The Hazara Mongols have been said to be descended from garrisons left in Afghanistan by Genghis Khan. The great conqueror actually left no troops when he returned to die in Mongolia in A.D. 1227, but a series of Mongol armies were sent west beginning in 1229. The Eastern Hazaras are descended chiefly from Turko-Mongol armies of Transoxiana who used Afghanistan as a base for invading India during the 13th and 14th centuries and gradually intermarried with the earlier Tajik population. The Western Hazaras may have their origin in rebels from the armies of Hulagu (grandson of Genghis Khan) and later Mongol Ilkhans of Iran.

The Western Hazaras are Sunni Muslims (*see* ISLAM), and speak dialects of Persian. Many were still nomadic or seminomadic in the 1960s. The Qal'a-i-Nau Hazaras spend their summers in felt-covered conical tents, while the Taimuri live in black tents of the Afghan type.

The Eastern Hazaras speak a peculiar kind of Persian which has many Mongol and Turkic words. They are Shi'a Muslims of the Twelver faith except for the Sheikh Ali, who were converted to Sunni Islam. The Eastern Hazaras dwell in fortified villages of flat-roofed houses of stone or mud built wall-to-wall around a central courtyard. These villages overlook the narrow valleys where the Hazaras intensively cultivate rotating crops of barley, wheat and legumes. Poplars or fruit trees are planted along streams, and cucumbers and melons are often raised. The vast, treeless mountains that dominate the landscape are used chiefly for pasturing sheep. The mountain slopes also provide plants for fuel, and fodder for the animals during the long winters when the snows lie heavy. In summer great flocks of sheep are driven to market in Kabul by Timuri tribesmen who also transport ghee (clarified butter) and felts of the Daizangi tribe. Since even with economy and hard work the land does not support the Hazara population, many men go to Kabul and Kandahar to work as unskilled labourers.

The Hazara population of Afghanistan in the mid-1960s has been estimated at about 500,000.

See Elizabeth E. Bacon, *Obok* (1958); Klaus Ferdinand, "Preliminary Notes on Hazara Culture," *Hist. Filos. Medd. Dan. Vid. Selsk.,* vol. 37 (1959). (EL. B.)

HAZARD, ROWLAND GIBSON (1801–1888), U.S. manufacturer and author, one of the founders of the Republican party, was born in South Kingstown, R.I., on Oct. 9, 1801. After studying at the academy of the Society of Friends in Westtown, Pa., he entered the Peace Dale woolen mills, founded by his father, and remained with the mills until 1866. Before this time delicate health forced him to spend his winters in the south, but this necessity permitted him to establish personal business contacts with many leading southern planters. In 1841–42 in New Orleans he won the release of free Negroes taken off ship and impressed in the chain gang. He became a bitter opponent of the fugitive slave laws and the extension of slavery into the territories. This led him to the organizational convention of the Republican party at Pittsburgh, Pa., in 1856. He attended three of the first four national conventions of the party and served often on policy-forming committees. Hazard was elected three times to the Rhode Island house of representatives and once to the state senate.

Hazard's literary interests were broad and largely metaphysical. He wrote numerous essays on politics, language, history and philosophy. At the request of William Ellery Channing, to whose views he devoted one of his essays, he prepared a treatise, *Freedom of Mind in Willing* (1864), in answer to Jonathan Edwards' writings on the freedom of the will. He addressed another volume, *Two Letters on Causation and Freedom in Willing* (1869), to his friend John Stuart Mill. This book opened a lengthy debate between Mill and Hazard, for their ideas on causation were in sharp conflict. Hazard was a senior member of the Rhode Island Historical society and a benefactor of Brown university. He died on June 24, 1888, at Peace Dale, R.I. (N. A. G.)

HAZARD (Spanish *azar,* unlucky throw at dice, misfortune; from Arabic *al* and *zar,* dice), a game of dice once popular in England, was played for high stakes at the rooms of Crockford (St. James's street) and Almack (Pall Mall), London. The name of the popular U.S. dice game of craps derives from a nickname ("crabs") of the cast 1–1 in hazard and the modern rules of craps grew out of the old English game. (*See* DICE: *Games Played With Dice: Craps.*)

In hazard the banker or "setter" sets a stake. The player or

"caster" calls a "main" (a number from five to nine inclusive) and then throws two dice. If he "throws in" or "nicks" he wins the stake. Five is nicked by 5; 6 by 6 or 12; 7 by 7 or 11; 8 by 8 or 12; 9 by 9. The caster "throws out," losing the stake, when throwing aces or deuce-ace (crabs or craps); or when throwing 11 or 12 to 5 or 9; 11 to 6 or 8; 12 to 7. Any other throw is his "chance"; he keeps throwing until the chance comes up, when he wins, or till the main comes up, when he loses. When a chance is thrown, the setter lays the appropriate odds in addition to the original stake. The odds are worked out from the number of ways the mains and chances can be thrown.

Suppose the caster called 7 (the best main, since it can be thrown in six ways): he wins if he throws 7 or 11, and loses if he throws crabs or 12; any other number is his chance. If he threw 4, the odds against him are 2 to 1, for 7 can be thrown in six ways, but 4 only in three. If the original stake was £1, the setter lays £2 to £1 in addition.

HAZARIBAGH, a town and district in the Chota Nagpur division of Bihar state, India. The straggling town lies 58 mi. N. of Ranchi by road on a 2,000-ft. plateau, and is one of the most healthful places in Bihar. Pop. (1961) 40,958.

Hazaribagh District comprises an area of 7,016 sq.mi. Pop. (1961) 2,396,411. There are three distinct physical units: (1) the 2,000-ft. upper Hazaribagh plateau (an elevated gneissic peneplain) in the west-central section, which is undulating and cultivated; (2) a lower (1,000-ft.) gneissic and schistose country in the north and east, partly cultivated and partly wooded, with steep scarps; (3) the coal-bearing sedimentary Damodar trough in the south. Cultivation is interspersed with forests, which cover 56% of the district. The leading crops are rice, oilseeds and millets. Hazaribagh contains the plateau section of the Damodar valley project, including the dams with hydroelectric plants at Tilaiya, Maithon and Panchet Hill, the dam at Konar and the large thermal plant at Bokaro (*see* Damodar). Hazaribagh contains the rich Giridih, Bokaro, Ramgarh and Karanpura coal fields and produces about half the world's mica. Lac is produced from the local forests. Giridih (pop. [1961] 36,881) is an important coal-mining town. (E. Ah.)

HAZE, a slight or moderate diminution of atmospheric visibility, when objects as near as about 1½ mi. are still identifiable, caused either by dry dust or salt particles or by water droplets so small or so widely dispersed as not to be discoverable individually by the unaided eye. There is a "smoky," opalescent or greasy, sometimes dirty-yellow, sometimes whitish, grayish or bluish cast to the air and distant objects. In the U.S. the weather services began in 1938 to distinguish dry haze as one caused chiefly by dust, and damp haze as caused largely by water droplets, but it often happens that dry and water particles are so mixed that the distinction is difficult to make in practice. In Great Britain haze is mainly "damp" and the term is generally used there synonymously with light fog (*q.v.*) or mist. In desert lands the prevalent dry dust haze may be given special names. The shimmering effect of the intensely heated air near the ground on a clear summer day is sometimes called optical haze. (R. G. Se.)

HAZEL, one of three English names that have long been applied to plants and nuts of the genus *Corylus*, the others being filbert and cobnut. The distinction was based wholly upon the relative length of the involucre or husk in comparison with the nut. Filberts were those having husks distinctly longer than the nuts; cobnuts, those with husks and nuts of about equal length; and hazels, those with husks shorter than the nuts. These names were not clearly distinctive; moreover, the relation of length between nut and husk varied both in different parts of the tree during the same year and in the same tree from year to year. In an effort to clarify the naming, in 1942 the American Joint Committee on Horticultural Nomenclature officially recognized filbert (*q.v.*) as the name that henceforth should be applied to this genus.

HAZEN, WILLIAM BABCOCK (1830–1887), U.S. soldier, noted for his contributions, as chief signal officer, to the improvement of weather-reporting and forecasting methods, was born in West Hartford, Vt., Sept. 27, 1830. On graduation from the United States Military academy, West Point, N.Y., in 1855, he entered service against the Indians in the west. He served with distinction during the American Civil War, afterward acting as an infantry colonel on the frontier. In 1880 he was appointed chief signal officer and remained in that capacity until his death, as a brigadier general, on Jan. 16, 1887.

Since 1870, under the first chief signal officer, Brig. Gen. Albert J. Myer, signal corps duties had included provision of the national weather service, using military telegraph lines to transmit weather data gathered at many reporting stations. Hazen continued Myer's practice of employing able meteorologists, notably Cleveland Abbe. Co-operating with other nations in arctic studies (actually the first International Geophysical year), Hazen in 1881 dispatched expeditions to Point Barrow, Alaska, and Ellesmere Island, Can. Members of the latter expedition, under Lieut. Adolphus W. Greely (*q.v.*), reached farther north than any white men to that date, but only 7 of the original party of 25 were alive when they were belatedly rescued in 1884. For his public criticism of the secretary of war's ineffective rescue efforts, Hazen was court-martialed and reprimanded. Meanwhile he introduced Abbe's standard-time meridians and improved upon weather-reporting methods and forecasting procedures, such as signaling the approach of storms and cold waves, to the benefit of commerce and agriculture. Hazen published a number of books, including *Our Barren Lands* (1875) and *A Narrative of Military Service* (1885). (G. R. T.)

HAZLETON, a city of Luzerne county in eastern Pennsylvania, U.S., stands on Buck Mountain plateau at an altitude of 1,624 ft. surrounded by rugged and picturesque terrain 23 mi. S.S.W. of Wilkes-Barre. Laid out in 1836 by the clerk of the Hazleton Coal company, it was incorporated as a borough in 1856 and as a city in 1891. The city's growth was identified with the expansion of anthracite coal mining, which ended with the depression of the 1930s and continued to diminish thereafter. Some of the unemployed found jobs in the textile mills, but population declined as the miners sought work elsewhere. Manufactures include fabrics, clothing, paints and crayons, furniture, electronic tubes, centrifugal pumps, iron wire and steel products, foam rubber, and paper boxes (at West Hazleton, a residential suburb incorporated 1889). The first settlers were from Wales and Ireland, the later ones from central and eastern Europe. Greek Orthodox churches with their towering domes and several Protestant and Roman Catholic churches testify to the transplanting of European culture to Hazleton. Pop. (1960) 32,056; Wilkes-Barre–Hazleton standard metropolitan statistical area (Luzerne county), 346,972. For comparative population figures *see* table in Pennsylvania: *Population.* (R. G. Co.)

HAZLITT, WILLIAM (1778–1830), English writer, who worked as journalist, lecturer, dramatic critic and painter, but will be remembered for his essays. His interests embraced politics, philosophy, literature and all the arts, but he was basically a student of human life and liberty and it is the humanity of his essays that gives them permanent value. He lived by his pen and his writings are voluminous; much of what he published is no longer of general interest, but many of his essays are classics in their kind and his opinions have permeated the national consciousness more than is commonly appreciated. His intellect was brilliant, yet his style of writing is "ordinary" in the best sense; it has no conscious artistry or literary pretensions and can be read for sheer enjoyment of the lively intelligence informing it.

Hazlitt was born at Maidstone, Kent, on April 10, 1778. He was the fourth child and younger son of William Hazlitt, Unitarian preacher, and of Grace Loftus, daughter of a Wisbeach ironmonger. The elder Hazlitt had settled at Maidstone in 1770, but while William was still an infant the family moved to Ireland and thence to America, the father's sympathies having been with the American rebels. There they remained for three years, but when William was nine they returned to England, settling at Wem in Shropshire. William was described as an exceedingly happy and lively child, but at the age of puberty his character changed and he became somewhat sullen and unapproachable. His father even said of him that he "passed under a cloud, which unfitted him for social intercourse." This tendency persisted through his life, and

gave rise to Coleridge's well-known description of his manners as "singularly repulsive—brow-hanging, shoe-contemplative, strange." He was always excessively conscious of himself, jealous and quick to take offense. Yet he could be a generous admirer of genius in others, and his consistent championship of Keats against his critics is always remembered to his credit.

As a youth Hazlitt read intensively and so laid the foundation of the wide knowledge of literature and philosophy that he used so effectively in his writing. Yet he found great difficulty in expressing himself both in conversation and writing, so that he turned first to painting as an outlet for his ambitions. His elder brother John was already in 1798 established in London as an artist, and his example no doubt had some influence. For several years Hazlitt worked hard at what seemed to be his profession. In 1802 he went to Paris to work in the Louvre but war between France and England in 1803 compelled his return. By 1804, when he first met Charles Lamb, he was a more than proficient portrait painter, and his portrait of Lamb (in the National Portrait gallery, London) is sufficient evidence that he could have excelled had he persisted. He was encouraged by Coleridge and Wordsworth, who had been his friends since 1798, but in 1805 he turned from his painting and gave his mind to the metaphysics and philosophy which had interested him earlier, publishing his first book, *On the Principles of Human Action.* Other books followed—*Free Thoughts on Public Affairs* (1806), an abridgment of Abraham Tucker's *Light of Nature Pursued* and a *Reply to Malthus's Essay on Population* (both 1807). He was also working on a collection of parliamentary speeches with comments on the speakers; two volumes appeared in 1807. In the same year he formed an attachment to Sarah Stoddart, a friend of the Lambs, and in May 1808 they were married, going to live at Winterslow on Salisbury plain, which was to become Hazlitt's favourite retreat for thought and writing. Here he worked on a series of literary projects—a *History of English Philosophy,* which was abandoned, an *English Grammar* (1810) and *Memoirs of Thomas Holcroft* (1816), the dramatist and novelist and a friend of Hazlitt's for some years up to his death in 1809.

Hazlitt's first child was born at Winterslow in 1809, but did not live. His second child, William, was born in 1811. He had before this again tried to return to painting in London, but he seemed to himself to have failed both as artist and writer, and by the end of 1811 he was penniless. He retrieved his position by a course of lectures on philosophy in London and by reporting for the *Morning Chronicle.* Two years later he was fully established as critic, journalist and essayist, his collected dramatic criticisms being published as *A View of the English Stage* (1818). He was also contributing to a number of journals, including Leigh Hunt's *Examiner.* This association led to the publication of *The Round Table,* 2 vol. (1817); 12 of the 52 essays were by Hunt, though only Hazlitt's name appeared on the title page. In the same year Hazlitt published his *Characters of Shakespeare's Plays,* which met with immediate approval in most quarters. At the same time he was fearlessly expressing himself in forcible terms in the journals and was involved in many quarrels with his friends. In addition he was savagely attacked by William Gifford in the *Quarterly Review,* the sales of his Shakespeare volume being greatly damaged thereby. In 1815 he had been profoundly upset by what was to him a bitter blow, the defeat of Napoleon at Waterloo. Napoleon had been his idol for some years, and B. R. Haydon, the painter, said that he attempted for a time to drown his mortification with drink. Hazlitt's irritability was accentuated by ill-health, perhaps initiated by his indulgences and certainly made worse by the journalistic battles which came to a head in the action he brought against *Blackwood's Magazine.* This was settled in his favour out of court and in 1819 he had the satisfaction of publishing his *Letter to William Gifford,* paying off old scores with barbed invective to the admiration of his friends, particularly Keats who, with Shelley, had been added to his circle of friends and admirers.

Meanwhile Hazlitt was consolidating his reputation as a lecturer, delivering a course *On the English Poets* (published in 1818) and another *On the English Comic Writers* (published in 1819). Keats was not able to hear the second course, but, having read them, quoted in a letter to his brother, George, "a specimen of his usual abrupt manner and fiery laconicism." In 1819 Hazlitt also published a collection of his political essays written during his years of journalism, adding some "characters" of statesmen first printed in earlier books. He resolved thereafter to withdraw from political controversy and occupied himself during 1819 with preparation of his *Lectures on the Dramatic Literature of the Age of Elizabeth.* These were the last lectures he delivered, and he subsequently devoted himself chiefly to essays for various journals, especially John Scott's *London Magazine,* of which he temporarily became editor after Scott's death.

Many of these essays were written at Winterslow, where he was often alone, having lived apart from his wife since the end of 1819. When in London he occupied lodgings in Southampton buildings, where he fell in love with Sarah Walker, daughter of his landlord. This girl he intended to marry after completing arrangements in Edinburgh for divorcing his wife. He was a free man by June 1822, but some weeks later it became known that he had been deceived by Sarah Walker, who, while seeming to favour his attentions, had admitted another lover. This rebuff caused him intense suffering, which he sought to "burn out of his mind" by writing an account of his affair. This strange work was published in 1823 under the title *Liber Amoris; or, The New Pygmalion,* and attracted greater notoriety than its merits deserve. Its publication was, however, necessary for its author's peace of mind.

Hazlitt's two most famous books of essays, *Table Talk* (1821) and *The Plain Speaker* (1826), contain all the best essays written in the years 1820–25. Many other essays were collected in posthumously published volumes edited by his son—*Sketches and Essays* (1829), *Literary Remains* (1836) and *Winterslow* (1850); many more remained to be collected as *New Writings,* 1st and 2nd series (1925–27) edited by Hazlitt's biographer, P. P. Howe. Hazlitt also found time to produce a volume of *Characteristics, in the Manner of La Rochefoucauld's Maxims* (1823), to edit a large volume of *Select British Poets* (1824) and to complete sketches of the *Principal Picture Galleries in England* (1824), including his celebrated essay on the Dulwich gallery.

In April 1824 Hazlitt married for the second time, his bride being a widow named Bridgwater whom he had met in a stagecoach; but the presence of the new Mrs. Hazlitt was resented by young William, to whom his father was devoted, and they separated three years later. Hazlitt had spent part of his second period of matrimony in France and Italy, and while in France on this and other occasions worked at his most ambitious and least successful work, the *Life of Napoleon,* 4 vol. (1828–30). His travels in 1824–25 he recorded in his *Notes of a Journey in France and Italy* (1826). He also published in 1825 a series of essays on contemporary figures entitled *The Spirit of the Age,* containing some of his most animated and effective writing. His last book, *Conversations of James Northcote* (1830), was a record of his friendship with that eccentric painter over many years, the "conversations" having been published as a series in the *New Monthly Magazine* (1826–27), and in other journals in 1829.

During these latter years Hazlitt's health had deteriorated and he died of cancer of the stomach at his lodgings in Frith street, Soho, on Sept. 18, 1830. He was buried at St. Anne's, Soho. His last words were reported by his son to have been, "Well, I have had a happy life." Although he had been through unhappy episodes, there is no doubt that his zest for living and his intense interest in human affairs had kept him happy most of his life. It may be said of him in the words which he wrote of Dr. Johnson, "He had faults, but they lie buried with him. He had his prejudices and his intolerant feelings, but his were not time-serving, heartless, hypocritical prejudices, but deep, inwoven, not to be rooted out but with life and hope, which he found from old habit necessary to his own peace of mind. I do not hate, but love him for them."

Hazlitt's essays are so numerous that it is difficult to select any small number for special mention. But it is generally agreed that he is represented at his brilliant best in essays such as "On Living to One's-self," "The Fight" (an account of his unpremeditated ex-

pedition to Hungerford to see Bill Neate fight the Gas-man), "On Disagreeable People," "My First Acquaintance with Poets" (chiefly about Coleridge and Wordsworth), and "Of Persons One would Wish to have Seen."

His *Complete Works* were edited by A. R. Waller and Arnold Glover, with an introduction by W. E. Henley, in 13 volumes (1902–06; reissued, edited by P. P. Howe, 21 volumes, 1930–34). Among selections from the essays are those edited by F. Carr (1889); by A. Ireland, with a memoir (1889); by D. Nicol Smith, on poetry (1901); by C. Whibley (1906); by Jacob Zeitlin (1913); by G. Sampson (1917); by P. P. Howe (1923); by C. H. Gray (1926); and by G. Keynes (1930).

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(G. L. K.)

HAZOR (modern TALL AL QEDAH, TALL WAQQAS), an ancient, ruined city lying on the edge of the Hule plain below the Upper Galilee mountain range, about 10 mi. N. of the Lake of Galilee in modern Israel. Hazor is first heard of, in the 19th century B.C., in the Egyptian execration texts (in which are listed potential enemies of Egypt in the outer provinces of the Egyptian empire). It was mentioned in the Mari letters (*c.* 1700 B.C.) and again in the Tell el-Amarna letters of the 14th century B.C. In two of these letters the kings of Tyre and Ashtaroth complain that the king of Hazor in league with the 'Apiru (Hebrews) had captured several of their cities. Two letters from the king of Hazor deny these charges.

In biblical times Jabin, king of Hazor, headed a league of states against Israel and was disastrously defeated by Joshua: "And Joshua turned back at that time, and took Hazor, and smote its king with the sword; for Hazor formerly was the head of all those kingdoms. And they put to the sword all who were in it, utterly destroying them; there was none left that breathed, and he burned Hazor with fire" (Josh. xi, 10–11). For an account of the defeat of the army of another king by this name *see* Judg. iv. At a later period King Solomon refortified Hazor (I Kings ix, 15), but in 732 B.C. it was captured by Tiglath-pileser III and the population were taken as captives to Assyria (II Kings xv, 29).

The site of Hazor was identified in 1928 by John Garstang, who carried out preliminary investigations. Full-scale excavation work was started in 1955 and carried on until 1958 by the James A. de Rothschild expedition of the Hebrew university, Jerusalem, under the direction of Yigael Yadin. The excavations prove that the largest part of the city, located north of the original mound, was occupied from about 1700 to about 1200 B.C. and that its abandonment was caused by the Israelite conquest of Canaan. Among finds have been a Late Bronze Age precursor of the temple of Solomon and a sanctuary of the same age with several memorial stelae. Most important, perhaps, has been the discovery of the Solomonic town, with characteristically 10th-century casemate wall and triple gateway, as at Megiddo and Gezer (also proved by Yadin).

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(W. F. A.)

HEAD, the upper portion of the body in man, consisting of the skull with its coverings and contents, including the lower jaw. It is attached to the spinal column by way of the first cervical vertebra, the atlas, and connected with the trunk of the body by the muscles, blood vessels, nerves, etc., that comprise the neck. The term also is used to describe the anterior or fore part of animals other than man.

See also BRAIN; SKULL; articles on the various organs, etc., that are located in the head; and references under "Head" in the Index volume. (F. L. A.)

HEADACHE is one of the commonest of the discomforts that trouble mankind. It is often a source of special concern because neither its intensity nor its location on the head denotes whether it is due to some ominous intracranial disease or to a minor and superficial disorder. In approximately 9 of 10 patients afflicted with headache, the condition stems from readily reversible changes in cranial arteries or in skeletal muscles of the scalp and neck; these changes are usually physiologic responses to adverse attitudes and stressful living situations.

Arterial (also called vascular) headaches result from dilatation of certain blood vessels, either intracranial or on the surface. Migraine (*q.v.*) is the major example of this mechanism, occurring in attacks at highly variable intervals throughout a lifetime, sometimes unilaterally, often accompanied by nausea and occasionally preceded by brief visual or other symptoms. The second common variety of headache is that due to sustained contraction of skeletal muscles of the scalp and neck, especially of the posterior nuchal group.

Much rarer but of major therapeutic importance are the intracranial headaches due to infection (*e.g.*, meningitis), hemorrhage or masses (such as blood clots or tumours), and the headaches associated with active infection of the nose and sinuses. A large number of other varieties are of minor significance.

Rational treatment requires not simply medications to ease pain but also measures aimed at reversing the pain mechanism and removing the underlying cause of the illness. When headache arises from a patient's discontents, as it so often does, he needs broad study and counseling. *See* also HISTAMINE.

See H. G. Wolff, *Headache and Other Head Pain* (1948).

(E. C. Ku.)

HEAD AND NECK, SURGERY OF, is a term that describes loosely a branch of modern surgery specializing in operations on the face, throat and neck. It does not include surgery of the brain, eye or neurosurgery, nor does it include dental operations. In medical centres in both Europe and America surgeons trained in general surgery, plastic surgery or both perform most of the major head and neck surgery. The largest number of these operations are performed to correct congenital deformities such as cleft lip and palate, to eliminate cancer of the face, oral cavity, larynx, salivary glands and jaws, and to correct the deformities and functional loss suffered as a result of injury to the facial bones and features. Because of the exposed location of the head and neck, deformity subsequent to disease, injury or surgery is extremely important to any patient. As a result, emphasis has been placed on the development of immediate and early reconstructive surgery to make operations less crippling to the patient. Plastic surgery has made great strides in this direction.

The rapid growth of the field of head and neck surgery results from several factors. (1) The use of antibiotics greatly reduced the dangers of infection following surgery; formerly the normal bacteria in the human oral cavity caused devastating infections after operations in which these organisms were allowed to enter the tissues of the neck. (2) The widespread use of blood transfusions has made it possible to carry out long and tedious operations without shock on that part of the body which is notorious for the amount of bleeding produced during surgery. (3) Modern techniques of anesthesia also have greatly reduced the dangers to the patient, so that even major operations in the head and neck region now carry an operative mortality of less than 1%.

The role of plastic surgery is important, and the experiences of World War II showed surgeons that techniques of rebuilding the human face could be used to great advantage in most head and neck surgery. These techniques include skin grafting to replace missing surface or features, muscle transplants for paralyzed facial muscle, nerve grafts and transplants, bone grafts to rebuild jaws or nose, and blood vessel grafts for arteries.

Maxillo-facial surgery is a term generally used to denote a field related primarily to dental surgery and jaw deformities.

See also PLASTIC SURGERY; TRANSPLANTS, TISSUE AND ORGAN.

(M. T. E.)

HEAD-HUNTING is the practice of removing and preserving human heads. Although probably due partly to acquisitive needs, it arises in some cultures from a belief in the existence of a more or less material soul matter on which all life depends. In the case of human beings this soul matter, often in diminutive human form, is held to be located particularly in the head. In removing a head the soul within is believed to be captured and added to the general

stock of soul matter belonging to the community, contributing to the fertility of the human population, the cattle and the crops. According to the Karens of Burma the soul was a sort of pupa which bursts, its vaporous contents spreading over and fertilizing the fields, passing again through the eaten grain or herb into the bodies of men or animals and so again into the seminal fluid enabling men and animals to propagate life. While precisely the same formula cannot be postulated of all head-hunters, head-hunting is commonly based on a similar belief in a cycle of life dependent on the possession of soul (*see* METEMPSYCHOSIS), and on a belief in life as something concrete and transferable.

Head-hunting has been associated (1) with ideas regarding the head as the seat of the soul; (2) with some forms of cannibalism (*q.v.*) where the body or part of the body is consumed in order to transfer to the eater the soul matter of the victim; and (3) with phallic cults and fertility rites intended to imbue the soil with productivity. It may thus develop into human sacrifice, a practice which has been generally associated with agriculture. Head-hunting, or some practice closely allied to it, has been found sporadically all over the globe. (*See* SACRIFICE.)

In Europe the practice actually survived until the early 20th century in the Balkan peninsula, where the taking of the head implied the transfer of the soul matter of the decapitated to the decapitator. The complete head was taken by Montenegrins as late as 1912, being carried by a lock of hair worn allegedly for that purpose. In the Balkan War of 1912–13, nose-taking was substituted, and it was the practice to cut off the nose and upper lip with the moustache (by which it was carried) just as in Kafiristan and in Assam an ear was sometimes carried off instead of the whole head. In the British Isles the practice continued approximately to the end of the middle ages in Ireland and the Scottish marches; and in Ireland, until the 20th century at any rate, a Martinmas pig was killed that the fields might be sprinkled with blood and so rendered fertile. In some parts of Europe murderers have been known to eat part of their victims to secure themselves against ill will on the part of the ghost, probably in the belief that the consumption of the flesh leads to spiritual identity.

In Africa the metempsychic notion has shown itself rather in the form of human sacrifice than of true head-hunting. Dahomey and Ashanti were notorious examples, and the fact that the human sacrifices in Dahomey were thought to make rain magic more efficacious suggests the working of the same ideas, while an instance is known of a Matabele chief who anointed his body and fertilized his fields with human fat. The eating of an enemy's heart has been reported from Dahomey and the use of skulls as drinking cups from the Guinea coast. Bona fide head-hunting occurred in Nigeria, where a number of customs strongly suggest Indonesian culture. As in Indonesia, head-hunting among the Kagoro, and perhaps other tribes in Nigeria, was associated with the fertility of the crops, with marriage and with the victim's obligation as a servant in the next world.

Herodotus mentions Asian head-hunters, and on a bas-relief from Nineveh in the British museum, London, is represented a battle in the 7th century B.C. between Assur-bani-pal and the king of Elam, in which the Assyrians are depicted as cutting and carrying off the heads of the slain. In Kafiristan on the northwest frontier of India head-hunting was practised until about the end of the 19th century, women showering wheat upon men returning with heads from a successful raid. In the northeast of India, Assam was famous for head-hunting. All the hill tribes living south of the Brahmaputra—Garos, Khasis, Nagas and Kukis—formerly were head-hunters, and some of the Naga tribes continued to practise the decaying cult.

Head-hunting in Assam was normally carried on by parties of raiders who depended upon surprise tactics almost entirely. The heads, and sometimes also the hands and feet or even whole limbs, were cut off and carried to the home village, where the head was usually placed on a stone or pile of stones kept for that purpose. The practice of cutting off the limbs possibly had a different origin, as there were tribes north of the Brahmaputra that did not take heads, but did cut off the feet and hands of slain enemies, presumably to incapacitate the ghost. The skull, after its virtue had passed into the stone on which it was laid, was either buried face downward (as by the Angami tribe), hung up in trees (as by Semas and Lhotas) or suspended in the chief's house or the bachelors' hall. In the latter case some tribes decorated the skull with a pair of buffalo horns, probably as a fertility symbol, and with long tassels of a broad-bladed grass which rustled when it was swung by a dancer at a feast, much as in Borneo. If several participants in a raid were all in at the death, the head was often divided on a fixed system, certain definite portions going to the first, second and third spears, etc. The insignia and, where tattooing was practised, the tattoo patterns worn by the successful warrior had specific reference to success in head-hunting. Thus the Angami warrior wore one hornbill feather for each success—"touching meat" as it was called—while the Konyak warrior had his neck tattooed only if he had actually performed the act of decapitation in person, though he might have his chest tattooed for "touching meat" and his face for the act of killing the enemy in person. With the Naga a head had to have cut its teeth to count, and a female head was at least as good as a male's; but with the Kuki, whose cult was probably mixed and whose desire for heads was merely to supply a dead relative with servitors in another world, any head, even that of an embryo, was good. The Kagoro and Moroa tribes of west Africa, like the Kuki of Assam and the Kayans of Borneo, desired slaves in the next world rather than soul matter in this. The Naga never took the head of a fellow villager even though clan feuds within the village were very bitter and led to much bloodshed; even outside the village as a rule heads were not taken between men of the same or nearly related clans, a self-denying ordinance shared with the Kagoro. The younger women were great instigators of head-hunting and refused to marry men who had not "touched meat," probably with the idea that until they had taken life they were unlikely to beget offspring.

In Burma several tribes followed similar customs. The Wa tribe observed a definite head-hunting season when the fertilizing soul matter was required for the growing crop and wayfarers moved about at their peril. In Borneo, Indonesia generally, the Philippines and Formosa similar methods of head-hunting were obtained, and the hill tribes of Malaya and Indochina probably have been head-hunters at some period. The Ibans of Borneo were particularly enthusiastic in this respect. The practice was reported in the Philippines by Martin de Rada in 1577, and was only abandoned formally by the Igorot and Kalinga of Luzon at the start of the 20th century, while in Formosa it prevailed among the hill tribes. Elsewhere in Indonesia it extended through Ceram, where the Alfurs were head-hunters, to New Guinea, where the Motu, like the Lhota Naga of Assam, wore a hornbill's head as the insignia of achievement; here and there, as in the Batak country and in Timorlaut, it seems to have been replaced by cannibalism.

In New Guinea the Tugeris (Marind-anim) used a bamboo knife for the act of decapitation, perhaps believing iron would adversely affect the soul within. Throughout Oceania head-hunting prevailed sporadically till recently. In the Solomon Islands the actual expedition to obtain a head formed the climax in a series of ceremonial acts extending over a number of years, and which comprised an important part of the social life. The suppression of head-hunting thus was a serious factor in the decay of society and the decrease of population which followed under British administration. Throughout Oceania head-hunting was closely associated with, and tended to be obscured by, cannibalism, but in many islands the importance attached to the head was unmistakable. In parts of Micronesia the head of the slain enemy was paraded about with dancing, which served as an excuse for raising a fee for the chief to defray public expenditure, after which the head would be lent to another chief for the same purpose. In Melanesia the head was often mummified and preserved, and sometimes, as in New Britain, seems to have been worn as a mask in order that the wearer might acquire the soul of the dead man. Similarly, it was reported that aboriginal Australians believed the spirit of a slain enemy entered the slayer. In New Zealand the heads of the foe were dried and preserved so that the tattoo marks and often the actual features were recognizable; this practice led to a development of head-hunting when tattooed heads became desirable curios and

the demand in Europe for Maori trophies caused "pickled heads" to become a regular article of ships' manifests.

In North America the general practice was to take the scalp rather than the head, indicating probably that the soul was thought to be located in the hair: an idea present in the biblical story of Samson; common in Malaya and Indonesia, where Nagas and Borneans used the hair of their dead enemies for ornaments, as did the North American Indians; in Oceania, where the Marquesans used the hair of the victims of their cannibal rites for making arm rings and necklets of magic virtue; and frequent in South America, where the heads were often preserved, as by the Jivaros, by removing the skull and packing the skin with hot sand, thus shrinking it to the size of the head of a small monkey while preserving the features intact as a vivid portrait in caricature. There, again, headhunting was probably associated with cannibalism in a ceremonial form, and the heads of certain animals were also treated similarly.

Head-hunting, therefore, has been worldwide. It was associated with tribes still living in the Stone Ages, and may even go back to paleolithic times, as in the Azilian deposits at Ofnet in Bavaria where heads were found carefully decapitated and buried separately from the bodies, indicating beliefs in the special sanctity or importance of the head.

Despite the fact that head-hunting activities have been legally banned, scattered reports of such practices (for example, the ambush and murder of a hunting party of eight men by Ilongot headhunters in the Philippine Islands) continued to appear during the 1960s.

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(J. H. H.; X.)

HEADLAM, ARTHUR CAYLEY (1862–1947), bishop of Gloucester, a vigorous promoter of Christian reunion, was born at Whorlton Hall, Durham, Eng., on Aug. 2, 1862. Educated at Winchester and New college, Oxford, he became a fellow of All Souls' college in 1885. He published (with William Sanday) in 1895 a commentary on the Epistle to the Romans that became a standard work. He was rector of Welwyn from 1896 to 1903, when he became principal of King's college, London (a college of the University of London from 1910). Headlam's work for King's college, particularly his administrative reorganization, was of outstanding importance. In 1918 he was appointed regius professor of divinity at Oxford, where his term of office was notable for his reform of the honour school of theology and for his Bampton lectures (1920) on *The Doctrine of the Church and Christian Reunion*. From 1923 to 1945 Headlam was bishop of Gloucester, and was a prominent champion of the cause of ecclesiastical reunion, both with the non-episcopal Protestant churches and with the Eastern Orthodox, Lutheran and Old Catholic churches, being chairman of the Church of England Council of Foreign Relations from 1933 to 1945. In 1934 he published a work on *Christian Theology*. He was a man of great physical strength, formidable powers of work, definite and forthright opinions and directness, not to say brusqueness, of manner, and was a great administrator, both in academic and ecclesiastical affairs. He died on Jan. 17, 1947, near Barnard castle, Durham. (N. S.)

HEALTH, EDUCATION AND WELFARE, DEPARTMENT OF: *see* Government Departments: *United States*.

HEALTH, MINISTRY OF: *see* Government Departments: *Great Britain*.

HEALTH AND SAFETY LAWS. One of the earliest and most important objectives of government and law is the provision of public health and safety. In many societies law as a distinct means of social control originates when some official agency is created to protect communal health and safety from some supposed danger threatened by natural or supernatural forces. In primitive cultures, and in western civilization up to the middle ages, this social concern usually was manifested in a negative way by the isolation or destruction of the patient in order to protect the healthy. Modern public health laws, social legislation and preventive medicine are largely the products of the scientific advancements of the 19th and 20th centuries.

INTRODUCTION

The interest of the individual and society in health and safety finds expression in the orders of executives, the ordinances and statutes of legislatures and councils, and the decisions of courts and administrative bodies. That such an interest is conceded to be among the most important values is also shown by the deference courts have shown for legislative and executive formulations of health and safety policy. In the United States, even during the period when courts wielded their power of judicial review to an unprecedented extent and readily substituted judicial preference for legislative judgment, health and safety laws were subject to milder scrutiny than measures involving, for example, economic experimentation. The common law at times gave priority to health and safety matters over property rights and economic interests.

Ultrahazardous undertakings, the creation or maintenance of dangerous conditions or objects, have long been a basis for special classification. Although most states of the U.S. have rejected the English doctrine of *Rylands* v. *Fletcher* (1868), which imposes strict liability for the escape of dangerous substances, the concept of nuisance has been construed to cover such cases.

The common law created an implied warranty of fitness for human consumption in the sale of foodstuffs, and the liability of products today may be based on the fact of sale rather than on negligence in processing or failure to inspect. In short, danger to human health and safety is a special circumstance and a paramount value. Summary procedure and something less than the due process usually required may be invoked when health authorities or fire marshals act to cope with emergencies, and both the police power of the state and the power of eminent domain may be utilized to protect or promote public health and safety.

HISTORY

In addition to isolation of the sick, principles of hygiene and sanitation have been developed by many preliterate peoples. Whenever these matters are deemed to be of sufficient social concern, they receive the coercive sanction of law, as well as the informal sanctions of custom or religion. The preservation of peace and order, the conservation of manpower and a desire to prevent offenses that may provoke the wrath of the gods against the community are among the immediate objectives of law that may be included under the general title of public health and safety laws. They are the forerunners of what is termed the police power of the modern state.

The history of health and safety laws has been determined in large measure by the influences of religion and science and by political and economic forces. A public concern with the health problems of community life, the control of communicable diseases and improvement of environmental and sanitary conditions, such as the provision of food and water, medical care, and sewerage and drainage facilities, may be found in varying degrees in primitive, ancient and modern societies. Moreover, religious and health objectives may be inextricably intermingled, as, for example, in dietary laws, the rules of hygiene and precautions against contagion specified in Leviticus and Numbers, prohibitions against consanguineous marriages and the merging of functions in priests and shamans. In the western world there was a close relationship, if not identity, between church and state until the Reformation,

and for centuries virtually all literate men were clerics, which meant that most scientific knowledge was in their hands and subject to church control.

Early Influences.—The emphasis of the early church upon spiritual matters and the belief that disease and death were the wages of sin stood as major obstacles to a positive program for public health and social reform. On the other hand, the church and its religious orders did establish and maintain relieving institutions for travelers, the sick and widows, such as that founded by Basil the Great in A.D. 370 at Caesarea; and Pope Leo XIII's encyclical *Rerum novarum* (1891) and Pope Pius XI's *Quadragesimo anno* (1931) were most important for the social reform movement of the 19th and 20th centuries. It is only since the Industrial Revolution that cleanliness has been officially promoted.

The middle ages (about A.D. 500–1500) saw a decline from the standards of hygiene and sanitation of classical Rome. Although we are greatly indebted to the Greeks for principles of personal hygiene and to the Romans for the development of public sanitation, there are records of elaborate programs in even more ancient times. Ruins in the Indus valley and at Harrapa, in the Punjab, reveal that building codes were in effect and that sanitation engineering was far advanced as early as 4000 B.C. Egyptian ruins dating from the middle kingdom (2100–1700 B.C.) include bathroom facilities and sewerage systems as do those of the Incas in the new world. In addition to the formulation of principles of hygiene, the Greeks were responsible for the first attempt to show a causal relation between environmental factors and disease. The book in the Hippocratic collection known as *Air Waters and Places* served for over 2,000 years as the basic text on epidemiology and helped to sustain the miasmatic (contaminating atmosphere) theory of disease (*see* HIPPOCRATES) until use of the microscope led to the discovery of microbes and the beginning of bacteriology (*q.v.*). The Romans perceived a relation between swamps and malaria, devised crude respirators to protect workers from dust, in the 2nd century instituted a public medical service, built sewerage systems and public baths and engineered 14 great aqueducts. They also built the first hospitals and codified and successfully administered health laws. Officials were appointed to maintain the banks of the Tiber, to guard the aqueducts against pollution, to inspect and maintain sewers, to destroy impure foodstuffs, to check weights and measures and to regulate public baths, brothels and burial grounds. Justinian I, when one of the worst plagues in history came to Byzantium in 532, set up quarantine posts and required certificates of health for admission to that city.

Middle Ages.—Upon the disintegration of the Roman empire, there was a general decline of urban culture and with it an abandonment of public health measures. Byzantium became the cultural and medical centre for Europe, and from there Greco-Roman medical knowledge spread to the Arab world, while in the west, health problems were still dealt with largely in terms of magic and religion. During medieval times some of the larger monasteries had proper water supplies and heating and ventilation facilities, but smaller buildings did not. Most medieval cities had a chronic problem in trying to provide a sufficient supply of nonpolluted water and in protecting the public from disease. During the middle ages in England the common-law concept of public nuisance provided a means for relief against some flagrant cases of pollution of water supply as did the common-law crime of malicious mischief, and in both England and on the continent, ordinances and statutes were enacted to outlaw some of the most prevalent threats to public health. For example, Douai, France, in 1271, Augsburg, Ger., in 1453 and Rome in 1468 forbade tanners to wash animal skins on the banks of streams, dyers to pour dye residue therein and the public from washing clothes at a river which served as a source of water supply. Early in the 15th century several German cities forbade the construction of hogpens facing the street. In 1185 the streets of Paris were paved to help keep the city clean. London from 1309 had ordinances dealing with the disposal of sewage and offal, and Milan from the 14th century had statutes regulating cesspools and sewers. Most of these ordinances and laws, however, received only sporadic enforcement and tended to become dead letters.

The health measures that received the most conscientious enforcement during the middle ages were those pertaining to the sale of adulterated or contaminated food and those providing for quarantine in the case of epidemics. Municipal authorities in many places policed the fairs and market place to protect purchasers of food. Inspection was practised, and detailed regulations were enforced. For example, Augsburg in 1276 ordered meat that was not freshly slaughtered to be sold at a special stand, and the Florentines forbade the sale on Monday of meat that had been offered for sale the previous Saturday.

Although epidemics were regarded by many as a punishment for man's sin, the transmissibility of certain diseases was well known during the middle ages and had been for centuries. Thucydides had portrayed a vivid account of an epidemic during the second year of the Peloponnesian War. Between the plague of Justinian (A.D. 543) and the Black Death (1348) there were a large number of plagues, involving such diseases as leprosy, bubonic plague, smallpox, diphtheria, measles, influenza and sweating sickness, and lesser diseases. The medieval urban dweller lived in constant fear of epidemics, and when leprosy reached serious proportions in the 13th and 14th centuries, quarantine laws were rigidly enforced. At the beginning of the 13th century, in France alone there were about 2,000 leprosaria, and in all of Europe the number probably exceeded 19,000, although many cases were admitted that were not leprous.

The third Lateran council in 1179 promulgated detailed rules to govern the commitment of lepers. The experience with lepers was carried over when the Black Death (bubonic plague) killed thousands of workers in the 14th century (*see* PLAGUE). Suspicious cases were required to report to local authorities who examined them; if the patients were found to have the plague, they were isolated, as were all those who came into contact with them, food and necessities were provided, the dead with their personal effects were buried outside the city, and the place where they had died was fumigated. Venice, the chief port for trade with the orient, usually is credited with originating the pattern of quarantine procedure that was in effect during the middle ages, and other seaports also established observation stations and isolation hospitals.

In England from the 12th to the 15th century more than 720 hospitals were established, 217 of which were for lepers. At the beginning of the 14th century, Paris had about 40 hospitals and at least an equal number of leper houses. During the latter part of the middle ages, cities and guilds took an active part in founding and maintaining hospitals.

Later History.—*Europe.*—By the close of the middle ages, medicine and public health had fallen under local governmental control. Regulations protecting the water supply from pollution were supplemented by other provisions dealing with street cleaning, garbage disposal and the like, all of which collectively might be termed sanitary codes. Physicians and surgeons were required to follow rigid codes and set fee schedules. In addition, writings on nutrition began to appear, and public bathhouses were licensed. When syphilis became widespread early in the 16th century, the first control measures were directed against prostitutes.

The attempt to deal with public health problems on a municipal basis was far from successful. Inland cities were all but defenseless against the spread of disease from the seaports. Moreover, in the larger cities the administration of particular ordinances was delegated to various boards, commissions and officials, so that the net result was a crazy quilt of sanitary committees. London in the 1830s divided such authority between the city corporation and the city companies, 7 boards of commissioners for sewers and nearly 100 paving, lighting and cleansing boards, and there were about 172 vestries of one sort and another and boards of guardians appointed under the poor laws. The parish of St. Pancras alone had 21 paving and lighting boards, on which sat about 900 commissioners.

Colonial America.—Colonial America followed the pattern of utilizing inspection and quarantine for communicable diseases and the enactment of sanitation legislation. The account of George Percy regarding the settlement of Jamestown, Va., describes the "cruell diseases, Swellings, Fluxes, Burning Fevers" and famine

that afflicted that colony. Almost half of the 100 (or 102) Pilgrims that landed at Plymouth, Mass., in Dec. 1620 died within three months after arrival. During the winter before the Pilgrims' arrival, an epidemic reduced the numbers of Indian warriors of New England from 9,000 to a few hundred. Inoculation was brought to the colonies by Zabdiel Boylston and Cotton Mather and later was regulated by colonial legislatures. As early as 1647, ships from the West Indies were quarantined in Boston harbour; and in 1663, during a smallpox epidemic, New York regulated entry into its city by travelers from contaminated regions. Abatement of public nuisances seems to have been in the hands of local authorities throughout most of the 17th century, but a South Carolina statute of 1692 forbade swine running at large in the city of Charleston and directed all persons to cut noisome weeds in and about the lots and streets. During the same year the Massachusetts general assembly empowered selectmen and justices to assign locations for slaughterhouses and places for the testing of tallow and the currying of leather. The charters granted by William Penn to Philadelphia and Chester, Pa., in 1701 conferred power upon mayors and magistrates to abate nuisances. Detailed quarantine regulations were enacted in Massachusetts in 1701. The first American health board was appointed in Baltimore, Md., in 1793, and by 1797 there were similar boards in New York and Massachusetts.

Influence of the Industrial Revolution.—The Industrial Revolution (*q.v.*) occasioned a tremendous increase in urban population, and slum conditions became acute in many manufacturing areas. The first English attempt at slum clearance was in London in the 1760s, when many timbered buildings were pulled down and replaced by brick structures, and streets were paved, drained and lighted. In addition to disease and slum conditions, the urban population faced poverty and frequent unemployment. The Elizabethan poor laws imposed the duty on the individual parish to provide relief, including medical relief, for the indigent (*see* Poor Law).

SOCIAL REFORM

By the beginning of the 19th century, in England and on the continent, the interrelationship between poverty, disease, physical environment and crime was apparent, and the view that such conditions were neither inevitable nor irremedial was gaining ground. To the rationalists of the age of reason, a scientific approach to social problems would provide the answers. Industrialists, such as Sir Robert Peel and Robert Owen, and physicians, such as Sir John Simon and Thomas Southwood Smith, joined the social reform movement under the leadership of Jeremy Bentham and Edwin Chadwick. Royal commissions investigated and reported, studies were made, statistics were compiled and, beginning in the 1830s, social legislation was enacted.

An integral part of the social reform movement was the compilation and publication of statistics which afforded a factual basis for legislative and other investigations and reports which were an essential prelude to legislation and which served to create a demand for reform by informing the public of existing conditions. William Farr was perhaps the greatest medical statistician in the 19th century, but the father of political arithmetic was the 17th-century physician, scientist and economist William Petty, who urged the collection of numerical data on population, education, diseases, revenue, etc. Petty's friend John Graunt wrote the first important study of health statistics in 1662. In Germany the philosopher Gottfried Wilhelm Leibniz recommended statistical investigations of health problems and in the 1680s published several essays on the urgent need for vital statistics. Leibniz' work was carried on and furthered by his contemporary Veit Ludwig von Seckendorff, who is credited with having developed the public health philosophy for Germany that was systematized by Johann Peter Frank and enacted into law by Bismarck. Sweden was the first country, however, to require nationwide reporting of vital statistics, legislation having been passed in 1748, following the recommendations of Pehr Elvius, mathematician and secretary of the Swedish Academy of Science.

In England the first national census took place in 1801. In the United States, Massachusetts was the first state to establish a bureau of labour statistics. The first important study of public health was the 1845 report of John Griscom, city inspector for the New York board of health. During the same year the National Institute of Washington undertook a survey of the nation's health. Perhaps the best-known early document dealing with public health problems in America was the Shattuck report, published in Boston in 1850. The report was written by Lemuel Shattuck, a Boston bookseller and publisher, who had helped found the American Statistical society in 1839 and had secured passage in 1842 of a Massachusetts vital statistics law that became a model for other states. Shattuck's work also led to the first effective state health department, namely that created in Massachusetts in 1869. Several other states followed the Massachusetts example within the next few years. In the second half of the 20th century the compilation of vital statistics was regarded as a matter of general public importance and in the United States constituted a proper exercise of police power. Almost all of the health, safety and welfare laws that were passed in the 19th and in the first half of the 20th century were based on factual studies and statistical reports. Louis D. Brandeis, as counsel in a case involving the constitutionality of Oregon's ten-hour day for women workers, secured judicial acceptance of such material when his so-called Brandeis brief was relied upon by the supreme court in its decision.

EARLY LEGISLATION

Europe.—There were but few examples of social or health legislation on a national scale before the 19th century. In order to check the high rate of infant mortality and for reasons of public morality, parliament passed a series of gin acts, culminating in an act of 1751 which gave control of licensing to magistrates, and perhaps the first example of social insurance was an act of 1757 "for the relief of coal-heavers working upon the River Thames," which required the employer to deduct sums from employees' wages for a fund from which benefits would be paid in case of sickness, invalidity, old age or death. Because of its abuse by employers, however, this early insurance plan was abolished in 1770 but was revived in 1792, when a similar act was passed providing for trustees to manage the fund. The Health and Morals of Apprentices act, sponsored by Sir Robert Peel, was enacted in 1802 to improve the conditions of child labour in the cotton mills. Although this legislation was largely ineffective, it did establish the government's interest in industrial conditions and led to agitation for child labour laws in other industries and countries.

The Benthamite reformer Edwin Chadwick, who was convinced people were poor because they were sick, was a prominent figure in both the commission that reported on the poor laws in 1834 and the commission that reported on public health in 1844 and 1845. As secretary of the poor law commission he wrote the famous *Report on an Inquiry Into the Sanitary Conditions of the Labouring Population of Great Britain*, which was published in 1842. These reports eventually were embodied in legislation and established national supervision over health, safety and social problems. The Factory act of 1833 was the immediate forerunner of modern industrial legislation, and the Liverpool Sanitary act of 1846 provided for health officers and borough engineers for that city. The Nuisances Removal and Diseases Prevention act and the Baths and Washhouses act, passed the same year, were preludes to the Public Health act of 1848. The first general housing acts were passed under the sponsorship of Lord Shaftesbury in 1851.

In addition to the rise of social legislation in England, similar movements gained momentum in Germany and France. Johann Peter Frank, German pioneer in public health, ambitiously undertook to systematize all existing knowledge on the subject and to devise detailed codes of hygiene for enactment. Frank, because of his broad scholarship, was one of the first to urge international regulation of health problems and creation of a national health authority to co-ordinate matters within the country. Advanced by Wolfgang Thomas Rau and Franz Anton Mai and endorsed by Frank was the creation of "medical police" to make and enforce health and safety regulations. In France, during the Revolution, the constituent assembly, on the motion of Joseph Ignace Guillotin,

created a Comité de Salubrité. In 1793 and 1794 a national system of social assistance, including medical care, was passed. Both France and Germany thus became committed to the proposition that government had a positive duty to promote the health, safety and welfare of workers. In 1884, when Bismarck indemnified workers against the risk of industrial accidents and provided for maternity care and benefits or pensions for sickness, disability, old age and death, Germany provided the inspiration and established the model for subsequent social legislation elsewhere in Europe and in America.

United States.—In the United States the same patterns that led to English legislation may be found, although English social legislation generally antedated its American counterpart by at least a generation and the American doctrine of judicial review slowed down development. Early in the 19th century there was considerable support for maximum hour laws to protect women and for restrictions upon child labour. A few of the industrial states passed such laws, but there was no effective enforcement because of fear of competitive disadvantage. For example, Massachusetts in 1842 enacted a child labour law, and in 1848 Pennsylvania prohibited the labour of children under the age of 12 in certain mills and limited the hours of work to ten unless there was a special contract. The latter provision was nullified when special contracts became customary, and since in any event the statutory sanction was merely a $50 fine, the statute had little effect. As early as the 1830s some industrialists suggested national legislation to regulate child labour and hours of work. Until after the American Civil War, state social legislation was regarded as constitutional. The judicial canon of laissez-faire philosophy that social legislation violated the due process clause or impaired the obligations of contracts did not gain currency until about the 1890s.

Congress enacted only a few pieces of social legislation before the 20th century. In 1798 a federal plan was established of state insurance for disabled seamen based on a 20 cent per month deduction from wages, and in 1870 the deduction was increased to 40 cents. In 1878 the National Quarantine act was enacted and empowered the surgeon general to enforce port quarantines, and the following year the national board of health was established.

RISE OF INDUSTRIAL MEDICINE

In the past, most regulation on behalf of the worker was an expression of religious conviction, such as the duties imposed upon the master in Deuteronomy, or a reflection of the ancient concept that a ruler was supposed to be a father to his people. During the middle ages the craft guilds regulated working conditions in detail. Rothari, king of the Lombards, in 643 ordered that bodily harm caused by accidents to builder's labourers should be compensated. The Ordinance of Labourers in 1349 and the Statute of Labourers in 1351, enacted in order to negate the economic bargaining power of the survivors of the Black Plague, impaired the mobility of the workers, as did the settlement laws that were part of the poor laws after 1601. Since workers in England were not free to travel about and to seek other jobs, humanitarian impulses alone furnished an incentive to improve their lot. Of greater direct importance were the decrees issued by Queen Elizabeth I in England and Colbert and Vauban in France which regulated working conditions.

Industrial medicine, the enactment of factory laws and safety laws and eventually the expansion of workmen's compensation acts to include occupational diseases in their coverage were a direct application of the new enlightenment. The founder of industrial medicine was Bernardino Ramazzini, professor at Modena and Padua, Italy, who in 1713 published his book *De morbis artificum diatriba,* which discussed the relation between disease and poverty. Before and after Ramazzini there were reports on industrial health, such as the pamphlet by Ulrich Ellenbog in 1473 "on the poisonous wicked fumes and smoke" that afflicted goldsmiths, the treatise on the diseases of miners by Georgius Agricola in 1556, that by Percivall Pott in 1775 on the diseases of chimney sweeps, and the comprehensive study of industrial disease and poverty by Charles Turner Thackrah in 1831. The latter study was relied upon heavily by social reformers such as Chadwick and Lord Shaftesbury.

Liability in Industrial Accidents.—Common-law principles in England and the United States resulted in placing the cost of industrial accidents on injured workers in the vast number of cases. To recover in a suit against his employer, the employee had to prove that the master was either personally at fault or had violated a nondelegable duty. Moreover, the injured worker had to overcome the defenses of contributory negligence, assumption of risk and the fellow servants rule, which meant that if the injured man had himself been careless for his own safety, or knew or should have known of the danger or was hurt because one of his fellow workers was negligent, the employer was not liable for damages. Although the courts recognized that certain nondelegable duties were assumed by the employer, such as an obligation to provide a reasonably safe place to work and reasonably safe machines, tools and appliances, kept in a reasonably good state of repair, and the issuing of safety rules and warnings of dangerous conditions, nonetheless a violation of such duties did not result in employer liability if one of the common-law defenses was applicable. Most significant, the common-law defenses frequently barred employer liability even though the employer had violated a health or safety statute or ordinance, as, for example, when the employee knew of the existing conditions and was said to have assumed the risk.

In England in 1880 parliament enacted the Employers' Liability act, which modified the defense accorded by the fellow servants rule but left untouched the defenses of contributory negligence and assumption of risk and required that there be negligence by the employer or a supervisory employee for the worker to maintain suit against his employer. This act was ineffective because English courts construed it so as to permit employees to contract away their rights under the act. The German compensation insurance laws enacted under the sponsorship of Bismarck in 1884 set the pattern for future legislation, and parliament's Workmen's Compensation act of 1897 was modeled on its provisions, as were the later U.S. statutes (*see* below).

In the United States prior to 1880 five states enacted statutes that made railroads liable to employees upon the same basis as they were liable to strangers. Georgia enacted such a law in 1855, Montana territory in 1873.

Between 1885 and 1910 most states enacted some kind of employer liability law, either trying to abrogate some of the common-law defenses or to impose safety inspection and regulation upon hazardous industries. In 1906 congress enacted the first federal Employers' Liability act, which covered railroad workers, but that act was held unconstitutional because employees not engaged in interstate commerce were included within its purview. The second Employers' Liability act was passed by congress in 1908 to remedy this defect and subsequently was upheld as constitutional. In effect, these railroad statutes abrogated the common-law defenses but required negligence for recovery. For example, contributory negligence by the employee diminished the amount of recovery had against his negligent employer, and assumption of risk remained a good defense until abolished by amendment in 1939.

Workmen's Compensation.—In the U.S., despite temporary setbacks and, for a time, strict judicial construction, workmen's compensation acts came to be enacted by each state. Additional congressional legislation covering occupations related to federal commerce, such as those of stevedores and longshoremen, were passed. All but a few states came to include occupational diseases, as well as accidents, as a basis for recovery when either arises out of and in the course of employment. Also, such acts have been extended beyond so-called hazardous industries to include most industrial and commercial enterprises. *See* WORKMEN'S COMPENSATION.

PUBLIC WELFARE

Public assistance, unemployment compensation and social insurance of various kinds became the subjects of national legislation in Europe in the 19th century and in the United States in the 20th. Until the poor laws were enacted at the start of the 17th century, care of the indigent usually had been a matter for church charity or mutual aid by people of the same occupation. The Jews made and enforced regulations for the relief of the poor and regarded

charity as a duty. Charlemagne ordered his counts to care for the poor at their own expense and made them *advocati* of the distressed. This action was the beginning of secularization and regulation of charity in Europe, and gradually poor relief was abandoned as a general function of the church and was assumed by the parish. From ancient times people in the same social class or occupation banded together in friendly societies that arranged burials, financial help where needed and benefits in case of sickness or widowhood. In time these societies expanded beyond a particular calling, and in England at the beginning of the 19th century they had a membership of 1,000,000 out of a total population of 9,000,000 and were almost as numerous in Holland and Belgium. Neither public nor private assistance, however, was adequate for the problems created by great depressions and chronic unemployments, and a national responsibility for the care of the sick and the poor was repeatedly urged. Sir Thomas More in his *Utopia*, which appeared at the beginning of the 16th century, advocated public health measures, social insurance, social security and public housing. "Freeborn John" Lilburne, pamphleteer for the Leveller movement during the Puritan revolution, called for a comprehensive program of government action to cope with social problems. Daniel Defoe in his *Essay Upon Projects*, at the end of the 17th century, proposed many reforms, including social insurance, and Denis Diderot in his *Encyclopaedia*, in an article on the *Hospital*, outlined a public assistance scheme, including old-age insurance and medical care.

England.—England finally eradicated the last traces of its Elizabethan poor laws in 1948 by the enactment of the National Assistance act, which eliminated the old concepts of parish responsibility, primary family responsibility and the rules as to settlement and removal. Even before World War I, the National Health Insurance act of 1911 had introduced the principle of state responsibility for the payment of sickness benefit to workers during illness and for the provision of some forms of medical care, on a basis of compulsory insurance. Near the end of and immediately following World War II, parliament also passed the National Insurance act (1944), the Family Allowances act (1945), the National Health Service act (1946) and the National Insurance act (1946). The report by Sir William Beveridge in 1942, experience with prior legislation, and postwar conditions combined to provide a favourable political climate for a comprehensive welfare system on a national scale. (*See* SOCIAL SECURITY: *Social Insurance in Great Britain and the Commonwealth.*)

United States.—*Federal Legislation.*—Although the department of health, education and welfare was created in 1953, most social legislation continued to be based on federal-state cooperation rather than on an exclusively national basis. For example, such acts as the Sheppard-Towner act of 1921 (Maternity and Infancy act), the National School Lunch act of 1946 and Title V of the Social Security act are based on federal-state cooperation, the federal government extending grants-in-aid and setting standards and the states administering the programs. The United States has not moved as far as England and the Scandinavian countries in creating the welfare state, but there has been a steady trend toward adoption of the insurance principle as a basis for social legislation.

It was not until the depression of the 1930s that public assistance, unemployment compensation, social security benefits and an integrated program of welfare legislation were enacted for the nation as a whole. The Social Security act of 1935 and the Fair Labor Standards act of 1938 were perhaps the most significant pieces of social legislation enacted by congress under its constitutional authority to regulate interstate commerce and matters affecting such commerce.

Beginning in 1937 the supreme court upheld the validity of such legislation, overruling prior decisions that had held that congress had no authority to abolish child labour or to regulate wages and hours. The separation of powers doctrine was viewed by the court as exacting due deference for the legislative and executive judgment and determination of public policy, and the court declined to substitute its economic and social predilections for those of congress. Most important, the powers reserved to the states or to the people under the 10th amendment were held to be no limitation whatsoever upon federal power granted by the constitution. Consistently with this commitment to judicial humility, the court also permitted state legislatures to experiment with social legislation unless a federal statute or power had pre-empted the field, and state welfare laws were sustained although analogous statutes formerly had been held unconstitutional. Sociological jurisprudence had replaced the laissez-faire commitment that had dominated the supreme court from the 1890s to 1937.

Although health, safety and welfare legislation, whether enacted by congress or by the states, was in the second half of the 20th century regarded as a legitimate exercise of the police power of government, there remained many issues as to substance and procedure that might arise under such laws. The principal limitation upon an attempted exercise of federal power was that some basis therefore must be found in the constitution.

States' Powers.—State courts determine the constitutionality of state legislation under state constitutions. Historically, health regulations have presented numerous issues, including problems as to the delegation of authority by the legislature to health officials, the specification of sufficient standards to guide administrators so that an arbitrary discretion is not assigned, the reasonableness of rules and regulations promulgated by officials and the reasonableness of legislative classification. Moreover, local boards are confined to their own territory and must act within it or they are without legal authority. Usually, the courts will not review the judgment of health officials who have legal authority to exercise discretion, and a private person who alleges he was aggrieved by a board's action ordinarily cannot hold officials personally liable for action taken in good faith within the scope of their authority. An arbitrary, capricious or unreasonable exercise of power, or action that lies outside the scope of the power delegated by statute, may raise a due process issue under state or federal law. Courts are reluctant to enjoin health officials except where there is an obvious abuse of authority.

State health officials utilize many methods of regulation, including inspection, destruction of private property to prevent the spread of contagion or to abate a nuisance, closing of public places, disinfection and sterilization, vaccination and quarantine. Compliance with orders may be sought by injunctions or the imposition of fines. Some states do not require health officials to give notice and to provide a hearing before taking summary action where the statute neglects such procedure, a condition which places a heavy burden on the citizen who cares to challenge the validity of the action in a subsequent legal proceeding. The state may act under either its power of eminent domain or its police power. Generally, if it exercises eminent domain, just compensation is due; such is not the case for an expression of police power. A citizen who upon reasonable grounds reports a suspected case of contagious disease to proper health officials usually is not held liable in damages to the person reported when the suspicion turns out to have been in error. One who negligently or deliberately infects another with a contagious disease may be held accountable for damages, at least if there was no consent to such contact.

ENFORCEMENT OF LEGISLATION

Food and Drug Laws.—One of the most important areas of health legislation is that pertaining to adulteration. Both Athens and Rome had laws to prevent the adulteration of wine, and England prohibited the adulteration of certain foods from the time of Henry III. Parliament from time to time passed statutes prohibiting the adulteration of such commodities as tea, cocoa and beer, and in 1872 enacted the Adulteration of Food and Drugs act, which had general application to foodstuffs; it provided for inspection and analysis of samples and for levying of a £50 fine for the first violation and six months imprisonment at hard labour for a second offense. After that time additional statutes were passed to plug loopholes and to correct judicial construction, culminating in the comprehensive Food and Drug act, 1955.

In the United States an act prohibiting the adulteration of drugs was passed by congress in 1848, and in 1890 a similar statute was passed regarding food. Between 1880 and 1906 there were 103 bills introduced in congress to control interstate traffic in food

and drugs, but none were enacted until the Pure Food and Drugs act of 1906 was signed by Pres. Theodore Roosevelt.

Difficulty was encountered in the enforcement of this act because of the definitions given to such terms as adulteration, the narrow construction given by the courts and the "distinctive name" exemption that permitted a manufacturer who adopted a distinctive name for his article to ship what he pleased. Moreover, the sanctions of a maximum fine of $200 for the first offense and $300 or a year's imprisonment, or both, for subsequent offenses, and the seizure provisions, did not prove to be successful deterrents.

Except for minor amendments, the 1906 act and similar state legislation remained in effect until the Federal Food, Drug and Cosmetic act of 1938 was passed following the tragic death in 1937 of at least 73 persons who had taken a drug known as Elixir Sulfanilamide. (Existing legislation did not prohibit the distribution of poisonous or dangerous drugs.) The 1938 act, within the limits of the commerce power, prohibits foods dangerous to health and also prohibits foods, drugs or cosmetics in insanitary or contaminated containers. Loopholes in the 1906 act, such as the distinctive name and compound exemptions, were eliminated. Penalties under the new law include seizure of the offending article and a maximum fine of $1,000 or a year in jail, or both, for each violation charged; in the case of intentional fraud or a second offense the fine may be $10,000 and imprisonment for three years. In addition, the federal courts were authorized to issue injunctions to restrain further violations. Enforcement of the act was given to a food and drug administration, and inspection stations were set up in several large industrial cities.

In addition to the 1938 Federal Food, Drug and Cosmetic act, state legislation is important in covering food and drugs that are outside the scope of the federal act because of its limitation to interstate commerce. Of jurisprudential significance is the fact that under both the federal law and the statutes of some states it is not essential that there be a specific criminal intent for conviction. It may be enough that the manufacturer or processor intended to ship the articles in question even though he neither knew nor had reason to know that there was a violation.

Safety Laws.—The enactment of safety legislation has been contemporaneous with the passage of workmen's compensation acts and public health laws. In this area, however, education and the activities of voluntary groups have almost completely overshadowed legal developments. There has been an intensive safety movement in the 20th century, and safety codes have been devised by engineers for various industries. At the outset humane industrialists promoted accident prevention campaigns by imposing safety rules in plants. In part this may be due to the fact that employers have come to realize that safe working conditions are an asset to the business, particularly if the factory comes under workmen's compensation laws. In the United States, cities and states at an early date required inspections of steam-power boilers, and later on building inspectors, fire marshals and elevator inspectors exercised municipal authority. Mine safety was a subject for legislation in many coal-producing states, and the Safety Appliances act for railroads, originally passed in 1887, and expanded and amended in 1893, 1903, 1910 and 1920, was the first significant federal statute. The Walsh-Healey Public Contracts act of 1936 requires government contractors to comply with the health and safety laws of the state where the contract is being fulfilled. During and since World War II it has been one of the most important statutes because it reinforces state laws that otherwise might be ignored. For the most part, state safety laws have been strictly enforced only in a few industrial states that have provided a sufficient number of inspectors. Substantial progress was mainly due to the efforts of certain large employers and the top priority given by modern management to accident prevention. The American Standards association has promoted a safety code program for American industry, and the International Association of Industrial Accident Boards and Commissions has been a major force in the movement. The United States department of labour and, since 1953, the department of health, education and welfare are both concerned with certain aspects of the general problem of industrial safety. Federal Coal Mine Inspection acts, passed in 1941 and 1952, require inspection and reports, empower the director of the bureau of mines to forbid miners to enter dangerous portions of a mine and specify detailed rules concerning roof support, ventilation, equipment, fire protection and other safety matters.

Before workmen's compensation acts were securely established as constitutional around 1920, most state safety acts relied upon inspection and indirect enforcement through civil litigation in damage suits brought by injured workmen. After 1920, when damage suits all but ceased because most workmen were limited to compensation claims, administrative boards with power to make rules, investigations and reports and to seek injunctions became the mode of enforcement. In a few states, *e.g.*, Washington, educational standards of safety, as well as rules dealing with safe working conditions, were, in the early 1960s, issued by the supervisor of safety. Statutes which provide for apprenticeship systems, limit the hours of work or require rest periods may be classified as safety laws because of their bearing on accident prevention. The constitutionality of safety laws in the second half of the 20th century was usually upheld unless there was a showing of arbitrary action in a particular situation, and such regulations typically were enforced by inspection plus criminal or administrative sanctions. In addition to laws pertaining to industrial safety are statutes concerning regulation of traffic; inspection of theatres, schools and other public places; highways and sidewalks, public carriers, bathing beaches and fire prevention. It should also be noted that collective bargaining agreements frequently contain provisions that have a bearing on industrial safety and that joint committees of management and employees may co-operate in formulating policies and rules.

INTERNATIONAL EFFORTS

International concern about health and safety has been expressed in the writings of public health pioneers, such as Johann Peter Frank, in international conventions, such as that held in Paris in 1851, and in health organizations within the framework of the League of Nations and United Nations (UN). The preamble to the constitution of the World Health organization (WHO) provides that "an informed opinion and active co-operation on the part of the public are of the utmost importance in the improvement of the health of the people"; it further declares that every individual has a fundamental right to the highest attainable standard of health. The WHO is committed to the principle of mutual aid in dealing with social and health problems, and its work is supplemented by and correlated with the activities of such other UN agencies as the United Nations Children's fund, the Food and Agriculture organization, the International Labour organization and the United Nations Educational, Scientific and Cultural organization.

Private organizations have also laboured in the field of international health and safety problems. The International Association of Industrial Accident Boards and Commissions has promoted safety codes, and the Rockefeller foundation has sponsored major international health work. Numerous international conferences have been held to promote health and safety. In 1833 Mohammed Ali, ruler of Egypt, called a conference to discuss quarantines and international hygiene, the International Association for the Legal Protection of the Poor was organized in Paris in 1900 and the International Labour office was organized at Basel, Switz., in 1901. The Bern conferences of 1905, 1906 and 1913 drew up international conventions prohibiting the use of white phosphorus in the manufacture of matches and employment of women or children under 16 on nightwork and limited their hours of work. President Truman's Point Four program included technical assistance on health matters, and many underdeveloped nations have continued to receive such help from the U.S. and other governments in an effort to eliminate various preventable diseases that were eradicated in Europe and the United States in the 19th century. Other nongovernmental agencies prominent in the international health and welfare fields include the International Red Cross and League of Red Cross Societies, the Save the Children fund and the Society of Friends.

The health and safety laws of the future will have to deal with such new matters as radiation from atomic power, fallout, air pollution and the dangers created by space travel. Such problems may be the subject of international regulation, as well as local law. Air pollution and urban redevelopment have created numerous problems in metropolitan areas. A sound solution of such problems will require the co-operation of local, state and national agencies. The increased urbanization of major industrial countries inevitably will intensify old and proliferate new health and safety problems. However, the prevailing perspective that national and international action is essential and that health and safety programs are no longer solely matters of local concern has made organized and concerted effort possible.

Among many articles dealing with health and safety regulations in general are the following: CHILD WELFARE; HEALTH INSURANCE; INDUSTRIAL ACCIDENTS; INDUSTRIAL MEDICINE; LABOUR LAW; MEDICAL JURISPRUDENCE; PREVENTIVE MEDICINE; PUBLIC HEALTH; SOCIAL SECURITY; SOCIAL SERVICE; WORKMEN'S COMPENSATION; WORLD HEALTH ORGANIZATION.

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(H. H. F.)

HEALTH EDUCATION. With the rapid development of medical science after about 1850 it became increasingly apparent to doctors, nurses and other health workers that education of the general public was essential in order to take advantage of the progress being made in immunization, communicable disease control, the reduction of infant and maternal mortality, sanitation and other areas of preventive medicine and public health. In a number of countries limited health education services were provided before 1900, usually in the form of printed leaflets or bulletins on infant care, tuberculosis, etc. (*e.g.*, the early state and local boards of health in the U.S.), and before World War I substantial programs in specific fields were initiated by voluntary organizations such as, in the U.S., the National Tuberculosis association (1904), the National Committee for Mental Hygiene (1909) and the American Society for the Control of Cancer, later the American Cancer Society (1913). Immediately after the war the U.S.S.R. set up a department of health education in the commissariat of health, and the United States a division of health education in the U.S. public health service (1918); England followed (1925) with the foundation of the Central Council for Health Education. In 1948 the World Health organization (*q.v.*) included health education as one of the basic units in its division of public health services.

One aspect of the problem throughout the history of health education, and one that has proved especially difficult in the newly emerging countries, has been to educate people to recognize that there is a problem at all. Where a majority of people suffer from ills such as malnutrition or trachoma, or where many infants die, these facts are accepted as normal and no remedies are sought. There may not even be a word for the condition.

Most communities have a mixture of folklore, science and magic dealing with health problems, mainly helpful but partly useless or worse, while some religious faiths prescribe health laws. What people will do depends largely on their attitudes, even where these contradict purely rational insight. The educator must therefore know how people customarily deal with the problem at hand, to whom they turn for help, who is responsible for acting and making decisions and who creates the climate of opinion before much in the way of health education can be accomplished.

In all countries during the 20th century there was an increasing realization of the importance of the health of young children, and this was reflected in the increased medical care of children from the prenatal period and throughout school life and in the provision of health instruction in schools. In its broadest sense, the term health education is taken to include both these aspects, since much of prenatal and postnatal care includes education as well as purely medical supervision (*see* MATERNAL AND CHILD HEALTH). The following discussion deals with the development of health education programs in the schools to protect the health of the students and instruct them in health habits, knowledge and attitudes.

See also HEALTH AND SAFETY LAWS; PREVENTIVE MEDICINE; NURSING.

HEALTH EDUCATION IN THE SCHOOL

Early school health programs were concerned only with prevention of spread of contagious disease. France in 1833 was perhaps the first nation to undertake school health work and to make school authorities legally responsible for sanitation of schools. In 1848 a government report in Wales drew attention to school lighting and ventilation. Regulations for protection of health of school children were instituted in Finland (1859), Sweden (1863), Norway (1865), Germany (1866), Russia (1871), Great Britain (1872) and Austria (1873). Sweden (1868) was first to use the term "school physician." In the 20th century the term health education replaced the earlier term hygiene, which was more or less restricted to the rules and practice of healthy living.

United States.—School health work was started in Boston in 1894 when physicians were employed to inspect school children. Later school health work was started in Chicago (1895), New York (1897) and Philadelphia (1898). The first state laws relating to medical inspection and examination of vision and hearing were passed by Connecticut (1899), New Jersey (1903), Vermont (1904) and New York (1905). The first school nurse was employed by New York city in 1902. By 1909 most states had legislation requiring public schools to offer instruction on effects of alcohol and tobacco.

Health agencies which contributed to the development of health education (with present names) include the American National Red Cross (1881), the American Association for Health, Physical Education and Recreation (1885), the United States public health service (1798) and the National Tuberculosis association (1904).

After the first White House conference on child health and protection (1910), advances in school health programs resulted from health legislation, creation of professional health organizations, national conferences on "physicians and the schools" promoted by the American Medical association, expanded services of city and state health departments, and advances in medical science, nutrition and school organization.

School health programs relate to health services, healthful school living, health teaching, nutrition, health of school personnel (teachers and other employees), safety provisions, in-service health education of school personnel and school-community health relationships and resources. Included in school health services are such preventive and protective procedures as daily observation of pupils by teachers and referral of those showing signs of possible health irregularities; health examinations of pupils, teachers and other school personnel; immunization procedures; first aid; follow-up remedial procedures; and some supervision of special education, adapted physical education and athletic training. Personnel involved in health services include family and school physicians, school nurses, dentists and dental hygienists, and such others as audiometrists, speech therapists, school psychologists, nutritionists, special education teachers and teachers of adapted physical education. Healthful school living involves lighting, seating, heating, cooling and ventilating, sanitation, safety, beauty and

the emotional atmosphere of pupil-teacher and other interpersonal relationships.

The curriculum of the elementary school includes instruction in health directed at desirable health habits and attitudes. It provides information relating to sleep, rest, relaxation, cleanliness and care of the body, exercise, posture, prevention of disease and injury, dietary habits, social relations and community health services.

In the secondary school, "health" is presented best as an organized school subject in a class meeting in daily periods and taught by a health teacher. Instruction is organized into teaching units based on life activities, topics including mental and emotional health, sex education and family life, appraisal of health and physical fitness, nutrition, dangers of alcohol and tobacco, drugs and narcotics, cancer, heart disease, use of professional health services, health vocations and community health services. Safety education, including driver education, generally is taught as a special subject. College programs of health education include clinic and limited hospital services, usually partially supported by student fees. Some colleges offer credit courses in personal and community hygiene. Undergraduate and graduate degree programs for preparation of teachers of health education are common.

(D. K. B.; X.)

Great Britain.—Health education in the United Kingdom has taken many forms. After the inception of the School Medical service in 1906 and 1907, it was increasingly realized that the effectiveness of its working depended upon the co-operation and the healthy practices of both the children and their parents, but there was never any compulsion on schools to include health education in their programs. (This follows the central government's policy of not imposing direction in matters of curriculum.) Consequently, health education in schools takes one of three forms.

It may be promoted merely by the existence of a general good will and the provision of a healthy atmosphere in the school. This, at nursery- and primary-school levels, may be actively carried out through the routine program of the child's day, although very little, if any, formal instruction is given. At the secondary-school level, health instruction is often given indirectly; *i.e.*, as a part of courses in biology, domestic science and citizenship and also through the activities of physical education. At this stage members of the health departments (especially the school nurse and health visitors) may be asked to supplement the teaching by lecturing on selected health topics.

See also EDUCATION, HISTORY OF; PHYSICAL EDUCATION.

(W. M. WA.)

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HEALTH INSURANCE is a system for advance financing of medical expenses. It consists of contributions or taxes paid into a common fund to finance all or part of health services specified in an insurance policy or law. The key elements are advance payment of premiums or taxes, pooling of funds, the elimination of part or all of the financial barrier to the receipt of medical care, and eligibility for benefits on the basis of contributions or employment without a means test. Health insurance is sometimes also considered to include cash payments for income loss due to sickness or disability. In the United States both private and public arrangements exist for insuring the risk of such loss of income. However, the two aspects—health services and income loss—are more and more being considered separately because they involve different problems.

A health insurance system that is organized and administered by a private agency, with the provisions specified in a contract, is a voluntary health insurance plan. If the system is financed by taxes levied by government and the provisions specified by statute, it is a governmental health insurance plan, usually referred to as "compulsory health insurance" by its opponents. The contrast between "voluntary" and "compulsory" health insurance, however, is not always a clear one. In some countries, such as Australia, Belgium, Denmark, Iceland, Japan and Switzerland, government subsidies are used to finance part of the cost of health benefits administered by nongovernmental societies which meet certain minimum standards.

Health insurance should be distinguished from socialized medicine and government medical care programs. These are usually financed wholly or predominantly from general tax revenues. Doctors are employed, directly or indirectly, by a government agency on a full-time or part-time salaried basis; and health facilities are usually owned or operated by the government. In several countries, including Australia, Chile, Czechoslovakia, Great Britain, Ireland, New Zealand, Sweden and the U.S.S.R., medical care, in whole or in part, is furnished on such a basis to broad general groups in the population. In some other countries health services are furnished by a social insurance institute established by the government as an independent or quasi-autonomous agency. In the United States medical care in veterans' hospitals, for the tuberculous or mentally ill, for seamen, Indians, or members of the armed forces, are examples of public or governmental medical care (or socialized medicine, as its opponents prefer to call it). (*See* also MEDICAL CARE, GOVERNMENT.)

In Great Britain the national health service is a public medical care program available to the entire population, but a small part of the cost is financed from social insurance contributions by employers and employees. Some voluntary health insurance plans also exist in Great Britain alongside the comprehensive national program.

All organized health plans have a public or social aspect. Voluntary insurance plans in the United States must conform to enabling or regulating acts passed by the various state legislatures and are under various degrees of state supervision or regulation. Doctors, hospitals, nurses, pharmacists and nursing homes are licensed by state laws. Many kinds of health services are wholly or partially tax-supported; some of them require a needs test and others do not.

Health insurance is not primarily a method of organizing medical care, although it may be combined with measures to improve the organization and distribution of medical services. It may be coupled with individual practice of medicine or with group practice. It may involve a limited or a comprehensive range of medical services. It may provide for full payment of the costs to the provider of services, in which case it is called a "service" plan; when the insurance payment is paid in cash to the beneficiary, it is referred to as an "indemnity." In the latter case, the payment is a predetermined amount which usually reimburses the beneficiary for only part of the cost.

In the United States health insurance plans operate in connection with both the individual and group practice of medicine and on both a service and an indemnity basis. In addition, health insurance plans are operated by nonprofit organizations such as Blue Cross (hospital care and largely controlled by hospitals), Blue Shield (physicians' services and largely controlled by physicians and medical societies), about 700 commercial insurance companies (both stock and mutual), and so-called independent plans, comprising community- and consumer-controlled plans, and those operated by unions, employers, welfare funds and private medical clinics.

Health insurance is usually financed on a group insurance basis but most plans also provide for individual policies. Group insurance expanded tremendously in the middle years of the 20th century because it provided greater protection to more people at less cost than individual policies.

Insurance of hospital costs, inaugurated during the 1930s, is the most prevalent form of voluntary health insurance coverage. By the early 1960s about 60% of all private expenditures for hospital care and about 30% of all such expenditures for physicians' services were being met by voluntary insurance. As a result, about 27% of all private medical care expenditures were met by voluntary insurance. About 25% of the aggregate of private and public expenditures for health care came from tax-supported funds.

Taken together, insurance and tax funds met about 43% of total national expenditures for health care.

The most rapidly growing type of voluntary health insurance in the early 1960s was major medical expense protection sold by commercial insurance companies. Under such plans an individual is insured for a maximum amount of health costs ($5,000, $10,000 or $20,000), with a "deductible" amount ($100, $250, or $500) usually paid by the beneficiary, and a "co-insurance" feature which provides that the insurance carrier will pay 75% or 80% of any costs above the deductible amount and up to the stated maximum. Advocates of major medical expense protection claim that it gives the individual protection against large catastrophic costs without the financial and administrative burdens involved in insuring small costs and that it provides a restraint on unnecessary use of services and facilities by placing part of the financial burden on the individual. Opponents claim that it discourages early diagnosis and treatment, encourages the inflation of health costs, and does not make a contribution to the more effective and efficient use of health services.

The health insurance movement was slow to develop in the United States. Once it overcame professional and technical obstacles, however, and took root, it flowered rapidly, in large part due to the fact that the American people were insurance minded. Health insurance in the United States underwent significant changes in the middle years of the 20th century. Many different kinds of plans were in operation under differing auspices, with wide variations in scope of benefits and costs, and sharply differing philosophies and objectives. Strong differences of opinion existed as to the advantages and disadvantages of each of these arrangements.

Health insurance plans faced many problems in the early 1960s. Health costs mounted rapidly as more and more people assumed that high quality medical care should be available to all. The increasing number of aged persons in the population called attention to the need for more effective financing arrangements and additional services and facilities. The lack of health insurance coverage among persons with low incomes raised many questions as to how to meet their needs. Proposals were frequently made for governmental subsidy of health insurance plans or establishment of governmental health insurance plans.

Canada developed a method of financing health services which differed from both that of the United States and Great Britain. The dominion government provided grants-in-aid to the provinces for comprehensive hospital insurance in ward beds without limits on duration and for hospital outpatient diagnostic services. The federal provisions were set forth in the Hospital Insurance and Diagnostic Services act, which was enacted in April, 1957, and became effective on July 1, 1958. The provinces financed their share of the program through retail sales taxes, general revenues of insurance premiums. *See* also PUBLIC HEALTH; SOCIAL SECURITY; SOCIAL WELFARE.

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HEALTH VISITOR: *see* NURSING.

HEALY, TIMOTHY MICHAEL (1855–1931), Irish statesman, leader in the campaign for Home Rule and for agrarian reform, became the first governor general of the Irish Free State. He was born at Bantry, County Cork, on May 17, 1855. He began work at 13 and moved to Newcastle upon Tyne in 1871 where he was a clerk on the North Eastern railway. There he became associated, through Isaac Butt, with the Home Rule association. His connection with politics increased in 1878 when he moved to London to become parliamentary correspondent of the *Nation*. In this way he met C. S. Parnell, who recognized his ability and cabled from the United States in 1880 for Healy to organize the Canadian extension of his tour.

For several years after 1880 Healy was closely associated with Parnell both in and out of parliament. Healy was arrested for intimidation on behalf of the Land league but was promptly returned as member of parliament for Wexford (1880) and subsequently acquitted at his trial in Dublin. In parliament he rapidly became a master of caustic wit and the techniques of obstruction but also showed constructive ability during the passage of the complex Land act of 1881. He became an authority on the land question and the "Healy clause" in this act, which protected the tenants' agrarian improvements from increases in rent, made him highly popular in Ireland and he even won seats in Protestant Ulster: County Monaghan (1883) and South Londonderry (1885). Healy was imprisoned in 1883 for encouraging violence. He was called to the Irish bar in 1884, specialized in the land law on which he became a leading authority and became a queen's counsel in 1899. He sat for North Longford (1887–92) and then for North Louth, which he held against the Parnellites until 1910.

Healy broke away from Parnell in 1886 and later attacked him bitterly over the O'Shea divorce (1890). He supported Gladstone, for whom he had much respect, as a more effective agent for Home Rule. After Parnell's death (1891), Healy led a small but vocal group until 1900 when the Irish members were reunited. In 1902 Healy was expelled from the Irish parliamentary party and, until he was reconciled with William O'Brien in 1910, he attacked John Dillon's leadership and anticonservative prejudice. He became a king's counsel in 1910.

The Easter rebellion in 1916 roused Healy against the Liberals and the official leaders of the Irish Nationalist party. This led him to support Sinn Fein after 1917. In 1918 he resigned his seat in Cork, which he had held since 1910, in favour of a Sinn Fein prisoner. Healy played no part in the guerrilla warfare of which he disapproved, but was regarded as an elder statesman and consulted by British and Irish ministries. After the Irish ratification of the peace treaty in Jan. 1922, Healy was proposed by both sides as governor general of the new Irish Free State. This office he filled with tact and patience until his resignation in 1928. He then retired and died at his home near Dublin on March 26, 1931. He published *Letters and Leaders of My Day*, two volumes (1928). *See* also IRELAND, REPUBLIC OF: *History*.

See M. Sullivan, *No Man's Man* (1943); Sir Dunbar Barton, *Timothy Healy* (1933). (D. G.)

HEARING is the sense by which an animal is able to perceive sound. All the higher vertebrates, and many more primitive animals, possess a specialized organ, the ear, for the reception of sound waves. In its simpler forms this organ has a particular biological value in mating, as it enables the sexes to find one another, but its most general adaptive function lies in its service in warning of impending danger. In the birds and mammals, hearing is particularly developed for communication, and in man it attains its highest utility in articulate speech and the art of music.

PARTS OF THE EAR AND THEIR FUNCTIONS

As treated in detail in the article EAR, ANATOMY OF, the ear is considered in three parts, the outer, middle and inner ear. The outer ear receives aerial waves; the middle ear conducts them inward; and the inner ear, through its receptor cells, translates their effects into patterns of nerve impulses that are sent through the auditory nerve to the brain centres and finally give rise to auditory perceptions.

The Outer Ear.—The visible portions of the ear include an expanded flap called the auricle or pinna and a short tube, the external auditory meatus. The auricle in man serves no important acoustic purpose. It is too small to deflect sounds into the ear, for to modify the paths of sound a surface must be large with respect to the wave lengths, and this condition is scarcely satisfied even for the highest audible tones. Animals with larger and funnellike pinnas, especially if they are sensitive to sounds still higher than man is, are aided by these members and have

well-developed muscles for moving them.

The meatus is a slightly curved tube about one inch in length, ending at the eardrum. It serves as the path of entrance for aerial waves.

The Middle Ear.—Beyond the eardrum is the middle ear cavity, an irregularly shaped, air-filled space in the temporal bone. A chain of three small bones, the auditory ossicles, bridges this space and provides a mechanical link between the drum and the oval window, which forms the entrance to the inner ear.

The drum is broadly conical in form, with its apex directed inward. The outer ossicle, the malleus (hammer), is attached at the apex and along one radius. The second ossicle, the incus (anvil), links the malleus with the third, the stapes (stirrup), whose innermost part, the footplate, nearly fills the oval window. The ossicles are interconnected and suspended in the cavity by a number of ligaments. There are two tympanic muscles which act upon the ossicular chain; one, the tensor tympani muscle, is applied to the malleus, and the other, the stapedius muscle, to the stapes.

The function of the middle ear is the efficient transmission of sound energy. The drum presents a large surface on which the air particles impinge, and their total force is applied through the ossicular chain to the smaller surface covered by the footplate; the result is a magnification of pressure. The efficiency of transmission is about 28%, which, though far from perfect, is remarkable in comparison with an estimated one-tenth of one per cent that would obtain if the middle ear mechanism were absent. The difference is apparent in a person who by accident has lost the drum and outer ossicles, for such a person is unable to hear conversation unless people shout or speak directly into his ear.

The tympanic muscles connect the ossicular chain with points of anchorage in the walls of the middle ear cavity and work together as a protective mechanism. They add to the strength of the ossicular chain and prevent displacements of excessive amplitude. When a loud sound stimulates the ear, a strong reflex contraction is produced which reduces sharply the transmission of the vibrations, and so the inner ear is protected against excessive stimulation. This protection, however, is limited, and a person who must expose himself to intense sounds of either an explosive or a lasting character will need to take extra precautions to guard the ears. He may wear a helmet that covers the ears or use plugs that fit snugly in the meatus to exclude the sounds.

The Inner Ear.—The bony labyrinth is a complex space in the temporal bone, two divisions of which, the vestibule and semicircular canals, are concerned with bodily equilibrium; a third division, the cochlea, serves for hearing. The cochlea is shaped like a snail's shell, from which it gets its name; it is a spiral organ, which in man has about two and one-half turns, and if straightened out (fig. 1) would be about one and one-half inches long.

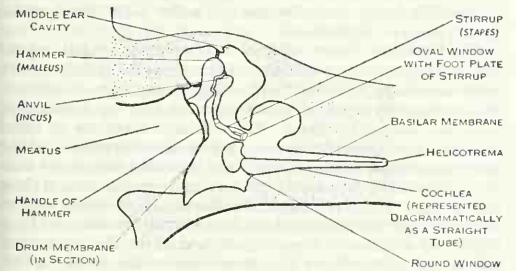

FIG. 1.—DIAGRAM OF SECTION THROUGH MIDDLE AND INNER EAR (*see* TEXT)

A partition divides the cochlea into vestibular and tympanic canals (fig. 2), which connect at the tip of the cochlea and contain a fluid, the perilymph. At the basal end each canal has an opening in the bony wall separating it from the middle ear cavity. The opening for the vestibular canal is the oval window, fitted with the footplate of the stapes; that for the tympanic canal is the round window, covered only by a thin membrane. The partition is made

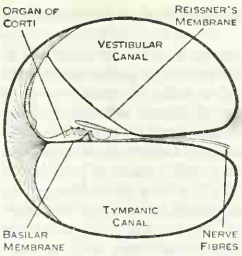

FIG. 2.—CROSS SECTION OF COCHLEA

up in part of a fibrous membrane, the basilar membrane, upon which lies a complex structure, the organ of Corti, in which the auditory receptor cells, the hair cells, are imbedded. Around the bases of the hair cells are the ends of the auditory nerve fibres, which run inward toward the axis of the cochlear spiral to form the auditory nerve. This sensory portion of the inner ear is bathed in a separate fluid, the endolymph in the cochlear duct, which is kept from mingling with the perilymph by a thin membrane, called Reissner's membrane.

When under the influence of an aerial sound the footplate of the stapes is momentarily pressed inward, the pressure exerted on the fluid of the inner ear is relieved mainly by an outward bulging of the round window membrane. As the footplate moves outward the pressure is reversed, and the membrane is displaced inward. The varying pressures are transmitted from vestibular to tympanic canals and to the cochlear duct by way of the basilar membrane, and in the process the sensory cells are excited. From the hair cells the excitation passes to the auditory nerve fibres, and from there to the higher nerve centres, and a sensation of hearing is produced.

The ear may be stimulated also by bone conduction. If a vibrating body is brought into contact with the bones of the skull the movements are conducted to the inner ear fluids and finally to the hair cells. The sensory effects are the same as in air conduction, but the efficiency is much less since the larger part of the energy is lost in vibrating the massive substance of the head.

SOUND AND ITS ANALYSIS

Sounds, physically considered, consist of rapid variations in the density of a medium, usually the air. Most often these variations have some uniformity of pattern, in that the same or nearly the same changes occur over and over; such sounds are periodic. Other sounds, which lack any repetitive character, are aperiodic. The periodic sounds are heard as tones, the aperiodic ones as noises. Many sounds have an intermediate quality, and are called noisy tones or pitched noises according to the dominating feature.

The periodic sounds vary in four ways: in frequency, intensity, wave form and phase. Frequency designates the rapidity of recurrence of the pattern; intensity, the energy of the disturbance; and wave form, the nature of the pattern. Phase refers to the particular aspect of the pattern presented at a given instant. Frequency is stated in cycles per second. The simplest wave form is sinusoidal, represented mathematically by a sine (or cosine) function, and special efforts are necessary to produce it; the tuning fork gently struck gives such a wave form. Other waves, like those of the singing voice and most musical instruments, are compound. In simple tones the phase is not perceived, but when two or more tones interact their phase relations become important.

A basic principle of physical acoustics, known as Fourier's law, is that any compound wave may be regarded as the sum of a series of simple waves whose frequencies bear to one another the ratios 1, 2, 3, 4, 5 and so on. The component of lowest frequency, corresponding to the ratio number 1, is called the fundamental; the others are overtones. For example, the note known as middle C, when produced on the piano, is compound, and consists of a fundamental of 264 cycles; a first overtone of 528 cycles; a second overtone of 792 cycles; and so on. Generally speaking, the earlier members of the series are the most important, and the magnitudes of the higher overtones diminish and finally become negligible.

The resolution of a compound tone into a fundamental and a series of overtones, with indication of the relative magnitudes and perhaps also of the phase relations of the components, may be

accomplished by mathematical methods, or by a mechanical device called a harmonic analyzer.

This type of analysis can be achieved also by the ear; this is Ohm's law of hearing. After suitable training a person can recognize that a sound, like the note of a violin, is made up of a fundamental and several overtones, and he can indicate, at least in a general way, how the components vary in strength. This analytic capacity is a remarkable feature of the functioning of the ear, and upon it depends much of the peculiar value of hearing.

Distortion.—The ear obeys Ohm's law in a general way, but it does not do so exactly. In some degree it imposes its own characteristics upon sounds as they are heard. The changes in the sound patterns produced within the ear constitute auditory distortion, and take two forms, frequency distortion and nonlinear distortion. Frequency distortion is a reflection of the fact that the ear is limited in range, and fails to respond to sounds below and above certain limits, and the further fact that the sensitivity varies greatly within that range. Therefore, certain components of a complex sound will be favoured, and others will be discriminated against.

Nonlinear distortion represents a failure of the ear's response to correspond in a simple way to the energy of the stimulating sound. It gives rise to a number of peculiar phenomena. One of these is aural overtones. A tone, although physically simple, if it stimulates the ear at anything greater than a very moderate intensity, will produce a compound effect: it is heard as a fundamental with a series of overtones. These overtones are subjective, in that they have their origin within the ear itself. Further phenomena, including the combination tones discussed below, likewise have their origin in the ear through nonlinear distortion. In experiments using human subjects and lower animals, the nature and origin of subjective overtones and combination tones have been carefully studied. It seems clear that the principal seat of nonlinear distortion is the inner ear.

PHENOMENA OF HEARING

Auditory experiences vary in three fundamental respects: pitch, loudness and timbre.

Pitch.—Tones vary in pitch according to the frequency of the sound vibrations. Slow frequencies give deep or low tones, like the bray of a foghorn, while rapid frequencies give shrill or high tones, like the chirp of a cricket. The normal range of audibility for man covers about 10½ octaves, from a lower limit of about 15 cycles per second to an upper limit of somewhat more than 20,000 cycles. Tones below the lower limit affect the ear, but they give noisy effects and not distinct pitches. Tones above the upper limit are altogether inaudible. Some young persons can hear tones as high as 23,000 cycles, but generally with advancing age the limit becomes lower and lower, so that few persons over 60 years of age are able to hear tones beyond 8,000 cycles.

Loudness.—The loudness of a sound depends upon both its energy and its frequency. Generally speaking, two tones of equal energy but different frequency will not seem equally loud; this is true because the ear's sensitivity varies over its range. Sensitivity is greatest for the middle high tones, those of frequencies from about 1,000 to 4,000 cycles, and it falls off progressively for the lower tones and with great rapidity for the higher tones. For the middle frequencies the amount of energy necessary barely to stimulate the ear is almost incredibly small, and it appears that man has developed, for this region, the maximum sensitivity that it is practical to possess, for if the ears were any keener they would respond to the unceasing molecular motions of the air particles themselves. The maximum loudness of sounds is governed by the intrusion of pain and the liability of the ear to damage by excessive stimulation. The amount of energy that becomes dangerous to the ear seems small when measured by ordinary standards, yet it is large compared with that which is just perceptible. Thus the ear operates over a wide energy range, a range of nearly 2,000,000,000,000 times.

Though the physical range of the ear is great, the perceived loudness is less extensive. The ear may be said to compress the intensity dimension, as indeed all our senses do. Within limits, the ear adheres to a general principle of sensation known as Weber's law, which states that an energy change, in order to be perceptible, must be a constant fraction of the original energy level. This means that a smaller energy change is necessary for a faint sound than for a loud one; and more generally that the perceived magnitude of a sound varies as the logarithm of its energy.

Timbre.—Two sounds may have the same fundamental frequency, and also may contain the same overtones, but if the distribution of energy among the overtones is different they will seem different to the ear. Such a difference, arising from the relative magnitudes of the components, is called the timbre of a sound.

Timbre is also used more widely to include variations of an aperiodic character, such as the thumps or scrapings incidental to the production of notes on most musical instruments. All instruments, because of their forms of construction and the ways in which they are played, produce sounds of characteristic timbre, through which they may be recognized. Similarly, the voices of singers who are executing the same note may be identified by their individual peculiarities of timbre.

Deafness.—Through accident and disease, the ear suffers alterations of its functions which produce deafness in various forms and degrees. Sometimes sensitivity to sounds is lost altogether, but more often the loss is only partial. An impairment may be extensive, in that all tones to be heard must be raised well beyond their usual intensity, or it may be only for certain tones. In general, high tones are more liable to impairment than low tones.

INTERACTION OF TONES

When two tones are presented to the ear at the same time there appear three types of phenomena: beats, combination tones and masking.

Beats.—If the two tones differ but little in frequency, and have approximately equal intensities, the result of their simultaneous action is a peculiar periodic variation in the loudness known as beats. The rate of the beats is equal to the frequency difference of the tones; thus two tones of 1,000 and 1,005 cycles will produce five beats a second. The character of the experience changes with the beat frequency. As the frequency of the beats is varied from zero upward, the experience is at first a slow waxing and waning of sound, then changes to an impressive surging or pounding, and finally to an unpleasant roughness, which then fades and finally disappears.

The phenomenon of beats represents a limitation of the ear's powers of analysis; rather, it indicates a kind of synthesis. The two stimulating waves are added, and the beats represent the periodic changes between a maximum when they agree in phase and a minimum when they are opposed in phase. If the ear obeyed Ohm's law perfectly, the two waves would be separated and no beats would be heard.

Combination Tones.—When the two tones stimulating the ear are fairly strong, and differ in frequency by 50 cycles or more, other tones may be heard besides the primary pair. These are the combination tones, of which there are two types, difference tones and summation tones. The difference tones are so called because they represent frequency differences between one of the stimulating tones or its multiples and the other tone or its multiples. Similarly, the summation tones represent the sums of these frequencies. These relationships are most simply shown by formulas. If the frequencies of the two stimuli are indicated by h and l, and any simple integers by m and n, the difference tones are derived as $D = mh - nl$ and the summation tones as $S = mh + nl$.

When m and n both are unity the difference and summation tones are of the first order. These are usually the strongest and most easily noticed. The first order difference tone is best heard when its frequency is well below that of either stimulus. For example, tones of 2,000 and 2,500 cycles will give a difference tone of 500 cycles, which is readily recognized. On the other hand, a difference tone is difficult to observe if its frequency lies between the two stimuli; thus 1,000 and 2,500 cycles give a difference tone of 1,500 cycles, which only careful observation

will reveal. In general, the combination tones will usually go unnoticed when their frequencies lie close to the stimulating tones, as a result of masking by these tones as explained in the following section.

While only a few combination tones are ordinarily noticeable, special procedures demonstrate a great many. They are a product of nonlinear distortion in the ear, and are accounted for in the same way as the aural overtones, as a transformation of a portion of the stimulus energy into new frequencies. Like the overtones, they originate principally in the inner ear.

Masking.—Everyone has experienced the difficulty of hearing in the presence of loud noises. Faint sounds, like the sounds of speech, are drowned out or masked, and conversation becomes possible only by vigorous shouting. A study of this phenomenon with simple tones shows that the masking effect is greatest for tones whose frequencies are close to the disturbing tone, and it falls off rapidly for more distant frequencies. Thus a loud tone of 1,000 cycles will have a profound effect upon 900 cycles, but practically none upon 100 cycles.

When either objective or subjective overtones are present (and the subjective overtones at least are inevitable when the tone is loud), there will be masking not only in the area of the fundamental but in the areas of the overtones as well. Since this is true, the masking effect of a given tone is generally greater in the frequency region above it than in that below. The low-pitched noises incidental to most industrial operations are far more disturbing of speech than high-pitched squeakings and hissings of equal loudness.

LOCALIZATION OF SOUNDS

We commonly perceive a sound as coming from some particular place in the environment, yet experience has taught that such perceptions are not altogether trustworthy, and we are often confused and misled. Actually our judgments of sound location are determined only in a limited way by the auditory cues, and to a considerable extent they include other signs, especially visual, together with our general knowledge of the surroundings. We look for reasonable sources of the sounds we hear and infer their locations on the basis of previous experience.

The auditory limitations have both a physical and an anatomical basis. Sounds do not travel in direct lines as light rays do, but bend around obstacles and reflect from broad surfaces, so that their terminal paths are often no proper indication of their true courses. Moreover, the single ear has no way of discerning the paths of the waves that strike it, but can signal only the intensity and character of the effects. Significant cues can be obtained as the head is moved, and, most important, since we have two ears, from differences in the binaural stimulation.

The Binaural Cues.—The position of a sound with reference to the right-left dimension is indicated by four types of binaural difference: the relative intensity, time of incidence, phase and complexity. A sound on the right—barring complex reflections—will be stronger in the right ear, both because its path is shorter and because the other ear is somewhat in a shadow cast by the head.

The shadow effect is insignificant for the low tones, because these bend around the head readily, but becomes important around 512 cycles and increasingly so for frequencies above. Because its path is shorter, the sound will reach the right ear sooner; and this temporal cue operates at the onset of the sound, at its cessation, and at any sudden alteration in its character. For simple tones a phase difference is present, as the longer time of travel to the farther ear allows the waves to get out of phase. The phase cue is most important for low tones, but becomes confusing for high tones since these have wave lengths that are of the order of the distance between the two ears, and under such conditions a phase difference may be lacking or even reversed in direction.

Complexity operates as a cue only for compound tones and noises, but for these it is most useful. Because the sound shadow effect is selective, the ear that is screened by the head receives the sound with its high-frequency components greatly attenuated, and a timbre difference results.

The ease and accuracy of localization varies for different kinds of sound because the cues operate differently. For high tones the binaural differences are mainly of intensity; for low tones, chiefly of phase; and for complex tones and noises, they include intensity, time and timbre. Accordingly, the high tones are localized with difficulty, the low tones more readily and noises with comparative ease.

Positions up and down or in front and behind, and the distance away, are not discriminated by the binaural conditions, and are indicated only by secondary cues, such as head movements, or inferred from the general conditions. By turning the head we may change, for example, the relative intensity at the two ears, and by grosser movements, which lead us toward or away from the source, we may change the intensity level. Such exploratory movements give a more certain localization than is possible with the binaural cues alone. At the same time, judgments are formed which include visual cues and our general experience. If the sound is familiar we look for its source in a reasonable place: the cricket's chirp leads us to scan the turf at our feet, and the bird's song to examine the branches overhead. (E. G. W.)

THEORIES OF HEARING

Historically, the so-called theories of hearing that have been proposed have been concerned primarily with analysis of sound by the end organ of hearing, the cochlea. They have been theories of cochlear function. A true theory of hearing must take into account not only events within the cochlea but also the patterns of activity set off in the auditory nerve by these events and the changes in the patterns of neural activity during transmission to higher centres of the central nervous system.

Place Theory.—According to a place theory of hearing, receptors in a given part of the cochlea are stimulated by a given frequency of sound (or by a narrow band of frequencies), and, in turn, impulses are set off in the particular nerve fibres supplying the receptors. The ability to discriminate between sounds of different frequency depends then upon which receptors and nerve units are excited. When one particular group is activated, a low tone is heard; when another group, a high tone.

In 1857 Hermann von Helmholtz proposed a theory of hearing called the resonance theory. This was a place theory. It stated that the cochlea contained a series of tuned resonators, the transverse fibres of the basilar membrane, and that a given frequency of sound striking the ear caused to vibrate those resonators that were tuned to that frequency. Complex sounds were likewise analyzed, the appropriate resonators being activated by the Fourier components of the sound.

Later research led investigators to conclude that the cochlea does not contain a series of tuned resonators. Experiments done by G. von Békésy showed that the basilar membrane, which stretches from base to apex of the cochlea and upon which the receptor cells lie, is under very weak and approximately equal tension in both its transverse and longitudinal directions and could not be made up of a series of tuned-string resonators. It does differ in elasticity from base to apex in a ratio of about 1:100. This is sufficient to provide for some frequency analysis.

Observation under the microscope of the movements of intracochlear structures when the ear is stimulated by sound, testing of hearing before and after experimental damage to parts of the intracochlear structures, recording of electrical activity from electrodes implanted at different points within the cochlea, and a number of other experimental techniques were used to accumulate evidence showing quite clearly that, within the cochlea, sounds are analyzed according to frequency. The highest perceptible frequencies at weak intensities set into motion a small part of the basilar membrane near the basal end of the cochlea. The receptor cells on this part of the membrane are stimulated, and they in turn, by some process not clearly understood, cause the firing of impulses in the nerve fibres that supply them. As intensity of the high-frequency sound is increased, there is some spread of activity along the basilar membrane and consequently more receptor cells

and their nerve fibres are excited. For these highest frequencies the amount of spread of excitation within the cochlea is not great. Even at very high intensities, it appears that excitation is confined to the basal region of the cochlea. With tones of lower frequency, a wider region of the basilar membrane and the receptor cells it supports are set into motion by near-threshold intensities of the tones, and with increase in intensity the extent of spread of the region of excitation is greater than it is for higher frequencies. There is considerable evidence that tones in the lowest range (500 to 1,000 cycles per second [c.p.s.] and below) at moderate to high intensities may stimulate receptors throughout most of the cochlea.

Frequency Theory.—In opposition to place theory, it was early suggested that frequency analysis might not take place in the cochlea but that the latter might act like a telephone transmitter, simply transmitting to the nervous system the same frequencies imposed upon it by sound waves impinging upon the ear. William Rutherford (1886) is usually given credit for this theory, which was appropriately named a telephone theory.

Experiment provided evidence not only in support of a place theory, as noted, but also suggesting that frequency theory may be partly correct. When electrophysiological methods were used to record activity in the auditory nerve, it was found that bursts of impulses in the whole nerve, which is made up of thousands of nerve fibres, were synchronous in frequency with a pure tone applied to the ear; that is, for each cycle per second of the sound wave there was a burst of nerve impulses. This synchronism occurred for frequencies in the lower range only, up to 4,000 to 5,000 c.p.s. For higher frequencies, synchronism between nerve response and stimulus could not be observed.

Since it is known that individual nerve fibres in the auditory nerve of the mammals that were used in these experimental studies do not fire at rates much above 300 per second, a volley principle was advanced to explain the firing of the total nerve in regularly spaced bursts at frequencies of 4,000 or more per second. The volley principle assumes that impulses in some individual nerve fibres are elicited by the first wave of a stimulating tone, others by the second, and so on, the result being that, by the alternate firing of different groups of nerve fibres, the end result of synchronism between total nerve discharge and frequency of the sound stimulus is achieved. There is experimental evidence that the volley principle does hold for response of the auditory nerve. It was suggested by some investigators, therefore, that discrimination of frequencies in the low range of frequencies (1,000 c.p.s. or perhaps 4,000 c.p.s. and below) is based partly on frequency; for example, a tone of 100 c.p.s. is heard when the frequency of nerve impulses in the auditory nervous system is 100 per second, and a tone of 200 c.p.s. is heard as having a higher pitch because the frequency of impulses is 200 per second.

Central Neural Mechanisms.—After the early 1940s, increasing attention was given to the events that take place in the central nervous system when the ear is stimulated by sound. It was found that there is topographic projection of the cochlea upon the higher centres in the auditory nervous system. Activity aroused in a small part of the cochlea produces neural excitation in a somewhat restricted part of each auditory pathway and each auditory centre. Since the cochlea does a frequency analysis of the sounds it receives, it follows that the auditory pathways and centres have a tonotopic organization; *i.e.*, a tone of a given frequency produces neural activity in a limited part of a pathway or centre. This evidence of tonotopic organization lent support to a place explanation of frequency discrimination.

Records made of the nerve impulses in higher centres of the auditory nervous system usually indicate that the synchronism between frequency of nerve impulses and frequency of sound stimulating the ear is progressively lost as the nervous system is ascended. Newer methods of recording and analyzing the electrical activity of the auditory system may reveal that the synchronism is maintained, at least in certain parts of the pathways and centres, and is being masked by other neural activity.

Conclusions.—It seems clear that both place and frequency principles must be considered in explaining discrimination of differences in frequencies of sound. In addition, auditory theory must account for discriminations that involve other dimensions of sound stimuli. For pure tones—and current theories are restricted almost entirely to dealing with discriminations of pure tones—the other primary dimension of the physical stimulus is intensity.

As noted above, increase in intensity of a pure tone presented to the ear results in spread of activity within the cochlea. More receptor cells along the basilar membrane are excited and nerve impulses are set off in more of the nerve fibres leading from the receptor cells into the central nervous system. In addition, experiments showed that there is an increase in the rate of firing of nerve fibres that are already active. The result is a greater total flow of nerve impulses per unit time as intensity of the stimulus is increased. This relationship between stimulus intensity and rate of flow of nerve impulses appears to be true for higher centres of the auditory nervous system as well as at the periphery.

A theory of hearing needs also to consider the neural events underlying localization of sound in space. Experimentation on this problem has been limited, but both the temporal and intensity differences noted above as being important in sound localization are reflected by temporal and amplitude differences in the nerve responses recorded in higher centres of the auditory system.

(W. D. N.)

EVOLUTION OF HEARING

The evidence of comparative biology shows that twice in the course of animal evolution the problem of hearing has been solved, once by the insects and again by the vertebrates. In each case the ear was derived from a more primitive form of mechanical sensibility, but otherwise the two developments were distinct.

The Hearing of Invertebrates.—Among the invertebrates hearing is known to exist only in certain species of insects. It is possessed by those few insects that are notable for sound production: the katydids, crickets and grasshoppers among the orthopterans, the cicadas and the water boatmen; and in addition by certain moths, which are largely dumb.

The ear of an insect is an elaboration of a simple sensory structure, the scolophore organ, which is widely distributed in insect bodies. In its simplest form (*see* fig. 3), this organ consists of three cells arranged in a column: a sensory cell, a sheath cell and a cap cell. The sensory cell contains a chitinous rod, the scolopale, which projects out of the cell at one end, where it is snugly enclosed by the sheath cell and surmounted by the cap cell. A nerve fibre, arising from a ganglion cell nearby, enters the sensory cell and ends in or about the scolopale. This columnar structure is usually found stretched across a portion of the body cavity from one point of the integument to another, and by its form and arrangement seems to be fitted for response to mechanical deformations of the body surface.

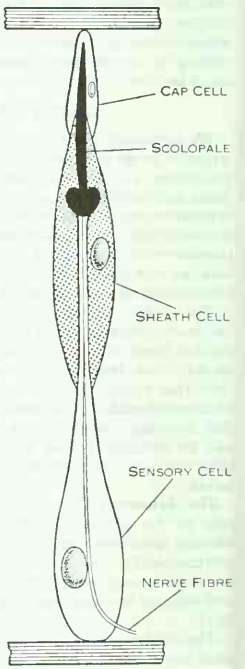

FIG. 3.—DIAGRAM OF SCOLOPHORE ORGAN

In the particular insect forms mentioned, the scolophore organ has become associated with a thin chitinous diaphragm or tympanic membrane, thereby forming a tympanal organ, which is

the insect ear. This organ is situated in different places in the insects: in katydids and crickets on the forelegs; in the water boatman and some moths on the metathorax; and in other moths, grasshoppers, and cicadas on the abdomen—everywhere, indeed, but on the head, where it would be expected.

The outer surface of the tympanic membrane is usually, as in grasshoppers, exposed directly to the external sounds, but sometimes, as in katydids, it faces an internal air chamber, in which case there is a secondary drum through which the sound waves first must pass. On the inner surface of the membrane lie the scolophores, with their scolopales pointing away and anchored against some relatively fixed structure.

It is well established that the tympanal organ is an auditory receptor. It is used generally in the process of mating, in which the male produces sounds and the female seeks him out. The most extensive observations have been made on crickets. A normal female let loose in a field was found to make straight for a cage containing a number of chirping males, but when her tympanal organs were destroyed this reaction ceased. Similar seeking behaviour was observed even when the chirp was conveyed over a telephone; here the orientation was to the receiver of the instrument. These experiments prove not only that the insects hear, but that the tympanal organ is the responsible structure.

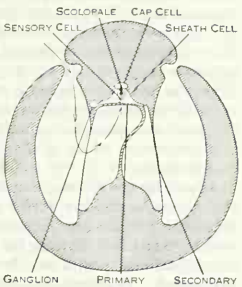

FIG. 4.—CROSS SECTION OF EAR OF KATYDID. ARROWS REPRESENT PATH TAKEN BY SOUND WAVES (*see* TEXT)

Detailed results on sensitivity have been obtained only in certain orthopterans by recording the electrical impulses set up in the tympanal nerve during acoustical stimulation. In these the ear was found to be remarkably sensitive to high tones, some and perhaps all forms being superior to man in this respect. In the middle range of frequencies, where the human ear is most sensitive, the insect ear is poor in acuity, and responds only to sounds that to man are uncomfortably intense. From this it follows that the insect's world of sound is vastly different from man's.

The Hearing of Vertebrates.—The sensory portion of the vertebrate ear is a side development of the labyrinthine sense, whose primary function is the maintenance of bodily equilibrium (*see* EQUILIBRIUM, ANIMAL). The whole is a differentiation from the lateral line organ, a sensory apparatus found in adult form only in fishes and some amphibians, and whose function though not fully understood seems to relate to the perception of water currents or slow wave movements.

In fish, amphibians and the lower reptiles, the endings for hearing are found in the saccule, one of the two main divisions of the labyrinth. In higher forms this auditory part of the saccule is expanded outward to become the cochlea. Evidence for hearing has been obtained in certain species of fishes and in representatives of all the higher vertebrate classes.

While fish possess the saccular organ, they lack external and middle ears and can be stimulated only by a process akin to bone conduction in higher animals. Those forms in which hearing is most assured are equipped with a special apparatus, the Weberian ossicles, which takes the place of the middle ear of higher forms.

Many fishes show disturbance from sounds produced in the water in their vicinity, but are largely unaffected by aerial sounds since these fail to penetrate the liquid surface. The clearest evidence of hearing is obtained in experiments in which the fish are trained to obtain food in response to an auditory signal. Sensitivity is shown for fairly rapid vibrations, and there are indications of some ability to discriminate sounds. That the saccule is responsible for the reactions is proved by tests in which this organ or its nerve is interfered with, or impulses are recorded from the nerve.

The amphibians have a middle ear of simple form, but no external ear. Some, like the frog, have an eardrum, which lies flush with the surface beneath the skin of the head. The frog's ear is fairly sensitive to low tones but poor for high tones.

In the reptiles the ear has undergone considerable differentiation. Some forms, like the tortoises and turtles, are little better equipped than their amphibian ancestors. Others, like the alligators, have a well-developed middle ear and a true cochlea. The alligators respond to sounds over a wide frequency range, up to 4,000 cycles or more.

The birds, as their songs proclaim, are keen of hearing and have an extensive range. In the pigeon both behavioural and auditory nerve studies indicate a hearing range up to 10,000 cycles.

In mammals the principal advance over lower forms is their further acquisition of range, though possibly there is greater acuity also. Most mammals that have been tested adequately have shown superiority to man in the hearing of high tones. Particularly notable here is the bat, which responds to tones far above man's upper limit, according to some evidence more than two octaves above.

The hearing of the cat has been carefully tested. For frequencies below 2,000 cycles per second its hearing is about like that of man. Above 2,000 cycles per second its sensitivity is much greater than that of man, and it responds to tones at least up to 60,000 cycles per second. The hearing of the dog is similar to that of the cat.

Over most of the hearing range the acuity of the monkey and chimpanzee is similar to man's, but in the high-frequency region they are definitely superior. The upper limit for the chimpanzee extends to about 30,000 cycles.

See also DEAFNESS AND IMPAIRED HEARING; EAR, ANATOMY OF; EAR, DISEASES OF; NOISE AND ITS CONTROL; SOUND; and references under "Hearing" in the Index volume. (E. G. W.)

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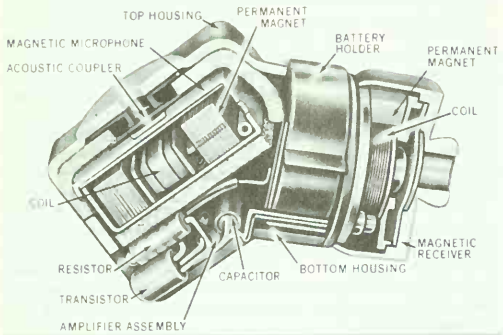
HEARING AID is a sound amplifier: a device that increases the loudness of sounds in the ear of the wearer. The earliest hearing aid was the ear trumpet. Ear trumpets have taken many forms, but they all have a large mouth at one end so as to collect the sound energy from a large area; the sound collected is led through a gradually tapering tube to a narrow orifice that can be inserted in the ear. Ear trumpets, then, amplify sound simply by collecting the sound energy from a larger area than is possible by means of the unaided ear, and all the sound energy delivered to the ear originates from the sound source. This is fundamentally different from the operation of all later types of hearing aid, in which the energy of an electrical battery is used to boost the original sound.

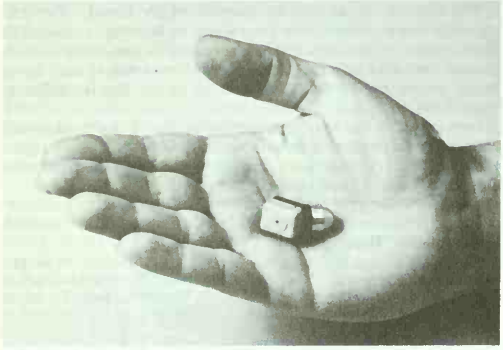
There are two main classes of electrical hearing aid: the carbon aid and the electronic aid. The carbon aid was used from the beginning of the 20th century up to the early 1930s. It consisted of a carbon microphone, a battery and a magnetic earphone, as in an ordinary telephone. The main difference between the carbon hearing aid and a telephone was that in the aid the electrical arrangement was such that the sound delivered by the earphone was substantially louder than the sound reaching the microphone.

The development of the radio electron tube (valve) made the electronic aid possible. The principal components of the electronic aid are (1) the microphone, which converts sound into electric voltage; (2) the amplifier, which amplifies this voltage; and (3) the earphone, which reconverts the amplified voltage into amplified sound. In some aids a "bone conduction receiver" is used instead of the earphone, and this stimulates the hearing

mechanism by vibrating the bones of the skull rather than by generating a sound wave in the external ear.

A typical hearing aid, as used between about 1930 and 1950, had a crystal microphone, a three-tube electronic amplifier and a magnetic earphone. The tube amplifier required two batteries, one supplying from 15 v. to 45 v. and the other 1½ v. or 3 v. In the 1930s the magnetic earphone took the form of a disk of up to two inches in diameter held in place by a headband. In the 1940s this external receiver was gradually replaced by the insert receiver, which is only ½ in. to ¾ in. in diameter and is held on the ear by being clipped onto an individually molded plastic insert in the external ear.

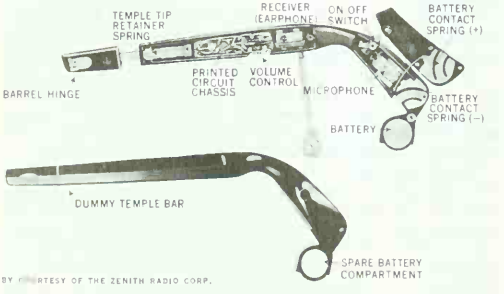




BY COURTESY OF MOTOROLA DAHLBERG HEARING AIDS

(TOP) CUT-AWAY DIAGRAM OF A MINIATURE HEARING AID; (BOTTOM) COMPLETE VIEW OF SAME HEARING AID

In the early 1950s transistors replaced the tubes in the amplifier. Transistors are smaller than tubes and need only one battery of 1½ v. or 3 v. At the same time smaller, magnetic microphones also became available. All these factors made possible the construction of much smaller aids. While a typical tube aid of the 1940s measured 4½ x 2½ x ¾ in., the modern transistor aid is often as small as 2 x 1 x ½ in., and can even be built into an eyeglass frame.



BY COURTESY OF THE ZENITH RADIO CORP.

EYEGLASS HEARING AID

Hearing aids may have widely differing characteristics, and the selecting of the most suitable aid for the needs of a particular user has been extensively investigated. The two characteristics of a hearing aid that influence the understanding of speech most are, first, the amplification of the various components of speech sounds and, second, the intensity at which the sounds are heard by the wearer. As regards the first characteristic, speech sounds contain many components, each of a different frequency, and a hearing aid amplifies each of these components to a varying extent depending on its frequency; the variation of amplification with frequency is called the frequency response of the aid. Experiments show that hearing aids with one particular type of frequency response are best for all deaf people. This optimum frequency response shows that an aid need only amplify sounds within the frequency range 400 cycles per second to 4,000 cycles per second, although the components of speech cover a much wider range. When the aid is used in noise or in very reverberant surroundings, reduced amplification of the low-frequency sounds is preferable. Some hearing aids offer a choice of frequency response; the switch that determines which of the alternatives is selected is called the tone control.

As regards the second characteristic—the intensity at which the sounds are heard—too loud a sound can be as difficult to understand as one that is too quiet; the intensity range over which speech is understood best is wide for some deaf people but narrow for others, and can be narrower than the variations in intensity of normal speech. Hearing aids with automatic volume control (AVC) help in some of these cases by smoothing out the intensity variations. The AVC device varies the amplification of the aid automatically so that the output intensity is kept constant whatever the variations of the input.

Even with an aid with the optimum frequency response and supplying the most suitable output intensity, the user will rarely understand speech as well as people with normal hearing. In some people, deafness produces only a straightforward reduction of auditory sensitivity, and this can be compensated for fairly successfully by the extra amplification provided by the aid. Many deaf people, however, suffer a loss not only of sensitivity but also of auditory discrimination. Such persons, when using an aid, hear sounds more loudly but still find it difficult to distinguish one speech sound from another. Even if the aid does not enable its user to follow a conversation, however, it may still be useful by making him more aware of events around him.

A binaural hearing aid consists of two separate aids, one for each ear. Such an arrangement can, under some circumstances, materially benefit certain classes of deaf users.

In schools for the deaf group hearing aids are common. The group aid consists of a single central amplifier that amplifies the sounds picked up by microphones in different parts of the room. The amplified sounds are heard through earphones by the pupils.

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HEARN, LAFCADIO (1850–1904), writer, translator and teacher in Japan, was born June 27, 1850, on Santa Maura, one of the Ionian Islands, west of Greece. He was the son of Surgeon Major Charles Bush Hearn, of Anglo-Irish descent, and Rosa Antonia Cassimati, a Greek native of one of the islands off Greece. Christened Patrick Lefcadio Hearn, he dropped the first name and changed the second to Lafcadio when he came to the United States. In 1856 his father had his marriage annulled in Ireland. Both his parents left the country and each remarried, and Hearn never saw his parents again. Left in charge of a grandaunt, a widow, Sarah Holmes Brenane, before he reached his teens he was enrolled in a Roman Catholic school in Normandy. He then spent four years at St. Cuthbert's college, Ushaw, County Durham. His early schooling led to his developing a hostility to Roman Catholicism.

At St. Cuthbert's his left eye was damaged either by the knotted end of a rope flung at him or, as he believed, punched out by a blow from a fist. He lost the sight of this eye. Financial difficulties of his grandaunt forced him to leave college in Oct. 1867. He spent most of 1868 in extreme distress and abject poverty in London. Finally in 1869 he was shipped off to Cincinnati, O., which he reached after a brief period in New York.

He suffered many hardships in Cincinnati, working at odd jobs and often sleeping in the streets. He soon met Henry Watkin, a printer, who exerted a great influence upon him. Watkin taught him the rudiments of his trade, and Hearn became a proofreader. Meanwhile he began to write, and in 1870 and 1871 contributed five articles on free thought under the pseudonym "Fiat Lux" to the Boston *Investigator*. By 1873 he was on the staff of the *Cincinnati Enquirer*, where both his scholarly and gruesome articles, written in a masterly poetic style, attracted attention. He was dismissed in the summer of 1875 either because of a marriage ceremony with a Negro woman with whom he had been living or because of political pressure. He was soon taken on the *Cincinnati Commercial* where his articles won even greater acclaim. He wrote about the Negroes and the Jews, continuing to praise and defend the latter for many years. He also began his first translations from the French, of Gautier and Flaubert.

Anxious to visit the south, he left for New Orleans, La., in Oct. 1877. He sent back to his paper articles signed "Ozias Midwinter," mostly containing his earliest impressions of New Orleans. In 1878 he became, after penniless months, assistant editor of the *New Orleans Item*. For the next three and a half years he contributed editorials on numerous topics, scientific and literary articles, "fantastics" or prose poems, sketches of life among the Creoles, and a few translations from the French and Spanish. In May 1880 he also began contributing translations to the *New Orleans Democrat*. There appeared the first English translations of De Maupassant and Pierre Loti.

The newly merged *New Orleans Times-Democrat* engaged Hearn in Dec. 1881. For the next five and a half years he contributed translations from French and Spanish writers almost every Sunday. He also published stories and sketches in poetic prose, and adapted from foreign literatures many tales that made up his two earliest works, *Stray Leaves From Strange Literature* (1884) and *Some Chinese Ghosts* (1887). He also contributed to the *Century Magazine*, *Harper's Weekly* and *Harper's Bazaar*. In New Orleans he met Elizabeth Bisland, who became his biographer.

His first novel, *Chita*, occupied an issue of *Harper's New Monthly* magazine and appeared in book form in 1889. He spent 1887–89 in the tropics, where he wrote *Two Years in the French West Indies* (1890) and obtained material for his second novel, *Youma* (1890). Returning to the United States, he spent six months in New York City and there translated Anatole France's *The Crime of Sylvestre Bonnard* (1890).

Hearn went to Japan on a tentative assignment for *Harper's New Monthly* magazine, arriving at Yokohama, April 4, 1890. He broke with *Harper's* in May. He spent some time living in temples and making pilgrimages. Through the intervention of Capt. Mitchell McDonald, to whom he brought a letter of introduction from Elizabeth Bisland and who became his closest friend and literary executor, and two others, one being Basil H. Chamberlain, he obtained a position as a teacher in the ordinary middle school at Matsue in the province of Izumo, beginning his duties Sept. 2, 1890. Through one of the fellow members of the English faculty, he met his future wife, Setsu Koizumi, a Japanese lady of high Samurai rank, whom he married in Jan. 1891.

In Sept. 1891 his articles on Japan began appearing in the *Atlantic Monthly*, while some appeared in Feb. 1892 in the *New Orleans Times-Democrat* and were syndicated in other newspapers. These essays and others were subsequently collected and published in two volumes as *Glimpses of Unfamiliar Japan* (1894). Late in 1891 he had himself transferred to the government college at Kumamoto in Kyushu, where he remained for three years. He was not happy there and began feeling disillusioned about Japanese officialdom. In the late summer or early fall of 1895 he became a Japanese subject in order to protect his wife's citizenship, the legality of their marriage and their rights of property.

Out of the East appeared in 1895 and *Kokoro* in 1896. In the summer of 1896 through the influence of Chamberlain he was invited to teach in the English department of the Imperial university of Tokyo. The next six years constituted his most prolific and brilliant period. There he wrote *Gleanings in Buddha-Fields* (1897), *Exotics and Retrospectives* (1898), *In Ghostly Japan* (1899), *Shadowings* (1900) and *A Japanese Miscellany* (1901).

About the spring of 1902 Hearn purchased a house at 266, Nishi Okubo, where he lived until his death. His next book, *Kottō*, appeared in the fall of 1902. His lectures as taken down by his students were published in the United States (1915–17), edited by John Erskine, as *Interpretations of Literature* (2 vol.), *Appreciations of Poetry* and *Life and Literature*. More complete editions of these lectures have been published in Japan. Also published in Japan, and based on his lectures, was *A History of English Literature*, two volumes (1927).

In the spring of 1903 Hearn left his position and prepared a series of lectures, intending to deliver them at Cornell university, Ithaca, N.Y., but the university withdrew an offer it had previously made. These undelivered lectures became the material for his best-known book on Japan, *Japan: an Attempt at an Interpretation* (1904). Another book, *Kwaidan*, mainly stories, had appeared earlier in the year. In the spring of 1904 he was invited to teach English at Waseda university. Under strain and anxiety he died from a heart attack on Sept. 26, 1904.

Hearn is notable not merely as a writer who revealed an idealized Japan to the western world, but also for his manifold interests. He was a devoted student of fairy tales, folklore and legends that unfolded the mental strata of entire peoples. He sought out kindly and generous emotions, high conceptions of duty and examples of self-sacrifice among the lowly, and delineated them in his unique and at times flowery prose, excelling especially in descriptive writing. He had philosophical preoccupations; he tried to find a linking bond between the doctrine of Karma in Buddhism, *i.e.*, prebirth conduct in one's ancestors, and the role of heredity in the theory of evolution. He dwelt much on race memories as manifested in the individual. He was, however, a rationalist and not a mystic. He was also a profound literary critic. While leaning toward Victorian standards, he leavened these with his proclivities for French romanticism and occasional realism. He was a great admirer of the Russian novelists and Henry James before interest in these writers became common.

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HEARST, WILLIAM RANDOLPH (1863–1951), U.S. publisher, whose methods profoundly influenced U.S. journalism, was born in San Francisco, Calif., on April 29, 1863. The son of George Hearst, a California pioneer who amassed a large fortune in ranch and mining lands and who served as U.S. senator from 1886

to 1891, he entered Harvard in 1882 and remained two years. Becoming interested in journalism, he visited Boston newspaper offices, studied newspapers from all parts of the country and paid special attention to the success of the *New York World* under Joseph Pulitzer.

On his return to California he first took partial and later, in 1887, complete control of the *San Francisco Examiner*, which the elder Hearst had bought for political reasons. Within two years he made it pay, and with an efficient staff used it for many newspaper experiments.

Hearst invaded New York journalism in Sept. 1895 by buying the unsuccessful *Morning Journal*, which he made a one-cent newspaper of highly popular type. To it he brought many able workers, including Julian Hawthorne, E. W. Townsend, Stephen Crane, Julian Ralph and the cartoonist Homer Davenport, while he immediately raided the *New York World* for the best members of Pulitzer's Sunday staff, including R. F. Outcault, the inventor of the modern coloured comic pictures. By the use of numerous illustrations, coloured magazine sections and glaring headlines, by sensational articles on crime and pseudoscientific topics, and by a jingo policy in foreign affairs, the *Journal* (an evening edition was started in 1896) shortly reached an unprecedented circulation. On the day after the election in 1896 it printed 1,506,000 copies of its several editions.

Under Hearst's control the *Journal* attacked England in the Venezuela affairs, supported William Jennings Bryan in 1896, demanded war with Spain in 1897–98, launched a series of attacks against municipal "franchise grabs" and supported Bryan again in 1900, bitterly assailing William McKinley and Mark Hanna as tools of the trusts. An editorial statement in April 1901 that "if bad institutions and bad men can be got rid of only by killing, then the killing must be done," led Theodore Roosevelt in his first message after McKinley's assassination to denounce "exploiters of sensationalism" in words which he later (1906) declared he meant for Hearst.

The success of the *Journal* led Hearst to establish the *Chicago American* in 1900, the *Chicago Examiner* in 1902 and the *Boston American* in 1904. Other newspapers were purchased in 1912, and in 1917 he launched an energetic policy of expansion, so that by 1925 he owned newspapers in cities of every section of the United States. After 1904, when he supported Alton B. Parker, he paid decreasing attention to editorial leadership. He opposed U.S. entrance into World War I; he waged unremitting warfare against the League of Nations, and demanded payment of the war debts in full. Late in 1916 the British and French governments denied Hearst the use of their mails and cables. But in 1927 he suddenly emerged as the champion of a bond of close friendship and practical co-operation among all English-speaking countries. Meanwhile, he had embarked in other publishing enterprises. He purchased the *Cosmopolitan* monthly in 1905, the *World To-day* in 1911, and *Harper's Bazaar* and other magazines, including *Nash's Magazine* in England, at later dates. He published books, chiefly fiction, and later in his career produced motion pictures on a large scale.

His holdings just after World War I were enormous, but living on a princely estate at San Simeon, Calif., and buying antiques and art on a munificent scale, he strained even his huge income. The long depression beginning in 1930 endangered his empire. First he had to pool some of his most valuable newspapers in a company which raised $50,000,000 by selling preferred stock; then in 1937 he had to assign control of his chief holding company, American Newspapers, Inc., to a banking-house trustee for ten years. Weak newspapers were ruthlessly sold or consolidated with stronger units. A great part of his collection of furniture, paintings, tapestries and other treasures was sold through department stores in 1941. But during World War II and in the immediate postwar period his newspaper properties again became profitable; his holdings still included newspapers scattered from Baltimore, New York city and Boston in the east to Los Angeles, San Francisco, and Seattle on the west coast, and several magazines, of which *Cosmopolitan*, *Good Housekeeping*, *Motor* and *Town and Country* enjoyed large circulations. He died at Beverly Hills, Calif., on Aug. 14, 1951.

Hearst's role in politics was ambitious but unsuccessful. While serving two inactive terms in the U.S. house of representatives (1903–07), he ran in 1905 for mayor of New York on an anti-Tammany municipal ownership ticket, and came within 3,000 votes of winning; and the following year, as Democratic nominee for governor of New York he was defeated by Charles E. Hughes. A heavier defeat for mayor of New York followed in 1909, and, though he was later frequently suggested for mayor or governor until his quarrel with Alfred E. Smith in 1924 destroyed his Democratic following, he was never again nominated.

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HEART, ANATOMY OF. Within the human chest is the most efficient pump ever created. It begins to pulsate and move blood through the developing tissues months before birth and it functions ceaselessly until death. In the newborn the heart is less than 3.75 cm. (1½ in.) in diameter and weighs approximately 28 g. (1 oz.). Both size and weight increase from birth, so that the adult heart is larger than the clenched fist and normally weighs a little less than 1 lb. In the embryo the heart first appears as a simple tube with two dilatations called the primitive atrium and the primitive ventricle. Later in embryonic development the tube becomes folded upon itself, and two partitions, the interatrial septum (fig. 6) and the interventricular septum (fig. 3B), divide the two primitive chambers into four. Still later a spiral septum subdivides the single outflow tract (truncus arteriosus) of the primitive ventricle into the aorta and the pulmonary artery (fig. 1). Many anomalies (abnormalities of structure) may result from faulty partitioning of either the primitive chambers or the great vessels that leave the base of the heart (*see* HEART AND LUNG, SURGERY OF: *Surgery of the Heart and Great Vessels: Congenital Cardiovascular Defects*).

External Anatomy.—The compact, four-chambered heart of adult man bears little resemblance to the tubular heart of the embryo. It is enclosed in a tough fibrous sac, the pericardium, which is attached to the diaphragm and separates the heart from the lungs. The broad base of the heart is formed by the two atria and the large vessels that enter and leave the heart. Between the fifth and sixth ribs, halfway across the left side of the chest, lies the apex of the heart, formed by the tip of the left ventricle; it points downward and to the left. The front surface of the heart lies behind the sternum (breastbone) and is formed largely by the wall of the right atrium and right ventricle.

Separating the atria from the ventricles is a deep groove called the coronary, or atrioventricular, sulcus. It contains fatty tissue, fibrous connective tissue, the coronary arteries, and nerves (fig. 1). A large vessel, the coronary sinus, carrying venous blood to

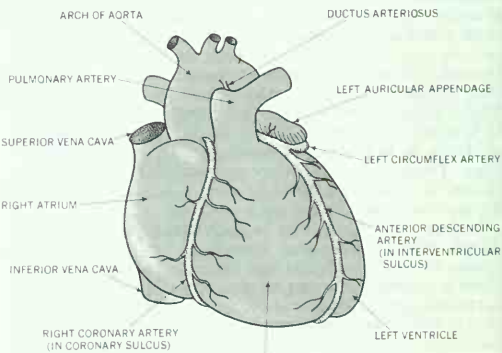

FIG. 1.—ADULT HUMAN HEART

Front view. Base of the heart is at the top; apex is at the bottom right

the right atrium, occupies the coronary sulcus on the back of the heart. Shallow grooves called the interventricular sulci, containing blood vessels, mark the separation between ventricles on the front and back surfaces of the heart.

Pumping Action.—The heart, although a single organ, can be considered as two pumps which propel blood through two different circuits (fig. 2). The right atrium receives venous blood from the head, chest, and arms via the superior vena cava, and from the abdomen, pelvic region, and legs via the inferior vena cava. Blood then passes through the tricuspid valve to the right ventricle, which propels it through the pulmonary artery to the lungs (fig. 1). In the lungs venous blood comes in contact with inhaled air, picks up oxygen, and loses carbon dioxide. Oxygenated blood is returned to the left atrium through the pulmonary veins (fig. 5). The low-pressure circuit from the heart (right atrium and right ventricle), through the lungs, and back to the heart (left atrium) comprises the pulmonary circulation. Passage of blood through the left atrium, bicuspid valve, left ventricle, aorta, tissues of the body, and back to the right atrium comprises the systemic circulation. Blood pressure is greatest in the left vertricle and in the aorta and its arterial branches. Pressure is reduced in the capillaries (vessels of minute diameter) and is reduced further in the veins returning blood to the right atrium. (*See* also BLOOD PRESSURE.)

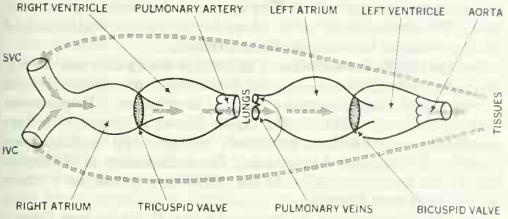

FIG. 2.—BLOOD FLOW THROUGH THE HEART, LUNGS, AND TISSUES OF THE BODY

Pulmonary circulation is indicated by solid arrows; systemic circulation, by dashed arrows (*see* text). SVC is superior vena cava; IVC is inferior vena cava

Skeleton of the Heart.—Fibrous layers separate the muscular layers of the atria from those of the ventricles. The fibrous layers are thickest and most dense around the orifice of the aorta, the orifice of the pulmonary artery, and the atrioventricular orifices (the openings between the atria and the ventricles). Here the fibres form the annuli fibrosi, or fibrous rings—the so-called skeleton of the heart. The rings provide firm attachment for the major valves of the heart (fig. 3) and the muscles that cause the heart to contract (fig. 4A). The annuli fibrosi are composed mainly of collagenous fibres and may show changes with age. (In other mammals the rings may consist of cartilage, as in the dog and the sheep, or of bone, as in the ox.)

Layers.—The wall of each chamber consists of three layers: a thin, glistening inner layer, the endocardium; a muscular middle layer, the myocardium; and an outer layer, the epicardium. The endocardium has a smooth internal layer, the endothelium, which is continuous with the linings of the large vessels. The endocardium is thick in the atria and thin in the ventricles. In the ventricles this layer also contains some of the specialized muscle fibres of the impulse-conducting system (*see* below). The epicardium is composed of fibrous tissue containing fat cells, blood and lymph vessels, and nerves. The myocardium is discussed in the following section.

Muscles.—The walls of the atria and ventricles are made up of two layers of muscle, together called the myocardium. Both the superficial and the deep layer gain anchorage and support by attachments into the fibrous skeleton (fig. 4A). The myocardium varies in thickness, being thinnest in the atria and thickest in the left ventricle. The superficial muscle bundles of the atria are oriented in a horizontal or oblique direction and continue over both atria. The deeper bundles of atrial muscle are nearly independent for each atrium and are arranged at right angles to the superficial bundles. The myocardium of the ventricles is more complicated. The superficial and deep layers run approximately at right angles to each other, and both arise from the fibrous rings (Fig. 4A). The superficial fibres spiral from the base to the apex, where they turn inward and form thick ridges (trabeculae carneae) on the inner surface of the heart. The superficial fibres attached to the tricuspid ring are called sinospiral fibres; those attached to the bicuspid ring, bulbospiral fibres.

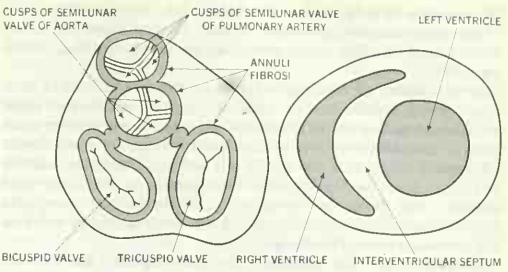

FIG. 3.—(LEFT) FIBROUS SKELETON AND VALVES OF THE HEART, VIEWED FROM ABOVE. (RIGHT) SECTION THROUGH VENTRICLES SHOWING COMPARATIVE SIZE AND RELATIONS OF THE VENTRICLES AND INTERVENTRICULAR SEPTUM

Other superficial fibres terminate in the papillary muscles (fig. 5). There are three papillary muscles in the right ventricle and two in the left. Fibrous strands (chordae tendineae) attach the papillary muscles to the margins of the valve cusps (discussed below), much like the shroud lines on the rim of a parachute. This arrangement prevents the valve leaflets from inverting into the atrium when the ventricle contracts.

The deep layer of the ventricular myocardium follows a more circular course on each ventricle, and some fibres have an S-shaped pattern as they pass from one ventricle to another through the interventricular system to regain attachment in the same annulus (fig. 4A). Other deep fibres encircle the upper portions of the ventricles and surround the bicuspid and aortic orifices. When the ventricular myocardium contracts, the distance between base and apex is shortened (fig. 4B) and the fibres, with their spiral arrangement, literally wring the remaining blood from the cavity of each ventricle.

Valves.—These flexible structures (fig. 5) are formed by the innermost tissues of the heart. The largest valves guard the atrioventricular orifices and prevent regurgitation of blood into the atria. They are firmly anchored to the annuli and chordae tendineae. The three leaflets of the tricuspid valve surround the orifice between the right atrium and the right ventricle. The two leaflets of the bicuspid, or mitral, valve are located in the left atrioventricular orifice. This valve not only prevents atrial regurgitation but serves also to direct the flow of blood from the

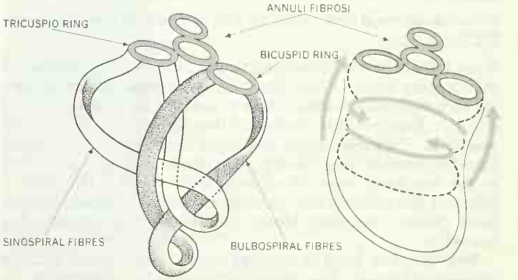

FIG. 4.—(LEFT) SPIRAL MUSCLES OF VENTRICLES. (RIGHT) DOTTED LINES INDICATE CHANGES IN SHAPE OF HEART DUE TO CONTRACTION OF VENTRICULAR MUSCLE (ARROWS)

left ventricle into the aorta. The valve of the aorta and the valve of the pulmonary artery consist, in each case, of three halfmoon-shaped cusps; for this reason the valves are called semilunar valves (fig. 3A).

A tiny nodule of cartilage is found on the free margin of each cusp. These nodules provide additional support as the valve cusps are forced together by backflow pressure, when the ventricles come to rest. Immediately above the aortic valve cusps are small sinuses (dilations) which give rise to the left and right coronary arteries (fig. 5). Two small embryonic folds remain in the adult right atrium. One forms the slender valve of the inferior vena cava (Eustachian valve); the other forms the crescent-shaped valve of the coronary sinus (Thebesian valve).

Circulation.—The blood that nourishes the heart itself is supplied through the two coronary arteries (fig. 1). These arise from the aorta, travel in the coronary sulcus, and have major branches that descend in the interventricular sulci. The right coronary artery is the smaller of the two; its branches travel in the epicardium to supply the right atrium and right ventricle. The left coronary artery has two large branches, the anterior descending artery and the circumflex artery, that supply the left atrium, left ventricle, and most of the interventricular septum. Venous channels also lie in the epicardium and coalesce to form the coronary sinus, which terminates in the right atrium. Small anterior cardiac veins from the right ventricle drain directly into the right atrium.

Impulse-Conducting System.—This unique pathway of small-, medium-, and large-sized muscle fibres is the mechanism that regulates the heartbeat (successive contractions in the atria and ventricles; fig. 6). The cardiac impulse is initiated in the sinoatrial, or pacemaker, node (mass of small fibres) and is propagated

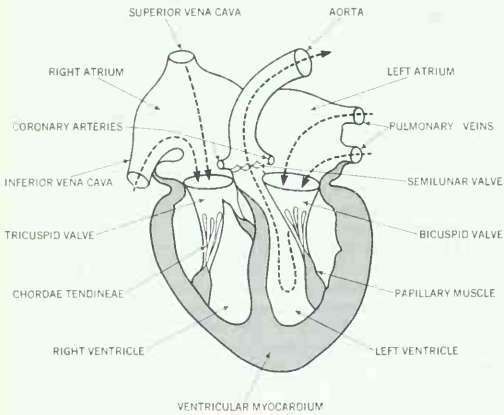

FIG. 5.—SECTION THROUGH FOUR CHAMBERS OF HEART SHOWING VALVE STRUCTURE

Arrows indicate flow of blood (except flow from right ventricle through pulmonary artery)

through the atria to the atrioventricular node, near the opening of the coronary sinus. From this node the impulse is carried down the atrioventricular bundle, which crosses the annulus and divides into two branches that descend within the endocardium of the ventricles. Purkinje's fibres, the largest components of the bundle branches, conduct very rapidly. The mechanism may be likened to the distributor wires of an automobile engine. Irritation or injury to this pathway may result in arrhythmias (disturbances in heart rhythm) and heart blocks (*see* HEART, DISEASES AND DEFECTS OF).

Nerves.—The heart is supplied by the vagus nerve and the sympathetic trunk. The nerves form extensive networks at the base of the heart and along the coronary arteries. The vagal fibres do not go directly to the heart muscle, but arborize about nerve cells in the atria. Small processes from the nerve cells then terminate on the sinoatrial and atrioventricular nodes, heart muscles, and coronary arteries. The vagus nerve (which belongs to the

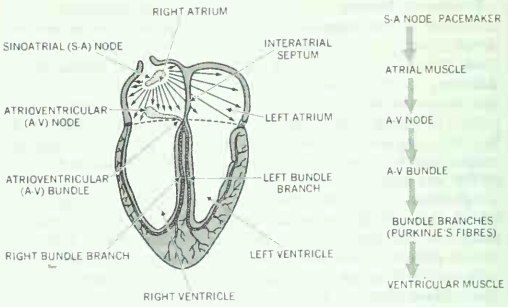

FIG. 6.—DIAGRAM AND WORD SCHEMA OF IMPULSE-CONDUCTING SYSTEM

parasympathetic system) acts upon the nodes to slow the heartbeat. The sympathetic nerve fibres accelerate the heartbeat and effect a stronger contraction of the ventricles.

Comparative Anatomy.—The heart is clearly differentiated in the higher invertebrates, *e.g.*, clam, crayfish, and cockroach, and is structurally most complex in the vertebrates. It possesses four primitive chambers in the higher fishes; is imperfectly five-chambered in amphibians and lower reptiles; and is fully four-chambered in birds and mammals. For a discussion of the evolution of the heart in relation to the circulatory system as a whole *see* CIRCULATORY SYSTEM.

See also CIRCULATION OF BLOOD; HEART, COMPARATIVE PHYSIOLOGY OF; and references under "Heart, Anatomy of" in the Index.

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HEART, COMPARATIVE PHYSIOLOGY OF.

The bodies of all except the simplest animals contain fluids that circulate through the body in a constant direction. Such circulation requires a repeating pump to propel the fluid, and any such pumping device is called a heart. To keep the fluid moving in a constant direction the heart must either compress the fluid in a continuous progressing wave, or it must have valves to prevent backflow. Both systems are found in animal hearts, sometimes one or the other and sometimes both together. Propulsion by contractile waves is characteristic of worms, whereas rhythmic contractions with valves to prevent backflow characterize arthropods, mollusks and vertebrates (including man).

The most characteristic feature of heart muscle tissue is its capacity for rhythmic contractions, a property that is also inherent in many nerve cells and in visceral muscles. Embryonic heart tissue is capable of spontaneous rhythmic contractions; in the early embryos of vertebrates the heart beats without anything regulating the contractions, and pieces of embryonic heart tissue cultured outside the body may develop rhythmic contractions. Such spontaneous contractions probably are a response of the muscle protoplasm to conditions of the cellular environment; perhaps the energy produced by intracellular oxidation builds up to a critical level, discharges, rebuilds to the critical level, etc., in an automatic cycle.

Adult heart muscle of all animals, however, seems to contract only as a result of stimulation. Heart muscle is extremely susceptible to stimulation, a great variety of artificial stimuli causing it to respond by contracting. As with other muscle tissue —skeletal muscle and smooth muscle—a stimulus must have a cer-

tain minimal intensity and a certain minimal duration in order to bring about a contraction. These values vary widely in different animals, and even from time to time in the same tissue as local conditions change. Like many other tissues, heart muscle also exhibits a refractory period, a brief period immediately following stimulation during which it is wholly unexcitable. The refractory period is not so clearly marked in invertebrates as in vertebrates. Each contraction of the vertebrate heart is maximal; *i.e.*, the heart contracts in "all or none" fashion, and a stronger stimulation will not induce more powerful contraction. In invertebrates, on the contrary, a normal contraction of the heart is never maximal. (*See* ALL-OR-NONE LAW.)

The demands made upon the heart by the body are constantly changing; demands may be temporarily increased several hundred per cent in an athlete following a 100-yd. dash, for example. Simple animals with low metabolic rates and open circulatory systems require less regulation of the heart than do active animals with closed systems under high pressure; the heart of a clam, for example, need not be so efficient as the heart of a bird or mammal. Nevertheless, the behaviour of even the simplest hearts is regulated to conform to the changing requirements of the body. Such controls are largely chemical, although the heart also responds to variations in such physical factors as temperature and pressure.

Pacemakers.—In all adult animals a special tissue, called a "pacemaker," initiates each heart beat. The pacemaker is always located within the heart itself, and two very different kinds of pacemaker tissue occur in animals. In vertebrates and mollusks the beat originates in the heart muscle tissue itself, and these are called myogenic hearts. In vertebrates the pacemaker is localized in the muscle tissue of the sinus venosus (fishes and frogs) or the atrioventricular node (birds and mammals), which differ from the muscle of other regions of the heart in recovering excitability very rapidly after a contraction. In mollusks the pacemaker is less localized; the beat can originate in muscle at any point over the heart.

Mammals and birds have in addition a special conduction system that greatly increases the efficiency of the heart and appears to be an adaptation to high body temperatures. In these animals the wave of excitation originating in the atrioventricular node is first spread over the atria and then is spread over the ventricles through special rapidly conducting tissue (called Purkinje tissue) that carries the wave to all parts of the ventricles at almost the same instant. In worms, arthropods and ascidians the beat originates in nerve cells located in or on the heart, and these are called neurogenic hearts. The two kinds of pacemaker tissue react very differently to certain drugs, notably acetylcholine, which inhibits myogenic hearts and accelerates neurogenic hearts. The striking differences in the two types of pacemaker mechanism indicate that they arose quite independently during the course of evolution. The myogenic pacemaker is more primitive than the neurogenic. (*See* CIRCULATION OF BLOOD: *Physiological Properties of the Heart.*)

Nervous Regulation of Hearts.—The heart rate of most animals is regulated by reflex nervous controls; and most hearts also respond to variations in blood pressure within the heart itself, the rate increasing when blood pressure falls and slowing when blood pressure rises.

In vertebrates, nerve fibres from the tenth cranial nerve (the vagus) pass from the brain to the heart, and stimulation of these fibres slows the heart and reduces the amplitude of its contraction. Fibres from the sympathetic nervous system reach the heart in all vertebrates except fishes; stimulation of these fibres accelerates the heart. Nerves seem to affect the heart rate by means of chemical mediators. Acetylcholine is associated with activity in the vagus; and sympathin, an adrenalinelike substance, is associated with activity in the sympathetic fibres. Acetylcholine inhibits vertebrate hearts, and adrenaline accelerates the hearts of both vertebrates and invertebrates.

In invertebrates various inhibitory and accelerator nerves pass from the central nervous system to the heart. These heart-regulating nerves form no consistent pattern among the various invertebrate groups, and the manner in which they affect heart rate is not well understood. (*See* also CIRCULATION OF BLOOD: *The Nervous Regulation of the Heart Beat.*)

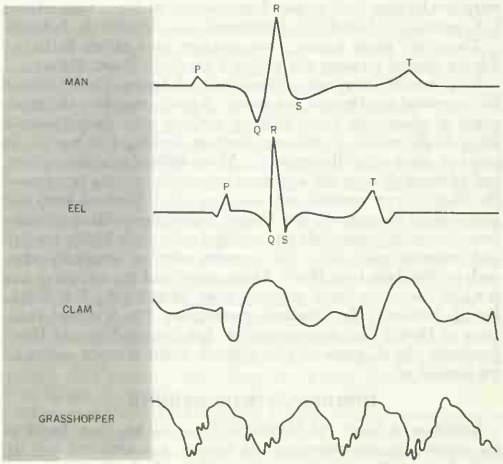
Heart Rates.—Among warm-blooded vertebrates each species has a "normal" heart rate, the average rate at which the heart beats in a healthy individual at rest. In cold-blooded animals body temperature varies with environmental temperature, and the heart rate also varies with the temperature of the animal's environment. In all animals the rate of the heart beat varies widely with changes in bodily activity, with stress and with body temperature—in other words, the heart rate is directly related to the metabolic rate of the body. Therefore, statements of heart rate are almost meaningless unless the conditions under which the rates were counted are clearly stated. For example, the human heart normally beats about 72 times per minute, but disease, nervous tension, emotion and many other factors may increase the rate to 100 or more, and the rate may temporarily exceed 200 following violent physical exertion.

The requirements of the tissues of an animal's body vary from time to time, often from moment to moment. For any cardiovascular system to function efficiently, therefore, there must be a mechanism to increase or decrease heart rate. Since the heart muscle itself uses oxygen, however, an equilibrium point is soon reached beyond which the heart itself uses up the additional oxygen resulting from any further increase in heart rate.

In general, heart rate is faster in active animals than in sluggish animals. The heart rate is 40–80 per minute in squids, which are active mollusks, whereas in the much more sluggish clams and mussels it is only 2–20 per minute. This is not always true, however. In the hare the heart beats about 64 times per minute, whereas in the more sluggish rabbit the rate is about 200 per minute.

Heart rate is partly related to body size, large animals tending to have slower rates than small animals. In large mammals such as elephants and horses the heart beats 25–40 times per minute, whereas in rats and mice the rate is 300–500 per minute. In birds the heart rate is very high, and this is related at least in part to their high body temperatures. In the domestic fowl the rate is 150–180, and in small birds it is 200 or more per minute.

Electrocardiograms.—Activity of heart muscle, like that of many other tissues, is accompanied by changes in electrical potential, and such changes can be measured by suitable instruments. A heart beat consists of a succession of events, each involving a different part of the heart, and each with its own characteristic change in electrical potential. A recording of the sequence of



ELECTROCARDIOGRAMS ILLUSTRATING THE COMPARATIVE PHYSIOLOGY OF THE HEART

these changes is called an electrocardiogram, which is therefore a graphic record of the varying electrical potential of the heart during one or more complete beats.

The electrocardiogram pattern is similar for all vertebrates, consisting of a series of slow waves representing positive and negative deflections. In the electrocardiograms shown in the figure, the patterns for man and the eel, both of which are vertebrates, are seen to be almost identical. There can be no doubt that the points of positive and negative deflection in these patterns (to which the symbols P, Q, R, S, T are conventionally applied in man) relate to the same events in all vertebrates. Electrocardiograms from other myogenic hearts likewise consist of slow electrical waves, but the patterns are not the same as for vertebrates. The difference is evident in the electrocardiogram of a clam, an invertebrate with a myogenic heart, in the figure. Neurogenic hearts, such as those of arthropods, produce very different electrocardiograms, as is illustrated by the electrocardiogram of a grasshopper. Electrocardiograms from neurogenic hearts are "oscillatory"; *i.e.*, each wave is accompanied by numerous small deflections instead of being smooth as in myogenic hearts. It is believed that the oscillations in electrocardiograms from neurogenic hearts correspond to discharges from the pacemaker ganglion cells.

For a discussion of the physiology of the human heart, *see* CIRCULATION OF BLOOD. *See* HEART, ANATOMY OF; HEART, DISEASES AND DEFECTS OF; HEART AND LUNG, SURGERY OF; *see* also references under "Heart, Comparative Physiology of" in the Index.

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HEART, DISEASES AND DEFECTS OF. Diseases of the heart and blood vessels were, in the mid-1960s, the most frequent causes of death and disability in the Western world—and they were increasing at an accelerated rate. The situation was related in large part to the increase in life expectancy: more people were living to ages predisposing to cardiac and vascular ailments.

"Heart attack" is a popular term for the commonest form of heart disease, known clinically as coronary thrombosis, coronary occlusion, or myocardial infarction (all essentially synonymous terms; *see* below, *Coronary Disease*). The popular name is an unfortunate one because of its ambiguity; it can be applied equally well to disturbances of heart rhythm, episodes of shortness of breath, or brief attacks of heart pain of various origin. The term is, moreover, unnecessarily alarming; even in a proved case of coronary thrombosis the outlook for an extremely active life afterward can be excellent, as was demonstrated in the careers of two U.S. presidents, Dwight D. Eisenhower and Lyndon B. Johnson.

The term "heart failure," too, is often used rather inexactly. For its clinical meaning *see* below, *Congestive Heart Failure*.

Diagnosis and treatment of practically all forms of heart disease has improved greatly in recent years. A good example is the treatment of congestive heart failure; patients who formerly were likely to die within a year may now be working fulltime for 10 years or more after the episode. Many individuals, institutions, and agencies all over the world are vigorously seeking to improve the diagnosis, prevention, and treatment of all kinds of heart and blood-vessel disease. In the United States the institutions range from community hospitals and medical schools to highly specialized research institutes. The agencies may be voluntary ones, such as the American Heart Association (and its affiliates) and the Life Insurance Fund, or public ones, of which the U.S. Public Health Service is the outstanding example. The National Institutes of Health, a federal enterprise, has its own National Heart Institute. In all parts of the civilized world research activities are carried on.

HISTORICAL BACKGROUND

Evidence of heart and blood-vessel disease has been found in the oldest Egyptian mummies. In Greece, during the 5th and 4th centuries B.C., the first observations relating to heart action were recorded: Hippocrates described the pulse, Herophilus studied its rate and rhythm, and Erasistratus described the heart chambers and valves. Aristotle proclaimed the heart as the seat of the soul. Galen (2nd century A.D.), the first experimental physiologist, demonstrated the relation between the heartbeat and the pulse.

There followed a long stagnant period before the Renaissance (15th century), in which students of the heart and blood vessels shared. Leonardo da Vinci, among others, made beautiful and accurate drawings of the gross anatomy of these structures. However, it was not until William Harvey (*q.v.*) discovered the true nature of the circulation of the blood (1628) that the background for more understanding was established.

Several important anatomical studies of heart diseases were made in the 17th and 18th centuries. Among these the descriptions of valvular ailments by Raymond Vieussens were outstanding, and great contributions were made by Giovanni Lancisi and Giovanni Battista Morgagni. Clinical recognition of various kinds of heart disease was given impetus by the invention of two techniques of physical examination. In 1761 Leopold Auenbrugger (*q.v.*) announced the value of percussion (tapping the body to detect the presence of an underlying solid structure; *e.g.*, an enlarged heart where there should be air-containing lung). In 1819 René Laënnec invented the stethoscope (an instrument which permits the examiner to hear abnormal heart or breath sounds more readily; *see* AUSCULTATION).

The 19th century brought a veritable flood of information on the gross and microscopic pathology of all forms of circulatory disease; Baron Karl von Rokitansky, F. G. J. Henle, Robert Remak, R. A. von Kölliker, Rudolf Virchow, and Sir Arthur Keith were among the leaders in this endeavour. The physiology of the circulation also received refined attention. Stephen Hales, Ernst and Wilhelm Eduard Weber, J. L. M. Poiseuille, Karl Ludwig, Sir Michael Foster, Charles Scot Roy, and Walter Gaskell added insight into such diverse matters as the measurement of blood pressure, the enervation and elasticity of the heart and blood vessels, and the dynamics of blood flow in the body and in particular organs. There was marked improvement in the diagnosis of structural and functional abnormalities of the circulatory system in the living patient. John Cheyne, Robert Adams, William Stokes, and Sir Dominic John Corrigan pointed out diagnostic and prognostic signs which are known by their names to this day.

The discovery of X rays by Wilhelm Röntgen (1895) and the invention of a practical instrument for electrocardiography (*q.v.*) by Willem Einthoven (1903) ushered in a period of greatly increased precision in the diagnosis of heart diseases. Sir Thomas Lewis did most to further the use of electrocardiography for this purpose. Diagnostic accuracy has been especially enhanced by angiocardiography (serial X-ray pictures of the passage of a material in any part of the circulatory system). Some of these improvements stemmed from the development of cardiac catheterization (*q.v.*; insertion of a thin tube through a vein or an artery into various parts of the heart) by Werner Forssmann (1929); the technique was extended clinically by André Cournand and Dickinson W. Richards.

Perhaps the greatest single achievement in the treatment of heart disease was the discovery of the value of digitalis (*q.v.*) by William Withering in the late 18th century—although its proper use was not well understood until the second quarter of the 20th century. Guido Farina and L. Rehn are credited with the first heart operations (1896) but it was not until R. E. Gross established the feasibility of operations on a form of congenital heart disease (1939) that they became commonplace. Surgical transplantation of the heart was a major development, still in the experimental stage, in the mid-1960s. (*See* also MEDICAL RESEARCH: *Organization of Medical Research: Cardiovascular Disease Research.*)

DESCRIPTIONS OF HEART AILMENTS

The New York Heart Association has published successive revised editions of a book (*see* bibliography) designed to enhance precision in the diagnosis of diseases and defects of the heart and blood vessels. The book takes into account several approaches to classification: anatomical, physiological, etiological (causative), and functional. In the following descriptions the etiological clas-

sification is used primarily, but certain anatomical, physiological, and functional considerations are also discussed. The diseases are presented approximately as they occur with chronological aging. (For a full understanding of the descriptions, the reader may find it helpful to consult the article HEART, ANATOMY OF.)

Congenital Heart Defects are those present at birth. There are several anatomical varieties, ranging in seriousness from some that kill the newborn to those that never cause any symptoms or disability. Some forms of congenital heart disease are much more frequent in cases where the mother suffered an attack of German measles during the first three months of pregnancy (*see* MEASLES AND GERMAN MEASLES). Some drugs taken during pregnancy are known to produce congenital defects (*see* PREGNANCY: *Drugs Harmful in Pregnancy*). However, the cause of congenital heart disease cannot, in most cases, be exactly ascertained.

Anatomical defects compatible with life include narrowing of various portions of the blood vessels entering and leaving the heart (pulmonary or aortic stenosis, coarctation of the aorta) and abnormal openings between chambers of the heart or blood vessels (interatrial or interventricular septal defects, patent ductus arteriosus). Sometimes there is a shunting of blood through one of these openings. When this is from the right side of the heart to the left side, venous blood is added to the arterial blood, producing cyanosis (as in the so-called blue baby disease, for example). When the shunt is in the other direction, as in patent ductus arteriosus from the aorta to the pulmonary artery, the left side of the heart has to work harder because some of the blood which it pumps will recirculate through the lungs instead of going out to the rest of the body.

Some kinds of congenital defects of the heart may be completely corrected by surgery; in others, surgery may be of great benefit even though some abnormality persists. It is important, therefore, that an accurate anatomic diagnosis of the type of heart disease be made. Cardiac catheterization, together with angiocardiography and the measurement of pressure relationships and the oxygen content of the blood in various places in the circulatory system are especially useful diagnostic techniques. The surgical procedures themselves have undergone rapid improvement and the risk has been markedly lowered. It is possible to repair defects on the inside of the heart through open-heart surgery. This involves shunting the blood through an artificial pump-oxygenator (heart-lung machine; *see* ARTIFICIAL ORGANS) while the heart is being repaired. Experiments have been tried involving the transplantation of the whole heart from one animal to another (*see* TRANSPLANTS, TISSUE AND ORGAN) and the introduction of mechanical auxiliary pumps in parts of the circulation. (*See* also HEART AND LUNG, SURGERY OF.)

Rheumatic Heart Disease follows one or more episodes of rheumatic fever (*q.v.*), a systemic disease which occurs most often in children and young adults. In about half the cases of proved rheumatic heart disease the acute illness which caused it had gone unrecognized, probably because the disease chiefly affected the heart and not the joints (arthritis) or the brain (chorea). The number of cases, including recurrences, has been greatly reduced by the prophylactic use of sulfa drugs and penicillin, but rheumatic heart disease remained, in the 1960s, the most important circulatory problem in young people.

Rheumatic fever affects the heart in about 40% of the cases. The disease may involve all parts of the heart—the lining (endocardium), the muscle (myocardium), and the covering (pericardium)—and it tends to leave permanent scars. It most often affects the valves (mitral and aortic) on the left side of the heart. The valves may be narrowed (stenosis) or prevented from closing properly (valvular insufficiency or leakage); often both kinds of damage occur. Such defects cause heart murmurs and make the appropriate part of the heart work harder. The severity of the valvular damage and the state of the heart muscle largely determine the course of the disease. The patient may develop congestive heart failure (*see* below) early or he may live to old age without further trouble from this source.

Surgery for rheumatic heart disease has greatly improved the outlook for some of these patients. Operations to correct narrowing of the mitral valve have been the most common and successful. Open-heart surgery has made possible the repair of damaged valves or the installation of artificial ones.

Subacute Bacterial Endocarditis is an infection (usually streptococcal) which is superimposed on a preexisting rheumatic valvular lesion or on a congenital heart defect. It is characterized by varying fever curves, systemic toxicity, and possible embolic accidents (material traveling from the affected area to other parts of the body). The causative organism usually gets into the blood stream and hence the heart during an episode of sore throat or a dental extraction, but it may do so during childbirth or (rarely) from other infected sites in the body. The use of large doses of penicillin when any of these conditions obtain in patients predisposed to infection by virtue of known rheumatic or congenital heart disease has greatly lessened the frequency of subacute bacterial endocarditis, which once was uniformly fatal.

Other bacteria, and molds, can cause infection of heart valves; fortunately, they rarely do so. These infections, which may or may not yield to antibiotic therapy, usually run a more acute course, terminating in days or weeks rather than months, as was the case in streptococcal endocarditis before it was treatable.

Hyperthyroidism and Hypothyroidism—malfunctions of the thyroid gland—cause heart troubles of different kinds. Hyperthyroidism (excessive activity of the gland) makes the heart beat faster and pump more blood with each beat. The patient is usually irritable and excitable. The condition usually can be treated successfully with one or more preparations, including radioactive iodine; or it may be treated surgically. Neglected cases may develop congestive heart failure. Hypothyroidism, or myxedema (thyroid deficiency), results in dilatation of the heart and the accumulation of fluid in the heart sac (pericardial effusion). It is marked by low voltages in the electrocardiogram. The patient is usually sluggish mentally. The condition is quickly remedied by appropriate doses of thyroid extract.

Cardiovascular Syphilis affects chiefly the aorta (the large artery that distributes blood from the left side of the heart). It causes trouble in one or more of the following ways: (1) The vessel may dilate to form an aneurysm (sac), which may rupture and cause instant death. (2) The aortic valve may be damaged, and fail. The mechanics of this lesion are quite similar to those of rheumatic aortic involvement. (3) The mouths of the coronary arteries (the blood vessels that supply the heart muscle) may be narrowed. In this case there is usually severe chest pain. The incidence of cardiovascular syphilis has steadily diminished, especially since the introduction of penicillin in the treatment of syphilis (1942).

Anemia (*q.v.*), from whatever cause, if of sufficient severity and duration may cause heart failure. This is because the heart has to overwork constantly and does not itself get sufficient oxygen and other nutrients. Anemia, of itself, results in no permanent heart damage; it is more often a problem in that it intensifies the symptoms in other kinds of heart disease.

Obesity (*q.v.*) may be a direct cause of heart trouble but is far more often a complicating feature in various forms of heart disease. It causes difficulty because the heart has to supply blood to the undesirable fatty tissue 24 hours a day, and the patient and his heart must work harder whenever he attempts any form of exertion. Furthermore, deposits of fat between the heart muscle fibres may interfere with their mechanical efficiency.

Myocarditis is inflammation of the heart muscle. Its causes are multiple; sometimes viruses are to blame. Diagnosis is difficult but is assisted by electrocardiography and biopsy (removal of bits of heart muscle for microscopic examination). Myocarditis is extremely variable in its manifestations and outlook. Some cases last only a few days; others are relentless and terminate fatally after several years. Rest is the only known treatment. Fortunately, myocarditis is relatively rare.

Hypertensive Heart Disease, a result of high blood pressure (*q.v.*), is one of the commonest causes of disability and death. Its origin is unknown in most instances, although in a few cases kidney disease may be responsible. The course of the disease varies greatly from person to person; in some it is compatible with

many years of active life, without any distress whatever, while in others it leads to death within a year. The proximate cause of death from high blood pressure is usually one of the following: heart failure; a vascular lesion in the brain (stroke); or kidney failure. Improved medical management of hypertension has greatly increased life expectancy. The control of the blood pressure by various drugs has almost eliminated the need for surgery on the sympathetic nervous system. Treatment of the failing heart has also contributed much to a better outlook in hypertension.

Coronary Disease affects the heart through hardening (sclerosis) of the coronary arteries (the vessels that supply the heart muscle and are the first branches of the aorta). These may be either narrowed or actually occluded. In an occlusion, the vessel may be shut off by the hardening itself or, more often, by the development of a thrombus, or blood clot, at the site (coronary thrombosis; *see* THROMBOSIS AND EMBOLISM). The chief symptom is angina pectoris (*q.v.*)—paroxysmic pains in the chest that frequently radiate to one or both arms or to the neck and teeth. In narrowing, the pain is usually of short duration, lasting no longer than 15 minutes, and is usually brought on by exertion or excitement. In occlusion, the pain usually lasts more than an hour and may persist for several days. The occlusion usually causes a withering of the portion of the heart muscle (myocardial infarction) supplied by the occluded branch of the coronary tree. This muscle is replaced by scar tissue if the patient lives. Both narrowing and occlusion are compatible with a reasonably active existence in many patients for many years. The use of oxygen and the anticoagulant drugs heparin and bishydroxycoumarin have improved the outlook considerably. Electrical devices to detect the onset of potentially fatal disturbances of heart rhythm, and resuscitation procedures including electrical defibrillators and pacemakers, have further improved the patient's chances during the acute episode. (*See* also ARTERIES, DISEASES OF.)

Psychoneurosis Affecting the Heart is usually one of two kinds. Neurocirculatory asthenia (effort syndrome) is primarily a psychiatric disorder. The heart does not respond well to exercise in patients with this difficulty because they will not exercise enough to keep it toned up. More important is the anxiety neurosis directed toward the heart in patients with or without organic heart disease. This may be produced in a few patients by physicians who are alarmists. It causes needless incapacity and worry.

Arrhythmias are deviations from normal heartbeat rhythm. (The reader may wish to consult the article HEART, COMPARATIVE PHYSIOLOGY OF, in which the mechanism of the heartbeat is explained.) Arrhythmias vary in severity from those of no clinical importance, such as simple sinus arrhythmia (variation of heartbeat with the phases of respiration), which nearly all children have, to ventricular fibrillation (convulsive contractions of muscle fibres, in this case in the ventricles of the heart), which produces sudden death. Other forms of arrhythmia include the following:

Premature, or Extra, Systoles are heartbeats touched off from either the top or the bottom part of the heart prematurely; they usually replace the next normal beat. This type of arrhythmia, even when it occurs frequently in an otherwise normal heart, is in no way incapacitating.

Paroxysmal Tachycardia is very rapid regular heart action, the rate ranging from 160 to 200 beats per minute. It is usually harmless unless it occurs as a complicating feature of some other form of heart disease, or in the elderly, or if it lasts a long time. Attacks begin and end suddenly, and last from a few seconds to a few weeks.

Atrial (Auricular) Flutter and Atrial Fibrillation are closely related maladies in which the top part of the heart (the atria, or auricles) is the primary seat of the disturbance. In flutter, the atria beat very rapidly, usually around 300 times a minute, while the rate in the bottom part (the ventricles) may be normal (about 70 beats a minute) or show a regular abnormality of coupled beats; in any event, the ventricular rate rarely exceeds 150 times a minute in the presence of flutter. In atrial fibrillation, atrial activity is chaotic and the ventricles beat rapidly and irregularly; when uncontrolled by digitalis, the ventricular rate is usually well over 100. Both of these disturbances can occur in attacks, but more often atrial fibrillation becomes the established pattern. Both can, but rarely do, occur in otherwise normal hearts. The paroxysmal variety may be prevented by the use of quinidine sulfate. Atrial fibrillation is compatible with years of active life in many instances but is to be regarded as a more serious arrhythmia than the ones previously described.

Heart Blocks represent various degrees of interference in some portion of the pathway over which the contractive impulse travels through the heart. They range from (1) partial atrioventricular block through (2) intraventricular conduction defects and (3) bundle branch blocks to (4) complete heart block. The first represents delayed conduction from auricle to ventricle; the second, slowing down of the impulse within the ventricular walls; the third, a block in the pathway on one or the other side of the heart; and the last, complete dissociation of auricular contractions from ventricular ones, with each chamber establishing its own rate. Most forms of heart block are the result of a diffuse pathological process that produces a physiological change when it includes the particular region of the heart involved in the conduction of the impulse to contract.

Congestive Heart Failure is a failure of the one function of the heart: to pump blood adequately. It may occur as a result of any type of organic heart disease. Heart failure is marked by an increase in venous pressure and (usually) a decrease in the delivery of adequate amounts of oxygen to the tissues. The increase in venous pressure, together with some other factors, may result in swelling of the liver and ankles and congestion in the kidneys and intestinal tract. When the left side of the heart is chiefly at fault, the lungs may be the site of most of the congestion, with an outpouring of watery fluid into the air sacs. Congestive failure may be acute or chronic. The acute variety may cause death in a few minutes; the chronic variety may last for many years. The outlook in nearly all of these cases has been greatly improved by the proper use of digitalis, the introduction of theophylline derivatives and mercurial and other diuretics, better knowledge of appropriate dietary regimens, an appreciation of the importance of a low intake of sodium ion.

See also PERICARDIUM, DISEASES OF; and references under "Heart, Diseases and Defects of" in the Index.

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HEART AND LUNG, SURGERY OF. Surgery of the heart and great vessels developed rapidly during the first half of the 20th century, with dramatic advances especially after 1939, and continued into the second half. Operations within the chest remained unsafe until new surgical techniques were introduced in the early 1930s. After that time rapid advances were made and the risk of removal of a portion of a lung was reduced to a minimum. Thus it was inevitable that removal of lung tissue eventually was applied in treatment of numerous pulmonary lesions.

SURGERY OF THE HEART AND GREAT VESSELS

Heart Wounds.—Traumatic injuries of the heart, either by a foreign body or by a sharp object, are usually fatal if both entrance and exit wounds are produced. Fatality more often results from filling of the pericardial cavity with blood (cardiac tamponade), thus interfering with heart function, than from loss of blood. If death does not immediately ensue, heart function may be maintained by aspiration (removal) of blood from the pericardial cavity, while preparations are being made for closing the defect by suture.

Although J. Roberts suggested closure of heart wounds by surgery in 1881, report of a successful operation by L. Rehn did not appear until 1896. More reports of successful cases soon followed and until 1940 it was thought that all wounds required closure by suture. In 1943 A. Blalock and M. M. Ravitch reported that many of these injuries could be satisfactorily managed by improving the return flow of blood to the heart through repeated aspiration of blood from the pericardial cavity. If bleeding continued, however, suture of the wound was required.

Traumatic injury to large vessels within the pericardial cavity is usually attended by immediate death, since this wound does not tend to seal as do wounds of the heart muscle, and cardiac tamponade becomes severe.

Foreign bodies may lodge in the heart muscle and remain for an indefinite period of time. If the blood supply to the heart through the coronary circulation is not materially affected, and the object is not large, it may cause no dysfunction. Larger foreign objects are apt to cause complications and should be removed. This removal usually can be accomplished without undue risk.

Heart Block.—By this is meant an interference in the conduction system between the sinoauricular node located in the right atrium (auricle) and the ventricles. Normally, the heart contractions are initiated by impulses arising in specialized tissue called the sinoauricular node and are carried by specialized myocardial fibres called the bundle of His to the walls of the ventricles. When the block is complete, the auricles and ventricles contract independently, resulting in a slowing of the ventricular rate to from 20 to 60 per minute. This results in a marked reduction in heart function with inadequate circulation for the body requirements, especially when the work of the heart is increased.

Three types of heart block are recognized: (1) congenital, (2) acquired following diseases such as coronary insufficiency or rheumatic heart disease, and (3) acquired following trauma usually resulting from the surgical repair of congenital defects of the heart. It was this latter cause of heart block that stimulated intensive study of methods of treatment for this condition. Through these investigations, P. M. Zoll and others and W. M. Chardack and others developed methods for electrically stimulating the ventricular contraction at a desirable rate for satisfying circulatory needs. Electrodes are inserted into the heart muscle and connected with a transistorized, battery-powered pacemaker implanted beneath the skin of the abdominal wall. Successful results were first obtained in this manner during the early 1960s.

Congenital Cardiovascular Defects.—*Patent ductus arteriosus* is a persistence of the opening between the aorta and pulmonary artery, which is necessary before birth. The ill effects caused by this lesion result from increased work put on the heart by abnormal recirculation of blood through the lungs. In some cases an infection develops in the ductus, and a blood stream infection ensues. Occasionally an aneurysm may form in this communication, with eventual death from its rupture.

Although surgical obliteration of a patent ductus was first suggested by J. C. Munro in 1907, this operation was not successfully performed until 1939 by R. E. Gross. Many successful operations for this lesion have since been performed. By closing this shunt from the systemic to the pulmonic circulation, either through division and suture or ligation (tying) of the ductus, normal circulatory arrangements are established. Life expectancy becomes normal unless irreparable damage to the heart has already occurred.

Tetralogy of Fallot is a congenital abnormality, the so-called blue baby disease. It consists of (1) stenosis (constriction) of the pulmonary artery; (2) a persistent defect in the wall between the ventricles; (3) an aorta so positioned (overriding) at the wall defect that it receives blood from both the right and left ventricles; and (4) thickening (hypertrophy) of the right ventricular walls. The epochal work of A. Blalock and H. Taussig, in 1945, on the operative treatment of this condition was a major advancement in this field of surgery. Ill effects of these lesions result chiefly from a deficient flow of blood through the lungs. The Blalock procedure produces a shunt from a systemic artery (subclavian) to a pulmonary artery, thus bypassing obstruction of the inlet of the main pulmonary artery. An operation similar in principle was reported by W. J. Potts, S. Smith and S. Gibson in 1946. This entailed uniting the aorta directly to a pulmonary artery by the use of a specially devised clamp. With the continued advances in cardiac surgery for this lesion by J. W. Kirklin *et al.*, the septal defect of most cases of tetralogy of Fallot came to be treated surgically under direct vision during extracorporeal circulation. The defect is closed by direct suture of the heart muscle or by securing a plastic patch over the defect.

The results of surgery in cases of tetralogy of Fallot are both dramatic and satisfactory; cyanosis (blueness of the skin) is relieved, exercise tolerance is greatly raised, and significant elevations of blood oxygen saturation levels are attained. The risk of the operation has been reduced to approximately 5% to 10%. The results of surgery have been very gratifying in that many children suffering from this heart abnormality have been returned to a relatively normal way of life.

Pulmonic and infundibular stenosis are a narrowing of the pulmonic valve or of the entrance to the pulmonic valve, named the infundibulum. They may occur without other abnormalities within the heart. In many such patients there is an associated defect in the wall between the atria. The ill effects of this lesion are similar to those in tetralogy of Fallot, since insufficient blood passes through the lungs for oxygenation of the tissues. R. C. Brock of London, Eng., in 1948 devised a direct approach to this problem by cutting and dilating the constricted valve with a specially constructed knife. His operation was also used in some cases of tetralogy of Fallot in which the pulmonary artery was enlarged beyond a constricted valve. In the case of pulmonic stenosis, dramatic results are achieved by opening this constricted valve, thus allowing a normal flow of blood from the right heart through the lungs. Correction of these lesions under direct vision, after reducing the body temperature to a very low level or under extracorporeal circulation, has given better results at little or no greater risk. If cyanosis has been present previously because of a defect in the wall between the atria, this condition immediately disappears and strain on the right heart is relieved.

Coarctation of the aorta consists of almost complete constriction of the thoracic aorta, usually at the point where the ductus arteriosus unites the aorta with the pulmonary artery before birth. Constriction of the vessel causes the blood pressure in the upper extremities and head region to become much elevated, while that below the site of constriction is below normal. This condition occurs in spite of the development of considerable collateral circulation around the point of stricture. Excessive heart strain with failure, the production of aneurysms and cerebral hemorrhages are common results of this lesion. Until 1945, when C. Crafoord of Stockholm, Swed., corrected this condition by cutting out the constricted portion and uniting the cut ends by suture, the life span of patients with this lesion was much shortened. Crafoord's accomplishment was duplicated soon thereafter by R. E. Gross. The risk of operation is less than 5%.

Septal defects consist of a communication between the right and left sides of the heart, either between the atria or between the ventricles. The deformity results from a failure of completion of the septum, or wall, between the two sides. A septal defect between the ventricles is likely to produce more harmful effects and be more difficult to repair than one between the atria. The ill effects of these lesions are usually caused by added strain on the heart with ultimate heart failure. A closed method of repair was devised and reported by C. P. Bailey and others in 1952 and by T. Sondergard, V. O. Bjork and Crafoord in 1953. Open or semi-open methods (under direct vision) were used by R. Gross and C. A. Hufnagel and by J. Gibbon. With the improvement of surgical techniques developed by J. C. Cooley and others, and with reduction of risk associated with extracorporeal circulation methods, closure of both atrial and ventricular septal defects under direct vision became the procedure of choice by 1960. The results following surgery are excellent, except in patients whose heart muscle has been under great strain for long periods of time. In such cases, the risk of surgery is greater and the results following the operation are less satisfactory.

Factors that have been of help during these operations include (1) hypothermia or lowering of the body temperature to as low as 30° C. and (2) extracorporeal circulation, in which the venous blood is removed from the body by a system of tubes and pumped into the arterial system after being reoxygenated (heart-lung bypass). (*See* also ARTIFICIAL ORGANS.)

Acquired Defects.—*Aortic and Mitral Insufficiency or Stenosis.*—Following an attack of rheumatic fever, infection of the aortic and mitral valves may ultimately lead to constriction of the valve opening or otherwise prevent it from functioning

properly. The chief ill effect of this defect is increased work on the heart with ultimate failure.

Although clinical investigation of mitral stenosis, and an attempt to relieve this condition by surgery, was reported as early as 1922, sustained satisfactory results were not obtained until Bailey devised an operation known as commissurotomy in 1948. Dilatation of the valve, by either finger or instrument, in many instances leads to return of valvular function to such a degree that the patient achieves normal status. The risk of operation is largely dependent upon the status of the valve and the heart at the time of surgery. For early cases mortality is less than 5%. Surgical treatment for advanced stages of mitral stenosis, mitral insufficiency, aortic stenosis and aortic insufficiency was extensively studied and developed by Bailey *et al.*, J. C. Davila *et al.*, C. W. Lillehei *et al.* and A. Starr during the late 1950s and early 1960s.

Operative correction under direct vision using heart-lung bypass or hypothermia gave increasingly encouraging results. A plastic valve devised by Hufnagel benefited many patients with aortic insufficiency. Valves made of plastic, steel and other materials were used in both laboratory animals and man with favourable results. In the early 1960s, the use of plastic protheses for replacement of the original aortic and mitral valves under direct vision with extracorporeal circulation proved successful in a high percentage of patients.

Constrictive Pericarditis.—In constrictive pericarditis, as the term indicates, the heart is tightly constricted by an envelope of scar tissue, which develops in the pericardial cavity as a result of chronic infection in that area. Rheumatic fever and tuberculosis are thought to be the commonest causes of this malady. The ill effects result from prevention of return flow of blood into the heart from the venous circulation. Removal of the constricting envelope of thickened pericardium and scar tissue was first proposed by E. D. Délorme of France in 1898. It was first successfully performed by L. Rehn of Germany in 1920 and resulted in complete relief of symptoms. In the United States, E. D. Churchill in 1929 reported the first successful case. When the operation is properly performed, most patients who do not have irreparable heart damage are completely relieved and live out a normal life span. *See* also Heart, Diseases and Defects of.

SURGERY OF THE LUNGS

Cancer of the Lung.—This tumour constitutes approximately 10% of all malignant tumours. After 1925 it increased by at least 400%. Although the cause has not been proved, the irritating effects of certain chemicals on the lining of the air passages undoubtedly contributes to its etiology.

Cancer of the lung was a hopeless condition until 1933, when E. A. Graham and J. J. Singer reported the first successful removal of an entire lung (pneumonectomy) for this lesion. The patient, a physician, was living and free of evidence of tumour more than 30 years after the operation. Concentrated studies of both cancer of the lung and of surgical means of alleviation have been made. In some early cases, especially in older persons, removal of less than the entire lung has given highly satisfactory results with less risk. Early detection of tumour by mass X-ray mobile unit screening should greatly aid (1) in increasing the percentage of removable tumours; (2) in increasing the percentage of cures following surgery; and (3) in avoiding strain on the heart since less lung removal is necessary. In younger persons (under 50) the risk of pneumonectomy is less than 5%. The risk in older patients is approximately 15%. All available means for making an early diagnosis should be utilized. These include the use of bronchoscopy and of improved techniques of X-ray study and examination of the sputum for cancer cells. (*See* also Cancer: *Identification of Cancer: Cancer of the Lung.*)

Congenital Malformation of the Lung.—Cystic disease of the lung may be congenital. Abnormal development of the lung may lead to the formation of cysts, which may be single or multiple, large or small. This abnormality interferes with pulmonary function in one of two ways, either by infection of the cyst and the production of a condition somewhat like lung abscess or bronchiectasis, or by overdistention of the cystic space, thus collapsing the normal lung tissue. This congenital type of cystic condition should not be confused with the acquired type, which consists of emphysematous blebs and bullae that are not lined by respiratory epithelium. This latter type usually occurs in persons over the age of 40 or 50, whereas the congenital type is seen at any age. After resection of lung tissue became safe in 1931, this therapy was applied to cystic disease of the lung. (The first successful pneumonectomy was performed in 1931 by Rudolph Nissen.) Removal of involved portions while sparing all possible functioning lung tissue is the object of surgical treatment. Since in most patients the disease is limited to less than one-fourth the entire lung, removal of the involved part returns the person to practically normal status.

Congenital malformation of the lung may involve chiefly the vascular elements. A common form of this is a fistula (communication) between the arterial and venous sides of the circulation within the lung. Since this condition returns unoxygenated blood directly to the left heart, the ill effects of the lesion are produced by lowering arterial blood oxygen saturation. These fistulas tend to increase progressively in size and may rupture, causing a fatal hemorrhage. Treatment consists of the surgical removal of the involved part. In an otherwise normal person, the risk of operation is less than 5%.

Pulmonary Tuberculosis.—One of the greatest contributions of chest surgery has been in the field of pulmonary tuberculosis. Before 1940, because of its safety and effectiveness, collapse of the chest wall by the removal of several ribs was the surgical procedure of choice. This operation (known as thoracoplasty) was first attempted in Europe by De Cerenville in 1885. L. Brauer (1909), L. P. Friedrich (1911) and F. Sauerbruch contributed to the development of the operation. Collapse therapy by a modified type of thoracoplasty in one stage with removal of only a small portion of one rib and using a paraffin prosthesis has been most useful in selected cases.

Resection (or excision of part) of the lung for tuberculosis made little progress until antituberculosis drugs became available. The risk of resection in 1942 was approximately 45% for pneumonectomy and 26% for lobectomy. With the development of the antimicrobial agents streptomycin in 1944, para-aminosalicylic acid in 1946 and isoniazid (isonicotinic acid hydrazide) in 1952, surgical resection became much safer and could be applied to many more severely involved patients. Also, with the use of these drugs, better control of the disease was obtained, and therefore lesions of a much lesser magnitude were presented for therapy. In addition to pneumonectomy (which was seldom performed after 1955) and lobectomy, segmental resection was added and is applicable in a high percentage of patients requiring surgical therapy. Of even greater importance is the marked improvement that may be anticipated from surgical therapy. In 1942 the results following pneumonectomy were satisfactory in only 41% and following lobectomy in 69% of the cases, whereas by 1955 excellent results could be anticipated in 95% of cases of segmental resection or lobectomy and in 85% to 90% of pneumonectomy.

Bronchiectasis.—Bronchiectasis, meaning dilatation of the bronchus, is the infection and destruction of the wall of the air passage with resultant dilatation and infection of the surrounding lung. After 1931, when resection of the lung had become a safe procedure, treatment was almost entirely surgical, and after 1945 the risk of operation was less than 2%. Removal of only the involved portion of the lung along segmental lines is usual. Since the disease is not infrequently bilateral, portions of either lung may be removed in stages with very satisfying results.

Lung Abscess.—With the development and use of antibiotics and the sulfonamides, the incidence of lung abscess decreased markedly. Furthermore, with various surgical advances, the occurrence of lung abscess following operations about the mouth, nose and throat became infrequent. A high percentage of these lesions respond to medical management. Those that resist this form of treatment may be managed either by simple drainage or by resection of that portion of the lung. The risk of operation is slight (5% or less), and highly satisfactory results may be expected.

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HEART FAILURE: *see* HEART, DISEASES AND DEFECTS OF.

HEARTH TAX. This impost was a tax imposed in England at a rate of *2s.* for each hearth; it was levied upon all houses unless the occupier (1) was exempt from paying church or poor rates, or (2) was certified as living in a tenement under the value of *20s.* per annum, and not having land to that value or possessing goods to the value of £10. It was first levied in 1662, but because of its unpopularity it was repealed in 1689, although it was producing £170.000 a year. The principle of the tax was not new in the history of taxation, for in Anglo-Saxon times the king derived a part of his revenue from a *fumage*, or tax of smoke, levied on all hearths except those of the poor. It appears also in the hearth-penny or tax of a penny on every hearth.

HEARTS, a game of cards which appeared in the United States about 1880, possibly a descendant of reversis as played in the 18th century. In all variants, the chief object is to avoid winning any hearts in tricks. The full pack of 52 cards is used, and all the cards are dealt out. With more or less than four players (the usual number), some small cards are discarded from the pack to equalize the hands. Eldest hand makes the opening lead, and the rules of play are as in whist, but there is no trump suit. Other hands must follow suit to a lead if able; the highest card of the suit led wins the trick; the winner of a trick leads to the next.

In the simplest form of the game, each heart counts one point against the player winning it in a trick. A running total score is kept for each individual, and final settlement of stakes is made on the difference of totals—the lowest score of course being best. It is usually preferred to make settlement after every deal, on the Howell plan. Equal numbers of chips are distributed to the participants at the outset. After play of a deal, each player pays into a pool as many chips for each heart he has taken as there are players in the game other than himself. He then takes out of the pool one chip for every heart out of 13 that he did not win. The pool is thus exhausted with every deal. Another alternative is "sweepstake" settlement. The pool is built up in the same way, but can be won only by a player who was "clear" (won no hearts) or split by two who were clear. In all other cases the pool is a "jack" and remains to be won with the ensuing pool.

In *Spot Hearts* the penalty value of each heart depends on its rank; the ace costs 14, king 13, queen 12, knave 11, others their pip value. In *Joker Hearts*, the joker is added to the pack and the deuce of hearts is discarded. The joker ranks as a heart, between the knave and the ten. It may not be played by discard, unless a higher heart has previously been discarded upon the same trick. Where each other heart costs the winner one chip, the joker costs five.

The basic game has largely been supplanted by variants that have borrowed features from other games (polignac, reversis, French whist). Most played is *Black Lady Hearts*. Besides the hearts, each counting one, the penalty cards include the queen of spades, counting 13. Prior to the opening lead, each player passes any three cards of his original hand to his right (or left) neighbour. *Omnibus Hearts* adds two more rules: the ten (or knave) of diamonds counts 10 *plus* for the player winning it in a trick, and if a player captures all the hearts, the queen of spades, and the ten of diamonds, he scores plus 26 instead of minus 16.

In *Domino Hearts* each hand is dealt only six cards. The balance of the pack is placed face down in the centre. In the early play, discarding is not permitted. A player unable to follow suit must draw cards from the top of the pack until he can. Discarding is allowed after the pack is exhausted. Each hand drops out of play on getting rid of his last card, and the last survivor must add his remaining cards to his tricks. Usually only the hearts are counted as "minus" cards.

Other variants are adaptations of the game to more or less than four players. In a two-hand version, each is dealt 13 cards. The rules of play are as usual, but after each trick the winner and then his opponent draws one card from the top of the pack. When the pack is exhausted, the 13 cards remaining in each hand are played out. The queen of spades is usually counted against the winner, as well as all hearts.

In *Cancellation Hearts*, for six to ten players, two packs are shuffled together and dealt out into equal hands. Odd cards remaining are put in a widow, which goes to the winner of the first trick. When two identical cards fall on the same trick, they cancel each other—neither can win the trick. When an entire trick is thus canceled out, it remains on the table and goes to the next winner of a trick. Usually the hearts and the queen of spades are the only cards counted in scoring.

HEAT is a general term applied to that branch of physical science which deals with the effects produced by heat on material bodies, the laws of transference of heat and the transformations of heat into other kinds of energy.

In this broad field of science, little progress was made until the early 19th century. In line with the division of the elements by the ancient Greek philosophers into earth, air, fire and water, heat was generally believed to be a separate, although weightless, substance. A body was supposed to be hot or cold in proportion to the quantity of this substance with which its pores were permeated. When an object became hot under hammering, it was explained that the impact had forced the imponderable substance, which was named "caloric," to the surface. (See *The Nature of Heat*, below.) The phenomenon of combustion was similarly explained; an object burned rapidly or with difficulty in accordance with the amount of another mythical substance, named "phlogiston," that it contained.

Even after the "phlogiston" theory had been upset and the real nature of combustion had been established by Antoine Laurent Lavoisier in 1775, belief in "caloric" persisted. Lavoisier himself listed it among the simple substances, or elements, in his *Traité élémentaire de chimie*, published in 1789. (*See* CHEMISTRY: *History of Chemistry.*)

The object here is to indicate the relation of the different branches of the science of heat and their historical development, which are discussed in greater detail in separate articles. Advances in the theories of the influence of heat on the properties of matter are discussed under QUANTUM MECHANICS.

For developments in the measurement of the effects of heat and applications in various fields of science and engineering *see* under THERMODYNAMICS, THERMOMETRY and HEATING AND VENTILATION.

This article is divided into the following sections:

I. Definitions
II. Temperature
  1. Evolution of the Thermometer
  2. Comparison of Scales Based on Expansion
III. Change of State
  1. General Phenomena of Fusion
  2. Superfusion, Supersaturation

3. Freezing of Solutions and Alloys
4. Calorimetry by Latent Heat
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6. Watt's Indicator Diagram; Work of Expansion
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2. Einstein's Theory
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4. Heat, Entropy and Information
5. Heat Capacities of Gases

I. DEFINITIONS

The term heat is employed in ordinary language in a number of different senses. This makes it a convenient term to employ for the general title of the science, but the different meanings must be carefully distinguished in scientific reasoning. For the present purpose, omitting metaphorical significations, we may distinguish four principal uses of the term: (1) sensation of heat; (2) temperature, or degree of hotness; (3) quantity of thermal energy; (4) radiant heat, or energy of radiation.

1. From the sense of heat, aided in the case of very hot bodies by the sense of sight, we obtain our first rough notions of heat as a physical entity, which alters the state of a body and its condition in respect of warmth, and is capable of passing from one body to another. By touching a body we can tell whether it is warmer or colder than the hand, and, by touching two similar bodies in succession, we can form a rough estimate, by the acuteness of the sensation experienced, of their difference in hotness or coldness over a limited range. If a hot iron is placed on a cold iron plate, we may observe that the plate is heated and the iron cooled until both attain appreciably the same degree of warmth; and we infer from similar cases that something which we call "heat" tends to pass from hot to cold bodies, and to attain finally a state of equable diffusion when all the bodies concerned are equally warm or cold. Ideas such as these derived entirely from the sense of heat are, so to speak, embedded in the language of every nation from the earliest times.

2. From the sense of heat, again, we naturally derive the idea of a continuous scale or order, expressed by such terms as summer heat, blood heat, fever heat, red heat, white heat, in which all bodies may be placed with regard to their degrees of hotness, and we speak of the temperature of a body as denoting its place in the scale, in contradistinction to the quantity of heat it may contain.

3. The quantity of heat contained in a body obviously depends on the size of the body considered. Thus a large kettleful of boiling water will evidently contain more heat than a teacupful, though both may be at the same temperature. The temperature does not depend on the size of the body but on the degree of concentration of the heat in it; *i.e.*, on the quantity of heat per unit mass, other things being equal.

It may be taken as axiomatic that a given body in a given state under given conditions must always contain the same quantity of heat, and that different quantities of the same substance in the same state under the same conditions must contain quantities of heat proportional to their several masses, except for the effect of shape on vibrational heat, normally not detectable. But it is for experiment to determine how the heat content varies for any given substance in different states, or for different substances in similar states, and how it is affected by variations of temperature and pressure in each case.

4. It is a matter of common observation that rays of the sun or of a fire falling on a body warm it and it was in the first instance natural to suppose that heat itself somehow traveled across the intervening space from the sun or fire to the body warmed, in much the same way as heat may be carried by a current of hot air or water. But we now know that energy of radiation is not the same thing as heat, though it is converted into heat when the rays strike an absorbing substance. The term radiant heat, however, is generally retained, because radiation is commonly measured in terms of the heat it produces and because the transference of energy by radiation and absorption is the most important agency in the diffusion of heat.

II. TEMPERATURE

1. Evolution of the Thermometer.—The first step in the development of the science of heat was necessarily the invention of a thermometer, an instrument for indicating temperature and measuring its changes. The first requisite in the case of such an instrument is that it should always give, at least approximately, the same indication at the same temperature.

The air thermoscope of Galileo, illustrated in fig. 1, which consisted of a glass bulb containing air connected to a glass tube of small bore dipping into a coloured liquid, though very sensitive to variations of temperature, was not satisfactory as a measuring instrument because it was also affected by variations of atmospheric pressure.

The French doctor Jean Rey describes in a letter dated 1631 a thermometer in which the expansion of water itself was used to indicate temperature, but it is not clear from his description whether the thermometer tube was left open or closed.

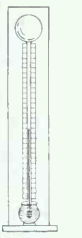

FIG. 1.—GALILEO'S AIR THERMOSCOPE

The type of thermometer familiar at the present time, containing a liquid hermetically sealed in a glass bulb with a fine tube attached, was first brought into general use by the grand duke Ferdinand II of Tuscany and he is said to have possessed such instruments as early as 1654. They were much employed by the members of the Accademia del Cimento founded under his protection at Florence, and were long known as Florentine thermometers.

Alcohol was the liquid first employed and the degrees, intended to represent thousandths of the volume of the bulb, were marked with small beads of enamel fused on the stem, as shown in fig. 2, which represents two thermometers as depicted in the *Saggi di naturali esperienze* published by the Accademia del Cimento in 1667.

In order to render the readings of such instruments comparable with each other, it was necessary to select a fixed point or standard temperature as the zero or starting point of the graduations. Instead of making each degree a given fraction of the volume of the bulb, which would be difficult in practice, and would give different

values for the degree with different liquids, it was soon found to be preferable to take two fixed points, and to divide the interval between them into the same number of degrees. It was natural in the first instance to take the temperature of the human body as one of the fixed points. In 1701 Sir Isaac Newton proposed a scale in which the freezing point of water was taken as zero, and the temperature of the human body as 12°. About the same date (1714) Gabriel Daniel Fahrenheit (for biographies of scientists mentioned in this article, *see* individual articles under their names) proposed to take as zero the lowest temperature obtainable with a freezing mixture of ice and salt, and to divide the interval between this temperature and that of the human body into 12°. To obtain finer graduations the number was subsequently increased to 96°.

The freezing point of water was at that time supposed to be somewhat variable, because as a matter of fact it is possible to cool water several degrees below its freezing point in the absence of ice. Fahrenheit showed, however, that as soon as ice began to form the temperature always rose to the same point, and that a mixture of ice or snow with pure water always gave the same temperature. At a later period he also showed that the temperature of boiling water varied with the barometric pressure, but that it was always the same at the same pressure, and might therefore be used as the second fixed point (as Edmund Halley and others had suggested) provided that a definite pressure, such as the average atmospheric pressure, were specified. The freezing and boiling points on one of his thermometers, graduated as already explained, with the temperature of the body as 96°, came out in the neighbourhood of 32° and 212° respectively, giving an interval of 180° between these points. Shortly after Fahrenheit's death (1736) the freezing and boiling points of water were generally recognized as the most convenient fixed points to adopt, but different systems of subdivision were employed. Fahrenheit's scale, with its small degrees and its zero below the freezing point, possesses undoubted advantages for meteorological work, and is still retained in the U.S. and Canada. For general scientific purposes, however, the Celsius (centigrade) system, in which the freezing point is marked 0° and the boiling point 100°, is now almost universally employed, on account of its greater simplicity from an arithmetical point of view. For work of precision the fixed points have been more exactly defined (*see* THERMOMETRY), but no change has been made in the fundamental principle of graduation.

FIG. 2.—EARLY FLORENTINE THERMOMETERS, 1667

Alcohol in glass, graduated with enamel beads on stem

2. Comparison of Scales Based on Expansion.—Thermometers constructed in the manner already described will give strictly comparable readings, provided that the tubes be of uniform bore, and that the same liquid and glass be employed in their construction; but they possess one obvious defect from a theoretical point of view, namely, that the subdivision of the temperature scale depends on the expansion of the particular liquid selected as the standard. A liquid such as water, which, when continuously heated at a uniform rate from its freezing point, first contracts and then expands, at a rapidly increasing rate, would obviously be unsuitable; but there is no a priori reason why other liquids should not behave to some extent in a similar way. As a matter of fact, it was soon observed that thermometers carefully constructed with different liquids, such as alcohol, oil and mercury, did not agree precisely in their indications at points of the scale intermediate between the fixed points, and diverged even more widely outside these limits. Another possible method, proposed in 1694 by Carlo Renaldini (1615–98), professor of mathematics and philosophy at Pisa, would be to determine the intermediate points of the scale by observing the temperatures of mixtures of ice-cold and boiling water in varying proportions. By this method, the temperature of 50° C. would be defined as that obtained by mixing equal weights of water at 0° C. and 100° C.; 20° C., that obtained by mixing 80 parts of water at 0° C. with 20 parts of water at 100° C. and so on. Each degree rise of temperature in a mass of water would then represent the addition of the same quantity of heat. The scale thus obtained would, as a matter of fact, agree very closely with that of a mercury thermometer, but the method would be very difficult to put into practice, and would still have the disadvantage of depending on the properties of a particular liquid, namely, water, which is known to behave in an anomalous manner in other respects.

At a later date, the researches of Joseph Gay-Lussac (1802) and Henri Regnault (1847) showed that the laws of the expansion of gases are much simpler than those of liquids. Whereas the expansion of alcohol between 0° C. and 100° C. is nearly seven times as great as that of mercury, all gases (excluding easily condensable vapours) expand equally, or so nearly equally that the differences between them cannot be detected without the most refined observations. This equality of expansion affords a strong a priori argument for selecting the scale given by the expansion of a gas as the standard scale of temperature, but there are still stronger theoretical grounds for this choice, which will be indicated in discussing the absolute scale (*see* in *Mechanical Theory of Heat*, below). Among liquids mercury is found to agree most nearly with the gas scale, and is generally employed in thermometers for scientific purposes on account of its high boiling point and for other reasons.

The differences of the mercurial scale from the gas scale having been carefully determined, the mercury thermometer can be used as a secondary standard to replace the gas thermometer within certain limits, as the gas thermometer would be very troublesome to employ directly in ordinary investigations.

For certain purposes, and especially at temperatures beyond the range of mercury thermometers, electrical thermometers, also standardized by reference to the gas thermometer, have been generally employed in recent years; while for still higher temperatures beyond the range of the gas thermometer, thermometers based on the recently established laws of radiation are the only instruments available. For a further discussion of the theory and practice of the measurement of temperature, *see* the article THERMOMETRY.

III. CHANGE OF STATE

Among the most important effects of heat is that of changing the state of a substance from solid to liquid, or from liquid to vapour. All substances, with the exception of some unstable compounds, are known to be capable of existing in each of the three states under suitable conditions of temperature and pressure. The transition of any substance from the state of liquid to that of solid or vapour under the ordinary atmospheric pressure takes place at fixed temperatures, the freezing and boiling points, which are very sharply defined for pure crystalline substances, and serve in fact as fixed points of the thermometric scale. A change of state cannot, however, be effected in general without the addition or subtraction of a certain definite quantity of heat. If a piece of ice below the freezing point is gradually heated at a uniform rate, its temperature may be observed to rise regularly until the freezing point is reached. At this point it begins to melt, and its temperature ceases to rise. The melting takes a considerable time, during the whole of which heat is being continuously supplied without producing any rise of temperature, although if the same quantity of heat were supplied to an equal mass of water the temperature of the water would be raised to the extent of nearly 80° C.

Heat thus absorbed in producing a change of state without rise of temperature is called latent heat, a term introduced by Joseph Black, who was one of the first to study the subject of change of state from the point of view of heat absorbed.

When a substance may be found in two or more characteristically different states which will continue to maintain their separate existence while in contact with each other, these states are called the phases of the system; thus a vessel containing ice and liquid water with an atmosphere of water vapour above the surface provides a system of three phases, and is said to have one component since it is made up of only one basic substance.

It is possible to have systems of two or more components which also exhibit several different phases; thus a solution of salt and water can provide three phases in coexistence. When heat is added or withdrawn so that some of the substance is converted from one phase to another phase, the process is known as a phase change of the first order.

In 1933 P. Ehrenfest pointed out that phase changes also are found in which the latent heat is theoretically of zero magnitude and the significant change lies in the values of the heat capacity above and below the transition point; he suggested the term second order phase change for such processes. There are also certain exceptional classes of phase changes which take place over a temperature interval rather than at a point. The mathematical and statistical theory of the different kinds of phase changes was critically reviewed by H. N. V. Temperly in 1956.

1. General Phenomena of Fusion.—There are two chief varieties of the process of fusion, crystalline and amorphous, which are in many ways distinct, although it is possible to find intermediate cases which partake of the characteristics of both. The melting of ice may be taken as a typical case of crystalline fusion. The passage from rigid solid to mobile liquid occurs at a definite surface without any intermediate stage or plastic condition. The change takes place at a definite temperature, the fusing or freezing point, and requires the addition of a definite quantity of heat to the solid, which is called the latent heat of fusion. There is also in general a considerable change of volume during fusion, which amounts in the case of ice to a contraction of 9%.

Some typical cases of amorphous solidification are those of silica, glass, plastic sulfur, pitch, alcohol and many organic liquids. In this type the liquid gradually becomes more and more viscous as the temperature falls, and ultimately attains the rigidity characteristic of a solid, without any definite freezing point or latent heat. The condition of the substance remains uniform throughout, if its temperature is uniform; there is no separation into the two distinct phases of solid and liquid, and there is no sudden change of volume at any temperature.

The melting or freezing of a pure crystalline solid is characterized most clearly by the perfect constancy of temperature during the process. In fact, the law of constant temperature, which is generally stated as the first of the so-called laws of fusion, does not strictly apply except to this case. The constancy of the freezing point of a pure substance is so characteristic that change of the freezing point is often one of the most convenient tests of the presence of foreign material.

In the case of substances like ice, which melt at a low temperature and are easily obtained in large quantities in a state of purity, the point of fusion may be very accurately determined by observing the temperature of an intimate mixture of the solid and liquid while slowly melting as it absorbs heat from surrounding bodies. In the majority of cases, however, it is more convenient to observe the freezing point as the liquid is cooled. By this method it is possible to ensure perfect uniformity of temperature throughout the mass by stirring the liquid continuously during the process of freezing, whereas it is difficult to ensure uniformity of temperature in melting a solid, however gradually the heat is supplied, unless the solid can be mixed with the liquid. It is also possible to observe the freezing point in other ways, as by noting the temperature at the moment of the breaking of a wire, of the stoppage of a stirrer or of the maximum rate of change of volume, but these methods are generally less certain in their indications than the point of greatest constancy of temperature in the case of homogeneous crystalline solids.

The table contains some of the most recent values of fusing points of metals determined (except the last three) with platinum thermometers. These points are often utilized as fixed points on the thermometric scale, especially for the calibration of thermocouples.

Fusion Points of Common Metals

	°C.		°C.
Mercury	−38.9	Antimony	630.5
Potassium	63.4	Aluminum	660.0
Sodium	97.5	Silver	960.8
Tin	231.9	Gold	1,063.0
Bismuth	271.0	Copper	1,083.0
Cadmium	320.9	Nickel	1,455.0
Lead	327.4	Palladium	1,550.0
Zinc	419.5	Platinum	1,769.3

2. Superfusion, Supersaturation.—It is generally possible to cool a liquid several degrees below its normal freezing point without a separation of crystals, especially if it is protected from agitation, which would assist the molecules to rearrange themselves. A liquid in this state is said to be "undercooled" or "superfused." The phenomenon is even more familiar in the case of solutions (*e.g.*, sodium sulfate or acetate) which may remain in the "metastable" condition for an indefinite time if protected from dust. The introduction into the liquid under this condition of the smallest fragment of the crystal, with respect to which the solution is supersaturated, will produce immediate crystallization, which will continue until the temperature is raised to the saturation point by the liberation of the latent heat of fusion. The constancy of temperature at the normal freezing point is due to the equilibrium of exchange existing between the liquid and solid. Unless both solid and liquid are present, there is no condition of equilibrium, and the temperature is indeterminate.

It is important to see clearly that the undercooling of a pure (one component) liquid and the supersaturation of a liquid solution (two or more components) are phenomena sharing essentially the same mechanism. In either case, a component is retained in a liquid condition at a temperature at which it normally would change into the crystalline phase if perfect equilibrium were established. This also emphasizes the close relationship between melting and dissolving into solution.

3. Freezing of Solutions and Alloys.—The phenomena of freezing of crystalline mixtures may be illustrated by the case of aqueous solutions and of metallic solutions or alloys, which have been most widely studied. The usual effect of an impurity, such as salt or sugar in solution in water, is to lower the freezing point, so that no crystallization occurs until the temperature has fallen below the normal freezing point of the pure solvent, the depression of freezing point being nearly proportional to the concentration of the solution. When freezing begins, the solvent generally separates out from the solution in the pure state. This separation of the solvent involves an increase in the strength of the remaining solution, so that the temperature does not remain constant during the freezing, but continues to fall as more of the solvent is separated. There is a perfectly definite relation between temperature and concentration at each stage of the process, which may be represented in the form of a curve as AC in fig. 3, called the freezing point curve.

The equilibrium temperature, at the surface of contact between the solid and liquid, depends only on the composition of the liquid phase and not at all on the quantity of solid present. The abscissa of the freezing point curve represents the composition of that portion of the original solution which remains liquid at any temperature. If instead of starting with a dilute solution we start with a strong solution represented by a point N, and cool it as shown by the vertical line ND, a point D is generally reached at which the solution becomes "saturated." The dissolved substance or "solute" then separates out as the solution is further cooled, and the concentration diminishes with fall of temperature in a definite relation, as indicated by the curve CB, which is called the solubility curve. Though often called by different names, the two curves AC and CB are essentially of a similar nature.

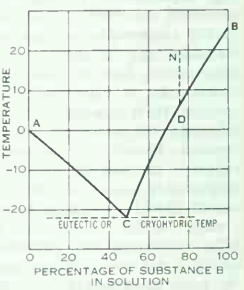

FIG. 3.—FREEZING POINT, OR SOLUBILITY CURVE: SIMPLE CASE

To take the case of an aqueous solution of salt as an example, along CB the solution is saturated with respect to salt, along AC the solution is saturated with respect to ice. When the point C

is reached along either curve, the solution is saturated with respect to both salt and ice. The concentration cannot vary further, and the temperature remains constant, while the salt and ice crystallize out together, maintaining the exact proportions in which they exist in the solution. The resulting solid was termed a cryohydrate by F. Guthrie, but it is really an intimate mixture of two kinds of crystals, and not a chemical compound or hydrate containing the constituents in chemically equivalent proportions. The lowest temperature attainable by means of a freezing mixture is the temperature of the freezing point of the corresponding cryohydrate. In a mixture of salt and ice with the least trace of water a saturated brine is quickly formed, which dissolves the ice and falls rapidly in temperature, because of the absorption of the latent heat of fusion. So long as both ice and salt are present, if the mixture is well stirred, the solution must necessarily become saturated with respect to both ice and salt, and this can only occur at the cryohydric temperature, at which the two curves of solubility intersect.

The curves in fig. 3 also illustrate the simplest type of freezing point curve in the case of alloys of two metals A and B which do not form mixed crystals or chemical compounds. The alloy corresponding to the cryohydrate, possessing the lowest melting point, is called the eutectic alloy, as it is most easily cast and worked. It generally possesses a very fine-grained structure, and is not a chemical compound. (*See* ALLOYS.)

4. Calorimetry by Latent Heat.—In principle, the simplest and most direct method of measuring quantities of heat consists in observing the effects produced in melting a solid or vaporizing a liquid. It was, in fact, by the fusion of ice that quantities of heat were first measured. If a hot body is placed in a cavity in a block of ice at 0° C., and is covered by a closely fitting slab of ice, the quantity of ice melted will be directly proportional to the quantity of heat lost by the body in cooling to 0° C. None of the heat can possibly escape through the ice, and conversely no heat can possibly get in from outside. The body must cool exactly to 0° C., and every fraction of the heat it loses must melt an equivalent quantity of ice.

Apart from heat lost in transferring the heated body to the ice block, the method is theoretically perfect. The only difficulty consists in the practical measurement of the quantity of ice melted. Black estimated this quantity by mopping out the cavity with a sponge which was weighed before and after the operation. But there is a variable film of water adhering to the walls of the cavity, which gives trouble in accurate work.

In 1780 Pierre Simon Laplace and Lavoisier used a double-walled metallic vessel containing broken ice, which was in many respects more convenient than the block, but aggravated the difficulty of the film of water adhering to the ice. In spite of this practical difficulty, the quantity of heat required to melt unit weight of ice was for a long time taken as the unit of heat. This unit possesses the great advantage that it is independent of the scale of temperature adopted.

At a much later date R. Bunsen in 1870, adopting a suggestion of Sir John Herschel's, devised an ice calorimeter suitable for measuring small quantities of heat, in which the difficulty of the water film was overcome by measuring the change in volume due to the melting of the ice. The volume of unit mass of ice is approximately 1.0920 times that of unit mass of water, so that the diminution of volume is 0.092 of a cubic centimetre for each gram of ice melted.

Since the ice calorimeter of necessity operates at 0° C., a temperature considerably below room temperature, there is always the necessity of taking precautions to prevent the unwanted leakage of heat from the room into the calorimetric vessel; this introduces both difficulties and inaccuracies into the procedure. In order to avoid this source of trouble, calorimeters have been built using diphenyl oxide instead of water as the calorimetric liquid. Since diphenyl oxide has a melting point of 27° C., and can be obtained easily in a high state of purity, this type of calorimeter is especially useful.

For measuring large quantities of heat, such as those produced by the combustion of fuel in a boiler, the most convenient method is the evaporation of water, which is commonly employed by engineers for the purpose. The natural unit in this case is the quantity of heat required to evaporate unit mass of water at the boiling point under atmospheric pressure.

5. Thermometric Calorimetry.—For many years the most accurate method for calorimetry was the observation of the rise in temperature of a known mass of water when the heat was introduced into it under suitable conditions which prevented unwanted heat leaks. This method was employed from a very early date by Count Rumford and was brought to a relatively high pitch of perfection by Regnault in his extensive calorimetric researches. It is still widely used, especially in combustion calorimetry. After the first decade of the 20th century, however, this method was superseded by procedures based on the electrically heated vacuum calorimeter of Walter Nernst whenever the highest accuracy was desired, particularly in the measurement of heat capacity and of latent heats associated with phase changes.

A weighed sample of the substance to be studied is placed in a sealed sample container, usually a small thin-walled can of copper, plated with gold or some other metal that will resist corrosion. Attached in close thermal contact to this can are a heating coil of known electrical resistance and an electrical resistance thermometer. This unit is placed in a vacuum chamber and usually surrounded by a thermal shield, maintained at a temperature as close to that of the sample container as possible. If an electrical current of known strength is passed through the heater for a measured interval of time, one can calculate the heat introduced which is easily measurable with a precision of 0.01% or better. One can also measure the temperature increment with comparable accuracy. By means of the vacuum and the thermal shield, any unwanted leakage of heat into or out of the sample container can also be reduced to an amount so small in ratio to the electrical heat produced that the heat capacity of the sample can be calculated with an accuracy of 0.1% to 0.01% depending on the extent of the precautions taken.

As carried out especially by W. F. Giauque and K. S. Pitzer and their collaborators at the University of California, Berkeley, by G. S. Parks and others at Stanford university, Calif., by H. M. Huffman and Guy Waddington at the U.S. bureau of mines Bartlesville (Okla.) station, by F. G. Brickwedde and his associates at the U.S. national bureau of standards and by other investigators, especially in the U.S., this method produced a vast amount of thermodynamic data which is the cornerstone on which the understanding of the role of heat in chemistry is based.

6. Watt's Indicator Diagram; Work of Expansion.—The rapid development of the steam engine (*see* STEAM: *Steam Engine*) in England during the latter part of the 18th century had a marked effect on the progress of the science of heat. In the first steam engines the working cylinder served both as boiler and condenser, a very wasteful method, as most of the heat was transferred directly from the fire to the condensing water without useful effect. The first improvement (about 1705) was to use a separate boiler, but the greater part of the steam supplied was still wasted in reheating the cylinder, which had been cooled by the injection of cold water to condense the steam after the previous stroke.

In a patent of 1769 James Watt showed how to avoid this waste by using a separate condenser and keeping the cylinder as hot as possible. In his earlier engines the steam at full boiler pressure was allowed to raise the piston through nearly the whole of its stroke. Connection with the boiler was then cut off, and the steam at full pressure was discharged into the condenser. Here again there was unnecessary waste, as the steam was still capable of doing useful work. He subsequently introduced "expansive working," which effected still further economy. The connection with the boiler was cut off when a fraction only, say $\frac{1}{4}$, of the stroke had been completed, the remainder of the stroke being effected by the expansion of the steam already in the cylinder with continually diminishing pressure. By the end of the stroke, when connection was made to the condenser, the pressure was so reduced that there was comparatively little waste from this cause. Watt also devised an instrument called an indicator, in which a pencil, moved up and down vertically by the steam pressure,

recorded the pressure in the cylinder at every point of the stroke on a sheet of paper moving horizontally in time with the stroke of the piston. The diagram thus obtained made it possible to study what was happening inside the cylinder, and to deduce the work done by the steam in each stroke. The method of the indicator diagram has since proved of great utility in physics in studying the properties of gases and vapours.

Fig. 4 represents an imaginary indicator diagram for a steam engine, taken from one of Watt's patents. Steam is admitted to the cylinder when the piston is at the beginning of its stroke at S; ST represents the length of the stroke or the limit of horizontal movement of the paper on which the diagram is drawn. The indicating pencil rises to the point A, representing the absolute pressure of 60 lb. per square inch. As the piston moves outward the pencil traces the horizontal line AB, the pressure remaining constant until the point B is reached, at which connection to the boiler is cut off. After cutoff at B the steam expands under diminishing pressure, and the pencil falls gradually from B to C, following the steam pressure until the exhaust valve opens at the end of the stroke. The pressure then falls rapidly to that of the condenser, which for an ideal case may be taken as zero, following Watt. The work done during expansion is found by dividing the area under segment BC as shown, into a number of small rectangles.

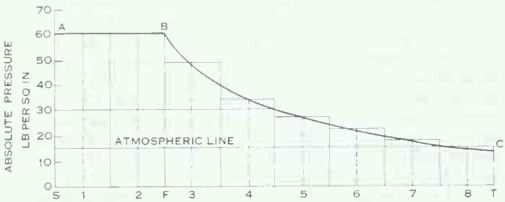

FIG. 4.—WATT'S INDICATOR DIAGRAM

The whole work done in the forward stroke is represented by the area ABCTSA, or by the average value of the pressure p over the whole stroke multiplied by the stroke l. This area must be multiplied by the area of the piston a in square inches to get the work done per stroke in foot-pounds.

7. Thermal Efficiency.—The thermal efficiency of an engine is the ratio of the work done by the engine to the heat supplied to it. According to Watt's observations, confirmed later by Clément and Desormes, the total heat required to produce 1 lb. of saturated steam at any temperature from water at 0° C. was approximately 650 times the quantity of heat required to raise 1 lb. of water 1° C. Since one pound of steam represented on this assumption a certain quantity of heat, the efficiency could be measured naturally in foot-pounds (ft.lb.) of work obtainable per pound of steam, or conversely in the pounds of steam which are consumed per horsepower-hour.

In his patent of 1782 Watt gives the following example of the improvement in thermal efficiency obtained by expansive working. Taking the diagram already given, if the quantity of steam represented by AB, or 300 cu.in. at 60 lb. pressure, were employed without expansion, the work realized, represented by the area ABFS, would be 6,000/4 = 1,500 ft.lb. With expansion to 4 times its original volume, as shown in the diagram by the whole area ABCTSA, the mean pressure (as calculated by Watt, assuming Boyle's law) would be 0.58 of the original pressure, and the work done would be 6,000 × 0.58 = 3,480 ft.lb. for the same quantity of steam, or the thermal efficiency would be 2.32 times greater.

The advantage actually obtained would not be so great as this, on account of losses by condensation, back pressure, etc., which are neglected in Watt's calculation, but the margin would still be very considerable. Three hundred cubic inches of steam at 60 lb. pressure would represent about .0245 of 1 lb. of steam, or 28.7 B.T.U., so that, neglecting all losses, the possible thermal efficiency attainable with steam at this pressure and four expansions (¼ cutoff) would be 3,480/28.7, or 121 ft.lb. per B.T.U.

About 1820, it was usual to include the efficiency of the boiler with that of the engine, and to reckon the efficiency or "duty" in foot-pounds per bushel or hundredweight of coal. The best Cornish pumping-engines of that date achieved about 70,000,000 ft.lb. per hundredweight, or consumed about 3.2 lb. per horsepower-hour, which is roughly equivalent to 43 ft.lb. per B.T.U. The efficiency gradually increased as higher pressures were used, with more complete expansion, but the conditions upon which the efficiency depended were not fully worked out until a much later date. Much additional knowledge with regard to the nature of heat, and the properties of gases and vapours, was required before the problem could be attacked theoretically.

IV. THE NATURE OF HEAT

In the early days of the science it was natural to ascribe the manifestations of heat to the action of a subtle imponderable fluid called caloric, with the power of penetrating, expanding and dissolving bodies, or dissipating them in vapour. The fluid was imponderable, because the most careful experiments failed to show that heat produced any increase in weight. The opposite property of levitation was often ascribed to heat, but it was shown by more cautious investigators that the apparent loss of weight because of heating was to be attributed to evaporation or to upward air currents. The fundamental idea of an imaginary fluid to represent heat was useful in helping the mind to a conception of something remaining invariable in quantity through many transformations, but in some respects the analogy was misleading, and tended greatly to retard the progress of science. The caloric theory was very simple in its application to the majority of calorimetric experiments, and gave a fair account of the elementary phenomena of change of state, but it encountered serious difficulties in explaining the production of heat by friction, or the changes of temperature accompanying the compression or expansion of a gas.

The explanation which the calorists offered of the production of heat by friction or compression was that some of the latent caloric was squeezed or ground out of the bodies concerned and became "sensible." In the case of heat developed by friction, they supposed that the abraded portions of the material were capable of holding a smaller quantity of heat, or had less "capacity for heat," than the original material. From a logical point of view, this was a perfectly tenable hypothesis, and one difficult to refute. It was easy to account in this way for the heat produced in boring cannon and similar operations, where the amount of abraded material was large.

To refute this explanation, Count Rumford in 1798 presented before the Royal society the results of his celebrated experiments with a blunt borer in one of which he succeeded in boiling by friction 26.5 lb. of cold water in 2½ hr., with the production of only 4,145 g. of metallic powder. He then showed by experiment that the metallic powder required the same amount of heat to raise its temperature 1°, as an equal weight of the original metal, or that its "capacity for heat" (in this sense) was unaltered by reducing it to powder; and he argued that "in any case so small a quantity of powder could not possibly account for all the heat generated, that the supply of heat appeared to be inexhaustible, and that heat could not be a material substance, but must be something of the nature of motion."

Unfortunately Rumford's argument was not quite conclusive. The supporters of the caloric theory appear, whether consciously or unconsciously, to have used the phrase "capacity for heat" in two entirely distinct senses without any clear definition of the difference. The phrase "capacity for heat" might very naturally denote the total quantity of heat contained in a body, which they had no means of measuring, but it was generally used to signify the quantity of heat required to raise the temperature of a body one degree, which is quite a different thing and has no necessary relation to the total heat.

In proving that the powder and the solid metal required the same quantity of heat to raise the temperature of equal masses of either one degree, Rumford did not prove that they contained equal quantities of heat, which was the real point at issue in this

instance. The metal tin actually changes into powder below a certain temperature, and in so doing evolves a measurable quantity of heat. A mixture of the gases oxygen and hydrogen, in the proportions in which they combine to form water, evolves, when burned, sufficient heat to raise more than 30 times its weight of water from the freezing to the boiling point; and the mixture of gases may, in this sense, be said to contain so much more heat than the water, although its capacity for heat in the ordinary sense is only about half that of the water produced. To complete the refutation of the calorists' explanation of the heat produced by friction, it would have been necessary for Rumford to show that the powder when reconverted into the same state as the solid metal did not absorb a quantity of heat equivalent to that evolved in the grinding; in other words that the heat produced by friction was not simply that attributed to the change of state of the metal from solid to powder.

Shortly afterward, in 1799, Humphry (later Sir Humphry) Davy described an experiment in which he melted ice by rubbing two blocks together. This experiment afforded a very direct refutation of the calorists' view, because it was a well-known fact that ice required to have a quantity of heat added to it to convert it into water, so that the water produced by the friction contained more heat than the ice. In stating as the conclusion to be drawn from this experiment that "friction consequently does not diminish the capacity of bodies for heat," Davy apparently uses the phrase capacity for heat in the sense of total heat contained in a body, because in a later section of the same essay he definitely gives the phrase this meaning, and uses the term "capability of temperature" to denote what we now term capacity for heat.

The delay in the overthrow of the caloric theory, and in the acceptance of the view that heat is a mode of motion, was no doubt partly due to some fundamental confusion of ideas in the use of the term "capacity for heat" and similar phrases. A still greater obstacle lay in the comparative vagueness of the motion or vibration theory. Davy speaks of heat as being "repulsive motion," and distinguishes it from light, which is "projective motion"; though heat is certainly not a substance—according to Davy in the essay under discussion—and may not even be treated as an imponderable fluid, light as certainly is a material substance, and is capable of forming chemical compounds with ordinary matter, such as oxygen gas, which is not a simple substance, but a compound, termed phosoxygen, of light and oxygen.

Accepting the conclusions of Davy and Rumford that heat is not a material substance but a mode of motion, there still remains the question, what definite conception is to be attached to a quantity of heat? What do we mean by a quantity of vibratory motion, how is the quantity of motion to be estimated and why should it remain invariable in many transformations? The idea that heat was a "mode of motion" was applicable as a qualitative explanation of many of the effects of heat, but it lacked the quantitative precision of a scientific statement, and could not be applied to the calculation and prediction of definite results. The state of science at the time of Rumford's and Davy's experiments did not admit of a more exact generalization. The way was paved in the first instance by a more complete study of the laws of gases, to which Laplace, John Dalton, Gay-Lussac, Pierre Louis Dulong and many others contributed both on the experimental and theoretical side. Although the development proceeded simultaneously along many parallel lines, it is interesting and instructive to take the investigation of the properties of gases, and to endeavour to trace the steps by which the true theory was finally attained.

V. THERMAL PROPERTIES OF GASES

The most characteristic property of a gaseous or elastic fluid, namely, the elasticity, or resistance to compression, was first investigated scientifically by Robert Boyle (1662), who showed that the pressure p of a given mass of gas varied inversely as the volume v, provided that the temperature remained constant. This is generally expressed by the formula $pv = C$, where C is a constant for any given temperature, and v is taken to represent the specific volume, or the volume of unit mass, of the gas at the given pressure and temperature. Boyle was well aware of the effect of heat in expanding a gas, but he was unable to investigate this properly as no thermometric scale had been defined at that date.

According to Boyle's law, when a mass of gas is compressed by a small amount at constant temperature, the percentage increase of pressure is equal to the percentage diminution of volume (if the compression is $v/100$, the increase of pressure is very nearly $p/100$). Adopting this law, Newton showed, by a most ingenious piece of reasoning, that the velocity of sound in air should be equal to the velocity acquired by a body falling under gravity through a distance equal to half the height of the atmosphere, considered as being of uniform density equal to that at the surface of the earth. This gave the result 918 ft. per second (280 m. per second) for the velocity at the freezing point. Newton was aware that the actual velocity of sound was somewhat greater than this, but supposed that the difference might be due in some way to the size of the air particles, of which no account could be taken in the calculation. The first accurate measurement of the velocity of sound by the French Académie des Sciences in 1738 gave the value 332 m. per second as the velocity at 0° C. The true explanation of the discrepancy was not discovered until nearly 100 years later.

The law of expansion of gases with change of temperature was investigated by Dalton and later by Gay-Lussac (1802), who found that the volume of a gas under constant pressure increased by $\frac{1}{267}$ of its volume at 0° C. for each 1° C. rise in temperature. This value was generally assumed in all calculations for nearly 50 years. More exact researches show that the precise value of the coefficient should be $\frac{1}{273.15}$. Thus in round numbers the value of the coefficient should be $\frac{1}{273}$. According to this law the volume of a gas at any temperature $t°$ C. should be proportional to $273 + t$; *i.e.*, to the temperature reckoned from a zero 273° below that of the centigrade scale, which was called the absolute zero of the gas thermometer. If $T = 273 + t$ denotes the temperature measured from this zero, the law of expansion of a gas may be combined with Boyle's law in the simple formula

$$pv = RT \qquad (1)$$

which is generally taken as the expression of the gaseous laws. If equal volumes of different gases are taken at the same temperature and pressure, it follows that the constant R is the same for all gases. If equal masses are taken, the value of the constant R for different gases varies inversely as the molecular weight or as the density relative to hydrogen.

Dalton also investigated the laws of vapours, and of mixtures of gases and vapours. He found that condensable vapours approximately followed Boyle's law when compressed, until the condensation pressure was reached, at which the vapour liquefied without further increase of pressure. He found that when a liquid was introduced into a closed space and allowed to evaporate until the space was saturated with the vapour and evaporation ceased, the increase of pressure in the space was equal to the condensation pressure of the vapour, and did not depend on the volume of the space or the presence of any other gas or vapour provided that there was no solution or chemical action. He showed that the condensation or saturation pressure of a vapour depended only on the temperature, and increased by nearly the same fraction of itself per degree rise of temperature, and that the pressures of different vapours were nearly the same at equal distances from their boiling points. The increase of pressure per degree centigrade at the boiling point was about $\frac{1}{28}$ of 760 mm. or 27.2 mm., but increased in geometrical progression with rise of temperature. These results of Dalton's were confirmed, and in part corrected, as regards increase of vapour pressure, by Gay-Lussac, Dulong, Regnault and other investigators, but were found to be as close an approximation to the truth as could be obtained with such simple expressions.

More accurate empirical expressions for the increase of vapour-pressure of a liquid with temperature were soon obtained by Thomas Young, J. P. L. A. Roche and others, but the explanation of the relation was not arrived at until a much later date.

1. Specific Heats of Gases.—In order to estimate the quantities of heat concerned in experiments with gases, it was necessary in the first instance to measure their specific heats, which presented formidable difficulties. The earlier attempts by Lavoisier and others, employing the ordinary methods of calorimetry, gave very uncertain and discordant results, which were not regarded with any confidence even by the experimentalists themselves. Gay-Lussac devised an ingenious experiment, which, though misinterpreted at the time, is very interesting and instructive. With the object of comparing the specific heats of different gases, he took two equal globes A and B connected by a tube with a stop-cock. The globe B was exhausted, the other A being filled with gas. On his opening the tap between the vessels, gas flowed from A to B and the pressure was rapidly equalized. He observed that the fall of temperature in A was nearly equal to the rise of temperature in B, and that for the same initial pressure the change of temperature was very nearly the same for all the gases he tried, except hydrogen, which showed greater changes of temperature than other gases. He concluded from this experiment that equal volumes of gases had the same capacity for heat, except hydrogen, which he supposed to have a larger capacity because it showed a greater effect. The method does not in reality afford any direct information with regard to the specific heats, and the conclusion with regard to hydrogen is evidently wrong.

At a later date Gay-Lussac adopted A. Crawford's method of mixture, allowing two equal streams of different gases, one heated and the other cooled about 20° C., to mix in a tube containing a thermometer. The resulting temperature was in all cases nearly the mean of the two, from which he concluded that equal volumes of all the gases tried, namely, hydrogen, carbon dioxide, air, oxygen and nitrogen, had the same thermal capacity. This was correct, except as regards carbon dioxide, but did not give any information as to the actual specific heats referred to water or any known substance.

About the same time, F. Delaroche and J. E. Bérard made direct determinations of the specific heats of air, oxygen, hydrogen, carbon monoxide, carbon dioxide, nitrous oxide and ethylene by passing a stream of gas heated to nearly 100° C. through a spiral tube in a calorimeter containing water. Their work was a great advance on previous attempts, and gave the first trustworthy results. With the exception of hydrogen, which presents peculiar difficulties, they found that equal volumes of the permanent gases, air, oxygen and carbon monoxide, had nearly the same thermal capacity, but that the compound condensable gases, carbon dioxide, nitrous oxide and ethylene, had larger thermal capacities in the order given. They were unable to state whether the specific heats of the gases increased or diminished with temperature, but from experiments on air at pressures of 740 mm. and 1,000 mm., they found the specific heats to be .269 and .245 respectively, and concluded that the specific heat diminished with increase of pressure. The difference they observed was really due to errors of experiment, but they regarded it as proving beyond doubt the truth of the calorists' contention that the heat disengaged on the compression of a gas was due to the diminution of its thermal capacity.

Dalton and others had endeavoured to measure directly the rise of temperature produced by the compression of a gas. Dalton had observed a rise of 5° F. in a gas when suddenly compressed to half its volume, but no thermometers at that time were sufficiently sensitive to indicate more than a fraction of the change of temperature.

Laplace was the first to see in this phenomenon the probable explanation of the discrepancy between Newton's calculation of the velocity of sound and the observed value. The increase of pressure because of a sudden compression, in which no heat was allowed to escape, or as we now call it an adiabatic compression, would necessarily be greater than the increase of pressure in a slow isothermal compression, on account of the rise of temperature. As the rapid compressions and rarefactions occurring in the propagation of a sound wave were perfectly adiabatic, it was necessary to take account of the rise of temperature because of compression in calculating the velocity. To reconcile the observed and calculated values of the velocity, the increase of pressure in adiabatic compression must be 1.410 times greater than in isothermal compression. This is the ratio of the adiabatic elasticity of air to the isothermal elasticity. It was a long time, however, before Laplace saw his way to any direct experimental verification of the value of this ratio. At a later date he stated that he had succeeded in proving that the ratio in question must be the same as the ratio of the specific heat of air at constant pressure to the specific heat at constant volume.

2. Experimental Verification of the Ratio of Specific Heats.—This was a most interesting and important theoretical relation to discover, but unfortunately it did not help much in the determination of the ratio required, because it was not practically possible at that time to measure the specific heat of air at constant volume in a closed vessel. Attempts had been made to do this, but they had signally failed, on account of the small heat capacity of the gas as compared with the containing vessel. Laplace endeavoured to extract some confirmation of his views from the values given by Delaroche and Bérard for the specific heat of air at 1,000 and 740 mm. pressure. On the assumption that the quantities of heat contained in a given mass of air increased in direct proportion to its volume when heated at constant pressure, he deduced, by some rather obscure reasoning, that the ratio of the specific heats S and s should be about 1.5 to 1, which he regarded as a fairly satisfactory agreement with the value $\gamma = 1.41$ deduced from the velocity of sound.

The ratio of the specific heats could not be directly measured, but a few years later, N. Clément–Desormes succeeded in making a direct measurement of the ratio of the elasticities in a very simple manner. He took a large globe containing air at atmospheric pressure and temperature, and removed a small quantity of air. He then observed the defect of pressure p_0 when the air had regained its original temperature. By suddenly opening the globe and immediately closing it, the pressure was restored almost instantaneously to the atmospheric, the rise of pressure p_0 corresponding to the sudden compression produced. The air, having been heated by the compression, was allowed to regain its original temperature, the tap remaining closed, and the final defect of pressure p_1 was noted. The change of pressure for the same compression performed isothermally is then $p_0 - p_1$. The ratio $p_0/(p_0 - p_1)$ is the ratio of the adiabatic and isothermal elasticities, provided that p_0 is small compared with the whole atmospheric pressure. In this way he found the ratio 1.354, which is not much smaller than the value 1.410 required to reconcile the observed and calculated values of the velocity of sound.

Gay-Lussac and J. J. Welter repeated the experiment with slight improvements, using expansion instead of compression, and found the ratio 1.375. The experiment has often been repeated since that time, and there is no doubt that the value of the ratio deduced from the velocity of sound is correct, the defect of the value obtained by direct experiment being due to the fact that the compression or expansion is not perfectly adiabatic. Gay-Lussac and Welter found the ratio practically constant for a range of pressure 144 to 1,460 mm., and for a range of temperature from −20° to +40° C. The velocity of sound at Quito, Ecuador, at a pressure of 544 mm. was found to be the same as at Paris at 760 mm. at the same temperature. Assuming on this evidence the constancy of the ratio of the specific heats of air, Laplace showed that, if the specific heat at constant pressure was independent of the temperature, the specific heat per unit volume at a pressure p must vary as $p^{1/\gamma}$ according to the caloric theory. The specific heat per unit mass must then vary as $p^{1/\gamma - 1}$ which he found agreed precisely with the experiment of Delaroche and Bérard already cited. This was undoubtedly a strong confirmation of the caloric theory. S. D. Poisson by the same assumptions obtained the same results, and also showed that the relation between the pressure and the volume of a gas in adiabatic compression or expansion must be of the form $pv^\gamma = \text{constant}$.

P. L. Dulong, adopting a method attributed to E. F. F. Chladni, compared the velocities of sound in different gases by observing the pitch of the note given by the same tube when filled with the gases in question. He thus obtained the values of the ratios of

the elasticities or of the specific heats for the gases employed. For oxygen, hydrogen and carbon monoxide, these ratios were the same as for air. But for carbon dioxide, nitrous oxide and ethylene gas, the values were much smaller, showing that these gases experienced a smaller change of temperature in compression. On comparing his results with the values of the specific heats for the same gases found by Delaroche and Bérard, Dulong observed that the changes of temperature for the same compression were in the inverse ratio of the specific heats at constant volume, and deduced the important conclusion that "Equal volumes of all gases under the same conditions evolve on compression the same quantity of heat." This is equivalent to the statement that the difference of the specific heats, or the latent heat of expansion R' per 1°, is the same for all gases if equal volumes are taken.

Assuming the ratio $\gamma = 1.410$, and taking Delaroche and Bérard's value for the specific heat of air at constant pressure $S = .267$, we have $s = S/1.41 = .189$, and the difference of the specific heats per unit mass of air $S - s = R' = .078$. Adopting Regnault's value of the specific heat of air, namely, $S = .238$, we should have $S - s = .069$. This quantity represents the heat absorbed by unit mass of air in expanding at constant temperature T by a fraction $1/T$ of its volume v, or by $\frac{1}{273}$ of its volume at 0° C.

If, instead of taking unit mass, we take a volume $v_0 = 22.30$ l. at 0° C. and 760 mm. being the volume of the molecular weight of the gas in grams, the quantity of heat evolved by a compression equal to v/T will be approximately 2 cal., and is the same for all gases. The work done in this compression is $pv/T = R$, and is also the same for all gases, namely, 8.3 joules. Dulong's experimental result, therefore, shows that the heat evolved in the compression of a gas is proportional to the work done. This result had previously been deduced theoretically by Nicolas Sadi Carnot (1824). At a later date it was assumed by Julius Mayer, Rudolf Clausius and others, on the evidence of these experiments, that the heat evolved was not merely proportional to the work done, but was equivalent to it. The further experimental evidence required to justify this assumption was first supplied by James Joule.

VI. CARNOT: ON THE MOTIVE POWER OF HEAT

A practical and theoretical question of greatest importance was first answered by Nicolas Carnot about this time in his *Réflexions sur la puissance motrice du feu* (1824). How much motive power (defined by Carnot as weight lifted through a certain height) can be obtained from heat alone by means of an engine repeating a regular succession or "cycle" of operations continuously? Is the efficiency limited, and, if so, how is it limited? Are other agents preferable to steam for developing motive power from heat?

In discussing this problem, we cannot do better than follow Carnot's reasoning which, in its main features, could hardly be improved. Carnot points out that in order to obtain an answer to this question, it is necessary to consider the essential conditions of the process, apart from the mechanism of the engine and the working substance or agent employed. Work cannot be said to be produced from heat alone unless nothing but heat is supplied, and the working substance and all parts of the engine are at the end of the process in precisely the same state as at the beginning.

For instance a mass of compressed air, if allowed to expand in a cylinder at constant temperature, will do work, and will at the same time absorb a quantity of heat which, as we now know, is the thermal equivalent of the work done. But this work cannot be said to have been produced solely from the heat absorbed in the process, because the air at the end of the process is in a changed condition, and could not be restored to its original state at the same temperature without having work done upon it precisely equal to that obtained by its expansion. The process could not be repeated indefinitely without a continual supply of compressed air. The source of the work in this case is work previously done in compressing the air, and no part of the work is really generated at the expense of heat alone, unless the compression is effected at a lower temperature than the expansion.

1. Carnot's Axiom.—Carnot here, and throughout his reasoning, makes a fundamental assumption, which he states as follows: "When a body has undergone any changes and after a certain number of transformations is brought back identically to its original state, considered relatively to density, temperature and mode of aggregation, it must contain the same quantity of heat as it contained originally." Clausius and others have misinterpreted this assumption, and have taken it to mean that the quantity of heat required to produce any given change of state is independent of the manner in which the change is effected, which Carnot does not here assume.

Heat, according to Carnot, in the type of engine we are considering, can evidently be a cause of motive power only by virtue of changes of volume or form produced by alternate heating and cooling. This involves the existence of hot and cold bodies to act as boiler and condenser, or source and sink of heat, respectively. Wherever there exists a difference of temperature, it is possible to have the production of motive power from heat; and conversely, production of motive power, from heat alone, is impossible without difference of temperature. In other words the production of motive power from heat is not merely a question of the consumption of heat, but always requires transference of heat from hot to cold. What then are the conditions which enable the difference of temperature to be most advantageously employed in the production of motive power, and how much motive power can be obtained with a given difference of temperature from a given quantity of heat?

2. Carnot's Rule for Maximum Effect.—In order to realize the maximum effect, it is necessary that, in the process employed, there should not be any direct interchange of heat between bodies at different temperatures. Direct transference of heat by conduction or radiation between bodies at different temperatures is equivalent to wasting a difference of temperature which might have been utilized to produce motive power. The working substance must throughout every stage of the process be in equilibrium with itself (*i.e.*, at uniform temperature and pressure) and also with external bodies, such as the boiler and condenser, at such times as it is put in communication with them. In the actual engine there is always some interchange of heat between the steam and the cylinder, and some loss of heat to external bodies. There may also be some difference of temperature between the boiler steam and the cylinder on admission, or between the waste steam and the condenser at release. These differences represent losses of efficiency which may be reduced indefinitely, at least in imagination, by suitable means, and designers had even at that date been very successful in reducing them. All such losses are supposed to be absent in deducing the ideal limit of efficiency, beyond which it would be impossible to go.

3. Carnot's Description of His Ideal Cycle.—Carnot first gives a rough illustration of an incomplete cycle, using steam much in the same way as it is employed in an ordinary steam engine. After expansion down to condenser pressure the steam is completely condensed to water, and is then returned as cold water to the hot boiler. He points out that the last step does not conform exactly to the condition he laid down, because although the water is restored to its initial state, there is direct passage of heat from a hot body to a cold body in the last process. He points out that this difficulty might be overcome by supposing the difference of temperature small, and by employing a series of engines, each working through a small range, to cover a finite interval of temperature. Having established the general notions of a perfect cycle, he proceeds to give a more exact illustration, employing a gas as the working substance. He takes as the basis of his demonstration the well-established experimental fact that a gas is heated by rapid compression and cooled by rapid expansion, and that if compressed or expanded slowly in contact with conducting bodies, the gas will give out heat in compression or absorb heat in expansion while its temperature remains constant. He then goes on to say:

This preliminary notion being settled, let us imagine an elastic fluid, atmospheric air for example, enclosed in a cylinder *abcd* (fig. 5) fitted

with a movable diaphragm or piston *cd*. Let there also be two bodies A, B, each maintained at a constant temperature, that of A being more elevated than that of B. Let us now suppose the following series of operations to be performed:

1. Contact of the body A with the air contained in the space *abcd*, or with the bottom of the cylinder, which we will suppose to transmit heat easily. The air is now at the temperature of the body A, and *cd* is the actual position of the piston.

2. The piston is gradually raised, and takes the position *ef*. The air remains in contact with the body A, and is thereby maintained at a constant temperature during the expansion. The body A furnishes the heat necessary to maintain the constancy of temperature.

3. The body A is removed and the air no longer being in contact with any body capable of giving it heat, the piston continues nevertheless to rise, and passes from the position *ef* to *gh*. The air expands without receiving heat and its temperature falls. Let us imagine that it falls until it is just equal to that of the body B. At this moment the piston is stopped and occupies the position *gh*.

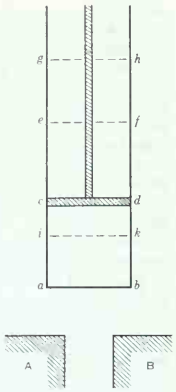

FIG. 5.—CARNOT'S CYLINDER (*see* TEXT)

4. The air is placed in contact with the body B; it is compressed by the return of the piston, which is brought from the position *gh* to the position *cd*. The air remains meanwhile at a constant temperature, because of its contact with the body B to which it gives up its heat.

5. The body B is removed, and the compression of the air is continued. The air being now isolated, rises in temperature. The compression is continued until the air has acquired the temperature of the body A. The piston passes meanwhile from the position *cd* to the position *ik*.

6. The air is replaced in contact with the body A, and the piston returns from the position *ik* to the position *ef*, the temperature remaining invariable.

7. The period described under (3) is repeated, then successively the periods (4), (5), (6); (3), (4), (5), (6); (3), (4), (5), (6); and so on.

During these operations the air enclosed in the cylinder exerts an effort more or less great on the piston. The pressure of the air varies both on account of changes of volume and on account of changes of temperature; but it should be observed that for equal volumes, that is to say, for like positions of the piston, the temperature is higher during the dilatation than during the compression. Since the pressure is greater during the expansion, the quantity of motive power produced by the dilatation is greater than that consumed by the compression. We shall thus obtain a balance of motive power, which may be employed for any purpose. The air has served as working substance in a heat-engine; it has also been employed in the most advantageous manner possible, since no useless re-establishment of the equilibrium of heat has been allowed to occur.

All the operations above described may be executed in the reverse order and direction. Let us imagine that after the sixth period, that is to say, when the piston has reached the position *ef*, we make it return to the position *ik*, and that at the same time we keep the air in contact with the hot body A; the heat furnished by this body during the sixth period will return to its source, that is, to the body A, and everything will be as it was at the end of the fifth period. If now we remove the body A, and if we make the piston move from *ik* to *cd*, the temperature of the air will decrease by just as many degrees as it increased during the fifth period, and will become that of the body *B*. We can evidently continue in this way a series of operations the exact reverse of those which were previously described; it suffices to place oneself in the same circumstances and to execute for each period a movement of expansion in place of a movement of compression, and vice versa.

The result of the first series of operations was the production of a certain quantity of motive power, and the transport of heat from the body A to the body B; the result of the reverse operations is the consumption of the motive power produced in the first case, and the return of heat from the body B to the body A, in such sort that these two series of operations annul and neutralize each other.

The impossibility of producing by the agency of heat alone a quantity of motive power greater than that which we have obtained in our first series of operations is now easy to prove. It is demonstrated by reasoning exactly similar to that which we have already given. The reasoning will have in this case a greater degree of exactitude; the air of which we made use to develop the motive power is brought back at the end of each cycle of operations precisely to its initial state, whereas this was not quite exactly the case for the vapour of water, as we have already remarked.

4. Proof of Carnot's Principle.—Carnot considered the proof too obvious to be worth repeating, but, unfortunately, his previous demonstration, referring to an incomplete cycle, is not so exactly worded that exception cannot be taken to it. We will therefore repeat his proof in a slightly more exact form.

Suppose that a reversible engine R, working in the cycle above described, takes a quantity of heat Q from the source in each cycle, and performs a quantity of useful work W_r. If it were possible for any other engine S, working with the same two bodies A and B as source and refrigerator, to perform a greater amount of useful work W_s per cycle for the same quantity of heat Q taken from the source, it would suffice to take a portion W_s of this motive power (since W_s is by hypothesis greater than W_r) to drive the engine R backward, and return a quantity of heat Q to the source in each cycle. The process might be repeated indefinitely, and we should obtain at each repetition a balance of useful work $W_s - W_r$, without taking any heat from the source, which is contrary to experience. Whether the quantity of heat taken from the condenser by R is equal to that given to the condenser by S is immaterial. The hot body A might be a comparatively small boiler, since no heat is taken from it. The cold body B might be the ocean, or the whole earth. We might thus obtain without any consumption of fuel a practically unlimited supply of motive power, which is absurd.

5. Carnot's Statement of His Prineiple.—If the foregoing reasoning be admitted, we must conclude with Carnot that the motive power obtainable from heat is independent of the agents employed to realize it. The efficiency is fixed solely by the temperatures of the bodies between which, in the last resort, the transfer of heat is effected. "We must understand here that each of the methods of developing motive power attains the perfection of which it is susceptible. This condition is fulfilled if, according to our rule, there is produced in the body no change of temperature that is not due to change of volume, or in other words, if there is no direct interchange of heat between bodies of sensibly different temperatures."

It is characteristic of a state of frictionless mechanical equilibrium that an indefinitely small difference of pressure suffices to upset the equilibrium and reverse the motion. Similarly in thermal equilibrium between bodies at the same temperature, an indefinitely small difference of temperature suffices to reverse the transfer of heat.

Carnot's rule is therefore the criterion of the reversibility of a cycle of operations as regards transfer of heat. It is assumed that the ideal engine is mechanically reversible, that there is not, for instance, any communication between reservoirs of gas or vapour at sensibly different pressures, and that there is no waste of power in friction. If there is equilibrium both mechanical and thermal at every stage of the cycle, the ideal engine will be perfectly reversible. That is to say, all its operations will be exactly reversed as regards transfer of heat and work when the operations are performed in the reverse order and direction. On this understanding Carnot's principle may be put in a different way, which is often adopted, but is really only the same thing put in different words: The efficiency of a perfectly reversible engine is the maximum possible, and is a function solely of the limits of temperature between which it works. This result depends essentially on the existence of a state of thermal equilibrium defined by equality of temperature, and independent, in the majority of cases, of the state of a body in other respects. In order to apply the principle to the calculation and prediction of results, it is sufficient to determine the manner in which the efficiency depends on the temperature for one particular case, since the efficiency must be the same for all reversible engines.

Carnot endeavoured to test his results by calculating the amount of work obtainable from an engine on his cycle, using steam as a working substance, and comparing the result with an engine performing a similar cycle, using air as the working substance. He found, using the experimental data available at that time, that the work to be obtained from 1,000 g.cal. of heat was roughly independent of the working substance, being about 1.13 kilogrammetre per kilocalorie per 1° fall at 100° C.; *i.e.*, when the limits of temperature of the cycle are 101° C. and 100° C. He was

able to show that the efficiency per degree fall probably diminished with rise of temperature, but the experimental data at that time were too inconsistent to suggest the true relation. He took as the analytical expression of his principle that the efficiency W/Q of a perfect engine taking in heat Q at a temperature $t°$ C., and rejecting heat at the temperature o° C., must be some function $F(t)$ of the temperature t, which would be the same for all substances. The efficiency per degree fall at a temperature t he represented by $F'(t)$, the derived function of $F(t)$. The function $F'(t)$ would be the same for all substances at the same temperature but would have different values at different temperatures. In terms of this function, which is generally known as Carnot's function, the results obtained in the previous section might be expressed as follows:

The increase of volume of a mixture of liquid and vapour per unit-mass vaporized at any temperature, multiplied by the increase of vapour-pressure per degree, is equal to the product of the function $F'(t)$ by the latent heat of vaporization.

The difference of the specific heats, or the latent heat of expansion for any substance, multiplied by the function $F'(t)$, is equal to the product of the expansion per degree at constant pressure by the increase of pressure per degree at constant volume.

Since the last two coefficients are the same for all gases if equal volumes are taken, Carnot concluded that: "The difference of the specific heats at constant pressure and volume is the same for equal volumes of all gases at the same temperature and pressure."

Taking the expression $W = RT \log_e r$ for the whole work done by a gas obeying the gaseous laws $pv = RT$ in expanding at a temperature T from a volume 1 (unity) to a volume r, or for a ratio of expansion r, and putting $W' = R \log_e r$ for the work done in a cycle of range 1°, Carnot obtained the expression for the heat absorbed by a gas in isothermal expansion:

$$Q = R \log_e r / F'(t) \qquad (2)$$

He gives several important deductions which follow from this formula, which is the analytical expression of the experimental result already quoted as having been discovered subsequently by Dulong. Employing the above expression for the latent heat of expansion, Carnot deduced a general expression for the specific heat of a gas at constant volume on the basis of the caloric theory. He showed that if the specific heat was independent of the temperature (the hypothesis already adopted by Laplace and Poisson) the function $F'(t)$ must be of the form

$$F'(t) = R/C\ (t + t_0) \qquad (3)$$

where C and t_0 are unknown constants. A similar result follows from his expression for the difference of the specific heats. If this is assumed to be constant and equal to C, the expression for $F'(t)$ becomes R/CT, which is the same as the above if $t_0 = 273$. Assuming the specific heat to be also independent of the volume, he shows that the function $F'(t)$ should be constant. But this assumption is inconsistent with the caloric theory of latent heat of expansion, which requires the specific heat to be a function of the volume. It appears in fact impossible to reconcile Carnot's principle with the caloric theory on any simple assumptions. As Carnot remarks: "The main principles on which the theory of heat rests require most careful examination. Many experimental facts appear almost inexplicable in the present state of this theory."

Carnot's work was subsequently put in a more complete analytical form by B. P. E. Clapeyron, who also made use of Watt's indicator diagram for the first time in discussing physical problems. Clapeyron gave the general expressions for the latent heat of a vapour, and for the latent heat of isothermal expansion of any substance, in terms of Carnot's function, employing the notation of the calculus. The expressions he gave are the same in form as those in use at the present time. He also gave the general expression for Carnot's function, and endeavoured to find its variation with temperature; but having no better data, he succeeded no better than Carnot.

Unfortunately, in describing Carnot's cycle, he assumed the caloric theory of heat, and made some unnecessary mistakes, which Carnot (who, we now know, was a believer in the mechanical theory) had been very careful to avoid. Clapeyron directs one to compress the gas at the lower temperature in contact with the body B until the heat disengaged is equal to that which has been absorbed at the higher temperature. He assumes that the gas at this point contains the same quantity of heat as it contained in its original state at the higher temperature, and that, when the body B is removed, the gas will be restored to its original temperature, when compressed to its initial volume. This mistake is still attributed to Carnot, and regarded as a fatal objection to his reasoning by many writers.

W. Thomson (Lord Kelvin) stated in 1852 that "Carnot's original demonstration utterly fails," and he introduced the "corrections" attributed to James Thomson and Clerk Maxwell respectively. In reality Carnot's original demonstration requires no correction.

VII. MECHANICAL THEORY OF HEAT

According to the caloric theory, the heat absorbed in the expansion of a gas became latent, like the latent heat of vaporization of a liquid, but remained in the gas and was again evolved on compressing the gas. This theory gave no explanation of the source of the motive power produced by expansion. The mechanical theory had explained the production of heat by friction as being the result of transformation of visible motion into a brisk agitation of the ultimate molecules, but it had not so far given any definite explanation of the converse production of motive power at the expense of heat. The theory could not be regarded as complete until it had been shown that in the production of work from heat, a certain quantity of heat disappeared, and ceased to exist as heat; and that this quantity was the same as that which could be generated by the expenditure of the work produced. The earliest complete statement of the mechanical theory from this point of view is contained in some notes written by Carnot, about 1830, but published by his brother in 1878. Taking the difference of the specific heats to be .078, he estimated the mechanical equivalent at 370 kilogram-metres. But he fully recognized that there were no experimental data at that time available for a quantitative test of the theory, although it appeared to afford a good qualitative explanation of the phenomena.

Carnot therefore planned a number of crucial experiments, such as the porous plug experiment, to test the equivalence of heat and motive power. His early death in 1832 put a stop to these experiments, but many later were made independently by other observers.

The most obvious case of the production of work from heat is in the expansion of a gas or vapour, which served in the first instance as a means of calculating the ratio of equivalence, on the assumption that all the heat which disappeared had been transformed into work and had not merely become latent. Marc Séguin, in his *De l'influence des chemins de fer* (1839), made a rough estimate in this manner of the mechanical equivalent of heat, assuming that the loss of heat represented by the fall of temperature of steam on expanding was equivalent to the mechanical effect produced by the expansion. He also remarks that it was absurd to suppose that "a finite quantity of heat could produce an indefinite quantity of mechanical action, and that it was more natural to assume that a certain quantity of heat disappeared in the very act of producing motive power." J. R. Mayer in 1842 stated the equivalence of heat and work more definitely, deducing it from the old principle, *causa aequat effectum* ("cause equals effect").

Assuming that the sinking of a mercury column by which a gas was compressed was equivalent to the heat set free by the compression, he deduced that the warming of 1 kg. of water 1° C. would correspond to the fall of a weight of 1 kg. from a height of about 365 m. But Mayer did not adduce any fresh experimental evidence, and made no attempt to apply his theory to the fundamental equations of thermodynamics. It has since been urged that the experiment of Gay-Lussac (1807), on the expansion of gas from one globe to another (see *Thermal Properties of Gases: Specific Heat of Gases*, above), was sufficient justification for the

assumption tacitly involved in Mayer's calculation. But Joule was the first to supply the correct interpretation of this experiment, and to repeat it on an adequate scale with suitable precautions. Joule was also the first to measure directly the amount of heat liberated by the compression of a gas, and to prove that heat was not merely rendered latent, but disappeared altogether as heat, when a gas did work in expansion.

1. Joule's Determinations of the Mechanical Equivalent.—The honour of placing the mechanical theory of heat on a sound experimental basis belongs almost exclusively to Joule, who showed by direct experiment that in all the most important cases in which heat was generated by the expenditure of mechanical work, or mechanical work was produced at the expense of heat, there was a constant ratio of equivalence between the heat generated and the work expended and vice versa. His first experiments were on the relation of the chemical and electric energy expended to the heat produced in metallic conductors and voltaic and electrolytic cells; these experiments were described in a series of papers published in the *London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, 1840–43. He first proved the relation, known as Joule's law, that the heat produced in a conductor of resistance R by a current C is proportional to C^2R per second. He went on to show that the total heat produced in any voltaic circuit was proportional to the electromotive force E of the battery and to the number of equivalents electrolyzed in it. Michael Faraday had shown that electromotive force depends on chemical affinity. Joule measured the corresponding heats of combustion, and showed that the electromotive force corresponding to a chemical reaction is proportional to the heat of combustion of the electrochemical equivalent. He also measured the electromotive force required to decompose water, and showed that when part of the electric energy EC is thus expended in a voltameter, the heat generated is less than the heat of combustion corresponding to EC by a quantity representing the heat of combustion of the decomposed gases.

Joule's papers so far had been concerned with the relations between electrical energy, chemical energy and heat which he showed to be mutually equivalent. The first paper in which he discussed the relation of heat to mechanical power was entitled "On the Calorific Effects of Magneto-Electricity, and on the Mechanical Value of Heat." In this paper in 1843 he showed that the heat produced by currents generated by magnetoelectric induction followed the same law as voltaic currents. By a simple and ingenious arrangement he succeeded in measuring the mechanical power expended in producing the currents, and deduced the mechanical equivalent of heat and of electrical energy. The amount of mechanical work required to raise 1 lb. of water 1° F. (1 B.T.U.), as found by this method, was 838 ft.lb. In a note added to the paper he states that he found the value 770 ft.lb. by the more direct method of forcing water through fine tubes.

In a paper in 1845 "On the Changes of Temperature Produced by the Rarefaction and Condensation of Air," he made the first direct measurements of the quantity of heat disengaged by compressing air, and also of the heat absorbed when the air was allowed to expand against atmospheric pressure; as the result he deduced the value 798 ft.lb. for the mechanical equivalent of 1 B.T.U. He also showed that there was no appreciable absorption of heat when air was allowed to expand in such a manner as not to develop mechanical power, and he pointed out that the mechanical equivalent of heat could not be satisfactorily deduced from the relations of the specific heats, because the knowledge of the specific heats of gases at that time was so uncertain.

He attributed most weight to his later determinations of the mechanical equivalent made by the direct method of friction of liquids. He showed that the results obtained with different liquids, water, mercury and sperm oil, were the same, namely, 782 ft.lb.; and finally repeating the method with water, using all the precautions and improvements which his experience had suggested, he obtained the value 772 ft.lb., which was accepted universally for many years, and has only recently required alteration on account of the more exact definition of the heat unit and the standard scale of temperature (*see* CALORIMETRY). The great value of Joule's work for the general establishment of the principle of the conservation of energy lay in the variety and completeness of the experimental evidence he adduced. It was not sufficient to find the relation between heat and mechanical work or other forms of energy in one particular case. It was necessary to show that the same relation held in all cases which could be examined experimentally, and that the ratio of equivalence of the different forms of energy, measured in different ways, was independent of the manner in which the conversion was effected and of the material or working substance employed.

As the result of Joule's experiments, we are justified in concluding that heat is a form of energy, and that all its transformations are subject to the general principle of the conservation of energy. As applied to heat, the principle is called the first law of thermodynamics, and may be stated as follows: When heat is transformed into any other kind of energy, or vice versa, the total quantity of energy remains invariable; that is to say, the quantity of heat which disappears is equivalent to the quantity of the other kind of energy produced and vice versa.

The number of units of mechanical work equivalent to one unit of heat is generally called the mechanical equivalent of heat, or Joule's equivalent, and is denoted by the letter J. Its numerical value depends on the units employed for heat and mechanical energy respectively.

The values of the equivalent in terms of the units most commonly employed are as follows:

778	foot-pounds	= 1 B.T.U. (lb. deg. F.)
1,401	foot-pounds	= 1 lb. deg. C. (lb.-calorie)
426.85	kilogram-metres	= 1 kilogram-deg. C. or kilocalorie
426.85	gram-metres	= 1 gram-deg. C.
4.1840	abs. joules or watt-seconds	= 1 for def. gram calorie
1.1628	watt-hours	= 1 def. kg. calorie
1.162	kilowatt-hours	= 1 ton calorie

The defined calorie above is based on the electrical equivalent of heat which is the most reproducibly measurable quantity of energy; it is closely equivalent to the amount of heat necessary to raise one gram of water from 14.5° to 15.5° C., one of the more common older definitions. The degree of temperature is based on the International Temperature scale adopted in 1948 by the International Committee of Weights and Measures. The acceleration of gravity used is 980.7 centimetre-gram-second (c.g.s.) units. For further details *see* CALORIMETRY.

The second law of thermodynamics is a title often used to denote Carnot's principle or some equivalent mathematical expression. In some cases this title is not conferred on Carnot's principle itself, but on some axiom from which the principle may be indirectly deduced. These axioms, however, cannot as a rule be directly applied, so that it would appear preferable to take Carnot's principle itself as the second law.

It may be observed that, as a matter of history, Carnot's principle was established and generally admitted before the principle of the conservation of energy as applied to heat, and that from this point of view the titles, first and second laws, are not particularly appropriate.

2. Combination of Carnot's Principle With the Mechanical Theory.—R. J. E. Clausius and W. J. M. Rankine were the first to develop at mid-19th century the correct equations of thermodynamics on the mechanical theory. When heat was supplied to a body to change its temperature or state, part remained in the body as intrinsic heat energy E, but part was converted into external work of expansion W and ceased to exist as heat. The part remaining in the body was always the same for the same change of state, however performed, as required by Carnot's fundamental axiom, but the part corresponding to the external work was necessarily different for different values of the work done. Thus in any cycle in which the body was exactly restored to its initial state, the heat remaining in the body would always be the same, or as Carnot puts it, the quantities of heat absorbed and given out in its diverse transformations are exactly "compensated," so far as the body is concerned. But the quantities of heat absorbed and given out are not necessarily equal. On

the contrary, they differ by the equivalent of the external work done in the cycle. Applying this principle to the case of steam, Clausius deduced a fact previously unknown, that the specific heat of steam maintained in a state of saturation is negative, which was also deduced by Rankine about the same time.

In applying the principle to gases Clausius assumes (with Mayer and C. H. A. Holtzmann) that the heat absorbed by a gas in isothermal expansion is equivalent to the work done, but he does not appear to be acquainted with Joule's experiment, and the reasons he adduces in support of this assumption are not conclusive. This being admitted, he deduces from the energy principle alone the propositions already given by Carnot with reference to gases, and shows in addition that the specific heat of a perfect gas must be independent of the density.

W. Thomson (Lord Kelvin) in a paper "On the Dynamical Theory of Heat," published in 1852, gave a very clear statement of the position of the theory at that time. He showed that the value $F'(t) = J/T$, assumed for Carnot's function by Clausius without any experimental justification, rested solely on the evidence of Joule's experiment, and might possibly not be true at all temperatures. Assuming the value J/T with this reservation, he gave as the expression for the efficiency over a finite range $t_1°$ to $t_0°$ C., or $T_1°$ to $T_0°$ K., the result,

$$W/Q = (t_1 - t_0)/(t_1 + 273) = (T_1 - T_0)/T_1 \qquad (4)$$

which, he observed, agrees in form with that found by Rankine.

3. The Absolute Scale of Temperature.—Since Carnot's function is the same for all substances at the same temperature, and is a function of the temperature only, it supplies a means of measuring temperature independently of the properties of any particular substance. This proposal was first made by Lord Kelvin in 1848, who suggested that the degree of temperature should be chosen so that the efficiency of a perfect engine at any point of the scale should be the same, or that Carnot's function $F'(t)$ should be constant. This would give the simplest expression for the efficiency of the caloric theory, but the scale so obtained, when the values of Carnot's function were calculated from Regnault's observations on steam, was found to differ considerably from the scale of the mercury or air thermometer. At a later date, when it became clear that the value of Carnot's function was very nearly proportional to the reciprocal of the temperature T measured from the absolute zero of the gas thermometer, he proposed a simpler method in 1854, namely, to define absolute temperature T as proportional to the reciprocal of Carnot's function. On this definition of absolute temperature, the expression $(T - T_0)/T$ for the efficiency of a Carnot cycle with limits T and T_0 would be exact, and it became a most important problem to determine how far the temperature by gas thermometer differed from the absolute temperature. With this object he devised a very delicate method, known as the porous plug experiment (*see* THERMOMETRY), of testing the deviation of the gas thermometer from the absolute scale. The experiments were carried out in conjunction with Joule, and finally resulted in showing in 1862 that the deviations of the air thermometer from the absolute scale as above defined are almost negligible, and that in the case of the gas hydrogen the deviations are so small that a thermometer containing this gas may be taken for all practical purposes as agreeing exactly with the absolute scale at all ordinary temperatures. For this reason the hydrogen thermometer has since been generally adopted as the standard.

VIII. AVAILABILITY OF HEAT OF COMBUSTION

Taking the value of 1.13 kilogram-metres per kilocalorie for 1° C. fall of temperature at 100° C., Carnot attempted to estimate the possible performance of a steam engine receiving heat at 160° C. and rejecting it at 40° C. Assuming the performance to be simply proportional to the temperature fall, the work done for 120° fall would be 134 kilogram-metres per kilocalorie. To make an accurate calculation required a knowledge of the variation of the function $F'(t)$ with temperature. Taking equation (4) above the work obtainable is 118 kilogram-metres per kilocalorie, which is 28% of 426, the mechanical equivalent of the kilocalorie in kilogram-metres. Carnot pointed out that the fall of 120° C. utilized in the steam engine was only a small fraction of the whole temperature fall obtainable by combustion, and made an estimate of the total power available if the whole fall could be utilized, allowing for the probable diminution of the function $F'(t)$ with rise of temperature. His estimate was 3,900,000 kilogram-metres per kilogram of coal. This was certainly an overestimate, but was surprisingly close, considering the scanty data at his disposal.

In reality the fraction of the heat of combustion available, even in an ideal engine and apart from practical limitations, is much less than might be inferred from the efficiency formula of the Carnot cycle, by taking the temperature obtainable by the combustion of the fuel as the upper limit of temperature in the formula. For carbon burned in air at constant pressure without any loss of heat, the products of combustion might be raised 2,300° C. in temperature, assuming that the specific heats of the products were constant and that there was no dissociation. If all the heat could be supplied to the working fluid at this temperature, that of the condenser being 40° C., the possible efficiency by equation (4) above would be 89%. But it is obvious that this could not be done even under the most ideal conditions. The heat given up by the products of combustion in cooling to atmospheric temperature could not be received by the boiler at 2,300° but at intermediate temperatures from 2,300° to 40°, which would reduce the mean effective temperature of heat reception from 2,300° to 1,640°, and the ideal efficiency from 89% to 62%. This, however, assumes a perfect regenerative boiler in which the working fluid leaves the boiler at a temperature of 2,300°, although the mean temperature of heat reception cannot exceed 1,640°. Carnot foresaw that there would be further limitations in the case of the steam engine owing to the properties of the working fluid.

The greater part of the heat required for generating steam in a boiler is the latent heat of vaporization, which is necessarily received by the steam at the saturation temperature corresponding to the pressure at which the boiler is designed to work. Thus at a pressure of 680 lb. per square inch, the latent heat of vaporization, amounting to about 400 cal., would be received at a temperature of only 260° C. (500° F.) permitting an ideal efficiency of 41% for the conversion of this part of the heat. But if the feed water from the condenser at 40° is pumped directly into the boiler, to heat it to 260°, the heat required, amounting to about 230 cal., would be received by the feed water at intermediate temperatures, and could not be so efficiently utilized. Rankine in 1854 was the first to show how the work obtainable from this part of the heat could be calculated. His formula gives an ideal efficiency of conversion of 25% for heat supplied in equal instalments between 40° and 260°. This would reduce the efficiency of an engine using the Rankine cycle with saturated steam at 680 lb. pressure to 35% as compared with 41% for the Carnot cycle, in terms of the heat actually received by the steam. If the temperature of the boiler were further raised to 360° C., corresponding to a pressure of 2,700 lb. (nearly four times as great as at 260°), the ideal efficiency of the Carnot cycle would be just over 50%, or half the latent heat could be utilized by a perfect engine. But the latent heat at 360° is only 177 cal., and is less than half the heat required for feed heating, which amounts to 400 cal., so that the corresponding efficiency of the Rankine cycle is only 38%, which is very near the limit theoretically attainable in this cycle with saturated steam.

1. Advantages of Internal Combustion.—As Carnot pointed out, the chief advantage of using atmospheric air as a working fluid in a heat engine lies in the possibility of imparting heat to it directly by internal combustion. Even with internal combustion, however, the full range of temperature is not available, because the heat cannot in practice be communicated to the working fluid at constant temperature, owing to the large range of expansion at constant temperature required for the absorption of a sufficient quantity of heat. Air engines of this type, such as the Rev. R. Stirling's or John Ericsson's, taking in heat at constant temperature, though theoretically the most perfect, are bulky and mechanically inefficient.

In practical engines the heat is generated by the combustion

of an explosive mixture at constant volume or at constant pressure. The heat is not all communicated at the highest temperature, but over a range of temperature from that of the mixture at the beginning of combustion to the maximum temperature. The earliest instance of this type of engine is the lycopodium engine of M. M. Niepce, discussed by Carnot, in which a combustible mixture of air and lycopodium powder at atmospheric pressure was ignited in a cylinder, and did work on a piston. The early gas engines of E. Lenoir (1860) and N. Otto and E. Langen (1867) operated in a similar manner with illuminating gas in place of lycopodium. Combustion in this case is effected practically at constant volume, and the maximum efficiency theoretically obtainable is $1 - \log_r r/(r-1)$, where r is the ratio of the maximum temperature T to the initial temperature T_0. In order to obtain this efficiency it would be necessary to follow Carnot's rule, and expand the gas after ignition without loss or gain of heat from T down to T_0, and then to compress it at T_0 to its initial volume. If the rise of temperature in combustion were 2,300° C., and the initial temperature were 0° C. or 273° K., the theoretical efficiency would be 73.3%, which is much greater than that obtainable with a boiler. But in order to reach this value, it would be necessary to expand the mixture to about 270 times its initial volume, which is obviously impracticable.

Because of incomplete expansion and rapid cooling of the heated gases by the large surface exposed, the actual efficiency of the Lenoir engine was less than 5%, and of the Otto and Langen, with more rapid expansion, about 10%.

Carnot foresaw that in order to render an engine of this type practically efficient, it would be necessary to compress the mixture before ignition. Compression is beneficial in three ways: (1) it permits a greater range of expansion after ignition; (2) it raises the mean effective pressure, and thus improves the mechanical efficiency and the power in proportion to size and weight; (3) it reduces the loss of heat during ignition by reducing the surface exposed to the hot gases. In the modern gas or gasoline motor, compression is employed as in Carnot's cycle, but the efficiency attainable is limited not so much by considerations of temperature as by limitations of volume. It is impracticable before combustion at constant volume to compress a rich mixture to much less than one-fifth of its initial volume, and, for mechanical simplicity, the range of expansion is made equal to that of compression.

The cycle employed was devised in 1862 by Alphonse Beau de Rochas, but was first successfully carried out by Otto (1876). It differs from the Carnot cycle in employing reception and rejection of heat at constant volume instead of at constant temperature. This cycle is not so efficient as the Carnot cycle for given limits of temperature, but, for the given limits of volume imposed, it gives a much higher efficiency than the Carnot cycle. The efficiency depends only on the range of temperature in expansion and compression, and is given by the formula $(T_1 - T_2)/T_1$, where T_1 is the maximum temperature, and T_2 the temperature at the end of expansion. The formula is the same as that for the Carnot cycle with the same range of temperature in expansion. The ratio T_1/T_2 is $r^{\gamma-1}$ where r is the given ratio of expansion or compression, and γ is the ratio of the specific heats of the working fluid. Assuming the working fluid to be a perfect gas with the same properties as air, we should have $\gamma = 1.41$. Taking $r = 5$, the formula gives 48% for the maximum possible efficiency. The actual products of combustion vary with the nature of the fuel employed, and have different properties from air, but the efficiency is found to vary with compression in the same manner as for air. For this reason a committee of the Institution of Civil Engineers in 1905 recommended the adoption of the air standard for estimating the effects of varying the compression ratio, and defined the relative efficiency of an internal combustion engine as the ratio of its observed efficiency to that of a perfect air engine with the same compression.

2. Effect of Dissociation and Increase of Specific Heat.—One of the most important effects of heat is the decomposition or dissociation of compound molecules. Just as the molecules of a vapour combine with evolution of heat to form the more complicated molecules of the liquid, and as the liquid molecules require the addition of heat to effect their separation into molecules of vapour, so in the case of molecules of different kinds which combine with evolution of heat, the reversal of the process can be effected either by the agency of heat, or indirectly by supplying the requisite amount of energy by electrical or other methods. Just as the latent heat of vaporization diminishes with rise of temperature, and the pressure of the dissociated vapour molecules increases, so in the case of compound molecules in general the heat of combination diminishes with rise of temperature, and the pressure of the products of dissociation increases. There is evidence that the compound carbon dioxide, CO_2, is partly dissociated into carbon monoxide and oxygen at high temperatures, and that the proportion dissociated increases with rise of temperature.

There is a very close analogy between these phenomena and the vaporization of a liquid. The laws which govern dissociation are the same fundamental laws of thermodynamics, but the relations involved are necessarily more complex on account of the presence of different kinds of molecules, and present special difficulties for accurate investigation in the case where dissociation does not begin to be appreciable until a high temperature is reached.

It is easy, however, to see that the general effect of dissociation must be to diminish the available temperature of combustion, and all experiments go to show that in ordinary combustible mixtures the rise of temperature actually attained is much less than that calculated above by Carnot on the assumption that the whole heat of combustion is developed and communicated to products of constant specific heat. The defect of temperature observed can be represented by supposing that the specific heat of the products of combustion increases with rise of temperature. This is the case for CO_2 even at ordinary temperatures, according to Regnault, and probably also for air and steam at higher temperatures. Increase of specific heat is a necessary accompaniment of dissociation, and from some points of view may be regarded as merely another way of stating the facts. It is the most convenient method to adopt in the case of products of combustion consisting of a mixture of CO_2 and steam with a large excess of inert gases, because the relations of equilibrium of dissociated molecules of so many different kinds would be too complex to permit of any other method of expression.

Although Carnot's principle makes it possible to calculate in every case what the limiting possible efficiency would be for any kind of cycle if all heat losses were abolished, it is very necessary, in applying the principle to practical cases, to take account of the possibility of avoiding the heat losses which are supposed to be absent, and of other practical limitations in the working of the actual engine. An immense amount of time and ingenuity has been wasted in striving to realize impossible margins of ideal efficiency, which a close study of the practical conditions would have shown to be illusory. As Carnot remarks at the conclusion of his essay: "Economy of fuel is only one of the conditions a heat-engine must satisfy; in many cases it is only secondary, and must often give way to considerations of safety, strength and wearing qualities of the machine, of smallness of space occupied, or of expense in erecting. To know how to appreciate justly in each case the considerations of convenience and economy, to be able to distinguish the essential from the accessory, to balance all fairly, and finally to arrive at the best result by the simplest means, such must be the principal talent of the man called on to direct and co-ordinate the work of his fellows for the attainment of a useful object of any kind."

IX. TRANSFERENCE OF HEAT

There are three principal modes of transference of heat, namely (1) convection, (2) conduction and (3) radiation:

1. In convection, heat is carried or conveyed by the motion of heated masses of matter. The most familiar illustrations of this method of transference are the heating of buildings by the circulation of steam or hot water, or the equalization of temperature of a mass of unequally heated liquid or gas by convection

currents, produced by natural changes of density or by artificial stirring.

2. In conduction, heat is transferred by contact between contiguous particles of matter and is passed on from one particle to the next without visible relative motion of the parts of the body. A familiar illustration of conduction is the passage of heat through the metal plates of a boiler from the fire to the water inside, or the transference of heat from a soldering bolt to the solder and the metal with which it is placed in contact.

3. In radiation, the heated body, through the thermal vibratory motion of its atoms, radiates out into space vibratory waves of an electrodynamic nature, these waves being visible light (in part) if the body is at a sufficiently high temperature (*e.g.*, red-hot); if the body is at a lower temperature, the waves are so called infrared radiation (invisible) which is similar in nature to light but contains just enough less energy per unit (photon) so that it cannot excite the optic nerve and be perceived by the human eye. But these waves can be absorbed by matter on which they impinge and can be reconverted into heat; *i.e.*, into thermal vibrations of the atoms.

The different modes of transference are subject to different laws, and the difficulty of disentangling their effects and subjecting them to calculation is often one of the most serious obstacles in the experimental investigation of heat. In space void of matter, we should have pure radiation, but it is difficult to obtain so perfect a vacuum that the effects of the residual gas in transferring heat by conduction or convection are inappreciable. In the interior of an opaque solid we should have pure conduction, but if the solid is sensibly transparent in thin layers there must also be an internal radiation, while in a liquid or a gas it is very difficult to eliminate the effects of convection. These difficulties are well illustrated in the historical development of the subject by the experimental investigations which have been made to determine the laws of heat transference, such as the laws of cooling, of radiation and of conduction.

1. Newton's Law of Cooling.—There is one essential condition common to all three modes of heat transference, namely, that they depend on difference of temperature, that the direction of the transfer of heat is always from hot to cold and that the rate of transference is, for small differences, directly proportional to the difference of temperature. Without difference of temperature there is no transfer of heat. When two bodies have been brought to the same temperature by conduction, they are also in equilibrium as regards radiation, and vice versa. If this were not the case, there could be no equilibrium of heat defined by equality of temperature.

A hot body placed in an enclosure of lower temperature, *e.g.*, a calorimeter in its containing vessel, generally loses heat by all three modes simultaneously in different degrees. The loss by each mode will depend in different ways on the form, extent and nature of its surface and on that of the enclosure, on the manner in which it is supported, on its relative position and distance from the enclosure and on the nature of the intervening medium. But provided that the difference of temperature is small, the rate of loss of heat by all modes will be approximately proportional to the difference of temperature, the other conditions remaining constant. The rate of cooling or the rate of fall of temperature will also be nearly proportional to the rate of loss of heat, if the specific heat of the cooling body is constant, or the rate of cooling at any moment will be proportional to the difference of temperature.

This simple relation is commonly known as Newton's law of cooling, but is limited in its application to comparatively simple cases such as the foregoing. Newton himself applied it to estimate the temperature of a red-hot iron ball, by observing the time which it took to cool from a red heat to a known temperature, and comparing this with the time taken to cool through a known range at ordinary temperatures. According to this law if the excess of temperature of the body above its surroundings is observed at equal intervals of time, the observed values will form a geometrical progression with a common ratio. Supposing, for instance, that the surrounding temperature were 0° C., that the red-hot ball took 25 min. to cool from its original temperature to 20° C., and 5 min. to cool from 20° C. to 10° C., the original temperature is easily calculated on the assumption that the excess of temperature above 0° C. falls to half its value in each interval of 5 min. Doubling the value 20° at 25 min. five times, we arrive at 640° C. as the original temperature. No other method of estimation of such temperatures was available in the time of Newton, but, as we now know, the simple law of proportionality to the temperature difference is inapplicable over such large ranges of temperature. The rate of loss of heat by radiation, and also by convection and conduction to the surrounding air, increases much more rapidly than in simple proportion to the temperature difference, and the rate of increase of each follows a different law.

At a later date Sir John Herschel measured the intensity of solar radiation at the surface of the earth, and endeavoured to form an estimate of the temperature of the sun by comparison with terrestrial sources on the assumption that the intensity of radiation was simply proportional to the temperature difference. He thus arrived at an estimate of several million degrees, which we now know would be about a thousand times too great. The application of Newton's law necessarily leads to absurd results when the difference of temperature is very large, but the error will not in general exceed 2% to 3% if the temperature difference does not exceed 10° C., and the percentage error is proportionately much smaller for smaller differences.

2. Surface Emissivity.—Similar considerations apply to many attempts which have been made to determine the general value of the constant termed by Jean Fourier and early writers the "exterior conductibility," but now called the surface emissivity. This coefficient represents the rate of loss of heat from a body per unit area of surface per degree excess of temperature, and includes the effects of radiation, convection and conduction. As already pointed out, the combined effect will be nearly proportional to the excess of temperature in any given case provided that the excess is small, but it is not necessarily proportional to the extent of surface exposed except in the case of pure radiation. The rate of loss of heat by convection and conduction varies with the form of the surface, and, unless the enclosure is very large compared with the cooling body, the effect depends also on the size and form of the enclosure. The effects of conduction and radiation may be approximately estimated if the conductivity of the gas and the nature and forms of the surfaces of the body and enclosure are known, but the effect of convection in any case can be determined only by experiment. It has been found that the rate of cooling by a current of air is approximately proportional to the velocity of the current, other things being equal. It is obvious that this should be the case, but the result cannot generally be applied to convection currents. Values which are commonly given for the surface emissivity must therefore be accepted with great reserve. They can be regarded only as approximate, and as applicable only to cases precisely similar to those for which they were experimentally obtained. There cannot be said to be any general law of convection. The loss of heat is not necessarily proportional to the area of the surface, and no general value of the coefficient can be given to suit all cases. The laws of conduction and radiation admit of being more precisely formulated, and their effects predicted, except insofar as they are complicated by convection.

X. CONDUCTION OF HEAT IN SOLIDS

The transference of heat in the interior of a solid body formed one of the earliest subjects of mathematical and experimental treatment in the theory of heat. The law assumed by Fourier was of the simplest possible type, but the mathematical application, except in the simplest cases, was so difficult as to require the development of a new mathematical method. Fourier succeeded in showing how, by his method of analysis, the solution of any given problem with regard to the flow of heat by conduction in any material could be obtained in terms of a physical constant, the thermal conductivity of the material, and that the results obtained by experiment agreed in a qualitative manner

with those predicted by his theory. But the experimental determination of the actual values of these constants presented formidable difficulties which were not surmounted until a later date.

The law of conduction, which forms the basis of the mathematical theory, although seldom explicitly stated as an experimental law, should really be regarded in this light, and may be briefly worded as follows: "The rate of transmission of heat by conduction is proportional to the temperature gradient." The rate of transmission of heat is here understood to mean the quantity of heat transferred in unit time through unit area of cross section of the substance, the unit area being taken perpendicular to the lines of flow. It is clear that the quantity transferred in any case must be jointly proportional to the area and the time. The "gradient of temperature" is the fall of temperature in degrees per unit length along the lines of flow.

The thermal conductivity of the substance is the constant ratio of the rate of transmission to the temperature gradient. To take the simple case of the "wall" or flat plate considered by Fourier for the definition of thermal conductivity, suppose that a quantity of heat Q passes per second through an area A of a plate of conductivity k and thickness x, the sides of which are constantly maintained at temperatures t_1 and t_2. The rate of transmission of heat is Q/A, and the temperature gradient, supposed uniform, is $(t_1 - t_2)/x$, so that the law of conduction leads at once to the equation

$$Q/A = k(t_1 - t_2)/x \qquad (5)$$

This relation applies accurately to the case of the steady flow of heat in parallel straight lines through a homogeneous and isotropic solid, the isothermal surfaces, or surfaces of equal temperature, being planes perpendicular to the lines of flow. If the flow is steady, and the temperature of each point of the body invariable, the rate of transmission must be everywhere the same. One of the simplest illustrations of the rectilinear flow of heat is the steady outflow through the upper strata of the earth's crust, which may be considered practically plane in this connection. This outflow of heat necessitates a rise of temperature with increase of depth. The corresponding gradient is of the order of 1° C. in 100 ft. but varies inversely with the conductivity of the strata at different depths.

A different type of problem is presented in those cases in which the temperature at each point varies with the time, as is the case near the surface of the soil with variations in the external conditions between day and night or summer and winter. The flow of heat may still be linear if the horizontal layers of the soil are of uniform composition, but the quantity flowing through each layer is no longer the same. Part of the heat is used up in changing the temperature of the successive layers. In this case it is generally more convenient to consider as unit of heat the thermal capacity c of unit volume, or that quantity which would produce a rise of 1° of temperature in unit volume of the soil or substance considered. If Q is expressed in terms of this unit in equation (5), it is necessary to divide by c, or to replace k on the right-hand side by the ratio k/c. This ratio determines the rate of diffusion of temperature, and is called the thermometric conductivity or, more shortly, the diffusivity. The velocity of propagation of temperature waves will be the same under similar conditions in two substances which possess the same diffusivity, although they may differ in conductivity.

1. Variable-flow Methods.—In these methods the flow of heat is deduced from observations of the rate of change of temperature with time in a body exposed to known external or boundary conditions. No calorimetric observations are required, but the results are obtained in terms of the thermal capacity of unit volume c, and the measurements give the diffusivity k/c, instead of the calorimetric conductivity k. Since both k and c are generally variable with the temperature, and the mode of variation of either is often unknown, the results of these methods are generally less certain with regard to the actual flow of heat. As in the case of steady flow methods, by far the simplest example to consider is that of the linear flow of heat in an infinite solid, which is most nearly realized in nature in the propagation of temperature waves in the surface of the soil. One of the best methods of studying the flow of heat in this case is to draw a series of curves showing the variations of temperature with depth in the soil for a series of consecutive days. The curves given in fig. 6 were obtained from the readings of a number of platinum thermometers buried in undisturbed soil in horizontal positions at McGill university, Montreal.

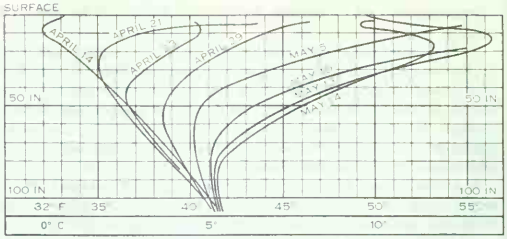

FIG. 6.—CURVES SHOWING THE VARIATION OF TEMPERATURE WITH DEPTH, AT VARIOUS DATES

The method of deducing the diffusivity from these curves is as follows: The total quantity of heat absorbed by the soil per unit area of surface between any two dates, and any two depths, x' and x'', is equal to c times the area included between the corresponding curves. This can be measured graphically without any knowledge of the law of variation of the surface temperature, or of the laws of propagation of heat waves. The quantity of heat absorbed by the stratum $(x'\ x'')$ in the interval considered can also be expressed in terms of calorimetric conductivity k The heat transmitted through the plane x is equal per unit area of surface to the product of k by the mean temperature gradient (dt/dx) and the interval of time in seconds. The mean temperature gradient is found by plotting the curves for each day from the daily observations. The heat absorbed is the difference of the quantities transmitted through the bounding planes of the stratum. We thus obtain the simple equation.

$$k'(dt'/dx') - k''(dt''/dx'') = c\ (\text{area between curves})/\text{time in sec.} \qquad (6)$$

by means of which the average value of the diffusivity k/c can be found for any convenient interval of time, at different seasons of the year, in different states of the soil.

For the particular soil in question it was found that the diffusivity varied enormously with the degree of moisture, falling as

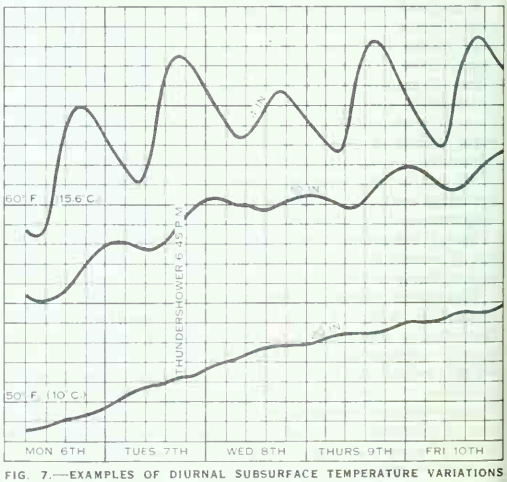

FIG. 7.—EXAMPLES OF DIURNAL SUBSURFACE TEMPERATURE VARIATIONS FOR DEPTHS OF 4, 10 AND 20 IN. (MONTH OF MAY)

low as .0010 c.g.s. in the winter for the surface layers, which became extremely dry under the protection of the frozen ice and snow from December to March, but rising to an average of .0060 to .0070 in the spring and autumn. The greater part of the diffusion of heat was certainly due to the percolation of water. On some occasions, because of the sudden melting of a surface layer of ice and snow, a large quantity of cold water, percolating rapidly, gave for a short time values of the diffusivity as high as .0300. Excluding these exceptional cases, however, the variations of the diffusivity appeared to follow the variations of the seasons with considerable regularity in successive years. The presence of water in the soil always increased the value of k/c, and as it necessarily increased c, the increase of k must have been greater than that of k/c.

2. Periodic Flow of Heat.—The foregoing method is perfectly general, and can be applied in any case in which the requisite observations can be taken. A case of special interest and importance is that in which the flow is periodic. The general characteristics of such a flow are illustrated in fig. 7, showing the propagation of temperature waves caused by diurnal variations in the temperature of the surface.

The daily range of temperature of the air and of the surface of the soil was about 20° F. On a sunny day, the temperature reached a maximum about 2 P.M. and a minimum about 5 A.M. As the waves were propagated downward through the soil the amplitude rapidly diminished, so that at a depth of only 4 in. it was already reduced to about 6° F., and to less than 2° at 10 in. At the same time, the epoch of maximum or minimum was retarded, about 4 hours at 4 in., and nearly 12 hours at 10 in., where the maximum temperature was reached between 1 and 2 A.M. The form of the wave was also changed. At 4 in. the rise was steeper than the fall, at 10 in. the reverse was the case. This is due to the fact that the components of shorter period are more rapidly propagated. For instance, the velocity of propagation of a wave having a period of a day is nearly 20 times as great as that of a wave with a period of 1 year; but on the other hand the penetration of the diurnal wave is nearly 20 times less, and the shorter waves die out more rapidly.

3. Laboratory Methods.—Measurements of thermal conductivity present peculiar difficulties on account of the variety of quantities to be observed, the slowness of the process of conduction, the impossibility of isolating a quantity of heat and the difficulty of exactly realizing the theoretical conditions of the problem. The following are some of the special cases which have been utilized experimentally:

The "Wall" or Plate Method.—This method endeavours to realize the conditions of equation (5), namely, uniform rectilinear flow. Theoretically this requires an infinite plate, or a perfect heat insulator, so that the lateral flow can be prevented or rendered negligible. This condition can generally be satisfied with sufficient approximation with plates of reasonable dimensions. To find the conductivity, it is necessary to measure all the quantities which occur in equation (5) to a similar order of accuracy. The measurement of the temperature gradient in the plate generally presents the greatest difficulty. If the plate is thin, it is necessary to measure the thickness with great care, and it is necessary to assume that the temperatures of the surfaces are the same as those of the mediums with which they are in contact, since there is no room to insert thermometers in the plate itself. This assumption does not present serious errors in the case of bad conductors, such as glass or wood, but has given rise to large mistakes in the case of metals.

Tube Method.—If the inside of a glass tube is exposed to steam, and the outside to a rapid current of water, or vice versa, the temperatures of the surfaces of the glass may be taken to be approximately equal to those of the water and steam, which may easily be observed. If the thickness of the glass is small compared with the diameter of the tube, say one-tenth, equation (5) may be applied with sufficient approximation.

Forbes's Bar Method.—Observation of the steady distribution of temperature along a bar heated at one end was very early employed by Fourier, César Mansuète Despretz and others for the comparison of conductivities. Originated by James David Forbes, it is the most convenient method, in the case of good conductors, on account of the great facilities which it permits for the measurement of the temperature gradient at different points; but it has the disadvantage that the results depend almost entirely on a knowledge of the external heat loss or emissivity, or, in comparative experiments, on the assumption that it is the same in different cases.

Calorimetric Bar Method.—To avoid the uncertainties of surface loss of heat, it is necessary to reduce it to the rank of a small correction by employing a large bar and protecting it from loss of heat. The heat transmitted should be measured calorimetrically, and not in terms of the uncertain emissivity. The apparatus shown in fig. 8 was constructed by H. L. Callendar and J. T. Nicolson with this object. The bar was a special sample of cast iron, the conductivity of which was required for some experiments on the condensation of steam. It had a diameter of 4 in., and a length of 4 ft. between the heater and the calorimeter. The emissivity was reduced to one-quarter by lagging the bar like a steampipe to a thickness of 1 in. The heating vessel could be maintained at a steady temperature by high-pressure steam. The other end was maintained at a temperature near that of the air by a steady stream of water flowing through a well-lagged vessel surrounding the bar. The heat transmitted was measured by observing the difference of temperature between the inflow and the outflow, and

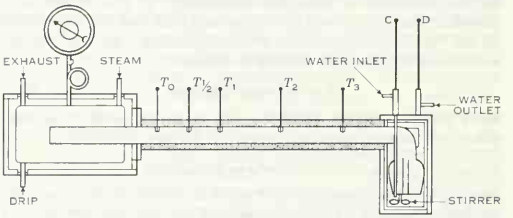

FIG. 8.—CALORIMETRIC BAR METHOD, IN WHICH HEAT FLOW IS MEASURED BY RISE OF TEMPERATURE OF COOLING WATER. GRADIENT IS MEASURED BY MERCURY THERMOMETERS

the weight of water which passed in a given time. The gradient near the entrance to the calorimeter was deduced from observations with five thermometers at suitable intervals along the bar. The results obtained by this method at a temperature of 40° C. varied from .116 to .118 c.g.s. from observations on different days, and were probably more accurate than those obtained by the cylinder method. The same apparatus was employed in another series of experiments by the periodic flow method, but this involves a knowledge of c, and is very laborious.

4. Electrical Methods.—There are two electrical methods which have been usefully applied to the measurement of the conductivity of metals, (1) the resistance method, devised by Callendar, and applied by him, and also by R. O. King and J. D. Duncan, (2) the thermoelectric method, devised by Friedrich Kohlrausch, and applied by W. Jaeger and H. Dieselhorst. Both methods depend on the observation of the steady distribution of temperature in a bar or wire heated by an electric current. The advantage is that the quantities of heat are measured directly in absolute measure, in terms of the current, and that the results are independent of a knowledge of the specific heat. Incidentally it is possible to regulate the heat supply more perfectly than in non-electric methods.

1. In the practice of the resistance method, both ends of a short bar are kept at a steady temperature by means of solid copper blocks provided with a water circulation, and the whole is surrounded by a jacket at the same temperature, which is taken as the zero of reference. The bar is heated by a steady electric current, which may be adjusted so that the external loss of heat from the surface of the bar is compensated by the increase of resistance of the bar with rise of temperature. In this case the curve representing the distribution of temperature is a parabola, and the conductivity k is deduced from the mean rise of temperature $(R - R_0)/aR_0$ by observing the increase of resistance $R - R_0$ of

the bar, and the current C. It is also necessary to measure the cross section q, the length l and the temperature-coefficient a for the range of the experiment.

In the general case the distribution of temperature is observed by means of a number of potential leads. The differential equation for the distribution of temperature in this case includes the majority of the methods already considered and may be stated as follows. The heat generated by the current C at a point x, where θ = excess temperature, is equal per unit length and time (t) to that lost by conduction $-d(qkd\theta/dx)/dx$, and by radiation $hp\theta$ (emissivity h, perimeter p), together with that employed in raising the temperature $qcd\theta/dt$, and absorbed by the Thomson effect $Cd\theta/dx$. We thus obtain the equation

$$C^2R_0(1 + a\theta)/l = -d(qkd\theta/dx)/dx + hp\theta + qcd\theta/dt + sCd\theta/dx \quad (7)$$

If $C = 0$, this is the equation of Ångström's method. If h also is zero, it becomes the equation of variable flow in the soil. If $d\theta/dt = 0$, the equation represents the corresponding cases of steady flow.

In the electrical method, observations of the variable flow are useful for finding the value of c for the specimen, but are not otherwise required. The last term, representing the Thomson effect, is eliminated in the case of a bar cooled at *both* ends, since it is opposite in the two halves, but may be determined by observing the resistance of each half separately. If the current C is chosen so that $C^2R_0a = hpl$, the external heat loss is compensated by the variation of resistance with temperature. In this case the solution of the equation reduces to the form

$$\theta = x(l - x)C^2R_0/2lqk \quad (8)$$

By a property of the parabola, the mean temperature is two-thirds of the maximum temperature; we have therefore

$$(R - R_0)/aR_0 = lC^2R_0/12qk \quad (9)$$

which gives the conductivity directly in terms of the quantities actually observed. If the dimensions of the bar are suitably chosen, the distribution of temperature is always very nearly parabolic, so that it is not necessary to determine the value of the critical current $C^2 = hpl/aR_0$ very accurately, as the correction for external loss is a small percentage in any case. The chief difficulty is that of measuring the small change of resistance accurately and of avoiding errors from accidental thermoelectric effects. In addition to the simple measurements of the conductivity made at McGill university in the 1890s, some very elaborate experiments were made by King on the temperature distribution in the case of long bars with a view to measuring the Thomson effect. Duncan of McGill, using the simple method under King's supervision, found the conductivity of very pure copper to be 1.007 for a temperature of 33° C.

2. The method of Kohlrausch, as carried out by Jaeger and Dieselhorst, consists in observing the difference of temperature between the centre and the ends of the bar by means of insulated thermocouples. Neglecting the external heat loss, and the variation of the thermal and electric conductivities k and k', we obtain, as before, for the difference of temperature between the centre and ends, the equation

$$\theta_{max} - \theta_0 = C^2Rl/8qk = ECl/8qk = E^2k'/8k \quad (10)$$

where E is the difference of electric potential between the ends. Lorenz, assuming that the ratio $k/k' = a\theta$, had previously given

$$\theta^2_{max} - \theta_0^2 = E^2/4a \quad (11)$$

which is practically identical with the preceding for small differences of temperature. The last expression in terms of k/k' is very simple, but the first is more useful in practice, as the quantities actually measured are E, C, l, q, and the difference of temperature. The current C was measured in the usual way by the difference of potential on a standard resistance.

The external heat loss was estimated by varying the temperature of the jacket surrounding the bar, and applying a suitable correction to the observed difference of temperature. But the method (1) previously described appears to be preferable in this respect, since it is better to keep the jacket at the same temperature as the end blocks. The variation of thermal conductivity with temperature is small and uncertain, whereas the variation of electrical conductivity is large and can be accurately determined, and may therefore be legitimately utilized for eliminating the external heat loss.

One of the chief objects of these experiments was to test the combined hypotheses of G. Wiedemann (1853) and L. Lorenz (1872), that the ratio of the thermal to the electrical conductivity was the same for all metals, and varied directly as the absolute temperature. This relation was strongly supported as a result of the development of the electron theory of conduction in metals by P. K. Drude (1900) and H. A. Lorentz (1905), and was approximately verified for some of the pure metals by Jaeger and Dieselhorst between 0° and 100° C. But the ratio appears to be affected in a marked degree by the presence of impurities which reduce the electric conductivity, and the majority of alloys give much higher values than the pure metals. It has since been shown by the experiments of C. H. Lees (1908), H. Kamerlingh Onnes (1914) and W. F. Meissner (1920) that the remarkable increase of electric conductivity of some pure metals at very low temperatures does not extend to the thermal conductivity. Sir J. J. Thomson in his *Corpuscular Theory of Matter* (1907) had already pointed out that there were serious difficulties in the electron theory of Drude and Lorentz, and proposed an alternative theory which did not require the presence of a large number of free electrons in the metal. With the development of quantum mechanics in the decade following 1926 a much more penetrating understanding was achieved of the nature of both thermal and electrical conductivity. New statistical laws were proposed by Paul A. M. Dirac and independently by Enrico Fermi which accounted qualitatively, at least, for the values observed.

XI. CONDUCTION IN GASES AND LIQUIDS

The theory of conduction of heat by diffusion in gases has a particular interest, since it is possible to predict the value of the conductivity on certain assumptions, if the viscosity (*q.v.*) is known. On the kinetic theory the molecules of a gas are relatively far apart and there is nothing exactly analogous to friction between two adjacent layers A and B in relative motion. There is, however, a continual interchange of molecules between A and B, which produces the same effect as viscosity in a liquid. Faster-moving particles diffusing from A to B carry their momentum with them, and tend to accelerate B; an equal number of slower particles diffusing from B to A act as a drag on A.

This action and reaction between layers in relative motion is equivalent to a frictional stress tending to equalize the velocities of adjacent layers. The magnitude of the stress per unit area parallel to the direction of flow is evidently proportional to the velocity gradient, or the rate of change of velocity per centimetre in passing from one layer to the next. It must also depend on the rate of interchange of molecules, that is to say, (1) on the number passing through each square centimetre per second in either direction, (2) on the average distance to which each can travel before collision (*i.e.*, on the "mean free path"), and (3) on the average velocity of translation of the molecules, which varies as the square root of the temperature. Similarly if A is hotter than B, or if there is a gradient of temperature between adjacent layers, the diffusion of molecules from A to B tends to equalize the temperatures, or to conduct heat through the gas at a rate proportional to the temperature gradient, and depending also on the rate of interchange of molecules in the same way as the viscosity effect.

Conductivity and viscosity in a gas should vary in a similar manner since each depends on diffusion in a similar way. The mechanism is the same, but in one case we have diffusion of momentum, in the other case diffusion of heat. Viscosity in a gas was first studied theoretically from this point of view by J. Clerk Maxwell, who predicted that the effect should be independent of the density within wide limits. This, at first sight, paradoxical result is explained by the fact that the mean free path of each molecule increases in the same proportion as the density is dimin-

ished, so that as the number of molecules crossing each square centimetre decreases, the distance to which each carries its momentum increases, and the total transfer of momentum is unaffected by variation of density. Maxwell himself verified this prediction experimentally for viscosity over a wide range of pressure. By similar reasoning the thermal conductivity of a gas should be independent of the density. Maxwell predicted a value 0.000055 c.g.s. for the conductivity of air, and a value seven times greater for hydrogen on account of the greater velocity and range of its molecules. A. Kundt and E. Warburg found that the rate of cooling of a thermometer in air between 150 mm. and 1 mm. pressure remained constant as the pressure was varied. At higher pressures the effect of conduction was masked by convection currents.

The question of the variation of conductivity with temperature is more difficult. If the effects depended merely on the velocity of translation of the molecules, both conductivity and viscosity should increase directly as the square root of the absolute temperature; but the mean free path also varies in a manner which cannot be predicted by theory and which appears to be different for different gases. Experiments by the capillary tube method have shown that the viscosity varies more nearly as $\theta^{\frac{3}{4}}$, but indicate that the rate of increase diminishes at high temperatures. The conductivity probably changes with temperature in the same way, being proportional to the product of the viscosity and the specific heat; but the experimental investigation presents difficulties on account of the necessity of eliminating the effects of radiation and convection, and the results of different observers often differ considerably from theory and from each other. The values found for the conductivity of air at 0° C. range from .000048 to .000057, and the temperature coefficient from .0015 to .0028.

Experimental determinations of the thermal conductivities of gases are still somewhat scarce and discordant because of the great practical difficulties, but are of special interest for the elucidation of the law of action between molecules. The hot-wire method of T. Andrews (1840) offers special facilities for relative measurements, such as the comparison of conductivities of different gases, or of the same gas at different temperatures, and has frequently been applied with this object in recent years. It has also been improved by introducing the usual compensation for end effects, and employing more accurate methods of electrical measurement, but it remains liable to the difficulties depending on the small dimensions of the wire and the elimination of the corrections for radiation. The determination of the thermal conductivities of gases gives a means of testing the value of the numerical coefficient f in the relation, $k = f\eta s$, between the conductivity k, the viscosity η, and the specific heat s at constant volume. According to the theoretical investigations of S. Chapman (1911) the value of the coefficient f should be 2.5 for a gas constituted of spherically symmetrical molecules, which agrees with Maxwell's theory based on the inverse fifth-power law of force, and also with experiment for monatomic molecules. Unfortunately the variation of viscosity with temperature does not satisfy the fifth-power law, which requires that the viscosity should be directly proportional to T. The conclusion is that monatomic gases may have spherically symmetrical molecules, but that the law of force is different. Theory gives no clear indication with regard to the appropriate value of f for other types of molecules. Experiment gives approximately a linear relation, $f = 2.816\gamma - 2.2$, between f and the ratio γ of the specific heats. This gives $f = 7/4$ for diatomic gases, which show fair agreement with each other. The experimental values for polyatomic gases are much less certain.

The thermal conductivity of liquids shows in one respect a remarkable contrast to that of gases, in that it has little or no relation to the viscosity. Excluding liquid metals, different liquids, such as water and glycerine, may vary widely in viscosity and yet differ little in conductivity. Most liquids show a very rapid diminution of viscosity with rise of temperature, without any corresponding change of similar magnitude in conductivity. But the experimental evidence is very discordant, as in the case of gases. The conductivity of liquids has been investigated by similar methods, generally variations of the thin-plate or guard-ring method.

The whole subject of heat conduction, both from the theoretical and experimental aspect, was reviewed critically in 1954 by L. R. Ingersoll, O. J. Zobel and A. C. Ingersoll. The subject has acquired a particularly intriguing facet through the discovery of heat conduction anomalies in the case of the so-called superfluids. Kamerlingh Onnes found in 1911 that certain metals lose all resistance to the flow of electricity when cooled to within a few degrees of the absolute zero of temperature (−273.15° C.). This appears to be caused by the shift of a certain number of electrons from the normal to the so-called superconducting state. These electrons can pass through the body of the metal without receiving or giving heat to their surroundings. Other apparently related anomalies have been found in the study of liquid helium. When cooled below −271° C., that is to within less than 2.2° of the absolute zero of temperature, some of the helium atoms can move freely through the body of the liquid without receiving or giving heat to their neighbours. *See* also LOW-TEMPERATURE PHYSICS (CRYOGENICS); SUPERCONDUCTIVITY.

XII. RADIATION

It was at one time supposed that there were three distinct kinds of radiation—thermal, luminous and actinic, combined in the radiation from a luminous source such as the sun or a flame. The first gave rise to heat, the second to light and the third to chemical action. The three kinds were partially separated by a prism, the actinic rays being generally more refracted, and the thermal rays less refracted than the luminous. This conception arose very naturally from the observation that the feebly luminous blue and violet rays produced the greatest photographic effects, which also showed the existence of dark rays beyond the violet, whereas the brilliant yellow and red were practically without action on the photographic plate. A thermometer placed in the blue or violet showed no appreciable rise of temperature, and even in the yellow the effect was hardly discernible. The effect increased rapidly as the light faded toward the extreme red, and reached a maximum beyond the extreme limits of the spectrum (Sir Frederick William Herschel), showing that the greater part of the thermal radiation was altogether nonluminous.

It is now a commonplace that chemical action, colour sensation and heat are merely different effects of one and the same kind of radiation, the particular effect produced in each case depending on the frequency and intensity of the vibration and on the nature of the substance on which it falls. When radiation is completely absorbed by a black substance, it is converted into heat, the quantity of heat produced being equivalent to the total energy of the radiation absorbed, irrespective of the colour or frequency of the different rays. The actinic or chemical effects, on the other hand, depend essentially on some relation between the period of the vibration and the properties of the substance acted on. The rays producing such effects are generally those which are most strongly absorbed. The spectrum of chlorophyll, the green colouring matter of plants, shows two very strong absorption bands in the red. The red rays of corresponding period are found to be the most active in promoting the growth of the plant. The chemically active rays are not necessarily the shortest. Even photographic plates may be made to respond to the red rays by staining them with pinachrome or some other suitable dye. The action of light rays on the retina is closely analogous to the action on a photographic plate. The retina, like the plate, is sensitive only to rays within certain restricted limits of frequency. The limits of sensitiveness of each colour sensation are not exactly defined, but vary slightly from one individual to another, especially in cases of partial colour blindness, and are modified by conditions of fatigue. We are not here concerned with these important physiological and chemical effects of radiation, but rather with the question of the conversion of energy of radiation into heat, and with the laws of emission and absorption of radiation in relation to temperature. We may here also assume the identity of visible and invisible radiations from a heated body in all their physical properties.

It has been abundantly proved that the invisible rays, like the visible, (1) are propagated in straight lines in homogeneous mediums; (2) are reflected and diffused from the surface of bodies according to the same law; (3) travel with the same velocity in free space, but with slightly different velocities in denser mediums, being subject to the same law of refraction; (4) exhibit all phenomena of diffraction and interference which are characteristic of wave motion in general; (5) are capable of polarization and double refraction; (6) exhibit similar effects of selective absorption.

These properties are more easily demonstrated in the case of visible rays because of the great sensitiveness of the eye. But with the aid of the thermopile or other sensitive radiometer, they may be shown to belong equally to all the radiations from a heated body, even such as are 30 to 50 times slower in frequency than the longest visible rays. The same physical properties have also been shown to belong to electromagnetic waves excited by an electric discharge, whatever the frequency, thus including all kinds of ethereal radiation in the same category as light.

1. Theory of Exchanges.—Pierre Prevost enunciated the theory of exchanges in 1791. Prevost's leading idea was that all bodies, whether cold or hot, are constantly radiating heat. Heat equilibrium, he says, consists in an equality of exchange. When equilibrium is interfered with, it is re-established by inequalities of exchange. If a refracting or reflecting body is introduced into a locality at uniform temperature, it has no effect in the way of changing the temperature at any point of that locality. A reflecting body, heated or cooled in the interior of such an enclosure, will acquire the surrounding temperature more slowly than would a nonreflector; it will less affect another body placed at a little distance, but will not affect the final equality of temperature. Apparent radiation of cold, as from a block of ice to a thermometer placed near it, is due to the fact that the thermometer being at a higher temperature sends more heat to the ice than it receives back from it. Although Prevost does not make the statement in so many words, it is clear that he regards the radiation from a body as depending only on its own nature and temperature, and as independent of the nature and presence of any adjacent body.

Heat equilibrium in an enclosure of constant temperature such as that postulated by Prevost has often been regarded as a consequence of Carnot's principle. Since difference of temperature is required for transforming heat into work, no work could be obtained from heat in such a system, and no spontaneous changes of temperature can take place, as any such changes might be utilized for the production of work. This line of reasoning does not appear quite satisfactory, because it is tacitly assumed, in the reasoning by which Carnot's principle was established, as a result of universal experience, that a number of bodies within the same impervious enclosure, which contains no source of heat, will ultimately acquire the same temperature, and that difference of temperature is required to produce flow of heat. Thus although we may regard the equilibrium in such an enclosure as being because of equal exchanges of heat in all directions, the equal and opposite streams of radiation annul and neutralize each other in such a way that no actual transfer of energy in any direction takes place. The state of the medium is everywhere the same in such an enclosure, but its energy of agitation per unit volume is a function of the temperature, and is such that it would not be in equilibrium with any body at a different temperature.

2. "Full" and Selective Radiation. Correspondence of Emission and Absorption.—The most obvious difficulties in the way of this theory arise from the fact that nearly all radiation is more or less selective in character, as regards the quality and frequency of the rays emitted and absorbed. It was shown by J. Leslie, M. Melloni and other experimentalists that many substances such as glass and water, which are transparent to visible rays, are extremely opaque to much of the invisible radiation of lower frequency; and that polished metals, which are perfect reflectors, are very feeble radiators as compared with dull or black bodies at the same temperature. If two bodies emit rays of different periods in different proportions, it is not at first sight easy to see how their radiations can balance each other at the same temperature.

The key to all such difficulties lies in the fundamental conception, so strongly insisted on by Balfour Stewart, of the absolute uniformity (qualitative as well as quantitative) of the full or complete radiation stream inside an impervious enclosure of uniform temperature. It follows from this conception that the proportion of the full radiation stream absorbed by any body in such an enclosure must be exactly compensated in quality as well as quantity by the proportion emitted, or that the emissive and absorptive powers of any body at a given temperature must be precisely equal.

A good reflector, such as polished metal, must also be a feeble radiator and absorber. Of the incident radiation it absorbs a small fraction and reflects the remainder, which together with the radiation emitted (being precisely equal to that absorbed) makes up the full radiation stream. A transparent material, such as glass, absorbs part of the full radiation and transmits part. But it emits rays precisely equal in quality and intensity to those which it absorbs, which together with the transmitted portion make up the full stream.

A thin platinum tube heated by an electric current appears feebly luminous as compared with a blackened tube at the same temperature. But if a small hole is made in the side of the polished tube, the light proceeding through the hole appears brighter than the blackened tube, as though the inside of the tube were much hotter than the outside, which is not the case to any appreciable extent if the tube is thin. The radiation proceeding through the hole is nearly that of a perfectly black body if the hole is small. If there were no hole the internal stream of radiation would be exactly that of a black body at the same temperature however perfect the reflecting power, or however low the emissive power of the walls, because the defect in emissive power would be exactly compensated by the internal reflection.

Balfour Stewart gave a number of striking illustrations of the qualitative identity of emission and absorption of a substance. Pieces of coloured glass placed in a fire appear to lose their colour when at the same temperature as the coals behind them, because they compensate exactly for their selective absorption by radiating chiefly those colours which they absorb. Rock salt is remarkably transparent to thermal radiation of nearly all kinds, but it is extremely opaque to radiation from a heated plate of rock salt, because it emits when heated precisely those rays which it absorbs. A plate of tourmaline cut parallel to the axis absorbs almost completely light polarized in a plane parallel to the axis, but transmits freely light polarized in a perpendicular plane. When heated its radiation is polarized in the same plane as the radiation which it absorbs. In the case of incandescent vapours, the exact correspondence of emission and absorption as regards wave length or frequency of the light emitted and absorbed forms the foundation of the science of spectrum analysis. Joseph von Fraunhofer had noticed the coincidence of a pair of bright yellow lines seen in the spectrum of a candle flame with the dark D lines in the solar spectrum, a coincidence which was afterward more exactly verified by W. A. Miller. Jean B. L. Foucault found that the flame of the electric arc showed the same lines bright in its spectrum, and proved that they appeared as dark lines in the otherwise continuous spectrum when the light from the carbon poles was transmitted through the arc. Sir George Stokes gave a dynamical explanation of the phenomenon and illustrated it by the analogous case of resonance in sound. G. R. Kirchhoff completed the explanation of the dark lines in the solar spectrum by showing in 1860 that the reversal of the spectral lines depended on the fact that the body of the sun giving the continuous spectrum was at a higher temperature than the absorbing layer of gases surrounding it.

Whatever the selective radiation from a body, the radiation of light of any particular wave length cannot be greater than a certain fraction E of the radiation R of the same wave length from a black body at the same temperature. The fraction E measures the emissive power of the body for that particular wave length, and cannot be greater than unity. The same fraction, by the principle of equality of emissive and absorptive powers, will measure the proportion absorbed of incident radiation R'.

If the black body emitting the radiation R' is at the same temperature as the absorbing layer, $R = R'$, the emission balances the absorption, and the line will appear neither bright nor dark. If the source and the absorbing layer are at different temperatures, the radiation absorbed will be ER', and that transmitted will be $R' - ER'$. To this must be added the radiation emitted by the absorbing layer, namely ER, giving $R' - E(R' - R)$. The lines will appear darker than the background R' if R' is greater than R, but bright if the reverse is the case. The D lines are dark in the sun because the photosphere is much hotter than the reversing layer. They appear bright in the candle flame because the outside mantel of the flame, in which the sodium burns and combustion is complete, is hotter than the inner reducing flame containing the incandescent particles of carbon which give rise to the continuous spectrum. This qualitative identity of emission and absorption as regards wave length can be most exactly and easily verified for luminous rays, and we are justified in assuming that the relation holds with the same exactitude for nonluminous rays, although in many cases the experimental proof is less complete and exact.

3. Relation Between Radiation and Temperature.—Assuming, in accordance with the reasoning of Balfour Stewart and Kirchhoff, that the radiation stream inside an impervious enclosure at a uniform temperature is independent of the nature of the walls of the enclosure, and is the same for all substances at the same temperature, it follows that the full stream of radiation in such an enclosure, or the radiation emitted by an ideal black body or full radiator, is a function of the temperature only. The form of this function may be determined experimentally by observing the radiation between two black bodies at different temperatures, which will be proportional to the difference of the full radiation streams corresponding to their several temperatures. The law now generally accepted was first proposed by Joseph Stefan as an empirical relation.

John Tyndall had found that the radiation from a white-hot platinum wire at 1,200° C. was 11.7 times its radiation when dull red at 525° C. Stefan (1879) noticed that the ratio 11.7 is nearly that of the fourth powers of the absolute temperatures as estimated by Tyndall. On making the somewhat different assumption that the radiation between two bodies varied as the difference of the fourth powers of their absolute temperatures, he found that it satisfied approximately the experiments of Dulong and A. T. Petit and other observers. According to this law the radiation between a black body at a temperature T and a black enclosure or a black radiometer at a temperature T_0 should be proportional to $(T^4 - T_0^4)$. The law was very simple and convenient in form, but it rested so far on very insecure foundations. The temperatures given by Tyndall were merely estimated from the colour of the light emitted, and might have been some hundred degrees in error. We now know that the radiation from polished platinum is of a highly selective character, and varies more nearly as the fifth power of the absolute temperature.

The agreement of the fourth-power law with Tyndall's experiment appears therefore to be attributed to a purely accidental error in estimating the temperatures of the wire. Stefan also found a very fair agreement with J. W. Draper's observations of the intensity of radiation from a platinum wire, in which the temperature of the wire was deduced from the expansion. Here again the apparent agreement was largely the result of errors in estimating the temperature, arising from the fact that the coefficient of expansion of platinum increases considerably with rise of temperature.

So far as the experimental results available at that time were concerned, Stefan's law could be regarded only as an empirical expression of doubtful significance. But it received a much greater importance from theoretical investigations which were even then in progress. James Clerk Maxwell (*Electricity and Magnetism*, 1873) had shown that a directed beam of electromagnetic radiation or light incident normally on an absorbing surface should produce a mechanical pressure equal to the energy of the radiation per unit volume. A. G. Bartoli (1875) took up this idea and made it the basis of a thermodynamic treatment of radiation. P. N. Lebedev in 1899, and E. F. Nichols and G. F. Hull in 1901, proved the existence of this pressure by direct experiments. L. Boltzmann (1884) employing radiation as the working substance in a Carnot cycle, showed that the energy of full radiation at any temperature per unit volume should be proportional to the fourth power of the absolute temperature.

The proof given by Boltzmann may be somewhat simplified if we observe that full radiation in an enclosure at constant temperature behaves exactly like a saturated vapour, and must therefore obey Carnot's or Clapeyron's equation (*see* THERMODYNAMICS). The radiation pressure at any temperature is a function of the temperature only, like the pressure of a saturated vapour. If the volume of the enclosure is increased by any finite amount, the temperature remaining the same, radiation is given off from the walls so as to fill the space to the same pressure as before. The heat absorbed when the volume is increased corresponds with the latent heat of vaporization. In the case of radiation, as in the case of a vapour, the latent heat consists partly of internal energy of formation and partly of external work of expansion at constant pressure.

Since in the case of full or undirected radiation the pressure is one-third of the energy per unit volume, the external work for any expansion is one-third of the internal energy added. The latent heat absorbed is, therefore, four times the external work of expansion. Since the external work is the product of the pressure P and the increase of volume V, the latent heat per unit increase of volume is four times the pressure. But by Carnot's equation the latent heat of a saturated vapour per unit increase of volume is equal to the rate of increase of saturation pressure per degree divided by Carnot's function or multiplied by the absolute temperature. Expressed in symbols we have,

$$T(dP/dT) = L/V = 4P \qquad (12)$$

where (dP/dT) represents the rate of increase of pressure. This equation shows that the percentage rate of increase of pressure is four times the percentage rate of increase of temperature, or that if the temperature is increased by 1%, the pressure is increased by 4%. This is equivalent to the statement that the pressure varies as the fourth power of the temperature, a result which is mathematically deduced by integrating the equation.

4. Experimental Verification of the Fourth-Power Law.—The verification of this law requires (1) a black body or bodies capable of emitting full radiation at a series of different temperatures over an extended range, (2) a thermometer or thermometers capable of measuring these temperatures on the absolute scale, (3) a bolometer or thermopile (*see* below) capable of giving accurate relative values of the intensity of the radiation emitted in each case.

These conditions were approximately satisfied by the experiments of Schneebeli (1884), who employed an air thermometer heated to various temperatures in a furnace, and observed the radiation from the bulb through a small aperture in the walls of the furnace. With this arrangement the radiation observed would be nearly that of a black body, but the verification was rather rough in some respects. Measurements by J. T. Bottomley, A. Schleiermacher, L. C. H. F. Paschen and others, of the radiation from electrically heated platinum, failed to give results in agreement with the fourth-power law on account of variations in the quality of the radiation, but greatly extended and improved methods of measuring radiation in other respects.

The most complete series of experiments, covering the range of the gas thermometer at the time available, were those of O. R. Lummer and E. Pringsheim (1897). They used a black body heated by steam at 100° C. for standardizing their bolometer, and, as their radiator, a black body consisting of a copper sphere heated in a salt bath for the range 200° to 600° C., and an iron cylinder heated in a gas muffle for the range 600° to 1,250° C. The temperatures were taken with a high-range mercury thermometer, and with thermocouples, corrected to the gas-scale by direct comparison with a gas thermometer up to 1,150° C. One of the chief experimental difficulties of this investigation is the wide range of variation of the intensity of the radiation to be measured, which is nearly 450 times as great at 1,250° C. as at 100° C. They employed a very sensitive form of bolometer, and a galva-

nometer capable of giving a deflection of 336 mm. under standard conditions, with a beam of radiation 16 mm. square at a distance of 633 mm. from the black body at 100° C. For the higher intensities it was necessary to reduce the sensitivity in a known ratio by varying the distance of the bolometer from the source, and the current in the bolometer circuit. The results for the relative intensities agreed on the average to about 1% with the fourth-power law over the whole range of the observations. The law has since been verified up to 1,500° C. by extending the range of the gas thermometer and thermocouples, and down to −250° C. with bolometers.

5. Sensitive Radiometers.—The term radiometer may be applied to any instrument adapted for measuring radiation, but we are here concerned chiefly with those types which are equally sensitive to radiant energy of all the wave lengths present in the radiation from a hot body. We may therefore omit the selenium cell which is very sensitive to luminous radiation, and the photoelectric cell for actinic rays, since these are comparatively insensitive to the infrared rays, and do not satisfy the condition of measuring total energy irrespective of wave length. The instruments chiefly employed at the present time for measurements of heat radiation, are the thermopile and the bolometer, the action of which depends on the same principles as those involved in the construction and operation of the corresponding types of electrical thermometers, namely the thermocouple and the electrical resistance thermometer, the theory of which is more fully discussed in the article THERMOMETRY.

The thermopile and bolometer are in fact essentially electrical thermometers, with sensitive receiving surfaces for the absorption of radiation, and especially designed for measuring the small differences of temperature thereby produced. The sensitivity and accuracy of these instruments depend to a great extent on the galvanometer and electrical measuring apparatus with which they are employed.

One of the oldest and most sensitive radiometers is the Melloni thermopile, the invention of which led to so many advances in the theory and measurement of radiation. Sensitivity is secured by using antimony and bismuth alloys (A and B), a single couple of which may give as much as 120 μv for a difference of temperature of 1° C. between the hot and cold junctions. With 100 couples connected in a continuous series A–B–A–B–A and so on, packed as usual in the form of a cube with alternate junctions on opposite faces, an electromotive force of 12 mv would be obtainable per 1° C. difference of temperature between the receiving surfaces of the pile. The chief defect of this type of instrument in practice is that it has a large thermal capacity because of its massive construction, and takes a long time to reach its maximum temperature. For many purposes quickness of action is quite as important as sensitivity in millivolts per degree, and the accuracy obtainable depends to a great extent on constancy of zero. In such cases the Melloni pile will be a most unsuitable instrument to employ, though it is still often used for demonstration purposes.

The conditions affecting quickness and constancy were first clearly elucidated by C. V. Boys (1888) in the construction of his radiomicrometer, in which the thermopile and galvanometer were combined in a single instrument. This was effected by attaching a very light A–B couple to a loop of copper wire suspended between the poles of a powerful magnet by means of a fine quartz fibre, which made it possible to combine the advantage of maximum deflection for weak sources of radiation with quickness of action and constancy of zero.

A similar arrangement was adopted some years later by W. Duddell in his thermogalvanometer, for measuring small alternating currents. The current to be measured is passed through a small heater fixed close below the suspended thermocouple, the deflections of which are approximately proportional to the square of the current. The radiomicrometer is essentially the same instrument except that the suspended thermocouple is heated by radiation incident on a blackened disk of copper or silver foil, and that its constant is determined by exposure to a known source of radiation, such as a standard candle at a considerable distance. The instrument must be set up like a sensitive galvanometer and carefully leveled on a good foundation in a permanent position, and the radiation to be measured must be brought to the receiver in a horizontal direction. In this respect the combination of the thermopile and sensitive galvanometer in a single instrument is less convenient in practice than the use of a separate thermopile in conjunction with a fixed galvanometer, since in the latter case the thermopile can be adjusted in any desired position independently of the galvanometer, and the sensitivity may easily be altered in a known ratio according to requirements by varying the resistance in the circuit without changing the position of either source or receiver.

The bolometer invented by S. P. Langley in 1878 depends for its action on change of electrical resistance, and consists essentially of a pair of grids of thin blackened foil of nearly equal resistance balanced one against the other in a Wheatstone bridge. Both are equally affected by changes in the temperature of the instrument, but if one grid is exposed to radiation while the other is screened, the resulting difference of temperature between them produces a current through the galvanometer approximately proportional to the intensity of the radiation. The whole exposed area of the grid constitutes the receiving surface, and extreme quickness of action can be secured by using very thin foil. The bolometer permits a wide range of variation of sensitivity since (in addition to other methods available with the thermopile) the current through the grids may be increased with a proportional increase in the deflection of the galvanometer. For this reason the sensitivity of a bolometer may considerably exceed that of a thermopile under otherwise similar conditions. There is, however, a practical limit to the increase of sensitivity thus obtainable, because of the heating effect of the current which produces a rise of temperature in the grids proportional to the square of the current. When this becomes excessive, the zero is liable to wander and no further improvement in accuracy of measurement can be gained. One can obtain the greatest change of specific electrical resistance for a small increment of temperature and, as a consequence, the greatest bolometric sensitivity by the use of a strip of metal or alloy maintained at a temperature so low that the material is just within the superconducting state; under these conditions the thermal fluctuations (Brownian movement) are also reduced to a minimum.

A linear thermopile, in which all the sensitive junctions are arranged in a vertical line, is entirely free from this source of trouble and is generally superior to the bolometer in point of stability of zero. Fig. 9 illustrates the construction of the Moll linear thermopile which is probably the most perfect instrument of this type in respect to constancy of zero as well as quickness of action. There are 20 thermocouples arranged with their hot junctions in a vertical line behind the centre of the slit. The metals employed are the alloys constantan and manganin, both of which possess the property that their resistance does not vary appreciably with temperature. These alloys have the required mechanical properties and can be rolled into very thin strips, which afford excellent receiving surfaces and respond with extreme quickness. One half of each strip consists of constantan and the other half of manganin. The strips are connected in a continuous series, C–M–C–M–C and so on, the cold junctions on either side being soldered to copper studs fixed in insulating blocks at right angles to the plane of the strips. The function of these studs is to keep the cold junctions at a uniform temperature as nearly as possible the same as that of the enclosing case. Great constancy of zero and steadiness of deflec-

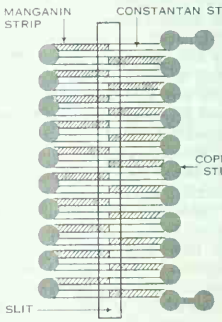

FIG. 9.—MOLL LINEAR THERMOPILE

Thermocouples of manganin and constantan strips with alternate junctions in a vertical line

tion is thus obtained. Thus although the thermoelectric power of a single constantan-manganin couple is only about 40 μv per degree, or less than a third of that obtainable with the antimony-bismuth alloys (which are brittle and difficult to work), the superior quickness and constancy and facility of construction of the constantan-manganin pile make the latter a more accurate and convenient instrument in practice.

In measuring the intensity of radiation at a distance from the source, where there is no restriction on the area of the beam received, the bolometer has the advantage that it can easily be made of any desired area, and that increase of area permits an increase of sensitivity. This condition cannot be satisfied easily in practice with a thermopile since the multiplication of couples involves a corresponding increase of resistance; but in dealing with images, such as spectral lines, of limited area, the thermocouple has the advantage that its sensitive receiving surface can be made to coincide with that of the image to be measured, as in the coronal pile for observing the sun's corona. Thus in the extreme case of a point image, such as that of a star, the single couple has a great advantage over the bolometer, which could not easily be made of the required size.

By using very small single couples enclosed in a vacuum to reduce external loss of heat, W. W. Coblentz (Lick observatory, 1915) succeeded in obtaining remarkably accurate measurements of the relative thermal intensities of star images in a large reflecting telescope. The vacuum thermopile devised by Moll, with a differential pair of junctions enclosed in a vacuum, would probably be well suited for this kind of work, as the effect of sky radiation would be compensated very accurately.

The Crookes' radiometer, with a delicately suspended vane in a vacuum of about 0.02 mm., as improved by Nichols, can be made nearly equal in sensitivity to the radiomicrometer of Boys, but has the disadvantage of requiring the radiation to be introduced through a window, which may in many cases give rise to uncertainty because of selective absorption, in addition to the difficulty of maintaining a constant vacuum.

During World War II there arose a military need for fast and sensitive devices for detecting infrared radiation, a need which stimulated the development of several new types of radiometric methods marking an advance in this field. It was found possible to produce thin ribbons of semiconductors which had a remarkably high change of electrical resistance for a small increment in temperature caused by impinging heat radiation; the term thermister has been used to designate these units. Marcel Golay and his associates developed a thermopneumatic cell in which the heat radiation caused a small amount of gas to expand, thereby moving a thin diaphragm with a mirror surface and deflecting a visible light beam across a photoelectric cell; this came to be generally spoken of as the "Golay detector" and has had wide use, especially in infrared spectrographs where extremely sensitive and fast detection is required.

D. H. Andrews and his associates built an infrared detector, using as the receiver a ribbon of niobium nitride, maintained in the intermediate zone between the normal and the superconducting state. The very low temperature (−258° C.), necessary to get this special kind of electrical conduction, is produced by a mixture of liquid and crystalline hydrogen kept under a partial vacuum in a small vacuum-jacketed copper vessel called a cryostat. The ribbon of niobium nitride (5 mm. long, 0.3 mm. wide and 0.006 mm. thick) is cemented to the top of a small copper post with a plastic adhesive and located in the vacuum chamber behind a rock-salt window which permits the heat radiation from the object under observation to pass from the atmosphere into the vacuum chamber and onto the receiver. Since very low heat capacity and very low thermal noise are associated with the temperature region near absolute zero in which the device is operated, both speed and sensitivity of detection are extremely high. The rate of change of electrical resistance with temperature is about 10 ohms per degree centigrade; and a change of temperature of as little as one ten-millionth of a degree in the receiver can be detected. This means that an amount of heat as little as one ten-million-millionth of a calorie can be observed in a single pulse of heat radiation falling on the bolometer. The instrument responds in less than one thousandth of a second. Because of this it is possible to use the device as a receiver in infrared television, a special kind of television by which the images of distant moving objects can be detected in complete darkness by means of the invisible heat radiation which they emit; the objects are scanned by an oscillating mirror and the images are presented to the observer on a fluorescent screen, similar to that used in standard television. This type of heat receiver is commonly referred to as a superconducting bolometer.

These devices developed during World War II are described in the *Journal of the Optical Society of America* (1946) together with a critical evaluation of their respective speed and sensitivity by Bell, Buhl, Nielsen and Nielsen. The superconducting bolometer appears to have the highest figure-of-merit of any detector of heat radiation developed by the mid-1960s; *i.e.*, the best combination of sensitivity and speed. It was subsequently used by R. D. Fowler, M. C. Williams and D. H. Andrews to detect the heat pulse produced by the impact of a single helium atom (alpha particle) ejected by a radioactive polonium atom (1949).

6. Absolute Measurement of Radiation.—The absolute measurement of the constant of radiation σ in the fourth-power law

$$R = \sigma(T^4 - T_0^4) \qquad (13)$$

is required for estimating the quantity of radiation R emitted per second per unit area by a black surface at the absolute temperature T. The law having been verified qualitatively, as previously described, by observing relative values at different temperatures, it suffices for the determination of the constant σ to select one particular temperature of the source, and to observe the intensity of the radiation received at a known distance with a receiver capable of giving the result in absolute measure, such as watts per second.

It is first necessary that the temperature of the emitter should be uniform and accurately known. For this reason a black body enclosure at 100° C. or $T = 373.1$ is commonly selected. The objection to this is that the intensity of the radiation is comparatively feeble and the quantity of heat to be measured inconveniently small as compared with accidental errors. A high temperature such as $T = 1{,}273°$ gets over this difficulty, but such temperatures are not known with sufficient accuracy, and are not easily regulated with the necessary uniformity and constancy. It appears best to select an intermediate temperature, such as the boiling point of sulfur (S.B.P.) at 444.6° C. or $T = 717.6°$, which has been determined with great care, and is easily maintained constant.

Fig. 10 shows the essential points of a black body emitter employed for this purpose. The black body consists of a double-walled enclosure constructed of sheet iron with brazed or welded joints, which must be absolutely tight to prevent any escape of the vapour. The sulfur is boiled in an iron boiler located in a fume cupboard at a lower level, and the vapour is brought up to the ap-

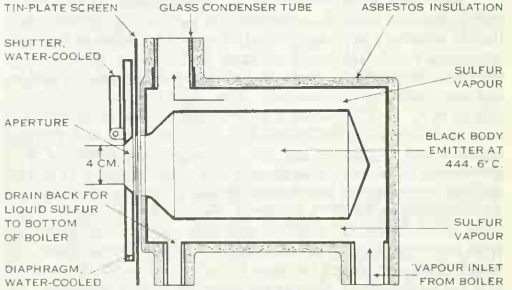

FIG. 10.—BLACK BODY EMITTER HEATED BY SULFUR VAPOUR, FOR MEASURING INTENSITY OF FULL RADIATION FROM A SOURCE AT A TEMPERATURE OF 444.6° C., THE BOILING POINT OF SULFUR

paratus through a long iron tube to avoid any possibility of superheating. When the sulfur boils, the heavy brown vapour soon makes its appearance in the glass condenser tube at the top of the apparatus. This tube is open at the top, and is exposed without lagging for a height of two or three feet. The boiler flame is regulated to keep the level of the vapour constant about halfway up the tube. The condensed liquid flows back through a small tube to the bottom of the boiler, and the apparatus will work for days with hardly any attention. The actual temperature inside the enclosure is observed occasionally with a long platinum thermometer, and is always a few tenths of a degree lower than that of the vapour because of loss by radiation. The inside of the enclosure is usually blackened in the first instance with platinum black, but soon becomes coated in any case with a protecting film of black oxide of iron, which is generally black enough for the purpose. The emitted beam is defined by an accurately turned aperture in a blackened diaphragm, cooled by a copious circulation of water at or near the atmospheric temperature.

The method of taking an observation consists in exposing the receiver, at a distance d from the diaphragm along the axis of the aperture, to the full normal beam of radiation, and taking a reading of the heat received. The aperture is then closed by the water-cooled shutter shown in the figure, and a zero reading is taken. The effect of closing the shutter is to substitute for the beam of full radiation at the temperature T of the enclosure, a beam from an exactly equal area of the shutter at the temperature T_0, which is the same as that of the diaphragm. The observed difference between the two readings gives the value of $\sigma(T^4 - T_0^4)$ as required in the equation, and eliminates any accidental stray radiation, which may affect the zero of the receiver, but is not altered by closing the shutter. If $T = 717.6°$ and $T_0 = 290°$, the correction for T_0^4 is less than 1.6%, so that a defect of 5% in the effective blackness of the diaphragm or shutter would give an error of less than 1 in 1,000 in the result for the constant σ, and it is not necessary to know the value of T_0 with great accuracy. The case is quite different, however, in using a black body at 100° C. or 373.1° K. in the same manner. The correction for T_0 would then be nearly 37%, or 23 times larger, and a defect of 5% in the blackness of the shutter might produce an error of nearly 2% in the result.

This fact, in addition to the other difficulties above mentioned, has often led to appreciable errors in the use of a black body at 100° C. for purposes of reference, and is one of the chief reasons why it is desirable to use a black body at a reasonably high temperature for the determination of the constant σ. Accidental errors of this kind, resulting from invisible reflections and stray radiation, are most perfectly avoided by completely enclosing the receiver in a water-cooled aluminum casting (aluminum for lightness and high conductivity) at the same temperature as the diaphragm and shutter. The casting has a removable lid permitting easy access for preliminary measurements and adjustments of distance, etc., but this method is so elaborate that it has seldom been attempted. It is also essential to exclude products of combustion such as CO, CO_2 and SO_2 which are highly absorbent for infrared radiation.

7. Absolute Radiometers.—The measurement of the radiation in absolute units is a more difficult part of the problem than that of securing a good approximation to full radiation at a known temperature. Instruments designed for absolute measurement were first developed for measuring the intensity of solar radiation, and were called pyrheliometers. The usual method, as first employed in C. S. M. Pouillet's pyrheliometer, was to receive the solar radiation on a blackened disk of known area and thermal capacity and to observe the rise of temperature produced in a given time. The original apparatus was rather sluggish in action, and the correction for heat loss somewhat uncertain. The method was improved by Sir G. G. Stokes, J. Violle and A. Crova, by using disks of small thermal capacity and high conductivity, protected from stray radiation by an enclosure at constant temperature. It is still largely employed for solar radiation, but is much less suitable for weak sources, such as are generally used in laboratory experiments, for which some electrical method of compensation is more convenient and accurate.

Ångström Pyrheliometer.—One of the oldest and best of these compensation methods was first devised by K. Ångström (1893) for measuring solar radiation. His pyrheliometer is illustrated in fig. 11 and 12, and depends on balancing the radiation by electric heating.

The front view, fig. 11, shows the pair of blackened strips of very thin manganin, 2 cm. long and 2 mm. wide, one of which is exposed to the radiation to be measured while the other is heated to the same temperature by an electric current. In this case the heat received from the radiation by one strip would evidently be equal to that generated by the current in the other, provided that the two were alike in all respects. Thus if R^1 is the radiant heat absorbed per square centimetre, b the breadth of the strip, C the current in amperes and r the resistance in ohms per centimetre, the value of R^1 in watts per square centimetre is given by the simple relation, $R^1 = C^2 r/b$. The ebonite block carrying the strips and their connecting terminals is fitted in a brass tube the front of which is closed by a cap with two slits corresponding in position with the strips. A swiveling shutter behind the cap permits the screening of either strip. The current is turned on the screened strip by the switch at the back and is adjusted by the rheostat until the galvanometer connected to the thermocouple indicates equality of temperature by absence of deflection. The thermocouple consists of a loop of fine constantan wire, the ends of which are connected to strips of copper foil attached to the backs of manganin strips as indicated in the diagram of connections (fig. 12). Each copper strip is attached as closely as possible to its manganin strip, but is insulated from it by thin silk paper and shellac. The copper strips provide a reliable attachment for the two junctions of the couple and help to equalize the temperature of the strip.

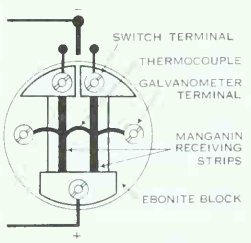

FIG. 11.—ÅNGSTRÖM PYRHELIOMETER, SHOWING FRONT VIEW OF STRIPS
Radiation received by one strip is measured by heating the other with an electric current to same temperature, as indicated by a thermocouple

The object of balancing one strip against the other is to make the reading as sensitive as possible and to eliminate any disturbances depending on changes of temperature of the case, which would affect both strips equally. To eliminate small differences between the strips, the reading is repeated with the second strip screened and heated by the current while the first is exposed to radiation. The mean of the results is free from errors resulting from want of symmetry, provided that such errors are small. In this balance method of observation the result is practically independent of the accuracy of the galvanometer, but an error of 1% in the current C as measured by the ammeter would give an error of 2% in the result, since it depends on C^2. The result also depends on the breadth of the strip b and on its resistance r per centimetre, both of which are difficult to measure accurately, more especially when the strip is blackened with smoke, which makes the edge somewhat ill-defined. In any case the value of R, representing the heat actually absorbed, will depend on the coefficient of absorption of the smoke film, which is generally taken as 98% but may vary somewhat for different wave lengths and different smoke films.

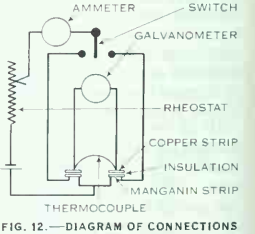

FIG. 12.—DIAGRAM OF CONNECTIONS OF THE ÅNGSTRÖM PYRHELIOMETER
Shown are ammeter circuit and insulated copper strips for attachment of thermojunctions

Kurlbaum's bolometric method can be applied to any sensitive bolometer of suitable construction, and avoids some of the difficulties of measurement inherent in Ångström's method, but introduces others which make it less convenient for solar radiation.

The method consists in observing the deflection D of the galvanometer when the bolometer is exposed to the radiation to be measured and is traversed by the small current c usually employed. The grid is then screened from radiation, and the current is increased to a larger value C such that the galvanometer gives the same deflection D because of the additional heat generated by the current in the grid. The intensity of the radiation R^1 in watts per square centimetre is given in terms of the resistance r per square centimetre of the grid by the formula, $R^1 = r\,(C^2 - c^2)C/c$. The difficulty of measuring the width of the strips may be avoided by using a pair of similar grids, adjusted in such a way that the strips of the second are behind the spaces between the strips of the first. The whole area of the grid may thus be utilized, and r is the whole resistance in ohms divided by the area in square centimetres. The factor C/c is required in the formula to allow for the fact that the deflection D of the galvanometer for a given increase of resistance of the grid is directly proportional to the current. The accuracy of measurement of the currents C and c is rather more important than in Ångström's method, but the bolometric method avoids the measurement of b and makes that of r very easy. On the other hand it is necessary to balance the bolometer against manganin resistances which are not appreciably affected by the current C. This makes it impossible to compensate for changes in the temperature of the surroundings in the usual way (by balancing the receiving grid against a precisely similar grid) since both would be equally heated by the current C. F. Kurlbaum employed a black body at 100° C. as source, and the actual rise of temperature of the grid due to the incident radiation with the small current c was only about a tenth of 1° C. The rise of temperature caused by increasing the current from c to C would be less than this in the ratio c/C. The successive observations of radiation and current heating would be unequally affected by any change in the surrounding conditions, and the difficulties of the method make it unsuitable for employment except in the laboratory with weak sources under very steady conditions.

Employing this method Kurlbaum (1898) found the value $\sigma = 5.32 \times 10^{-5}$ ergs per square centimetre per second, or 5.32×10^{-12} w. per square centimetre, but this rested on a somewhat doubtful estimate of the absorption coefficient of the bolometer employed, and was raised at a later date (1912) from 5.32 to 5.45. L. C. Paschen and W. Gerlach (1912) employed a modification of Ångström's method, but with a single strip (in place of a pair of strips) of measured area and resistance, which was alternately exposed to the radiation to be measured and heated by a measured electric current. The rise of temperature of the strip was indicated, and adjusted approximately to the same value in either case, by observing the deflection of a galvanometer connected to a linear pile fixed in position close behind the strip but not in contact with it.

The method is inferior in some respects to Ångström's, especially in the absence of a balancing strip, and in its dependence on the accurate observation of successive deflections. On the other hand the single strip employed by Paschen and Gerlach is easier to make than the compound strip employed by Ångström, and the measurement of its breadth b and resistance r per centimetre should be more accurate. They used a linear thermopile equal in length to the strip, and deduced the value of r per centimetre from measurements of the whole length and resistance, whereas Ångström measured r by observing the potential difference between a pair of needlepoint potential terminals fixed at a distance of 1 cm. apart, and brought into contact with the central portion of the strip while a measured current was passing through it. This was a delicate operation, but was necessitated by the fact that he used a single couple at the centre of the strip, and that there might be some uncertainty about the resistance of the contacts at the end of the strip, since the compound strip could not be soldered satisfactorily to the terminal plates.

Gerlach's later measurements (1916), in which corrections were applied for the imperfect blackness of platinum black and for atmospheric absorption, gave a final value $\sigma = 5.80 \times 10^{-12}$ w. per square centimetre which, though appreciably lower than his original uncorrected value, 5.85, was still nearly 7% higher than Kurlbaum's final value 5.45 by the bolometric method. It was suggested that these discrepancies might be because of inequalities of temperature resulting from loss of heat by conduction from the ends of the strip. Coblentz and Emerson (1916) endeavoured to avoid this difficulty by attaching potential terminals to the strip at a short distance from the ends. These terminals tend to cool the strip locally, but they estimate the cooling effect as only about 0.3%. Comparing a number of different receivers of this type they found variations amounting in some cases to 2%, with a probable order of 1% for the accuracy of the mean. They gave a final value 5.73 for the constant after applying corrections for imperfect blackness and atmospheric absorption.

The radio balance, employed by H. L. Callendar (1910), was the first serious attempt to eliminate uncertain coefficients of absorption (which depend on the wave length of the radiation as well as on the blackness and conductivity of the film) by employing a black body receiver, designed to give complete absorption with an error of less than 0.1%. The construction of this receiver, which can be used in any position, is illustrated in fig. 13, on an enlarged scale. The radiation to be measured is admitted through an optically worked aperture of 2 mm. diameter (which is comparatively easy to measure with the requisite degree of accuracy) and falls on the bottom of a small copper cup, where it is directly compensated by the absorption of heat arising from the Peltier effect in a thermojunction formed between the cup and a constantan wire through which a suitable current is passed. Any change of temperature of the cup is indicated by a sensitive galvanometer, connected to a thermopile in which the cup is mounted as shown in fig. 14. The junctions of the pile are insulated from the cup by thin silk paper and paraffin wax, which is nonhygroscopic, and are bound firmly round the cup with a lapping of fine silk. The pile wires are iron and constantan, each 0.2 mm. in diameter, and are sufficiently stiff to hold the cup securely in place. The cold junctions of the pile are similarly fixed to a copper cylinder screwed to the base of the copper box 5 mm. thick, enclosing the sensitive parts of the apparatus at a uniform temperature, which is indicated by a delicate mercury thermometer with its bulb inserted between the two piles. Since it is always desirable to take observations by a balance method (most especially in measuring strong sources of radiation, such as 1 cal. per square centimetre per minute, or 0.07 w. per square centimetre, which would give unbalanced deflections of the galvanometer of the order of 7,000 mm.) the cup exposed to

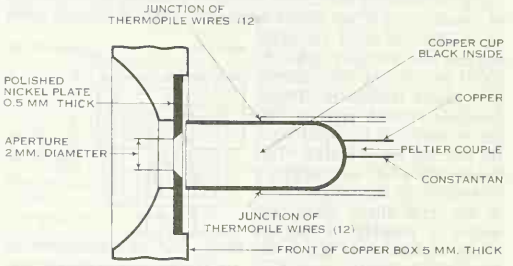

FIG. 13.—BLACK BODY RECEIVER OF RADIO BALANCE

The radiation to be measured is received in a blackened copper cup giving practically complete absorption, and is balanced by heat absorbed in a Peltier thermojunction

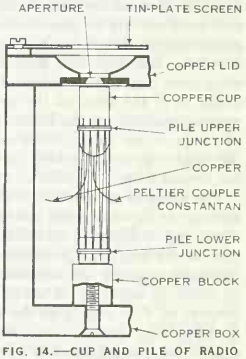

FIG. 14.—CUP AND PILE OF RADIO BALANCE, SHOWING MOUNTING OF CUP IN SENSITIVE THERMOPILE WITH 12 JUNCTIONS INSIDE COPPER BOX

radiation is balanced against a similarly mounted cup, as indicated in the diagram of connections in fig. 15, the piles in which the cups are mounted being connected in opposition in the galvanometer circuit. This method gives perfect elimination of external disturbances because of the small size and high conductivity of the copper box in which the two piles are enclosed.

The advantage of using the Peltier effect for the absolute measurement of radiation, in place of the more familiar Joule effect employed in other instruments such as the Ångström pyrheliometer, is that heat reception can be directly compensated by heat absorption, and that the heat absorbed is proportional to the current C (instead of to C^2) and changes sign when the current is reversed. The value of the Peltier coefficient P for a single copper-constantan junction as here employed is approximately 12 mv, which when multiplied by the current C in amperes gives the heat absorption PC in milliwatts. Thus with an aperture of 2 mm. in diameter the current required to compensate radiation of intensity 0.07 w. per square centimetre, which is near the mean for sunshine, is about 200 milliamperes with a single couple. In actual practice the same current C is passed through the Peltier junctions of both cups so that the exposed cup is cooled while the screened cup is heated. This doubles the effect and requires a current of 100 milliamperes only, in the case above given, and makes it possible to measure strong sources up to 0.4 w. per square centimetre, without changing the 2 mm. aperture.

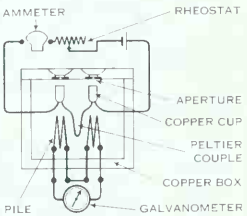

FIG. 15.—DIAGRAM OF CONNECTIONS FOR RADIO BALANCE

Both cups, with circuit of Peltier junction separate from that of piles and galvanometer, are shown

In taking readings by this method, one cup is exposed to radiation while the other is screened, and the current is adjusted to reduce the deflection of the galvanometer to zero. After reading the current, the radiation is switched over to the other cup (by moving a shutter close in front of the aperture and behind the tin-plate screen in fig. 14) and the current is simultaneously reversed without altering its value. This procedure has the effect of exactly eliminating any small heating effect in the wires conveying the current to the cups, and gives the simple formula $R' = 2PC/a$, for the intensity R' of the radiation received in terms of the aperture a in square centimetres. If the radiation is variable, as is usually the case with sunshine even on the clearest day, it is preferable to keep the current constant and to observe the small residual deflections of the galvanometer, which are readily translated into milliamperes by observing the deflection produced by reversing a small current when both cups are screened. If the piles are not accurately balanced, or if the areas of the apertures are not exactly equal, the appropriate value of the balancing current will be different for the two cups. Any small differences of this kind may be treated in the same way by observing galvanometer deflections, but should not exceed a small fraction of 1%.

The value of the coefficient P is most easily determined by observing the thermoelectric power p of a junction made of the same wires, and multiplying by the absolute temperature T. Both factors in the product Tp increase with temperature, so that it is necessary to know the temperature to 0.2° C. in order to secure an order of accuracy of 0.1% in R', since the temperature coefficient of P is usually in the neighbourhood of 0.5% per 1° C. A more direct method is to balance the Peltier effect in each cup against the heating effect in a resistance coil fitting the cup. This method affords the most simple and accurate verification of the thermodynamic theory, and measures the effect under working conditions for the actual couples employed. To find the value of σ by observing the radiation emitted from a black body such as that illustrated in fig. 10, with a water-cooled aperture of radius b, it is necessary to adjust the aperture a of the receiver to be coaxial with that of the emitter and to measure the distance d between their planes. The normal intensity R' as measured by the receiver is given in terms of the black body intensity R in formula (13) by the simple relation $R' = Rb^2/(d^2 + b^2)$, which may be found in most textbooks of geometrical optics.

Observations taken with a radio balance in conjunction with the black body illustrated in fig. 10, by N. L. Jones, gave a mean result $\sigma = 5.690 \times 10^{-12}$ w. per square centimetre. The observations were taken at night under favourable conditions, but no correction was applied for atmospheric absorption, as the distance (20 to 33 cm.) was not varied sufficiently. Later observations made by Callendar using a black body at 100° C. with the same instrument, in which the distance d was varied from 6 to 56 cm. under similar conditions, gave a result 5.752 when corrected for atmospheric absorption. The Peltier couple in this instrument was tested by the thermoelectric method using samples of the same wires, iron and constantan respectively. Another balance, with a copper-constantan couple, tested by both methods with consistent results, and corrected for atmospheric absorption in the same way, gave a slightly higher result, 5.766. The differences between observations taken on different days averaged about 0.2% and appeared to depend mainly on variations of atmospheric absorption, the correction for which doubled the time and labour of taking observations. The percentage absorbed varies to some extent with the quality of the radiation as determined by the temperature of the emitter as well as the state of the atmosphere, and is not simply proportional to the distance traversed as commonly assumed. The observations with the black body at 444.6° C., when corrected by reference to hygrometric records, using the coefficient found at 100° C., were raised from a mean value 5.690 to 5.804, which suggests that the absorption correction should be smaller for radiation at 444.6° C. than at 100° C. The mere presence of an observer radiating heat and exhaling variable quantities of CO_2 is a source of uncertainty in absolute measurements. Apart from atmospheric absorption, the instrument appeared to be capable of an order of accuracy of at least 0.1%. It was accordingly decided to enclose the receiver in a water-cooled metal casting from which absorbing gases could be excluded. Unfortunately at this stage the work was interrupted by World War I; no favourable opportunity subsequently occurred for making the final corrections for absorption. It appears, however, that the result would probably be intermediate between those of Gerlach and Coblentz by the Ångström method. The range was further extended in 1942 to the region just beyond 100μ with the aid of a superconducting bolometer and a source of radiation which was maintained at temperatures between 24° and 54° K. Some experienced observers have found values as high as 6.5, but there are many most insidious sources of error in these difficult experiments.

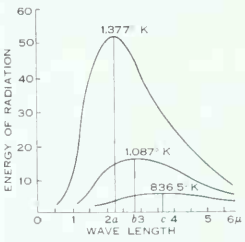

FIG. 16.—DISTRIBUTION OF ENERGY IN THE SPECTRUM OF A BLACK BODY

8. Wien's Displacement Law.—Assuming that the fourth-power law gives the quantity of full radiation at any temperature, it remains to determine how the quality of the radiation varies with the temperature, since as we have seen both quantity and quality are determinate. This question may be regarded as consisting of two parts. (1) How is the wave length or frequency of full or "black" radiation changed when its temperature is altered? (2) What is the form of the curve expressing the distribution of energy among the various wave lengths in the spectrum of full radiation, or what is the distribution of heat in the spectrum? The researches of Tyndall, Draper, Langley and other investigators had shown that while the energy of radiation of each frequency increased with rise of temperature, the maximum of intensity was shifted or displaced along the spectrum in the direction of shorter wave lengths or higher frequencies. W. Wien (1898), applying Doppler's principle to the adiabatic compression of radiation in a perfectly reflecting enclosure, deduced that the wave length of each constituent of the radiation should be short-

ened in proportion to the rise of temperature produced by the compression, in such a manner that the product λT of the wave length and the absolute temperature should remain constant. According to this relation, which is known as Wien's displacement law, the frequency corresponding to the maximum ordinate of the energy curve of the normal spectrum of full radiation should vary directly (or the wave length inversely) as the absolute temperature, a result previously obtained by H. F. Weber (1888). Paschen, Lummer and Pringsheim verified this relation by observing with a bolometer the intensity at different points in the spectrum produced by a fluorite prism. The intensities were corrected and reduced to a wave length scale with the aid of Paschen's results on the dispersion formula of fluorite (1894). The curves in fig. 16 illustrate curves obtained by Lummer and Pringsheim (1899) at three different temperatures, namely, 1,377°, 1,087° and 836.5° K., plotted on a wave length base with a scale of microns or millionths of a metre. The wave lengths *a*, *b*, *c*, corresponding to the maximum ordinates of each curve, vary inversely as the absolute temperatures given. The constant value of the product λT at the maximum point was found to be 2,920. Thus for a temperature of 1,000° K. the maximum is at wave length 2.92μ; at 2,000° the maximum is at 1.46μ.

9. Distribution of Energy in the Spectrum.—Assuming Wien's displacement law, it follows that the form of the curve representing the distribution of energy in the spectrum of full radiation should be the same for different temperatures with the maximum displaced in proportion to the absolute temperature, and with the total area increased in proportion to the fourth power of the absolute temperature.

Observations taken with a bolometer along the length of a normal or wave length spectrum would give the form of the curve plotted on a wave length base. The height of the ordinate at each point would represent the energy included between given limits of wave length, depending on the width of the bolometer strip and the slit. Supposing that the bolometer strip had a width corresponding to $.01\mu$ and were placed at 1.0μ in the spectrum of radiation at 2,000° K., it would receive the energy corresponding to wave lengths between 1.00 and 1.01μ. At a temperature of 1,000° K. the corresponding part of the energy, by Wien's displacement law, would lie between the limits 2.00 and 2.02μ, and the total energy between these limits would be 16 times smaller. But the bolometer strip placed at 2.0μ would now receive only half of the energy, or the energy in a band $.01\mu$ wide, and the deflection would be 32 times less. Corresponding ordinates of the curves at different temperatures will therefore vary as the fifth power of the temperature, when the curves are plotted on a wave length base. The maximum ordinates in the curves already given are found to vary as the fifth powers of the corresponding temperatures.

The equation representing the distribution of energy on a wave length base must be of the form

$$E = C\lambda^{-5} F(\lambda T) = CT^{5}(\lambda T)^{-5}F(\lambda T) \qquad (14)$$

where $F(\lambda T)$ represents some function of the product of the wave length and temperature, which remains constant for corresponding wave lengths when T is changed. If the curves were plotted on a frequency base, because of the change of scale, the maximum ordinates would vary as the cube of the temperature instead of the fifth power, but the form of the function F would remain unaltered. Reasoning on the analogy of the distribution of velocities among the particles of a gas on the kinetic theory, which is a very similar problem, Wien was led to assume that the function F should be of the form $e^{-c/\lambda T}$, where e is the base of Napierian logarithms, and c is a constant having the value 14,600 if the wave length is measured in microhs. This expression was found by Paschen to give a very good approximation to the form of the curve obtained experimentally for those portions of the visible and infrared spectrum where observations could be most accurately made. The formula was tested in two ways: (1) by plotting the curves of distribution of energy in the spectrum for constant temperatures as illustrated in fig. 17; (2) by plotting the energy corresponding to a given wave length as a function of the temperature. Both methods gave very good agreement with Wien's formula for values of the product λT not much exceeding 3,000.

A method of isolating rays of great wave length by successive reflection was devised by H. Rubens and E. F. Nichols (1897). They found that quartz and fluorite possessed the property of selective reflection for rays of wave length 8.8μ and 24μ to 32μ respectively, so that after four to six reflections these rays could be isolated from a source at any temperature in a state of considerable purity. The residual impurity at any stage could be estimated by interposing a thin plate of quartz or fluorite which completely reflected or absorbed the residual rays, but allowed the impurity to pass. H. Beckmann, under the direction of Rubens, investigated the variation with temperature of the residual rays reflected from fluorite employing sources from −80° to 600° C., and found the results could not be represented by Wien's formula unless the constant c were taken as 26,000 in place of 14,600. In their first series of observations extending to 6μ, O. R. Lummer and E. Pringsheim (1899) found systematic deviations indicating an increase in the value of the constant c for long waves and high temperatures. In a theoretical discussion of the subject, Lord Rayleigh (1900) pointed out that Wien's law would lead to a limiting value $C\lambda^{-5}$, of the radiation corresponding to any particular wave length when the temperature increased to infinity, whereas according to his view the radiation of great wave length should ultimately increase in direct proportion to the temperature. Lummer and Pringsheim (1900) extended the range of their observations to 18μ by employing a prism of sylvine in place of fluorite. They found deviations from Wien's formula increasing to nearly 50% at 18μ, where, however, the observations were very difficult on account of the smallness of the energy to be measured. Rubens and F. Kurlbaum (1901) extended the residual reflection method to a temperature range from −190° to 1,500° C., and employed the rays reflected from quartz 8.8μ, and rock salt 51μ, in addition to those from fluorite.

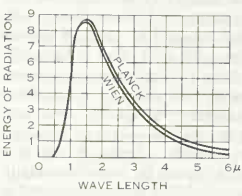

FIG. 17.—DISTRIBUTION OF ENERGY IN THE SPECTRUM OF FULL RADIATION AT 2,000° K., ACCORDING TO FORMULAS OF PLANCK AND WIEN

It appeared from these researches that the rays of great wave length from a source at a high temperature tended to vary in the limit directly as the absolute temperature of the source, as suggested by Lord Rayleigh, and could not be represented by Wien's formula with any value of the constant c. The formula now generally accepted is that proposed by Max Planck (1901), namely,

$$E = C\lambda^{-5}(e^{c/\lambda T} - 1)^{-1} \qquad (15)$$

which agrees with Wien's formula when T is small, where Wien's formula is known to be satisfactory, but approaches the limiting form $E = C\lambda^{-4}T/c$, when T is large, thus satisfying the condition proposed by Lord Rayleigh. The accepted value of the constant c in Planck's formula was 1.4385 cm.-deg. In order to compare Planck's formula graphically with Wien's, the distribution curves corresponding to both formulas are plotted in fig. 17 for a temperature of 2,000° K., with a scale of wave length in microns. The curves in fig. 18 illustrate the difference between the two formulas for the variation of the intensity of radiation with temperature for a fixed wave length 30μ which is five times as long as the limit 6μ of the curves in fig. 17. But at 2,000° K. the energy to be measured at 30μ is about ten thousand times less than at the maximum of the curve in fig. 18.

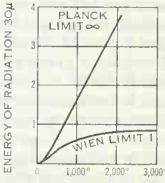

FIG. 18.—VARIATION OF ENERGY OF RADIATION CORRESPONDING TO WAVE LENGTH 30μ WITH TEMPERATURE OF SOURCE

Assuming Wien's displacement law, the curves may be applied

to find the energy for any other wave length or temperature by simply altering the wave length scale in inverse ratio to the temperature, or vice versa. Thus to find the distribution curve for 1,000° K., it is only necessary to multiply all the numbers in the wave length scale of fig. 17 by 2; or to find the variation curve for wave length 60μ the numbers on the temperature scale of fig. 18 should be divided by 2. The ordinate scales must be increased in proportion to the fifth power of the temperature, or inversely as the fifth power of the wave length respectively in fig. 17 and 18 if comparative results are required for different temperatures or wave lengths.

XIII. THE NATURE OF HEAT IN MATTER

1. Classical Theory of Heat.—Following the proof that heat was essentially motion or energy and not a mysterious caloric fluid, the next major step in the understanding of its nature came out of the study of the relation of heat to the principles of probability. Many lines of evidence showed that the thermal motion of the atoms in a gas like helium could be thought of as something like the motions of a large number of small round shot violently agitated in a closed jar. Thus the shot (atoms) fly through the air in straight lines except when colliding with each other or the walls of the jar. Conceivably under these circumstances the atoms might all move with the same speed, but actually it has been proved that they move with a great variety of speeds, some very fast, some very slow and many at the various speeds in between, grouped about an average or mean velocity. Again, if one were to watch a single particular atom it would be seen continually changing its speed at each collision with other atoms or the walls. Occasionally after a collision it would be found moving very fast, occasionally very slowly, thus covering over a length of time the whole gamut of speeds, which one had seen at a single instant distributed among the entire assembly of atoms when observing the gas as a whole at a single glance. Similarly if one observed at a single instant the positions of the atoms in the vessel, they would be found to be almost evenly distributed throughout the entire space inside the jar; or if one were to observe, over a period of time, the wanderings of a single particular atom it would be found to pass through roughly every part of the jar, spending about equal lengths of time in each part in the course of its travels.

One can see the relation of space distribution to probability by means of an example, such as two helium atoms, which we will label respectively A and B, existing in the gaseous state confined within a small box. We postulate that we can see the positions of the two atoms as they bounce back and forth in the box colliding with the walls and with each other, executing the motions which constitute the heat they possess; in particular, we can distinguish when each atom is in the left half or in the right half of the box. There are four possibilities of distribution between the two halves of the box: (1) A and B may both be in the left half of the box; (2) A may be in the left half and B in the right half; (3) B may be in the left half and A in the right half; and (4) A and B may both be in the right half. We note that this parallels the possible distribution of "heads" and "tails" if one were to toss two coins, A and B: (1) both may come up "heads"; (2) A may be "heads" and B "tails"; (3) B may be "heads" and A "tails"; or (4) A and B both may come up "tails." Thus, one may expect that there is twice the chance of throwing one "heads" and one "tails," case (2) or (3), as there is of throwing both "heads," case (1); and in the same way one might conclude that there is twice the chance of finding the atoms distributed evenly through the box, case (2) or (3), as there is of finding both atoms in the left side, case (1).

Now, the law of probability states that if the coins are identical in every respect, the chance of throwing "heads" is exactly the same as the chance of throwing "tails," the 50–50 chance, each 50% or one-half of the total probability taken as 100% or one. And the statistical theory of heat asserts that under uniform conditions there is an equal chance of finding atom A in the left half of the box or in the right half; of course, the same holds for atom B. Thus we conclude that, just as the case of "one heads and one tails" is twice as probable as "both heads," the case of uniform distribution of the atoms, one "right" and one "left," is twice as probable as "both left." This seemingly simple principle has been extended in application throughout the complex domain of the motions which constitute heat, not only in the gaseous state of matter but in liquids and solids as well, and has resulted in an exact and profound understanding of the vast and complicated phenomena of physical and chemical equilibriums and changes of state. Since the addition or subtraction of heat is certainly one of the most universal means of bringing about changes and of producing varieties of matter and interactions between them, this principle and its applications constitute a cornerstone of the foundations of all science. And the story of the evolution of these ideas is a fascinating chapter in the history of thought.

It was largely the result of the work of J. Clerk Maxwell and Ludwig Boltzmann that the relation between heat and probability was first made plain. They showed the plausibility of the concept that each distribution of atoms with respect to space and matter properly specified was equally probable; in our example, each of the four distributions of the two atoms A and B between the two halves of the box was equally probable. In order to extend the mathematical analysis to much more complicated situations, use was made of the concept of multidimensional space; *i.e.*, space of more, in this case vastly more, than the three dimensions, length, breadth and height, of the ordinary space in which we instinctively feel we live and move and have our being.

At first thought, the idea of even conceiving of such a space as an imaginary entity seems to have been deeply repellent to the human mind. It was so profoundly different from natural space and so boundless in its potential for generating further strange and novel forms, possibly of a monstrous nature, that to admit even the logic of the idea was to open a door which led out of the comfortable security of a familiar garden into a limitless *terra incognita* that seemed to be almost a domain for the mad.

The credit for taking this first almost inconceivably bold step in thought certainly should go to H. G. Grassman (1809–77) although the possibility was suggested previously in the work of W. R. Hamilton; the application to heat was first made clear in detail by W. Gibbs who immediately followed Grassman's pioneering adventure. In Gibbs's phase space we conceive of the motion of a single point in a space of $6n$ dimensions, where n is the number of elementary particles with which we are concerned. In our example of two helium atoms, $n = 2$ and this imaginary space would have 6×2 or 12 dimensions. The first three represent the position of atom A in the box with respect to the Cartesian co-ordinate system X, Y, Z or the length, width and height of the box. The second set of three provides similarly a way of representing the position of atom B. The third set of three provides a way of representing the momentum of atom A (in effect its speed, since momentum is the product of speed or velocity times mass). Similarly, the position of the point with respect to the fourth set of three dimensions tells the velocity of atom B. The faster the atom is moving lengthwise in the box (direction x) the further to the right of the centre or zero point of the co-ordinate system will be the phase point or dot which tells by its position in the 12 dimensional space where our atoms are and how they are moving.

The fact that these two atoms are confined in the box means that the phase point must lie within a volume of space on the first three dimensions corresponding to the volume of the box and within a similar volume on the second three dimensions. If our system possesses a fixed amount of energy, and we will assume it does, then the point will have to lie within a certain volume in the third set of dimensions and similarly in the fourth, defined by a so-called hypersphere in the six dimensions of momentum space.

The fundamental assumption is made that there are a certain number of positions possible for the point within this hypervolume in 12 dimensions, and that each one of these positions is equally probable. This assumption is the extension of the logic that each kind of throw of the two coins is equally probable and that each of the four space distributions of the atoms A and B between the two halves of the box is equally probable.

The effect of heat on matter is thus based on the laws of proba-

bility or statistics. From this chain of logic there evolved the Maxwell-Boltzmann law for the distribution of energy among the atoms of a gas and the generalizations of statistical thermodynamics which stem from the Gibbsian concept of multidimensional phase space. During the latter part of the 19th century when these theories were being worked out, it seemed logical to believe that there were an indefinite number of values of energy possible for each atom. There was no evidence for any atomization of energy; it seemed reasonable that the amount of energy could be varied by infinitesimally small amounts, and that the points in phase space representing the possible states of the system lay infinitesimally close together. This was the classical basis for the theory of heat.

One of the most important conclusions drawn from this classical theory was the principle of the equipartition of energy. For example, a gaseous atom like helium could move in three dimensions in physical space. It was said to have three degrees of freedom of motion. Moving in free space there was certainly no difference between motion along the X axis, lengthwise in the box, or motion along the Y axis, crosswise; likewise motion along the Z axis, or up and down, should be no different from the other two; accordingly all were regarded as equally probable. According to the principle of equipartition, energy was then shared equally on the average among all three degrees of freedom of the so-called translational motion. Calculation showed that the amount in each should be $\frac{1}{2}RT$, where R is the gas constant with a value of roughly two calories per degree per gram molecule and T is the absolute temperature in degrees Kelvin. Since the heat capacity is the rate of increase of energy with temperature, it is clear that one should find the value $\frac{1}{2}R$ per degree of freedom, or $\frac{3}{2}R$ for the heat capacity of one gram molecule of a monatomic gas like helium when measured at constant volume. This value was precisely confirmed experimentally for a number of monatomic gases.

In the case of a diatomic gas such as nitrogen we have the two atoms joined together to make a kind of dumbbell-shaped molecule. In this case the dumbbell can rotate in space. This adds two more degrees of freedom of rotation which summed with the three degrees of freedom of translation makes five in all; we therefore expect and actually find experimentally a heat capacity of $\frac{5}{2}R$. In other words, although the two kinds of motion are superficially quite different—translation or straight-line motion across the box contrasted with rotation or spinning—the principle of equipartition of energy states that energy is still shared equally among all the degrees of freedom.

Suppose now that the atoms are cooled down and condense first into a liquid and finally freeze into crystalline form, how will the situation alter? In the crystal we expect that instead of moving freely through space as in a gas, the atom will vibrate back and forth about a mean position under the influence of forces of attraction and repulsion between it and its neighbouring atoms. It will now possess both kinetic energy of motion and potential energy because of the action of the forces. Classical mechanics tells us that under these conditions, with these two kinds of energy present, the total average energy per degree of freedom will be twice as much, and the heat capacity accordingly will be $3R$ per gram atom in the crystalline state as contrasted with $\frac{3}{2}R$ in the gaseous state for a monatomic substance like helium. Since most metals exist in the crystalline state as individual atoms, not joined to form molecular groups, one would expect the heat capacity of metals to be $3R$ per gram atom. This fact had been observed experimentally and was known as the rule of Dulong and Petit.

On the whole, by the end of the 19th century there were a large number of experimental observations to confirm the classical theory of heat, but a certain number of notable exceptions remained unexplained. For example, some of the light elements exhibited values of the heat capacity which fell farther and farther below $6R$ as temperature was lowered, for example, carbon, boron and silicon. With the increasing use of liquefied gases such as oxygen, nitrogen and hydrogen to produce temperatures of 200° or more below 0° C., these anomalies became more and more striking. Sir James Dewar carried out a series of heat-capacity measurements at low temperatures, made possible by the invention of the Dewar flask which provided the necessary thermal insulation to preserve liquid hydrogen for hours at a time, which gave quantitative proof of this deviation.

2. Einstein's Theory.—It was just at this time that Planck had challenged the classical idea of the continuous range of values of energy with his quantum hypothesis. Albert Einstein was the first to see the connection between the quantum theory and the anomalies in heat-capacity values at low temperatures. He pointed out that the atoms of carbon, for example, might be expected to vibrate in the crystalline state with a single frequency, each atom behaving pretty much like an independent oscillator. Planck's theory would lead one to believe that the energy in such an oscillator would not take on a range of continuous values but that only a number of discrete values would be possible. In phase space this meant that, in effect, only a discrete and relatively small number of regions, usually referred to as cells, could be occupied by the phase point. Retaining the idea of equal probability for distribution of the energy as a whole, but over this finite number of cells, one calculated an entirely different formula for the heat capacity. One found first of all a parametric temperature (usually given the symbol Θ, called the characteristic temperature and expressed on the absolute scale of temperature) which provided an index to the behaviour of the substance. For example, Θ for lead is approximately 100° while Θ for diamond (crystalline carbon) is approximately 2,000°. When heat capacity is measured at the characteristic temperature it will be $0.9 \times 3R$; at twice the characteristic temperature it will be almost exactly $3R$; but at a temperature of one-half the characteristic temperature it will fall to less than one-half the Dulong and Petit value of $3R$. The heavier the atom which vibrates, the lower will be the characteristic temperature. Thus lead will have a heat capacity close to $3R$ at room temperature (300° K.), which is three times its characteristic temperature, while diamond will have a heat capacity far below $3R$, since room temperature is only about one-sixth of the characteristic temperature of diamond.

Einstein's formula for the heat capacity s at constant volume per gram atom is given by the expression:

$$s = 3Rz^2e^z/(e^z = 1)^2;\ z = \frac{h\nu}{kT} \qquad (16)$$

where h is Planck's constant, k is Boltzmann's constant, ν is the characteristic frequency at which the atom vibrates and T is the temperature in degrees absolute. Einstein showed (1907) that the experimental results of H. F. Weber on the variation of the heat capacity of diamond from $T = 222°$ to 1,258° K. were in good agreement with his formula. Taking the substances calcium fluoride, sodium chloride, calcium carbonate and silicon dioxide for which the optical frequencies of absorption (ν_0) in the infrared were known, he pointed out that the values of ν required by his formula were in reasonable agreement with the values of ν_0 optically observed. This was a major triumph for the newly created quantum theory of Planck.

3. Debye's Theory.—The interest aroused by Einstein's theory of the heat capacity of solids led to an important series of measurements of heat capacity by W. Nernst, F. A. Lindemann (Lord Cherwell) and their collaborators. They studied a number of metals and salts for which the optical frequencies were known, extending the experiments to the lowest temperatures available with liquid hydrogen and making use of the precise calorimetric methods developed at their laboratory. The results showed that while the Einstein theory was satisfactory in explaining the results at the higher temperatures, it failed to account for the heat capacity at the lower end of the temperature scale; values were many times higher than the theory predicted.

The explanation of this anomaly was put forward by P. Debye (1912) who pointed out that one would not expect the atoms in the crystal lattice to vibrate independently as Einstein had postulated, but rather in joint modes of motion. In a cube-shaped crystal the longest mode would have a wave length twice the distance from one face of the cube to the opposite face. The shortest mode would have a wave length twice the distance between two neighbouring atoms. If the crystal were 1 cm. across, there would be a set of waves with the wave length varying about 100,000,000 times from

the longest to the shortest value. While these waves contain in their motion the heat of the crystal, they also may be regarded as acoustic waves or sound; if sound waves in the air impinge on the crystal, elastic waves similar in type to the heat waves will be set up, carrying the sound through the crystal.

According to a theorem attributed to Lord Rayleigh (1877) the number of possible degrees of freedom of a system of N discontinuous mass points will be $3N$. According to another theorem by the same author (1900), the number of possible frequencies in a given volume of a continuous medium between the limits ν and $\nu + d\nu$ may be represented by $C'\nu^2 d\nu$ where C' is a constant dependent on the volume and on the velocity of propagation. The total number of possible frequencies from 0 up to a limit ν_m is $C'\nu_m{}^3/3$. If we equate this to $3N$, we find $C' = \frac{9N}{\nu_m{}^3}$. Adopting Planck's expression for the energy of a harmonic oscillator with one degree of freedom as applying to each mode, we obtain the energy $(RT/N)Z/(e^z - 1)$ for each frequency. Multiplying by the number of frequencies and integrating from 0 to ν_m we can obtain the energy of a gram atom at T, and thence obtain the heat capacity by differentiation with respect to T. This yields a rather complicated expression which is similar to Einstein's in general form, being a function of Θ/T, but which has much higher values of the heat capacity precisely in the low-temperature region where Einstein's function is so unsatisfactory. This is because Debye's function takes into account the existence of the vibrational modes with long wave length which retain their heat at very low temperatures (the range where the short-wave vibrations, on which Einstein's theory was based, have effectively no heat at all). Debye's theory thus predicts that at very low temperatures the heat capacity will vary as the cube of the absolute temperature, a relationship which has been found experimentally to hold in dozens of cases. The major features of Debye's theory are thus experimentally substantiated and there is no doubt but that it marks an important step forward in our understanding of the nature of heat in solids.

One of the weakest points in the Debye theory lies in the use of the formula for the distribution of frequencies in a continuous medium while equating the total number of frequencies to $3N$ as expected in discontinuous lattice. Obviously, real crystals are made up of discontinuous sets of mass points; and the theory of such lattices has offered a challenge to investigators ever since the importance of crystal dynamics became apparent. M. Born and T. von Karman pioneered in working out mathematical methods for lattice problems (1912). After 1935 M. Blackman carried on a series of studies, improving the earlier methods and applying them to many substances. Starting in 1944, E. W. Montroll and his associates made important contributions to clarify our understanding of the theory.

An especially interesting application of the mathematics of topology (*see* TOPOLOGY, GENERAL) to the problem was suggested by L. van Hove (1953). All these developments were critically summarized by Blackman in 1955.

Thus, the investigations over this period have shown that, by and large, the Debye theory accounts with astonishing precision for the variation of heat with temperature in many varieties of crystalline substances, in spite of the doubtful assumption of the continuous distribution of frequencies which Debye himself clearly pointed out to be an approximation. On the other hand, if a new theory can be based strictly on the dynamics of discontinuous lattices, it is clear from the results already obtained that much more important information on the distribution of heat in crystals may be expected.

A still more complex problem is posed by crystal lattices made up of molecules where groups of atoms are bound together in groups by the relatively strong forces of chemical bonds, while these groups are in turn bound to neighbouring groups in the rows of the crystal lattice by relatively weak forces. The lattice of crystalline benzene (C_6H_6) is of this sort, typical of organic compounds and of some inorganic ions such as SO_4^-. With considerable accuracy, the Debye theory even accounts for the heat contained in the vibration of these complex molecules against each other, as shown by R. C. Lord, J. E. Ahlberg and D. H. Andrews (1937). In this case there appear to be coupled torsional waves as well as the translational waves found in monatomic crystals.

The heat contained in the vibrations of the atoms within the molecule, however, must be calculated by an Einstein function, since the coupling between molecules is so weak that the individual molecules vibrate within themselves independently of each other. Consequently, the frequencies do not lie in a nearly continuous band as in the Debye case, but are a discrete set of $3n-6$ values where n is the number of atoms in the molecule. Occasionally because of molecular symmetry, or similar factors, the values for different types of motion will be equivalent numerically and this reduces the number of distinct values below the number $3n-6$. The Einstein formula has been widely applied in calculating the heat capacity caused by these internal molecular vibrations, both for solids and for gases. Thus, although this formula has been completely supplanted by the Debye formula in the case of heat distribution in lattices, the case for which Einstein originally developed it, the applications for calculating the internal heat in molecules have made its uses ultimately far more numerous than those of the Debye formula. These applications are discussed in the final section of this article dealing with the heat capacities of gases.

4. Heat, Entropy and Information.—During World War II new and profound advances were made in understanding the basic nature of "information," so novel in fact as to constitute the beginning of a new field of science. This came about simultaneously in several related fields such as the improvement of radio and telephone communication, the making and breaking of secret codes and the development of various servomechanisms such as automatically controlled antiaircraft weapons. As the theory of information developed there appeared an astonishing parallelism to the theory of heat, because probability enters into the communication of information in much the same way that it enters into the equilibration of heat. The initial developments along these lines were attributed primarily to the work of C. E. Shannon; and the advances in the decade after the war were summarized by L. Brillouin in 1956.

The measure of information I is now generally defined by the formula $I = K \ln P$ where I is the information of one outcome in a situation which had P possible outcomes all equally probable, K is an arbitrary constant, and ln means logarithm to the base e. The customary measure of the probability of a given heat distribution is, of course, the entropy S customarily defined by the Boltzmann expression: $S = k \ln W$, where k is the Boltzmann gas constant, and W is the number of microscopic ways in which the macroscopic state corresponding to S can be realized. The identity in form of these two expressions reveals a very profound relationship between the two fields.

The similarity of the theory of heat to the theory of information also is striking in many other ways. The second law of thermodynamics states that the entropy always increases in any spontaneous change; in the limit, entropy remains constant if the change takes place reversibly; and it never decreases spontaneously. Similarly, information always decreases as the result of being communicated; in the limit it remains constant as the communication becomes perfect; *i.e.*, when no randomness such as electrical noise is introduced in the act of communication; but information never increases as the result of communication. Thus entropy and information are strictly isomorphic quantities, though differing in "sign," the first increasing and the second decreasing when randomness occurs.

Now there is every reason to believe that our increasing knowledge about the nature of information will aid our understanding of the nature of thought itself. And since thermal energy or heat plays such a vital part in governing the course of chemical reactions, including biochemical processes, we may expect that advances in the theory of heat will help in our understanding of basic neurological action. Thus, at the common frontier where these two closely related fields meet in the physiological and epistemological aspects of the brain, one may expect important developments.

In this connection it should be pointed out that the representation of the phenomena associated with heat distribution by means of multidimensional space, as initiated by Gibbs, was the beginning of a trend of thought which has spread far since that time, a change in epistemological attitude which has shifted emphasis from the analytic to the synthetic. Thus Debye took into account the action of heat in the whole crystal, instead of treating it as atomized into independent oscillators as Einstein did. The mathematical structure of the new quantum mechanics (*q.v.*) has emphasized still further the "aspect of the whole" as representable in generalized space, a point frequently made by H. Weyl in his studies of the philosophy of mathematics and the physical sciences. In quantum mechanics we find probability in wave-clothing dominating the behaviour of elementary particles with a formalism isomorphic with the generalized Debye treatment of heat in crystals.

In the new information theory we find probability and generalized space again, once more closely isomorphic with fundamental aspects of the theory of heat. In all this we are surely glimpsing a profound change in our knowledge of the physical world and in knowledge itself.

The philosophical implications of this aspect of the whole were discussed by N. Bohr (1958) who stressed the importance of this point of view in interpreting the relationships between processes at the atomic level and at the biological level. The essential, characteristic feature of the living organism is dynamic stability. While the individual building blocks of the organism, the atoms, come and go by the trillion or more through respiration and metabolism, the structure of the organism retains its characteristic form relatively unchanged for a period of time billions or more times longer than the interval required for an individual atomic replacement.

We therefore must regard this characteristic form as a dynamic energy pattern which subtly combines change with invariance. Its dynamism is heat, the warmth of life, but because this heat embodies form, there emerges a stable entity of the whole, which in its survival through time holds a reality that dominates and transcends its ephemeral and ever changing material parts.

5. Heat Capacities of Gases.—Early attempts at understanding the nature of heat inside molecules like benzene were hampered by a lack of knowledge of the proper set of frequencies to use in the Einstein equation. The discovery of the new type of spectrum bearing his name, by Sir C. V. Raman in 1928, marked a major advance in providing adequate data for the thermal analysis of molecules.

Shortly after Raman's first work, E. B. Wilson and his collaborators began a long series of studies, combining quantum mechanics and the mathematical theory of groups to provide methods for the exact analysis of the thermal motions of molecules. The improvement of instrumental techniques in the study of infrared spectra also contributed greatly in making it possible to calculate accurately the internal heat capacity of molecules. Advances in this field were summarized by Wilson, J. C. Decius and P. C. Cross in 1955. At that time something like 50 molecules of considerable complexity had been subjected to precise vibrational analysis. This not only made possible the accurate calculation of heat capacities in the gaseous state, but, coupled with experimental measurements of thermal properties in the solid and liquid state, it provided thermodynamic data for quantities like entropy and free energy in a form which permitted calculations with regard to chemical behaviour under conditions such as high temperature, high pressure and complex composition where the direct experimental approach becomes difficult or impossible. This part of the theory of heat has yielded invaluable information to industry especially in the fields of petroleum chemistry and synthetic organic chemistry.

See CALORIMETRY; DIFFUSION; LATENT HEAT; LOW-TEMPERATURE PHYSICS; THERMODYNAMICS; THERMOMETRY; VAPORIZATION; HEATING AND VENTILATION; KINETIC THEORY OF MATTER; *see* also references under "Heat" in the Index volume.

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(H. L. C.; D. H. A.)

HEAT, ANIMAL: *see* ANIMAL HEAT.

HEAT EXCHANGER. In many engineering applications it is desirable to increase the temperature of one fluid while cooling another. This double action may be economically accomplished with the aid of an apparatus called a heat exchanger. Some important applications are the cooling of one petroleum fraction while warming another, the cooling of air or other gases with water between stages of compression, and the preheating of combustion air supplied to a boiler furnace using hot flue gas as the heating medium. Others are the transfer of heat from liquid metals to high-pressure water in atomic power plants and the reclaiming of heat energy from the exhaust of a gas turbine by transferring heat to the compressed air on its way to the combustion chambers. There are also many other applications.

The primary function of a heat exchanger is to provide two paths of flow, one for the warm fluid and one for the cold, by

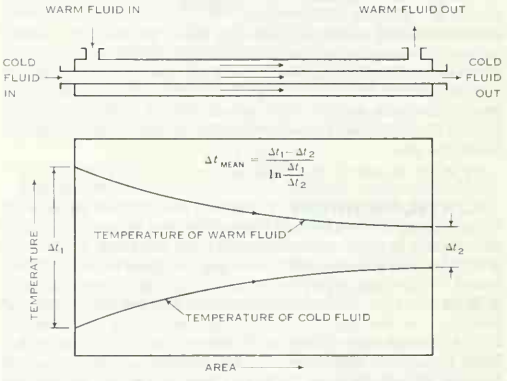

FIG. 1.—PARALLEL FLOW IN A CONCENTRIC TUBE HEAT EXCHANGER

means of which heat can be transferred through walls or partitions separating the fluids.

The quantity of heat transferred is governed by three factors, namely: (1) the amount and nature of the heat transfer surface area exposed to the two fluids; (2) the over-all coefficient of heat

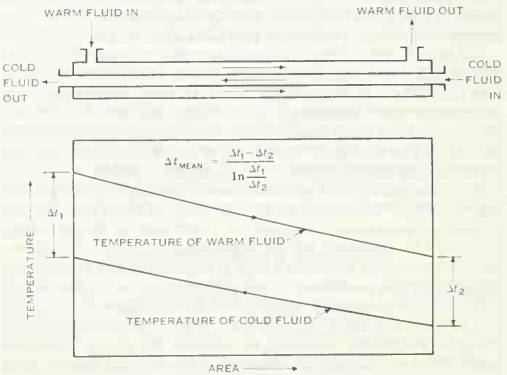

FIG. 2.—COUNTERFLOW IN A CONCENTRIC TUBE HEAT EXCHANGER

transfer from one fluid through the intervening wall to the other fluid; and (3) the mean temperature difference across the intervening wall from one fluid to the other.

Numerous flow arrangements and geometrical designs are possible. Perhaps the simplest is the concentric tube or double-pipe heat exchanger in which one pipe is placed inside another. The fluids flow in the inner pipe and in the space between the two pipes. The flow may be either parallel (fig. 1) or counterflow (fig. 2) with temperature relations between fluids as illustrated. Concentric tube heat exchangers are built in several ways such as, for example, in the form of a coil or in straight sections placed side by side and connected in series.

The commonest type of heat exchanger is the shell and tube type illustrated in fig. 3. Here one fluid flows through tubes while the other flows back and forth across the tubes between baffles. Over-all direction of flow may be either parallel or counter, but is usually the latter.

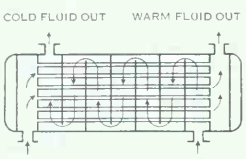

FIG. 3.—SHELL AND TUBE HEAT EXCHANGER

Another commonly employed type heat exchanger is the regenerative type in which hot and cold gas streams flow in opposite directions through opposite halves of a rotating drum composed of honeycombed metal sections through which the gases can pass. As the drum slowly rotates the honeycombed metal alternately absorbs heat from the hot gas stream and surrenders it to the cold gas stream thus effecting the desired heat interchange between the two gases. This type exchanger is widely used in power plants for preheating combustion air while simultaneously reclaiming waste heat from the boiler flue gases.

See W. H. McAdams, *Heat Transmission,* 3rd ed. (1954).
(RD. A. BR.)

HEATH, NICHOLAS (*c.* 1501–1578), English ecclesiastic, archbishop of York and lord chancellor, who opposed many of the religious changes under Edward VI and Elizabeth I, was born in London and educated at Oxford and at Christ's college, Cambridge. After minor preferments he was appointed archdeacon of Stafford in 1534. He then accompanied Edward Fox, bishop of Hereford, on his mission to the Lutheran princes of Germany. In 1539 he was made bishop of Rochester and in 1543 succeeded Hugh Latimer at Worcester. He accepted the earlier reforms of Edward VI and the first Book of Common Prayer after it had been modified by the house of lords in a Catholic direction. His definite breach with the Reformation occurred on the question of the ordinal drawn up in 1550. Heath was one of the bishops appointed to prepare a form for ordination, but he refused to accept the version suggested by Archbishop Thomas Cranmer. He was imprisoned and in 1551 was deprived of his bishopric. On Mary I's accession he was restored, made president of the council of the Marches and Wales, and in 1555 was promoted to the archbishopric of York. He became lord chancellor on Jan. 1, 1556.

On Mary's death Heath as lord chancellor at once proclaimed Elizabeth I. Although Elizabeth did not renew his commission as lord chancellor, he continued to sit in the privy council until the government had determined to complete the breach with the Roman Catholic Church and as late as April 1559 he assisted the government by helping to arrange the Westminster conference and reproving his more truculent coreligionists. Heath refused to crown Elizabeth because she had already shown at Christmas that she would not be present at the elevation of the Host, and ecclesiastical ceremonies and doctrine could not, in Heath's view, be altered or abrogated by any mere national authority. Hence he steadily resisted Elizabeth's Acts of Supremacy and Uniformity, although he had acquiesced in the acts of 1534 and 1549. Heath was therefore necessarily deprived of his archbishopric in 1559, but he remained loyal to Elizabeth. After a temporary confinement he passed the remaining 19 years of his life in peace and quiet, never attending public worship and sometimes hearing mass in private.

HEATH, WILLIAM (1737–1814), a major general in the American Revolution, was born in Roxbury, Mass., on March 2, 1737. He emerged as a public figure in 1770 when he took command of the Boston artillery company, became a member of the general court, and advocated military preparedness. As Massachusetts began to move toward revolution he served on its committee of public safety and during 1774–75 was a member of the provincial congress. On the day of fighting at Lexington and Concord, Heath came to the fore to direct the pursuit of the British regulars hurrying back to the safety of Boston. He accepted a brigadier general's commission in the new Continental army, but his one bid for military glory ended in fiasco when his attempt to take Ft. Independence failed miserably in 1777. His administrative talents, however, made him useful to General Washington. In 1781 when Washington moved south to meet Cornwallis he left General Heath and his command to watch Clinton in New York. At the war's end Heath returned to his farm in Roxbury. He continued to be active in state affairs and was a member of the Massachusetts convention that ratified the federal constitution in 1788. He died at his home on Jan. 24, 1814.

See *Memoirs of Major-General Heath . . .* (1798) and his correspondence, *The Heath Papers,* vol. iv–v, seventh series, *Massachusetts Historical Society Collections* (1904–05). (W. W. A.)

HEATH, the English name given to almost all species of *Erica,* an extensive genus of mostly low evergreen shrubs, belonging to the family Ericaceae. The heaths have small narrow leaves, in whorls usually set rather thickly on the shoots; the persistent flowers have four sepals and a four-cleft bell-shaped or tubular corolla, in many species more or less inflated; the dry capsule is four-celled and opens in four segments, to the middle of which the partitions adhere. The plants are mostly of low growth, but several African kinds reach the size of large bushes, and a common south European species, *E. arborea,* occasionally attains almost the aspect and dimensions of a tree.

The purple or Scotch heath or bell-heather (*E. cinerea*), one of the most beautiful of the genus, abounds on the lower moors and commons of Great Britain and western Europe. The flowers yield much nectar.

The genus contains about 500 known species, by far the greater part being indigenous to the western districts of south Africa, but it is also a characteristic genus of the Mediterranean region, while several species extend into northern Europe. No species is native

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CROSS-LEAVED HEATH (ERICA TETRALIX)

in America, but several have been introduced. Among the British species are: *E. cinerea*, *E. tetralix* (cross-leaved heath or bog heather), both abundant on heaths and commons, *E. vagans* (Cornish heath), found also in western Europe, *E. ciliaris* in the west of England and Ireland and *E. mediterranea* in Ireland. *E. arborea*, the white heath, found in southern France and elsewhere in the Mediterranean region, is known as *bruyère*, and its stout underground roots yield the "briarwood" used for pipes.

Among cultivated heaths the south African species excel, but only in the cool greenhouse or outdoors in California. Among the finest are *E. melanthera*, *E. verticillata* and *E. ventricosa*.

See also ERICACEAE.

HEATHCOAT, JOHN (1783–1861), English inventor of lacemaking machinery, was born at Duffield near Derby on Aug. 7, 1783. After being apprenticed to a framesmith, he constructed in 1808 a machine to produce an exact imitation of pillow lace, which was the most expensive and complex textile apparatus then existing. A mill at Loughborough for the exploitation of the new process, owned by Heathcoat and his partner Charles Lacy, a Nottingham manufacturer, was attacked by the Luddites in 1816, and the 55 lace frames were destroyed. Heathcoat then constructed new and greatly improved machines at Tiverton, Devon. He followed his great invention by others, including contrivances for ornamenting net while in course of manufacture and for making ribbons and plaited and twisted net upon his machines and improved yarn-spinning frames and methods for winding raw silk from cocoons. He also patented a steam plow and an improved process for extracting and purifying salt.

In 1832 Heathcoat was elected a member of parliament for Tiverton, where he died on Jan. 18, 1861.

See William Felkin, *A History of the Machine-Wrought Hosiery and Lace Manufactures* (1867). (K. R. G.)

HEATHER, a name properly applied only to the low evergreen shrub *Calluna vulgaris*, of the heath family (Ericaceae), also termed ling, but often used loosely to include some of the heaths (*q.v.*). Heather is distinguished from the heaths on account of the peculiar dehiscence of the fruit, and from the coloured calyx, which extends beyond the corolla, having a whorl of sepal-like bracts beneath.

JACK SKEEL

COMMON HEATHER OR LING (CALLUNA VULGARIS)

This shrub derives some economic importance from its forming the chief vegetation on many extensive wastes in the more sterile lands of northern and western Europe, which are hence known as heaths. When growing erect to the height of three feet or more, as it often does in sheltered places, its purple stems, close-leaved green shoots and feathery spikes of bell-shaped flowers render it one of the handsomest of the Ericaceae; but on more arid slopes it frequently rises only a few inches above the ground. In all moorland countries the heather is applied to many rural purposes; the larger stems are made into brooms, the shorter tied up into bundles that serve as brushes, while the long trailing shoots are woven into baskets. Pared up with the peat about its roots it forms a good fuel, often the only one obtainable on the drier moors.

The shielings (huts) of Scottish Highlanders were formerly constructed of heather and heath stems, cemented together with peat mud worked into a kind of mortar with dry grass or straw; hovels and sheds for temporary purposes are still sometimes built in a similar way and roofed in with heather. Laid on the ground, with the flowers above, it forms a soft springy bed, the luxurious couch of the ancient Gael. The young juicy shoots and the seeds, which remain long in the capsules, furnish the red grouse of Scotland with the larger portion of its sustenance; the ripe seeds are eaten by many birds.

See also ERICACEAE.

HEATH HEN (*Tympanuchus cupido cupido*), an extinct North American grouse, an eastern race of the prairie chicken (*q.v.*), which inhabited wooded districts. Once numerous, this choice game bird subsequently disappeared, as a result of overhunting and the opening of farm lands, from all parts of its range, the last to survive having been seen on the island of Martha's Vineyard, Mass., in the early 1930s.

HEATH RIVER rises on the lower slopes of the Cordillera Oriental, Bolivia, and flows northeast through heavily forested and sparsely inhabited country to its confluence with the Madre de Dios near Puerto Heath.

Along its 100 mi. length are numerous rapids making navigation possible only by small craft. The Heath is named for the American, Edwin Heath, whose explorations in 1879 revealed the wealth of the region, chiefly rubber. Col. P. H. Fawcett, employed on a 1910 boundary survey project by the Bolivian government, explored the Heath to its source. The river forms part of the boundary between Bolivia and Peru. (J. L. Tr.)

HEATING AND VENTILATION. These two branches of engineering are so closely interrelated that they usually are treated as a dual subject. Both are concerned with providing a required atmospheric environment within a space, the former with respect to heat supply to produce a desired temperature for maintaining comfort, health or efficiency of the occupants, the latter with regard to supply and removal of air, frequently with emphasis on contamination of the air. A third subject, air conditioning (*q.v.*), is closely related to both heating and ventilation.

HEATING

While the necessity for heat in cold climates seems self-evident, actually the matter is not so simple when the physiology of the human being is taken into account. The food and oxygen intake of the body is converted into energy, and the body dissipates this energy in the form of heat and work. Even on a cold day a person vigorously exercising is conscious of perspiring, so that he is losing heat by evaporation. Why, then, must the body require heat if it is losing heat?

The body of a healthy person is generally at a temperature of 98.6° F. (36.6° C.) and normally produces heat at a rate of from 300 to 2,000 B.T.U. per hour (a British thermal unit, or B.T.U., is the quantity of heat required to raise the temperature of one pound of water 1° F.). This heat must be dissipated at the same rate it is produced if the body temperature is not to rise or fall. If heat is lost too rapidly, the body temperature falls; when this happens, life is endangered.

The purpose of heating, then, is to prevent the too-rapid loss of heat from the body. By heating the ambient air or walls, ceiling or floor, the rate of heat loss from the body is controlled. When the rate of heat loss is properly controlled, the individual feels comfortable.

The output of heat, and consequently the degree to which heat must be supplied, depends on the degree of physical activity (*see* Table I). For example, when a man is engaged in heavy work he must dissipate from 1,400 to 1,600 B.T.U. per hour; for his body to do this, the atmospheric environment must be cool to allow the interchange of heat from his body to the surroundings. When he is relaxed in a chair, dissipating only 400 B.T.U. per hour, his environment must be warmer to provide for the lower rate of heat exchange.

TABLE I.—*Heat Output of Human Beings*

Activity	Heat output, B.T.U. per hour	Activity	Heat output, B.T.U. per hour
Seated, relaxed	325–400	Light factory work	725–825
Office worker	425–500	Moderately heavy work	900–1,100
Walking	450–575	Heavy work	1,400–2,000

Note: Lower values for women, higher for men.

How the Body Loses Heat.—Some concepts of heating were gradually changed as engineers obtained more precise knowledge about how the body loses heat. Insufficient attention formerly was paid to loss by radiation, which is the transmission of energy in the form of waves from a body to surrounding bodies at a lower temperature, independent of the air temperature between. The human being also loses heat by conduction (through his clothes) and convection, the latter by air currents past his skin or outside clothing surface, and also by evaporation of moisture from his skin (perspiration) and by respiration.

The loss by radiation depends on the temperature of the walls, floor and ceiling of the enclosure which the human being is occupying. The lower these temperatures are, the greater the loss by radiation. The mean radiant temperature (M.R.T.) is the weighted average of the various floor, wall and ceiling temperatures. When the M.R.T. is below 80° F. (26.7° C.), the average surface temperature of a normally clothed adult, the body loses heat by radiation to the surroundings; when the M.R.T. is higher than 80° F., the body is gaining heat by radiation. The effect of low M.R.T. on the comfort of room occupants was noticed as early as 1857, when the commissioners of the London board of health laid down a rule that for comfort the walls of an apartment should be warmer than the air.

Loss of heat by convection is dependent on air temperature and rate of air motion. The cooler the air in the room, the more the body heat loss by convection, and the greater the air motion, the greater the loss by convection.

Evaporation of moisture from the skin (and expired air) depends on the relative humidity, air movement and air temperature. Evaporation increases as the relative humidity of the air decreases and as air movement increases. Loss by evaporation decreases with increase of air temperature.

Heat can be lost from the body or gained by radiation or convection; evaporation always results in a heat loss. Consequently, it is not possible to indicate the proportions of these losses unless the specific conditions are stated. For the specific case of a nude person in a 76° F. (24.4° C.) air-and-wall-temperature environment, low relative humidity and no air motion, the heat loss is one-fifth by evaporation, less than two-fifths by radiation and more than two-fifths by convection.

Measures of Heating Effectiveness.—Within certain limits, it is possible to vary the heat loss by different means, increasing one and decreasing another, and still maintain a constant net loss and, consequently, the same feeling of comfort. For example, if, because of cold walls, the loss by radiation is high, the loss by convection and evaporation can be reduced by maintaining a higher air temperature. The result is that, since there are so many variables, there are many combinations of air temperature, mean radiant temperature, relative humidity and air movement that will result in a comfortable environment. Many attempts have been made to combine these variables into one scale of numbers or indexes which will define the environmental condition in terms of body heat loss as it relates to comfort.

Principal among these are the following:

Effective Temperature.—This scale is determined by subjective tests of the feeling of comfort under various combinations of air temperature, humidity and air motion, but without taking M.R.T. into account. This scale, devised by the American Society of Heating and Air Conditioning Engineers, Inc., applies only to the United States and only to still air (air movement not more than 25 ft. per minute). The effective temperature scale as applied to winter heating conditions is illustrated in fig. 1. Combinations of air temperature and humidity resulting in a 65° or 70° effective temperature (E.T.) were satisfactory to 85% of the subjects tested, while 95% were comfortable at 66° and 69° E.T. and 97% were comfortable at an E.T. of 67°. Most comfortable of all was an E.T. of 68°, at which 99% of the subjects were comfortable. The 68° E.T. curve is a plot of the combinations of temperature and humidity which were most, and equally, popular.

The chart in fig. 1 applies to convection (not radiant panel) heating systems of the central type only.

Equivalent Temperature.—This scale, developed in Great Britain, measures the combination of effects of radiation, air temperature and air motion but not humidity. It appears to be the best available index of warmth within the limit of 75° F. (23.9° C.), beyond which it does not apply.

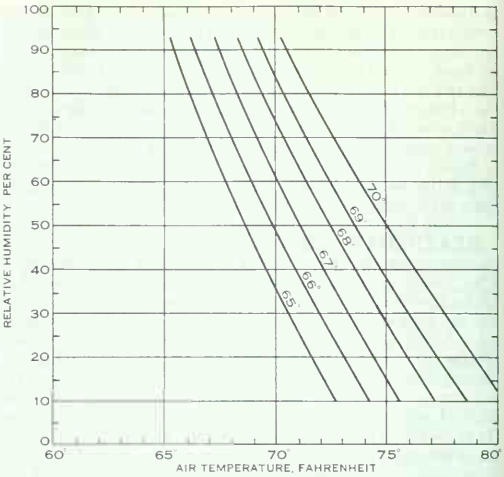

FIG. 1.—EFFECTIVE TEMPERATURE CURVES SHOWING COMBINATIONS OF TEMPERATURE AND RELATIVE HUMIDITY DEFINED BY THE AMERICAN SOCIETY OF HEATING AND AIR CONDITIONING ENGINEERS, INC., AS REPRESENTING RELATIVE SUBJECTIVE FEELINGS OF COMFORT. THE 68° EFFECTIVE TEMPERATURE LINE REPRESENTS THE MOST NEARLY IDEAL COMBINATIONS FOR MOST PERSONS

Equivalent Warmth.—Also a British scale, this takes into account humidity, mean radiant temperature, air temperature and air motion. It is reported that it gives results very close to that of the resultant temperature, a scale developed in France. Neither of these scales is used in the U.S.

Operative Temperature.—A scale developed in the John B. Pierce Laboratory of Hygiene in New Haven, Conn., takes into account mean radiant temperature and air temperature. Since it applies only to moderate air movement, it can be said to take air motion into account within limits. Humidity is not included. For practical purposes, the mean between the air temperature and the mean radiant temperature can be taken as the operative temperature. Thus if the air temperature is 70° F. (21.1° C.) and the mean radiant temperature is 60° F. (15.6° C.), the operative temperature is 65° F. (18.3° C.).

Environmental Standards.—All of the foregoing has considerable practical significance. For example, drafts (another term for air motion) increase the convection and evaporative heat loss and may produce a feeling of chill. Less appreciated is the fact that when the walls are cold, the occupant can lose so much heat by radiation that he is cold, complains of drafts (which may not be present) and is uncomfortable even with a relatively high air temperature. This loss of heat by radiation is especially noticeable if a person is sitting next to a window when the glass is cold. At the same time another occupant who is not losing heat by radiation may feel quite comfortable. Such situations cause great irritation among occupants of homes and offices.

Since there is no universally accepted standard in regard to mean radiant temperature, relative humidity and air motion, air temperature is, in actual practice, the primary basis for design.

Other variables enter into the picture—quantity of clothes worn, age and sex of the individual, environment to which the individual is accustomed and state of health—but the heating system must be designed for the average case. The number of these variables involved is an indication of the difficulty in setting a precise standard.

In the United States an inside design temperature of 70° F. is commonly used for most buildings where the occupants are seden-

tary or even exercising lightly, with lower temperatures, from 55° to 65° F., employed for various industrial buildings. Actually, however, the temperature maintained is usually above 70° in residential, commercial and institutional buildings, depending on the amount of outside wall space. For rooms with one outside wall, 71° is nearly ideal, while 73° is common for rooms with two cold walls.

The effect of these cold walls is to increase the heat loss by radiation from the body; the higher air temperature reduces the loss by convection and evaporation and maintains the thermal balance.

In Great Britain, inside temperatures are usually much lower. British people feel very uncomfortable at the higher air temperatures maintained in American buildings, but are comfortable at temperatures from 60° to 65° F. The human body can in time adjust itself to the standards of either region.

Industrial buildings, gymnasiums and other buildings where the degree of activity is high, as compared with homes, maintain lower air temperatures, because the heat loss from the body is greater, and the lower air temperatures thus permit greater evaporation and convection losses to maintain the heat balance.

Heat Loss and Insulation

The determination of the capacity or size of the various components of the heating system is based on the fundamental concept that heat supplied to a space equals heat lost from the space.

The requisite capacity of the boiler or furnace and, in fact, of the whole heating system depends on the amount of heat to be supplied, and the equation shows that this equals the heat lost. Heat lost from the space is made up of two principal items of which the first is the heat lost through walls, roof, windows, doors and floors.

Heat Loss From Buildings.—To explain how heat is lost through walls, roofs and floors, it is necessary to have some understanding of how heat transfer takes place. Heat flows from a region of higher temperature to one of lower temperature, just as water flows downhill, and it does this in three ways: (1) by conduction, the flow of heat through matter unaccompanied by visible motion of the material, as in an iron rod, one end of which is held in a flame; (2) by convection, the transfer of heat by moving matter (in the case of buildings, air); when air is heated it becomes less dense and rises while the colder, denser air falls and displaces it, and in turn becomes heated; (3) finally, heat is transferred by radiation, the process by which energy is transferred through space, the energy being in the form of waves similar to light or radio waves, but longer. The energy is emitted from a hot or warm surface, is transmitted through the air or space, and when the waves fall on a cooler surface the energy is converted to heat. All three of these processes are involved in heat loss from buildings.

For example, in the simple wall of a house shown in fig. 2, heat flows in winter by conduction from the inside of the building through the plaster and the plasterboard. The warm surface transfers some of its heat by convection to the air in the air space, and this air, in turn, gives up some of its heat to the cooler surface. In addition, the warm surface emits radiant energy which flows in waves across the air space, and this is absorbed by the cooler surface and becomes heat. The heat then continues its flow by conduction through the sheathing and stucco, and finally this heat is transferred by convection to the cold outside air and by radiation to surrounding cold objects.

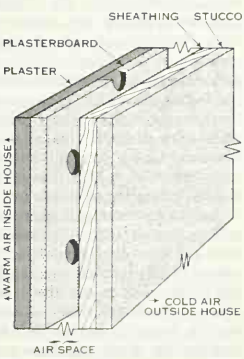

FIG. 2.—SECTION OF A SIMPLE HOUSE WALL

There is, therefore, a great deal more to be considered in the design of a wall or roof than making it aesthetically pleasing and rainproof. Its heat transfer properties are of the greatest importance and should be such that the heat transmitted will be at a minimum so that the quantity of fuel used also will be low. To accomplish this, wherever winters are other than mild, insulation is necessary.

Characteristics of Insulating Materials.—Insulation does not completely stop heat flow, but rather reduces the flow. Broadly speaking, denser materials are better conductors of heat, so that stone walls, for example, lose heat rapidly. This can be overcome by making the walls or roof very thick, but except in the case of monumental buildings such as cathedrals this generally is impractical.

Conversely, less dense materials are better insulators in retarding heat flow by conduction. Usually, too, a material transmits more heat when it is damp than when it is dry.

The quantity of heat which flows through one square foot of a material one inch thick in one hour when the temperature is 1° F. higher on one side than the other is called the conductivity of that material. According to an arbitrary classification, when this conductivity is less than 0.5 the material is considered an insulator. The conductivities of some common building materials are given in Table II.

Since the figures given in Table II are per inch thickness they are not directly usable; for example, there is no such thing as a one-inch-thick brick wall. Furthermore, walls and roofs are always made up of a combination of materials. However, the figures in Table II do show the relative rate of heat transfer, and obviously the last five materials conduct far less heat than the first five.

TABLE II.—*Conductivity of Common Building Materials*

(Figures are in B.T.U. per square foot per inch thickness per hour per 1° temperature difference)

Material	Conductivity	Material	Conductivity
Brick	5.6 to 9.9	Cork	0.27 to 0.35
Concrete	2.3 to 12.0	Glass fibre	0.22 to 0.33
Plaster	2.5 to 4.0	Mineral wool	0.25 to 0.33
Granite	19.0 to 20.5	Insulating board	0.33 to 0.40
Wood	0.6 to 1.1	Vermiculite	0.32 to 0.48

Types of Insulating Materials.—Some insulating materials are supplied in the form of boards or rigid sheets; these are termed insulating boards. Others, such as loose rock wool or vermiculite, can be poured into the air spaces between joists or studs. A third type is the bat, which is a more or less loose insulation held together in heavy paper which can be tacked onto wood joists or studs. Finally, and in a class by themselves, are the reflective insulators which do not insulate against conducted heat but against radiated heat.

The dense materials which are good conductors of heat differ from the insulators in that in the latter there are tiny air spaces, and in ultrasmall spaces air is a very good insulator. However, when the air spaces are large, the heat transfer is aided by convection currents and the air space is not then a particularly good insulator. The conductivity of an air space (per inch) is 1.09. Above $\frac{3}{4}$ in., the addition of thickness of the air space is of little value in reducing conduction.

From fig. 2 and Table II, it becomes obvious that the use of an insulating board of low conductivity in place of the wood sheathing would reduce the heat transfer through the wall. Similarly, use of a mineral wool in the air space would sharply decrease the convection air currents and would eliminate the radiation across the space, since radiation takes place only across a space, so that the wool-filled wall would also be a good insulator. If both the insulating board and mineral wool were used, the wall would be improved even further.

Heat transfer by radiation across the air space can be retarded in still another way—by use of a reflective metal foil. This material, usually aluminum, reflects the radiant rays back to their source; only a very small amount of the energy is absorbed as heat by the foil and conducted to the outside. This type of insulation is useful on either the warm or cold side of an air space, or in an air space, inasmuch as it is not only a good reflector but also a poor radiator of heat energy.

Since the transfer of heat across an air space is aided by convection currents, the use of reflective foil insulation is of more value in winter for floors than for ceilings. This is because the warm surface is at the top of the air space and the foil below the air space in the case of the floor, so that there is virtually no convection. In the ceiling, the reverse is true, and convection is at a maximum. On the other hand, reflective insulations are especially good insulators in roofs in the summer to prevent heat entering the house.

Use of Insulating Materials.—Among the different types of insulation, each has its advantages and uses. The loose or bat type can be used to advantage in filling up air spaces to reduce both conduction and convection. On the other hand, such materials do not add to the strength and rigidity of the building as do the insulating boards, which can be used both as sheathing and as the plaster base or in place of plaster. Finally, the reflective type is advantageous in air spaces to retard heat flow; it may be used in conjunction with other insulating materials or by itself, especially in floors.

It is understandable that each additional increment of insulation yields less return in fuel savings than the first increment, so that there have been attempts to determine how much insulation is justified. Unfortunately, during periods of monetary inflation the cost of fuel may rise far above that contemplated originally, so that a few years later an originally accurate computation becomes highly unbalanced, and far more insulation would have been justified.

Similarly, a more expensive fuel may be employed at a later date, which would justify more insulation than was the case when a low-cost fuel was burned.

In general, then, for a new house it is well to consider the maximum possible use of insulation: for example, bats or loose fill between attic floor joists and reflective insulation on the attic roof; reflective insulation below floors exposed to unheated spaces, and edge insulation along slab floors laid on the ground; insulating board for sheathing and either loose fill or reflective insulation in the air spaces; sealed double windowpanes for all large windows and at least storm windows on others; storm doors on all doors; and windows weather-stripped.

Calculation of Heat Losses.—The heat lost from a building through the walls, windows, roofs, doors and floors is calculated from the equation

Heat lost = coefficient of transmission × temperature difference × area.

In this equation, heat lost is in terms of B.T.U. per hour; the coefficient is in B.T.U. per square foot of area per hour per degree difference in temperature between the inside and outside; temperature difference is that between the inside temperature and the outside design temperature in degrees (Table III); and area is the area in square feet of floor, roof, wall and window in the space involved. The coefficients can be found in engineering tables.

Thus the heat to be supplied increases (1) as the areas of walls, roofs, glass and doors increase; (2) as the temperature difference increases (*i.e.*, the lower the outside design temperature, the greater the temperature difference and therefore the more heat necessary); and (3) as the heat transmission coefficient increases.

TABLE III.—*Outside Design Temperatures for Various Cities*

City	Design temperature, °F.	City	Design temperature, °F.
Atlanta, Ga.	10	Jerusalem	30
Boston, Mass.	0	Johannesburg, S. Af.	30
Chicago, Ill.	−10	London, Eng.	35
Denver, Colo.	−10	Manila, Phil.	60
Houston, Tex.	20	Melbourne, Austr.	35
Los Angeles, Calif.	35	Mexico City, Mex.	30
Minneapolis, Minn.	−20	Montreal, Que.	−15
New York, N.Y.	0	Moscow, U.S.S.R.	−40
Seattle, Wash.	15	Paris, France	10
Washington, D.C.	0	Rio de Janeiro, Braz.	55
Adelaide, Austr.	40	Rome, Italy	25
Berlin, Ger.	5	Stockholm, Swed.	0
Buenos Aires, Arg.	30	Sydney, Austr.	45
Cape Town, S. Af.	35	Tokyo, Jap.	20
Glasgow, Scot.	30	Toronto, Ont.	−10
Hamilton, Bermuda	55	Vancouver, B.C.	10
Havana, Cuba	50	Vienna, Aus.	5
Honolulu, Hawaii	60	Winnipeg, Man.	−35

In addition to the heat lost by conduction through the building enclosing surfaces there is a second loss, that by infiltration. Cold air leaks into a building through cracks around doors and windows and through doors and windows when opened. All such air must be heated, adding to the heat lost, because for every cubic foot of air that enters, a cubic foot of warm air leaks out. The importance of infiltration is indicated by the fact that in a typical five-room house infiltration can account for as much as 37% of the total heat loss. The infiltration loss is calculated from the equation

Heat lost by infiltration = air volume entering per foot of crack × .018 × temperature difference × feet of crack.

In this equation, heat lost is in B.T.U. per hour, air volume in cubic feet per hour is from engineering tables based on tests, temperature difference is as previously defined, the length of crack is as measured and .018 is the B.T.U. necessary to raise the temperature of one cubic foot of air one degree.

Similarly, for ventilation air, B.T.U. per hour is determined by

Heat lost by ventilation = volume of ventilation air × .018 × temperature difference.

Generally, for homes and apartments, the infiltration air is enough to supply ventilation. In public buildings the necessary quantity of ventilation air is considerable and the resulting heat load is more important than the infiltration loss.

Heat flows from a region of higher temperature to one of lower temperature in proportion to the difference in temperature. In a wall, for example, with room air on the inside at 70° F. (21.1° C.) and cold air on the outside at 0° F. (−17.8° C.), there will be 70 times as much heat flow through each square foot as when the inside is at 70° and the outside at 69°. In the former there is a 70° temperature difference, in the latter a 1° difference.

Outside design temperatures are based on the lowest temperature experienced in the locality. This outside design temperature is not the lowest temperature of record but ordinarily is the lowest temperature which occurs at least once every three to five years. Table III shows common values of outside design temperatures in a number of important cities.

In calculating the heat loss, each room is figured separately, then the totals added. Since there is no heat flow between rooms at the same temperature, usually only the outside walls have to be considered.

A special case in insulation is that of concrete slab floors laid directly on the ground. Since an important part of the heat lost through the slab is that around the edges, insulation should be applied around these outside edges.

Insulation and Secondary Effects.—The influence of insulation in reducing fuel consumption is so great that this aspect usually overshadows other important advantages of insulation. The temperature of the surface of the inside wall (or roof or floor) is greatly affected by the construction of the wall; and this temperature is higher with insulated than with uninsulated construction. It has been shown that the human body loses heat by radiation to cold surroundings. If the inside surfaces of the walls and windows are relatively cold, this radiation loss greatly affects the feeling of comfort of the occupants. To overcome this, the air temperature is maintained higher than would be the case if the walls were warmer. Since the occupants feel more comfortable when not losing too much heat by radiation, an advantage of the insulated room is that lower air temperatures can be maintained with equal feeling of comfort.

A second advantage concerns the staining of surfaces, especially ceilings. It is commonly believed that the alternating strips of light and dark on, for example, a wood lath and plaster ceiling are caused by the dust left when air passes through the plaster between the laths. This is not the case. Actually, this stain occurs because convection currents of air are created when there is a difference in temperature between the surface and the adjacent air. The surface friction of these currents generates a charge of static electricity of random polarity, the intensity of which depends upon the air velocity, which in turn is governed by the temperature

difference between the surface and air. The dust particles suspended in the air have the same polarity as the air, usually negative. The surface, which usually has a charge of positive polarity, attracts the negative dust particles and discoloration results.

If the polarity of the surface and the air happens to be the same, the dust particles are repelled and a noticeably clean streak appears on the surface. Since the temperature difference between the surface and air is less with insulation (*i.e.*, in the areas backed by laths), the velocity of the convection currents is lower, the static charge is less, the attraction of the dust particles is weaker and less discoloration occurs.

With floors, perhaps more than with other surfaces, the effect of warmth or coolness is of great importance. A warm floor can be obtained directly by radiant heating in the floor. In this case it is important that the floor temperature be about 77° F. (25° C.), with 85° F. (29.4° C.) as a maximum (an exception is the bathroom floor, where a higher temperature may be pleasant). The floor frequently can be kept at a desirable temperature by use of insulation.

Insulation and Condensation.—The combination of rather high relative humidity in a house, especially when a humidifier is used, low outside temperature and insulation creates the problem of condensation within the wall or roof structure.

With a wall made up of different elements and with a high temperature on the inside and a low one on the outside, the temperatures of the inner surfaces will be somewhere between those of the outer surfaces. Air inside the building, when it has a high relative humidity, also has a high dew point temperature—the temperature at which the moisture in the air will begin to condense. Building materials are permeable to the vapour in the air, and when the temperature inside the wall is at or below the dew point, the moisture from inside the house will condense inside the wall and may cause damage.

To overcome this, the usual practice is to apply a vapour barrier on the warm side of the wall. In some cases this is a sheet of paper containing asphalt; in others the vapour-resistant material is applied to an insulating board. In either case, the resistant material should be continuous, with no openings through or around it. Also, it is important that the material be in the warm or inside portion of the wall. If placed on the outside it can make the problem worse.

Vapour barriers are more necessary with a high degree of insulation than with little or no insulation, more necessary the colder the climate and more necessary the greater the amount of moisture release inside the house from humidifier, cooking and washing. It is especially important that vapour barriers be well overlapped and tightly sealed so that the vapour cannot flow through leaks in the barrier.

Heating Load

The subject of heat loss thus far has been treated entirely on the design basis; that is, the maximum hourly heat loss that is anticipated for extremely cold days. Obviously this does not represent the average load, nor does it give much indication of the total load or fuel consumption for a whole winter.

In the early 1920s it was discovered that the gas consumption of a number of heating plants was proportional to the difference between 65° F. and the daily mean temperature when the latter was below 65°. This difference multiplied by 1 (day) gave the number of degree-days for that day. For example, on a day when the mean temperature is 42° F. there are 65 − 42 = 23 degree-days. The total number of degree-days from fall to spring in a given city is the degree-day total for that city for that heating season. A longtime average of such seasonal totals gives the normal number of degree-days for that city (*see* Table IV).

The degree-day has several uses. One is based on the fact that a building will consume fuel in any period at a rate in proportion to the number of degree-days in that period. For example, if in a winter having 5,000 degree-days a house used 2,000 gal. of oil, and if the next winter there were only 4,000 degree-days, the oil used in the second winter will be $\frac{4,000}{5,000}$ or 80% as much as in the first, or 1,600 gal. In short, use of the degree-day makes it possible to measure with precision the effect of a cold winter or a mild winter on fuel consumption.

Table IV.—*Normal Number of Degree-Days per Heating Season in Typical U.S. and Canadian Cities*

City	No. of degree-days	City	No. of degree-days
Atlanta, Ga.	2,811	Louisville, Ky.	4,279
Birmingham, Ala.	2,780	Minneapolis, Minn.	7,853
Boston, Mass.	5,791	Montreal, Que.	8,501
Chicago, Ill.	6,310	New Orleans, La.	1,175
Cleveland, O.	5,717	New York, N.Y.	5,059
Denver, Colo.	5,673	San Francisco, Calif.	3,069
Detroit, Mich.	6,404	Seattle, Wash.	4,438
Halifax, N.S.	7,608	Toronto, Ont.	7,322
Houston, Tex.	1,276	Vancouver, B.C.	5,465
Kansas City, Mo.	4,888	Washington, D.C.	4,258
Los Angeles, Calif.	1,451	Winnipeg, Man.	10,919

An ingenious use of the degree-day is to anticipate fuel usage. For example, at the end of three months the fuel oil supplier finds that a house used 600 gal. of oil and during that period there were 1,200 degree-days; the house is thus using 0.5 gal. of oil per degree-day. From past experience, he knows that the subsequent two months will have a probable 2,300 degree-days; therefore he knows that the house will need 1,150 gal. of oil in that period. By this method he can predict when the oil tank will be nearly empty and deliver oil before the fuel supply runs out.

From the normal number of degree-days kept on a monthly basis for each city, it is possible also to predict reasonably well the average percentage of the total winter's fuel consumption which will be used each month (*see* Table V).

The degree-day on a 65° base is used in the U.S. and Canada. The degree-day is used also in the British Isles, but there, because of lower inside temperatures, the base is 60°. The figure 4,200 is a good average seasonal total of such degree-days for England.

Table V.—*Heat Load and Fuel Consumption by Months in Percentage of Heating Season Total*

Month	Denver	Los Angeles	New Orleans	New York
September	2%	—	—	1%
October	8	3%	2%	5
November	12	8	12	11
December	17	16	25	18
January	17	20	26	19
February	15	17	21	18
March	14	15	11	15
April	9	11	3	9
May	5	8	—	3
June	1	2	—	1
Total	100%	100%	100%	100%

Fuels

Fuels commonly used for heating buildings include coal, oil, manufactured and natural gases and wood. There are two other not uncommon sources of energy for building heating: electricity, and steam or high-pressure, high-temperature water piped to groups of buildings from a remotely located generating plant. The latter is a special case, usually called district or institutional heating in the U.S.

Wood.—In early times this was the only important fuel and was burned in fireplaces and later in stoves designed for heating. It was gradually displaced by coal and by the 20th century had become a relatively unimportant fuel in North America and much of Europe.

Coal.—Bituminous (soft) coal, which contains not only carbon but hydrocarbons as well, is an important fuel for heating buildings, but rather more so for larger buildings than for homes. It can be fired by hand or by mechanical stokers, and it is the lowest-cost fuel in many areas. However, it is relatively dirty, ash removal is a task and even a mechanical stoker is not completely attention-free, so that its use has declined.

Anthracite (hard) coal is almost pure carbon and once ignited burns with less attention than soft coals. While cleaner than bituminous coals, its disadvantages are much the same, and in addition it is more expensive.

Oil.—Fuel oil was used first for building heating on the Pacific coast of the U.S. and became of some consequence in the early

1920s. By the end of that decade it had made important inroads on coal in the heating of houses and larger buildings, especially the former. Its primary advantage is that, being a liquid, it can be controlled more precisely and burned automatically under control of a room thermostat. In addition, and of great interest to home occupants, it is stored in a tank with no attendant dust, and it leaves no dirty ash which requires periodic removal. As a result of these advantages, and in spite of the higher price of oil during the early days, oil began seriously to displace coal as a heating fuel in the mid-1920s, and this trend continued unbroken except for wartime periods of shortage.

Gas.—Natural gas has long been used for building heating, but its use at first was confined to areas in close proximity to gas deposits, from which it was piped to buildings. Manufactured gas, made by a variety of processes from coal and oil and first widely used for illumination and later for cooking, was considered too expensive for heating, relatively, until about 1920, when it began to be burned in house-heating plants of persons with high incomes.

Gas has all the advantages of oil, plus a few of its own, including the fact that it is even easier than oil to burn and to control, the homeowner needs no storage tank and pays for the fuel after he has used it, the burner can be operated, if necessary, when electric service is interrupted because of storms, and fuel delivery is unaffected by snowstorms or forgetfulness. The apparatus needed is simpler than that required for oil and has few moving parts. The cost, however, is relatively high except in locations near gas deposits. After 1940 the commercial production and marketing of liquefied propane greatly increased as a result of the popularity of gas fuel in districts isolated from natural-gas pipelines. (*See* also Gas Industry.)

Electricity.—This form of energy ranks highest in ease of control for heating and in simplicity of apparatus, but the cost in most cases is far too high for widespread use. Exceptions to this are areas near hydroelectric generating plants. Electricity also has a wide range of possible applications as a secondary or supplementary form of heat, as for bathrooms, buildings used only occasionally (such as churches), rooms with poor heating facilities where the cost of correcting the trouble would be high, and similar special cases.

Solar Heating.—Another source of heat with promise of greater importance at mid-20th century is energy from the sun. By careful orientation of the house with respect to the sun it is possible, with proper shading, to allow sunlight to enter the windows in winter when the sun is far to the south and to prevent it from entering in the summer when the sun is overhead. (*See* also Solar Energy, Utilization of.)

Fuel-Burning Equipment

Among the more important types of self-contained heat sources are (1) the fireplace; (2) space heaters, room cabinets or stoves fired by coal, oil or gas; (3) radiant heaters, burning gas or containing electric resistance coils, and of either the portable or fixed type; and (4) convection unit heaters burning gas or containing electric resistance coils and equipped with a fan to blow air over the hot surfaces. All these are of the more or less self-contained type for individual room use.

For central heating, where the fuel is burned in one place—the basement or utility room—and from which steam, hot water or warm air is distributed to adjacent and remote spaces to be heated, there are (1) hand-fired coal furnaces and boilers; (2) stokers for automatically burning coal; (3) oil burners, oil furnaces and oil boilers; and (4) gas burners, gas furnaces and gas boilers.

History and Development of Heating Equipment.—At the beginning of the Christian era, the Romans had developed a central heating system which utilized conduction, convection and radiation. A furnace was constructed beneath the floor of a building or adjacent to it. The products of combustion were conveyed under the floor, up through flue panels in the walls, and finally discharged to the atmosphere. Several of these systems were uncovered in London after World War II, relics of the ancient Roman occupation. Similar systems are used in certain provinces in China and Japan.

While feudalism was reaching its crest during the 11th and 12th centuries, fortified castles were built. The castles were multiple-storied structures and the disposition of smoke from the fireplaces presented a problem. A solution was achieved by moving the fireplaces to niches in outside walls and providing sloping passages through the wall through which the smoke could escape. The chimney was not introduced until the 14th century.

The great halls or assembly rooms of the castles were provided with one or more large fireplaces, while the occupants of the smaller rooms depended for warmth on individual metal baskets or braziers, filled with coals. It is interesting to note that the interior walls opposite the great fireplaces were constructed of solid masonry of much greater thickness than was structurally necessary. These walls of tremendous thermal capacity absorbed radiation from the fireplaces and reradiated heat to the room long after the fires had burned low. This idea was retained and reappeared in the U.S. early in the 19th century. Many brick houses had two fireplaces on one side of the room while the opposite wall was constructed of solid brick masonry 27 in. or more in thickness.

The fireplace remained in wide use at mid-20th century. In England, although it was gradually giving way to central heating, the fireplace was still an important source of heat in residences.

The earliest reported improvement in the fireplace was that of Louis Savot, who in 1624 developed for the Louvre a fireplace in which room air was drawn through passages under the hearth and behind the fire grate and then discharged into the room through a grille in the mantelpiece, so that occupants were warmed by convected as well as radiant heat. A century later there was introduced a fireplace which warmed air drawn from either the inside or outside of the building.

Fireplaces produce warmth principally by radiation from the fire and from hot bricks at the back and hearth. Air passes through the fire and up the chimney, carrying most of the heat outside, and cold outside air must be drawn into the room to replace the air thus exhausted. Consequently, the fireplace is only about one-third as efficient as a good stove.

Stoves.—The first stove of record was produced in 1490 at Alsace, France. It was constructed of brick and tile. The products of combustion escaped from the stove through a heavy brick and tile flue. Later developments resulted in the Scandinavian stove, which had a tall hollow iron flue containing iron baffles arranged to lengthen the gas travel, and the Russian stove, which had as many as six thick-walled masonry flues. This type of stove is in common use in the regions bordering the North sea. The stove is often built at the intersection of inside partition walls in such a manner that a portion of the stove and its flue is in each of four rooms. A fire is maintained until the stove and flues are thoroughly warmed; then the fire is extinguished and the flues are closed. The stored heat is delivered to the rooms by radiation and convection.

The first manufactured cast-iron stove was produced at Lynn, Mass., in 1642. This stove had no grates and was simply a cast-iron box.

In 1744 Benjamin Franklin improved the stove which bears his name and which was used in conjunction with the fireplace. He also established basic principles of stove design. At about the same time (1792), William Strutt, in England, made a further advance by passing air from a stove through channels so that more remote rooms could be heated.

The first round cast-iron stoves with grates were manufactured at Philadelphia, Pa., in 1800 by Isaac Orr. The base-burner stove for burning anthracite coal was invented in 1833 by Jordan A. Mott.

Although petroleum was known and animal and vegetable oils were used in crude lamps during ancient times for warmth, it was not until the 19th century that oil-burning equipment was specifically designed for producing warmth.

Coal-Burning Equipment.—The basic requirements for burning any form of coal efficiently are (1) a grate on which the fuel is burned and through which air can pass to the fuel bed, and which can be shaken to drop ashes to a pit below; (2) means for carrying the products of combustion to the outside, usually a chimney; (3)

means for providing a draft so that air will flow into the ashpit through the grate and provide the primary air necessary to allow sufficient oxygen to mix with the carbon in the coal during the combustion process; (4) means for admitting a secondary supply of air over the fire to supply oxygen for burning the volatile gases and hydrocarbons in the coal, this being of more importance in burning bituminous coal than anthracite; (5) a metal surface, over which the hot products of combustion pass, sufficiently large that heat is transferred to that surface, which in turn will heat water or air; and (6) a chamber of sufficient volume surrounding the grate to allow the air to mix with the fuel.

All these requirements are fulfilled in hand-fired, coal-burning furnaces and boilers, as well as in mechanical stokers, which, in addition to the above, provide means for feeding coal gradually and automatically to the grate and make the process of firing including the disposal of the ashes to a pit, a continuous one. Such stokers have wide application in industrial and commercial installations, but for residences the stoker, which had wide popularity during the 1930s and early 1940s, gradually lost ground because of the advantages of oil and gas.

Oil Burners.—Oil burners used in residences are of two principal types—vaporizing and atomizing. In burning oil, the liquid must be gasified to burn, and the vaporizing burner accomplishes this by evaporation, the oil being heated for this purpose.

In fig. 3 the principle of one type of vaporizing burner is illustrated. Oil is fed to the bottom of a bucket-shaped perforated vessel; vapour rises from the oil and is mixed with the primary air and finally, at the top, begins to burn, with a secondary supply of air fed to the flame through the perforation at the top. The heat of the flame itself causes more oil to vaporize, so that the process is continuous.

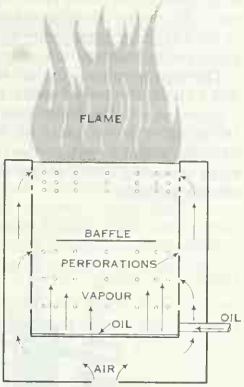

FIG. 3.—VAPORIZING OIL BURNER. THE OIL BURNS AFTER BEING EVAPORATED TO GAS

In the atomizing- or pressure-type burner, illustrated in fig. 4, the oil is atomized or broken up into small drops by pressure. The air pressure is supplied by a motor-driven fan, the air supply being regulated by a shutter. Oil is fed to a nozzle under pressure by a pump and is ejected from the nozzle in a cone-shaped spray into the air stream. This burner is also called a gun-type burner.

Another type of atomizing burner is the rotary burner. The rotary type employs a motor-driven cup or disk from which the oil is thrown off in a cone-shaped spray.

In large installations there is an increasing tendency to use burners so designed that they can burn either gas or oil, or pulverized coal, arranged for convenient change from one to the other. The advantage is that when one fuel becomes more expensive than another, or when one is in short supply, another may be used.

Gas Burners.—Gas burners are generally of simple design. Gas is supplied to the burner at a pressure sufficient to induce a supply of primary air to mix with it, the mixture then passing through orifices or ribbonlike openings over which secondary air is admitted. In the usual case this is all accomplished without a forced draft, so that the mechanism is simple and trouble-free.

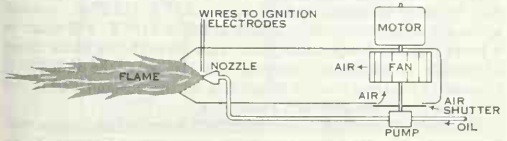

FIG. 4.—ATOMIZING OIL BURNER. BURNING OCCURS AFTER THE OIL HAS BEEN CHANGED TO A GAS BY BEING FORCED UNDER PRESSURE THROUGH A SMALL NOZZLE INTO AN AIR STREAM

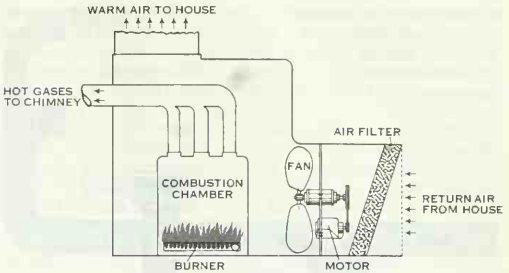

FIG. 5.—FORCED WARM-AIR FURNACE

Requirements for burning gas also include a combustion chamber and means of heat transfer and, finally, venting to the atmosphere for safety. The fuel used is completely independent of the method for transferring the heat to the rooms to be heated; that is, whether the heating system utilizes warm air, steam or hot water, the fuel can be coal, oil or gas.

Electricity.—Although not a fuel, electricity is a form of energy used for heating, and the commonest method of converting the energy to heat is by coils or other means of introducing resistance into the circuit, so that the heating elements become hot and directly heat air or water or, in other cases, emit radiant energy.

Heating Systems

Heat is generated by fuel burning either in a furnace, an arrangement by which air is warmed by contact with metal surfaces heated in turn by the hot gases of combustion, or in a boiler, a vessel containing water heated by contact with hot surfaces. The boiler can be either a steam or hot-water boiler and may be used with a steam or hot-water system.

Warm Air.—The principle of the warm-air furnace is illustrated in fig. 5. The furnace is conventionally made of steel, and the essential requirements are that (1) the combustion chamber and its connections to the flue must be gastight to prevent fumes from getting into the stream of air supplied to the house; (2) there must be sufficient metal surface to provide for the transfer of most of the heat of combustion to the air; (3) there must be a tight casing around the whole apparatus; and (4) the furnace should be compactly arranged. The drawing is simplified to show the principle; a centrifugal fan rather than a propeller fan usually is employed.

The warm air from a furnace, being lighter than the cooler air around it, can be carried by gravity in pipes or ducts to the room to be heated, and until about 1930 this was the usual method. A gravity system, however, required sheet metal ducts of 8 to 14 in. in diameter to reduce air friction, and this resulted in the basement's being filled with ductwork. The pressure, or head, resulting from the difference in density of the air is quite small, and for this reason rooms distant from the furnace, especially those to windward, frequently were underheated. Use of a motor-driven fan to move the air made possible the use of small, compact, rectangular ducts giving a neat installation and forcing heated air to the most remote rooms.

The heated air is introduced into the room through registers, grilles or diffusers in a variety of types, including arrangements resembling baseboards along outside walls. The heated air, after giving up its heat to the room, is returned to the furnace, usually through one or two return ducts, as shown in fig. 6. An advantage of this method of forced warm-air heating is that the air can be passed through filters and cleaned as it circulates through the system.

Hot-Water Heating.—Hot-water heating seems to have originated in France early in the 18th century and was used first in a greenhouse. An incubator for hatching chickens for the Paris market was heated by a hot-water circuit even before the French Revolution. Hot-water pipes were employed by Sir John Stone

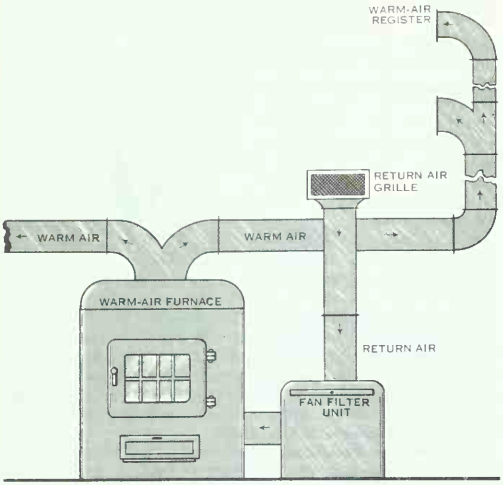

FIG. 6.—FORCED WARM-AIR SYSTEM. HEATED AIR IS BLOWN TO ROOMS BY A FAN, AND THE AIR RETURNS TO THE FURNACE FOR REHEATING

in 1792 to heat the Bank of England, but it was not until about 1840 that Robert Briggs began the installation of hot-water heating in the U.S.

A hot-water system consists of the boiler and a system of pipes connected to radiators suitably located in rooms to be heated, the principle being shown in fig. 7. The pipes, usually of steel or copper, feed hot water to radiators or convectors, which give up their heat to the room. The water, now cooled, is returned to the boiler for reheating. Two important requirements of a hot-water system are (1) provision to allow for the expansion of the water in the system, which fills the boiler, radiators and piping; and (2) means for allowing air to escape from each radiator by a manually or automatically operated valve.

Early hot-water systems, like warm-air systems, operated by gravity, the cool water, being more dense, dropping back to the boiler, forcing the heated lighter water to rise to the radiators. Neither the gravity warm-air nor gravity hot-water system could be used to heat rooms below the furnace or boiler. Consequently, motor-driven pumps or circulators introduced to supply positive means of circulating water made it possible to locate the boiler anywhere with regard to its elevation compared to the radiators—

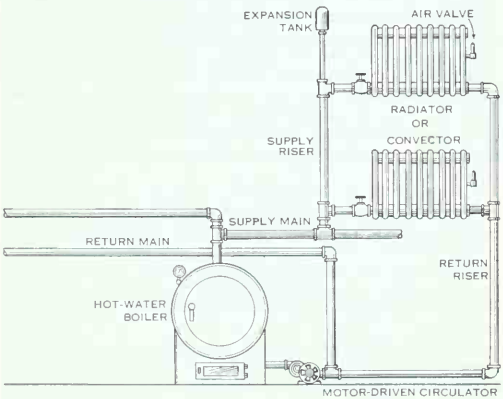

FIG. 7.—FORCED HOT-WATER SYSTEM. WATER IS DRIVEN THROUGH THE SYSTEM BY A CIRCULATOR

even in the attic if desired. As with warm air, smaller pipes can be used when the fluid is pumped than with gravity operation.

Steam Heating.—Steam heating on a practical scale was investigated by James Watt in 1784, and in 1791 a Halifax inventor patented a steam-heating method. Thomas Tredgold in 1824 employed cast-iron pipes to heat by steam a silk mill in Watford, Eng. Early Americans who contributed to the development of steam heating included John H. Mills, who in 1877 designed an overhead downfeed one-pipe steam system. Frederick Tudor in 1883 developed the modulating valve and in 1902 made improvements in a return line system vented to the atmosphere. In 1899 James A. Trane developed a vapour system, and in 1903 C. A. Dunham marketed a fluid-filled thermostatic trap for steam systems.

Steam systems are those in which steam is generated, usually at less than 5 pounds per square inch in the boiler (fig. 8), and the steam is led to the radiators through steel or copper pipes. The steam gives up its heat to the radiator and the radiator to the room, and the cooling of the steam condenses it to water. The condensate is returned to the boiler either by gravity or by a pump. Arrangement of a simple one-pipe system is shown in fig. 9. The air valve on each radiator is necessary to allow air to escape. Otherwise it would prevent steam from entering the radiator.

The vapour system (fig. 10) differs from the one-pipe system in that (1) the condensed steam returns from the radiator through a return pipe to the boiler (instead of through the supply pipe); (2) a trap, a device which allows water and air but not steam to leave the radiator, guards the return outlet; and (3) air is eliminated through a device at the boiler instead of through air valves on each radiator.

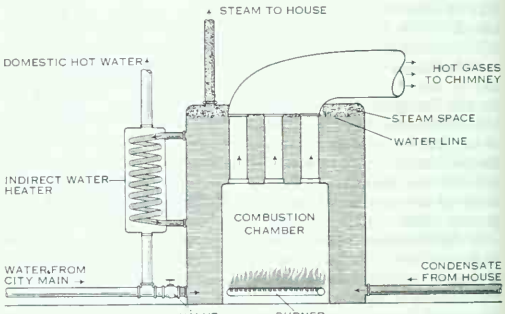

FIG. 8.—STEAM HEATING BOILER

A system widely used in larger buildings is the vacuum system (fig. 11). A vacuum pump maintains a pressure below that of the atmosphere in the return lines, draws all the air and water to it, expels the air and pumps the water back into the boiler. A feature of this system is its ability to raise the condensate from a radiator below the boiler.

Much ingenuity has been applied to steam heating, including methods for controlling the steam temperature. By maintaining a vacuum in the radiator as well as in the return lines, the pressure inside the radiator can be reduced to such a point that water will boil at temperatures well below the 212° F. (100° C.) at atmospheric pressure. Consequently, on the coldest days no vacuum is applied, and the steam in the radiator is at 212°. The warmer the day, the more vacuum is applied, until at 65° F. (18.3° C.) outside a vacuum sufficient to cause boiling at below 212° F. will result in a lower radiator temperature, and so on through the whole range of outside temperatures expected. In this way, the radiator is constantly emitting heat in proportion to the demand and is not alternately heating and then cooling off.

The hot-water system differs from both warm-air and steam systems in an important respect—both warm air and steam, being gases, have a low mass as compared with hot water. As a result, with an intermittently fired fuel, such as oil or gas, in which the

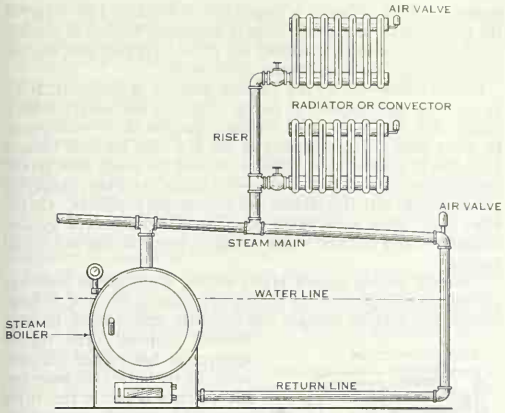

FIG. 9.—SIMPLE ONE-PIPE SYSTEM IN WHICH STEAM FLOWS UPWARD THROUGH A RISER TO THE RADIATORS, WHILE CONDENSATE FROM THE RADIATORS IS RETURNING DOWNWARD THROUGH THE SAME PIPE TO THE BOILER

fuel is burning at one period and off the next, the hot-water system can "hold" heat for a longer period and not undergo the sharp temperature fluctuations of steam and warm-air systems.

To perform most efficiently, steam systems require more apparatus than hot-water or warm-air systems. As a result, warm air and hot water have largely replaced steam in house heating. On the other hand, in larger structures, such as office buildings, hotels and apartment houses, steam has such advantages that it is strongly preferred.

Heat Distribution Devices.—With each of the three systems there are many variations in the method of transferring the heat to the space to be heated. For example, with steam and hot water, an alternative to the common radiator (which, incidentally, is misnamed, because it emits much of its heat by convection) is the convector, an arrangement of finned pipes through which the heating fluid circulates at the base of an enclosure open at top and bottom; air flows upward over the heating surface and is discharged at the top of the enclosure; cooled air drops to the floor and re-enters the convector.

Still another arrangement is the baseboard radiator or convector, usually placed along the bottom of an outside wall to counteract the loss of heat through the walls.

Many industrial buildings are heated with a special form of heater called the unit heater, which consists of an arrangement of finned tubes through which hot water or steam circulates, and a motor directly connected to a fan which forces air over the tubes. Unit heaters are made both in suspended types, mounted above the floor (fig. 12), and in floor-mounted units. The forced convection results in a rapid rate of heat transfer.

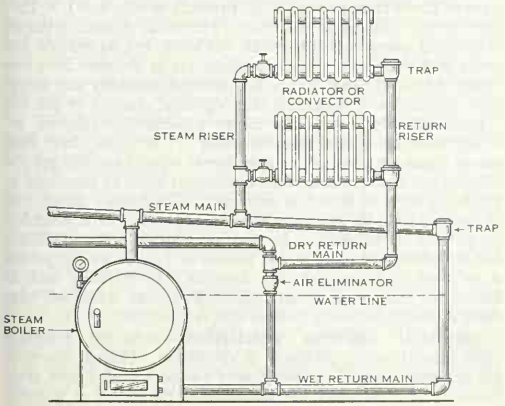

FIG. 10.—VAPOUR SYSTEM, IN WHICH THE AIR IS REMOVED FROM THE SYSTEM AT A CENTRAL ELIMINATOR RATHER THAN THROUGH VALVES ON EACH RADIATOR

There are many combination systems using steam and hot water with warm air, called split systems. Many public buildings are heated by hot-blast systems in which steam is generated in a boiler and flows to large banks of heat-transfer surfaces over which air is blown by large fans; the warmed air is supplied to rooms through ducts. This type of system is often used for air conditioning, the heat-transfer surface being fed cold water in summer, steam in winter.

For residences there is an arrangement of hot water piped to small heat-transfer devices below the floor or in the walls; over them air is blown by fans and enters the room through grilles. In the summer, chilled water circulates to the heat-transfer units, which are located throughout the house so that no long runs of space-consuming ductwork are needed. All these methods are primarily convection types of heating, although there is some transfer by radiation.

Radiant Heating.—The Roman hypocaust system, in which a hollow wall or floor was heated by gases from a fire below and in turn radiated heat into a room, was the first application of what is now known as radiant or panel heating. This principle was ignored for centuries until 1908, when A. H. Barker of England observed the comfortable effect obtained from walls warmed by chimneys. He later patented several arrangements for heating floors, walls and ceilings, and many such systems were installed in England. The idea was first widely adopted in the U.S. not long before World War II.

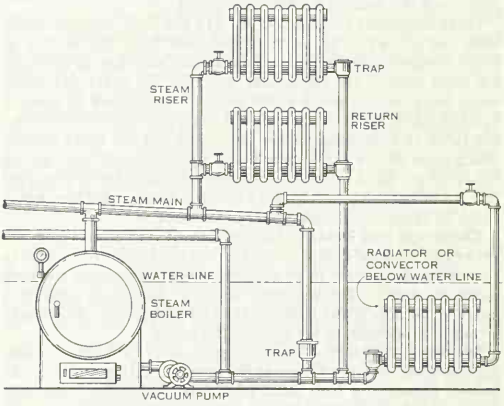

FIG. 11.—VACUUM SYSTEM IN WHICH CONDENSED STEAM IS PUMPED BACK INTO THE BOILER. THE SYSTEM OPERATES AT LESS THAN ATMOSPHERIC PRESSURE

Although there are many variations, radiant heating systems usually employ either (1) hot-water pipes embedded in the floor or ceiling (occasionally in the walls); (2) warm-air ducts embedded in the floor; or (3) some form of electrical resistance panels applied to ceiling or walls or, in some cases, the floor. The energy in the heated surface is transmitted through the air in the form of infrared rays, with practically no temperature effect on the air, and converted to heat when the rays impinge on solids, whether room surfaces, furniture or human beings. With many of these systems there is no visible heating equipment in the room, and this is an advantage in decorating. A disadvantage is the extent to which a ceiling or floor might be ruined in case of trouble with corroded or faulty hot-water piping where this method is employed.

Heat Pumps.—Rather than burning fuel and directly liberating its energy for heating purposes, an alternative approach is to ab-

stract heat from some large source at low temperature—*e.g.*, the sea—and to reject this heat at a more suitable level of temperature. The device for doing this is called a heat pump.

There is no theoretical difference, except in terminology, between a heat pump and a refrigerator, but in practice the removal of heat from some enclosure is the primary function of the refrigerator, while with the heat pump the principal object is to reject heat into an enclosure. An ideal heat pump to which heat is supplied from a source at 32° F. (0° C.) and from which it is ejected at 60° F. (15.6° C.) would produce about 18 B.T.U. of heat for every 1 B.T.U. supplied to operate the pump. In practice, of course, results are much less favourable, but it is feasible to obtain up to 2 B.T.U. for heating purposes per 1 B.T.U. supplied as fuel. By comparison, the useful heating output of a boiler is about 0.8 B.T.U. per 1 B.T.U. supplied as fuel.

The heat pump has not found wide application partly because the high cost of the necessary equipment largely offsets the lower fuel cost and partly because of the difficulty of extracting heat from the most usual sources—the atmosphere, the earth, rivers, ponds, wells, etc.

Heating Controls.—Oil and gas fuels never would have attained their great popularity had it not been for automatic operation of the heating plant. Automation was made possible principally by the thermostat, a device which, when the temperature in a space drops to a predetermined point, will actuate the heating plant until the demand for heat is satisfied.

Other important controls include (1) the limit control, which, when the air, water or steam temperature from the furnace or boiler reaches a point considered dangerous, will shut off the heating plant even if the thermostat still calls for heat; (2) boiler water level control, which either shuts off the burner or opens a valve to admit water to the boiler if the water level in the boiler has fallen to a dangerously low level; and (3) the flame control, which shuts off the fuel supply if the ignition system for lighting the oil or gas flame fails. Modern heating plants are so protected by such devices that nearly every conceivable circumstance which could be dangerous is anticipated and controlled.

Chimneys and Draft.—The products of combustion from oil, gas or coal must be vented to the air, and the chimney provided to carry them away must be of sufficient height to produce a certain minimum draft. The one-story house in particular presents a problem, because if the chimney is to be adequate its height may be out of proportion to the scale of the house.

Service Hot Water.—The heating of water for bathing, washing and other purposes is part of the over-all heating problem. In houses, formerly, a very small hand-fired coal boiler commonly was used for this purpose alone. This was largely superseded by (1) the separate gas, electric or oil water heater in which the heating burner or element is included in the same unit as the hot-water storage; when hot water is drawn off, cold water enters, affecting a thermostat which turns on the heat until the tank temperature again reaches the predetermined level; or (2) a heat exchanger of small size connected to the house-heating boiler and extracting heat from the boiler water to heat the service water (*see* fig. 8).

With the separately fired unit, the heating system and hot-water system are entirely independent of each other, an advantage in case of trouble and during seasons when the heating system is not needed. With the combination system, the heat used to heat the water is by no means all waste heat, and a larger boiler must be provided if an indirect heater is to be installed. On the other hand, some tests have indicated greater economy with the indirect heater. With a warm-air furnace the homeowner has little choice but to use a separate, direct-fired heater.

The total hot-water use ranges from 7 to 12 gal. per day per person on the average, although the range may be as much as 4 to 25 gal. per day per person, and some authorities even use a figure as high as 40 gal. per day per person. The figure varies widely with different families.

The trend is toward higher temperature hot water because of (1) the importance of killing bacteria in dishwashing, tests of which have demonstrated the need for temperatures of at least 180° F. (82.2° C.); and (2) the desirability of very hot water for washing clothes. Since it is impracticable to carry 180° water in the whole system and in fact actually dangerous because of possible scalding, dish-washing machines are often equipped with electric heaters to raise the temperature of the water.

District Heating.—First put into practice in Lockport, N.Y., in 1877, the arrangement of piping steam (or hot water) from a steam plant to a number of buildings became fairly widespread. In many large cities, especially in the U.S., the business became a sideline of electric utility companies, and the steam lines served the business districts of the city—the larger buildings; supplying private homes with this service was not deemed profitable. On the other hand, there were hundreds of small towns served by municipally owned utilities whose principal function was residential heating.

Centrally located private plants serving a number of buildings are still commonplace in the U.S. in two other cases: first, in large institutions, such as colleges and hospitals, and, second, in large housing projects. The former application has existed for decades. In the latter case, however, the practice began in the 1930s when the federal government sponsored or built many such plants.

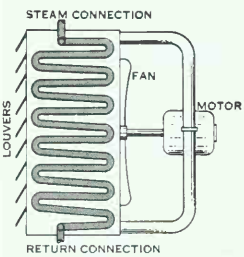

FIG. 12.—UNIT HEATER THROUGH WHICH AIR IS BLOWN BY A FAN. ADJUSTABLE LOUVERS DEFLECT HEAT IN DESIRED DIRECTION

VENTILATION

As early as 1553 a rotary fan was used by Georgius Agricola to ventilate a mine; and during the 18th century, French, English and Swedish inventors were concerned with improving the fan for mine and ship ventilation. The reason behind the need for ventilation, however, was a mystery: some investigators said it was excessive heat; others disputed this and said the reason was inequality of temperature in the room or space. In 1777 the French chemist Antoine Lavoisier suggested that the increase of carbon dioxide in an occupied space was the objectionable factor, but Max Joseph von Pettenkofer in 1863 showed that this was quantitatively too small (0.03% to 0.05%) to explain the results observed. Similarly, the reduction of oxygen content was said to be small, from a normal 21% to about 20%.

In the late 19th century the French physiologist Charles Édouard Brown-Séquard advanced the theory that the harmful effects of air in an occupied space were attributable to certain poisonous substances in the air called anthropotoxins or morbific matter.

All these theories were finally abandoned, as a result of the work of Karl Flügge in 1905, F. G. Benedict in 1907 and J. S. Haldane in 1907. Flügge showed that (1) chemical changes in the air in occupied spaces are not harmful; (2) headaches, nausea and dizziness in ill-ventilated space are solely due to deficient heat loss (from the body); and (3) the temperature, humidity and movement are far more important than chemical changes in the air.

Essentially this covers the theory subsequently adopted, although there are special cases including (1) factories where dangerous fumes are given off, or even homes where unvented gas appliances can result in dangerous conditions; and (2) situations in which the effect of odours is important. The modern theory can be summed up in the statement that for places of general assembly the purpose of ventilation is to carry away excess heat and odours, and that normally 10 cu.ft. per minute of outside air per person is sufficient to accomplish this objective. In buildings such as homes, the leakage of air through cracks around doors and windows is usually sufficient to meet this requirement.

Industrial Building Ventilation.—Industrial buildings often present special problems in ventilation. Certain processes are accompanied by the production of air-borne dust, fumes, toxic vapours and gases which are hazardous to the health of workers. Research has determined the limits of concentration permissible for human tolerance to prolonged exposure. The problem of industrial ventilation is also complicated by the hazards of fire and

explosion of combustible dust and gases.

Successful methods have been developed for the control of the concentration of toxic gases and harmful dusts within safe limits for the health of the occupants of spaces, but the control of inflammable and explosive concentrations of gases and dusts is much more difficult and uncertain.

Three types of ventilating systems are in use for the control of dangerous gases and dusts: exhaust systems, dilution systems and combinations of the two. Exhaust systems require the least amount of air and are most effective when the contaminants originate at localized spots. The contaminated air is exhausted at high velocity from hoods which have sufficient entrance velocity to pick up the contaminants. Exhaust systems are least effective in the ventilation of bins, coal bunkers, etc.

The dilution method is used when the sources of contamination are not localized but are dispersed over a wide area. It is very effective but is seldom used to dilute heavy concentrations because of the large quantities of air required. The cost of heating the air is often prohibitive.

The third method of control by ventilation is a combination of exhaust and dilution, and is used when contaminants can be confined to and exhausted from booths. The development of air-cleaning devices and air-purification processes makes it possible in many cases to recirculate the air and greatly reduce the quantity of fresh air required, thus reducing the expense of operation.

Motor-driven fan systems are not always necessary, and natural forces—gravity and wind—may be used to facilitate air movement. In a building where the air temperature inside is higher than that outside, the difference in density can be employed as it is in a chimney. Any opening in the roof can be employed, and the warm, light air flows out, its place being taken by cooler air flowing in below. This method is crude, because rain can enter through the opening and because the air flow is very low when the difference between inside and outside temperatures is small.

Ventilating Apparatus.—To overcome these disadvantages, many types of roof ventilators have been designed. A typical gravity roof ventilator is designed so that wind rotates it into such a position that the flow of air past the ventilator draws room air through the ventilator and also so that rain or snow cannot enter. Motor-driven roof ventilators also are made to give air movement regardless of available wind and temperature differences.

In winter the exhausting of air from a building at any point necessarily results in cold outside air entering elsewhere, and this cold air can produce disagreeable drafts. Consequently make-up air-heating units are frequently employed to heat the outside air introduced so as to balance the warm air being exhausted.

For relatively damp climates, a more efficient system of ventilation is one in which all ventilating air is drawn from outside the building, passing first through a filter and then over the cold dehumidifying coils of a vapour-cycle refrigerator. In summer this cool, relatively dry air may be passed directly into the building; in winter some form of heating coils restores the air to a comfortable temperature. In place of dehumidifying coils, a solid absorbent such as silica gel or a liquid such as lithium chloride may be used to reduce the humidity of the incoming air. (*See* also FAN [MECHANICAL].)

Attic Ventilation.—A fan located in the attic may be so arranged in a house with open stairways that during the summer the fan operates at night when temperatures drop and, with open windows in the house, draws warm air from the house through the fan and discharges it to the outside, cool night air being drawn in through the open windows.

Fans which exhaust directly to the outside from the attic space should be located so that they discharge with and not against the prevailing wind. Those which exhaust into the attic from the space below should be located over a central hall. The discharge from the fan should be as far as possible from adjacent walls and chimneys. A minimum distance of six to eight feet should be maintained, if possible.

Air Sanitation.—Although ventilation was formerly concerned with the supply of fresh air (a misnomer for outside air) to and the removal of hot and contaminated air from the space, it gradually came to embrace—or at least to be associated with—what can be termed air sanitation, the cleaning of air, whether the contaminating substance be dust, toxic fumes, odours or bacteria.

Air pollution in large cities is caused by the dumping into the atmosphere of exhaust gases from gasoline and diesel engines and coal, oil and gas-fired boilers, and dusts and fumes from a wide variety of industrial operations. Of these the most attention formerly was paid to coal boiler operations, and the problem was generally believed to be a smoke problem. Perhaps the turning point in this viewpoint was the Donora, Pa., disaster in 1948, when smog, a combination of factors—fumes from an industrial plant, a natural fog, and a valley location isolated from breezes at the time—caused 20 deaths. This disaster coincided with a rapid decrease in the number of coal-fired steam locomotives, which were replaced by diesel engines, but which formerly were among the important smoke producers. As a result, there was an increasing tendency to look on air pollution as a problem comprising more factors than control of smoke-producing apparatus alone would eliminate. (*See* also SMOKE AND ATMOSPHERIC POLLUTION.)

Dust can be removed from the air by four basic methods: (1) filters, mechanical devices of porous mediums through which dust-laden air is passed and in which the dust is trapped by impinging upon or enmeshing in the filter medium, a common type being coated with a viscous substance to which the dust clings; (2) electrical precipitation, by which the dust particles are attracted and held by oppositely charged wires; (3) the wet method, or washing of the air by water sprays; and (4) dynamic precipitation, by which the dust is thrown off by centrifugal force in a mechanical device such as the so-called cyclone.

In general, air filters are used where the dust concentration is relatively low and does not exceed 4 gr. per 1,000 cubic feet of air. The dusts these filters remove can be termed temporary atmospheric impurities, including house dust and pollens, which are specific nuisances to persons allergic to them. The filtering medium varies, and glass fibre, wire screen, steel wool, animal hair and hemp fibres have all been employed.

Electric precipitators are of two types—one of the ionizing type in which dust particles are given a charge in passing through an ionizing zone, and the second variety having charged collectors by means of which the energized, collecting medium induces a charge on the particles. These machines are highly efficient in removing dusts so fine that they have no gravitational settling tendency. Precipitators are especially useful for removing smoke from the air.

There are a number of different types of wet collectors wherein the contaminant is brought into contact with water in order to remove the dust from the air stream. This type of dust collector is particularly adapted to high-temperature, moisture-laden gases. Generally, however, its use is in the industrial field rather than in the field of comfort ventilation.

Dynamic precipitators are also of several types, of which the cyclone is widely employed for the removal of coarse dust from an air stream or as a separator to remove dust from industrial operations.

Indications are that in the future ultrasonic agglomerators may have wide application. High-intensity sound can be used to coagulate very fine aerosols such as smoke, fumes or fine dusts into particles large enough to be collected by one of the types of dust-collection equipment previously described. (*See* ULTRASONICS.)

About the only practical method for removing odours from air is adsorption of the odour by activated carbon, which is effective against cooking, body and tobacco odours. Some of the bacteria in contaminated air are removed by filters and electric precipitators; however, a better method is by ultraviolet irradiation. Propylene glycol mists also have been found effective against certain types of bacteria. However, the killing of bacteria and the removal of chemical fumes are both matters needing far more research. The impetus for this is expected to come from the demand by urban centres for lessening atmospheric contamination. *See* also references under "Heating and Ventilation" in the Index volume.

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HEATSTROKE is the term for the most serious disorder due to exposure to environmental or climatic heat. The term sunstroke, a less commonly used and unnecessary term, refers to the same disorder when exposure to direct sunlight is the main source of environmental heat. The fundamental feature of the disorder is an extreme and uncontrolled elevation of body temperature. The high temperature (106° to 110° F. [41.11° to 43.33° C.], or even higher) exerts its harmful effect chiefly on the central nervous system.

There is good evidence that heatstroke in its uncomplicated form is due to the failure of sweating to remove the heat produced in the body. The average human body produces 70 calories of heat per hour at rest and up to eight times this figure in severe muscular work. In mild climates this heat is eliminated by radiation and convection from the skin and lungs, and by evaporation of sweat. As the climate becomes hotter (the wet-bulb temperature is the best single index of climatic severity), all methods of heat elimination become ineffective except the evaporation of sweat. Experiments involving prolonged work in heat demonstrate a slow decline in rate of sweating. Thus, physiologic mechanisms for control of body temperature weaken as exposure to heat is prolonged. This does no harm so long as the amount of sweat necessary for evaporative cooling is sufficient. When an insufficient sweat rate is reached, the body temperature rises. Changes may occur rapidly; these include a further drop or near cessation of sweating, a more rapid rise in temperature, collapse, coma and death if prompt treatment by cooling is not instituted.

It is notable that continuous exposure to heat for many hours is necessary to produce heatstroke. Climatic areas with hot days and cool nights are not danger areas for heatstroke; high incidence of heatstroke has been reported in Red sea areas, southern Asia and in crowded urban areas and military camps in the United States. Experience on naval ships demonstrates that the air conditioning of sleeping quarters generally controls the incidence of heatstroke in the tropics.

The victim of heatstroke, when seen early, is irrational or comatose with rapid bounding pulse and hot, dry, flushed skin. As collapse persists, the coma deepens and a weak, thready pulse and a more dusky skin will follow. Rapid cooling of the body is urgent if the victim's life is to be saved. Ice water baths or packs, with massage to promote circulation, are effective under any climatic conditions; evaporative cooling with sprayed water and fans will be effective if the temperature and humidity allow rapid evaporation. Cooling should stop when the rectal temperature reaches 102° F. (38.89° C.) but should be reinstituted if temperature rises again.

After this first-aid procedure, expert medical care is necessary to manage the circulatory disorder and brain damage effects. Deaths from these residual damages are not unusual. The recovered patient may have increased susceptibility to the ill effects of heat.

Individuals exposed to extreme environmental heat may and often do experience other difficulties. They need large amounts of water and salt to replace those lost in the sweat. Without sufficient water, they suffer from dehydration and may collapse from inadequate circulation. This collapse, whether due to dehydration or other causes, is called heat exhaustion. It can be distinguished readily from heatstroke by the moderate or absent elevation of body temperature and by the persistence of heavy sweating. Salt depletion may contribute to heat exhaustion or cause other difficulties, among them heat cramps, which are relieved specifically by supplying added salt to the diet. Although such factors may complicate or even precipitate heatstroke, they are complications rather than essential features.

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HEAT-TREATMENT. The heat-treatment of metals and alloys is carried out to alter their mechanical properties. For industrial applications *see* ANNEALING. The following discussion of heat treatment is divided into three categories: (1) recovery and recrystallization, which are accomplished by heating a metal that has been plastically deformed at room temperature; (2) precipitation, or age hardening, which is characteristic of the alloys that have a decreasing solubility of one constituent in another with decreasing temperature; and (3) hardening (or softening) by means of phase changes in the solid state on heating or cooling through certain temperature ranges.

RECOVERY AND RECRYSTALLIZATION

The atoms of a metal crystal that is not strained or deformed are arranged in an orderly pattern. Two of the commoner atomic arrangements are those of the body-centred cube and the face-centred cube (*see* ALLOYS: *Structure of Alloys*).

Metals and alloys used for engineering applications are not single crystals but are made up of many crystals. These crystals are called grains in the metal. When a metal is plastically deformed or cold-worked at a low enough temperature; *i.e.*, room temperature for most metals, the metal is strain-hardened. The strain hardening results from the fact that slip is occurring on the crystallographic planes of the grains and the orderly arrangement of atoms is replaced by a distorted lattice (*see* CRYSTALS, DISLOCATION OF).

The normal equiaxed grains of the unstrained material are replaced by elongated grains resulting from the plastic deformation. The plastic deformation is accompanied by an increase in the tensile strength, yield strength and hardness, and a decrease in ductility as measured by elongation and reduction of area in the tensile test. Obviously the cold working could be carried out to the point where fracture would occur.

Since the cold work as performed in commercial processes is nonhomogeneous, macroscopic stresses are set up in the metal. A cold-drawn wire will have residual compressive stresses at the centre and residual tensile stresses at the surface of the wire. In addition, there are microscopic stresses set up because of the slip that occurs on the atom planes during the cold working of the metal. These residual stresses may or may not improve the quality of the part.

FROM SACHS AND VAN HORN, "PRACTICAL METALLURGY"; REPRODUCED BY PERMISSION OF AMERICAN SOCIETY FOR METALS

FIG. 1.—DIAGRAMMATIC REPRESENTATION OF THE DIFFERENT TYPES OF CHANGES IN PROPERTIES PRODUCED BY ANNEALING A COLD WORKED METAL

If the residual stresses are in tension at the surface of the part, they are detrimental as far as fatigue and stress corrosion are concerned. If the residual stresses are in compression at the surface, they are beneficial as far as fatigue is concerned.

The heat treatment of a cold-worked part simply involves heating of the metal to some elevated temperature to allow diffusion; *i.e.*, atom movement, to take place. This tends to allow the atoms to again assume an orderly pattern. Two distinct processes

occur on heating a cold-worked metal. The first, which is termed recovery, occurs at low temperatures and results primarily in relieving the residual stress without any appreciable change in hardness or microstructure. The elongated grains of the cold-worked metal are unaffected during the recovery period. Process equipment, such as welded pressure vessels, is frequently subjected to a low-temperature anneal after welding in order to remove the residual stresses produced during the welding operation.

The second process is termed recrystallization and grain growth. When the temperature is increased to a sufficient degree, very small unstrained grains begin to replace the strained grains of the cold-worked metal; in other words, the metal is undergoing recrystallization. Grain growth is merely an enlargement of the recrystallized grains.

Recovery and recrystallization and growth are time dependent. Increasing the temperature increases the rate at which both occur, and if the temperature is high enough both processes will proceed simultaneously. The temperature of recrystallization varies a great deal from metal to metal, and is also dependent on the amount of cold work applied to the metal, the grain size of the metal, composition of the alloy and purity of the metal.

Recrystallization and grain growth are accompanied by a lowering of the strength of the cold-worked metal. This is shown schematically in fig. 1. It can be seen from this diagram that the residual stress is relieved to a great extent before any change in strength or microstructure occurs. Recrystallization occurs over a narrow temperature range for a constant time of annealing, and grain growth occurs on heating to higher temperatures.

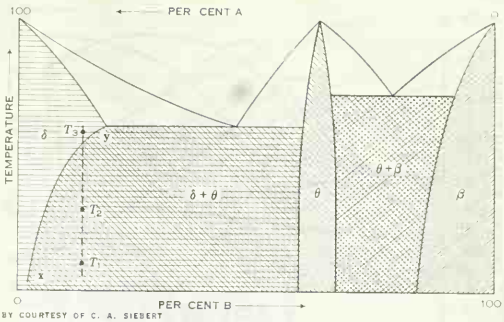
Many commercial products are fabricated by cold-stamping or -drawing operations. In many instances it is necessary to subject the partially formed parts to annealing treatments so that recrystallization occurs which restores the ductility to the material and conditions it so that further cold-working operations may be carried out.

The manufacture of cartridge cases illustrates an operation of this type. Most of the cartridge cases are made of an alloy composed of 70% copper and 30% zinc. This alloy is a solid solution where the zinc atoms substitute for the copper atoms in the face-centred cubic lattice of the copper crystal. The manufacture of a cartridge case begins with a flat plate which is blanked into a circular disk and cold formed into a cup. The effect of the cold work resulting from cupping must be removed by annealing before any further cold forming can be carried out. In the production of the cartridge case it may be necessary to perform as many as seven annealing treatments depending upon the size of the cartridge case.

PRECIPITATION OR AGE HARDENING

Many of the useful alloys are heat-treated by precipitation or age hardening. The alloys which respond to this heat-treating process are in the alloy systems which have a decreasing solubility of one constituent in another constituent with decreasing temperature. This is illustrated schematically in fig. 2, which shows a phase diagram of alloys of metals A and B. The solubility of B in A is represented by the line xy. An alloy composition represented by the dotted line is composed entirely of a solid solution when heated to and maintained at temperature T_3. The solid solution δ consists of atoms of B dissolved in metal A. (At the opposite side of the diagram, solid solution β consists of atoms of A dissolved in metal B; the θ phase is discussed below.) Two types of solid solutions are possible, namely, substitutional and interstitial. The substitutional solid solution is formed by atoms of B substituting for atoms of A in the crystal lattice of the metal A. An interstitial solid solution is formed when atoms of B fit in between the atoms in the lattice of metal A. Practically all of the solid solutions useful for the age-hardening process are of the substitutional type.

When the solid solution formed by heating to temperature T_3 is slowly cooled to room temperature T_1, a precipitate will form at the grain boundaries because the solubility of B in A is less at T_1 than at T_3. The line xy represents the saturation limit for the solubility of B in A at any given temperature, and on slow cooling



BY COURTESY OF C. A. SIEBERT

FIG. 2.—SCHEMATIC PHASE DIAGRAM ILLUSTRATING CONDITIONS NECESSARY FOR AGE HARDENING

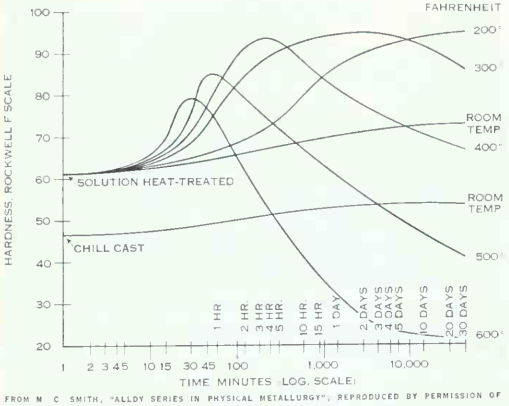
precipitation begins as soon as the dotted line intersects the line xy, and continues as the temperature decreases to T_1. The precipitate formed is not the metal B, but is the next phase on the diagram, which is θ. This diagram shows θ as an intermetallic compound and these compounds are frequently assigned chemical composition formulas; *e.g.*, $CuAl_2$, Fe_3C, etc. In many instances the slowly cooled condition described above produces inferior mechanical and corrosion resisting properties.

When the solid solution produced by heating to temperature T_3 is quickly cooled by quenching into water, the precipitation of the θ phase is prevented and the condition existing at temperature T_1 is a highly supersaturated solution of B in A. Reheating the quenched alloy to the temperature T_2 and holding for a period of time allows θ to precipitate from the supersaturated solid solution. However, the θ phase does not precipitate out at the grain boundaries as was the case in the slowly cooled condition, but precipitates out as minute particles in the crystal lattice on planes of cleavage of the solid solution. These particles are too small to be seen under the optical microscope, but their presence is detected by the changes in the mechanical and physical properties of the alloy which accompany the aging process. Not all of the useful industrial alloys require that the quenched alloy be reheated to a temperature of T_2 for the submicroscopic particles to form, since age hardening does occur on holding at room temperature in some of the alloys.

Subcooling—as by packing in dry ice—those alloys which age-harden at room temperature will prevent the age-hardening process from taking place. The precipitation of the submicroscopic particles in the lattice of the solid solution increases the hardness, tensile strength and yield strength and decreases the ductility of the alloy.

Many of the industrially important alloys are hardened by this heat-treating process. Among the more important of these age-hardenable alloys are the aluminum and copper base alloys. The aluminum base copper alloy is selected to illustrate the general age-hardening process.

Copper is soluble in aluminum to the extent of 5.5% at 1,018° F. and to less than 1% at room temperature. An alloy of 5.0% copper when heated to 1,000° F. and quenched into water is a supersaturated solution of copper in aluminum. It will not age-harden to any great extent on holding at room temperature. However, on heating to various temperatures above room temperature, the age-hardening process will take place. Since this age-hardening process depends upon atom movements; *i.e.*, diffusion, and since the rate of diffusion is increased with increasing temperature, the increase in strength will be accomplished in shorter periods of time at higher temperatures than at lower temperatures. However, the precipitation and growth of the precipitated phases are not uniform and since an optimum particle size of the precipitated phase is necessary to produce the maximum increase in the hardness and strength of the alloy, the lower temperatures of aging are the ones that produce these conditions, although the



FROM M. C. SMITH, "ALLOY SERIES IN PHYSICAL METALLURGY", REPRODUCED BY PERMISSION OF HARPER & BROTHERS

FIG. 3.—EFFECT OF AGING TEMPERATURE UPON THE PRECIPITATION HARDENING OF AN ALLOY CONTAINING 95% ALUMINUM, 5% COPPER, WHICH WAS SOLUTION HEAT-TREATED AT 1,000° F. AND WATER QUENCHED

time of aging is necessarily longer.

The lower temperatures of aging produce a greater number of nuclei; *i.e.*, centres for precipitated particles to form on and a greater number of small particles are formed than is the case at the higher temperatures. The increase in strength results from interference that these particles offer to plastic deformation. Therefore, the greater the number of these particles of an optimum size the greater the strength of the material. However, since diffusion continues at these higher temperatures with time, the particles of the precipitated phase continue to grow and therefore there are fewer particles of a larger size to offer resistance to plastic deformation.

The material decreases in strength and is considered overaged. This is illustrated for a 5% copper, 95% aluminum alloy in fig. 3. The increase in hardness above the as-quenched condition, which is an indication of the increase in strength, at room temperature after 30 days is approximately 8 Rockwell F. The increase in hardness after aging at 300° F. for approximately two days is 32 Rockwell F. On holding at 300° F. longer periods than two days, the alloy became softer, or overaged. The aging temperatures of 400°, 500°, and 600° F. show lower maximum hardness peaks and shorter times of overaging setting in with increasing temperatures. The actual time-temperature sequence which is used for a given alloy in an industrial application naturally depends upon economics. The strength level needed and the length of aging time required to produce it, and therefore the cost, become primary considerations.

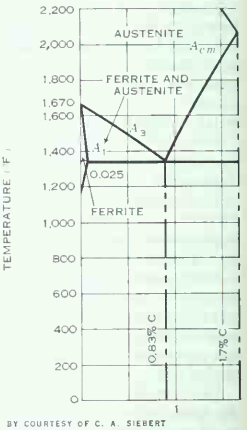
HARDENING PHASE CHANGES

A number of alloys undergo hardening and therefore an increase in strength because of a phase change from one type of lattice structure to another occurs in the alloy with a change in temperature. When the equilibrium condition is disturbed by rapid cooling a whole new series of microstructures is produced, resulting in a whole new series of mechanical properties in these alloys. The most important alloys of this classification are the steels and their alloy modifications, and the heat-treatment of steel will be discussed to illustrate this process.

The metal iron has the atoms arranged in a body-centred cubic lattice from room temperature to 1,670° F., and in a face-centred cubic lattice from 1,670° F. to 2,535° F. Carbon dissolves rather readily in the face-centred cubic lattice but only to a very slight extent in the body-centred cubic lattice. It is this difference in solubility of carbon in the two phases of iron which accounts for the fact that steel can be heat treated.

It is necessary to consider the equilibrium conditions of the iron-carbon system in order to appreciate the nonequilibrium conditions which exist in hardened steel. Fig. 4 shows a portion of the iron-carbon equilibrium diagram. There is a eutectoid (pearlite) at 0.83% carbon which forms from the solid solution of carbon in face-centred cubic iron (austenite) at a temperature of 1,333° F. Pearlite is a mechanical mixture of ferrite (solid solution of carbon in body-centred iron) and cementite (Fe_3C).

An 0.5% carbon steel, heated to 1,600° F. has a microstructure of 100% austenite at that temperature. On very slow cooling the austenite would begin to reject ferrite when the temperature reached the A_3 line on the diagram (fig. 4) and would continue to do so until the temperature reached the A_1 line on the diagram. While the temperature was changing from the A_3 to the A_1 level and ferrite was being rejected, the carbon content of the austenite was increasing from 0.5% to 0.83%, the latter being the eutectoid composition. The A_{cm} line in fig. 4 represents the saturation limit of carbon in austenite. Therefore, in steels having a carbon content greater than 0.83%, cementite would precipitate on cooling, and the carbon content of the austenite would again approach 0.83% as the temperature approached 1,333° F.

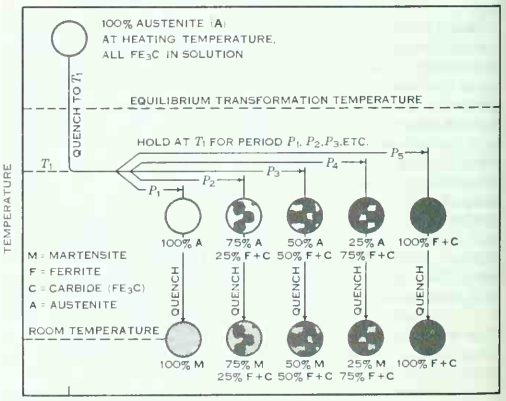


BY COURTESY OF C. A. SIEBERT

FIG. 4.—A PORTION OF THE IRON-CARBON EQUILIBRIUM DIAGRAM

The above illustrates the decomposition of austenite on slow cooling approaching equilibrium conditions. The nonequilibrium condition associated with the hardening of steel can best be illustrated by considering the isothermal decomposition of austenite at temperatures below 1,333° F.

Suppose a number of thin wafers of 0.83% carbon steel were heated to a high temperature where the microstructure was 100% austenite, and then quenched into a molten lead bath maintained at some temperature T_1 which is below 1,333° F. Individual specimens could then be removed from the lead bath after varying time intervals, and quenched into water. The process is illustrated in fig. 5. The time period P_1 was not long enough for the austenite to begin to decompose into pearlite, so on subsequent quenching to room temperature it showed a structure of 100% martensite (the nature of martensite is discussed below). Time period P_2 was long enough for some



FROM W. CRAFTS AND J. LAMONT, "HARDENABILITY AND STEEL SELECTION", REPRODUCED BY PERMISSION OF PITMAN PUBLISHING CORPORATION

FIG. 5.—HEAT-TREATING CYCLES EMPLOYED IN STUDIES OF ISOTHERMAL TRANSFORMATION

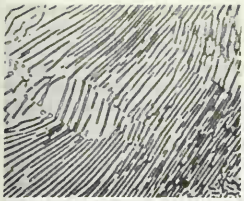


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FIG. 6.—COARSE PEARLITE FORMED AT 1,300° F. (MAGNIFIED 2,000 ×.)

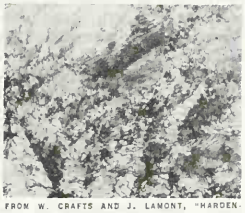
austenite to transform to pearlite, and time periods P_3 and P_4 show an increasing amount of pearlite, while time period P_5 is long enough for all of the austenite to transform to pearlite.

It can be seen that the above process depends upon nucleation and diffusion, with the nuclei of pearlite (ferrite and cementite) forming at the austenite grain boundaries. As the temperature T_1 is lowered the pearlite becomes increasingly finer in texture, as shown in figs. 6 and 7.

Repeating the above experiment at various temperature levels would result in the accumulation of data for the beginning and ending of austenite decomposition at the various temperature levels. The data could then be plotted as a conventional time-temperature-transformation (T-T-T) diagram. The T-T-T diagram shown in fig. 8 is a schematic diagram for carbon steels and includes the proeutectoid line for ferrite and carbide, which applies to steels of less than or greater than 0.83% carbon respectively.

It should be noted that the proeutectoid line joins the beginning of pearlite transformation line at approximately 1,000° F. This means that only pearlite would be present when fully transformed at this temperature, regardless of the carbon content of the steel, and the carbon content of the pearlite in any steel other than 0.83% carbon can only have that value when transformed at 1,333° F.

The transformation of austenite by isothermal decomposition below the knee of the diagram (1,000° F.) results in the formation of a microstructure distinctly different from pearlite formed above 1,000° F., and this structure, called bainite, is shown in fig. 9. The degree of fineness of the bainite structure increases as the temperature of formation is lowered from 1,000° F. It is generally thought that pearlite is nucleated by cementite and bainite by ferrite.



FROM W. CRAFTS AND J. LAMONT, "HARDENABILITY AND STEEL SELECTION"; REPRODUCED BY PERMISSION OF PITMAN PUBLISHING CORPORATION

FIG. 7.—FINE PEARLITE FORMED AT 1,185° F. (MAGNIFIED 2,000 ×.)

As the temperature of the quenching bath is lowered, a temperature level is reached where austenite will undergo some transformation instantaneously on reaching that temperature. A period of inactivity when held at that temperature is followed by further decomposition to bainite for longer holding times. The microstructure formed immediately on reaching this temperature is martensite. Martensite will continue to form instantaneously as the temperature is lowered but will not form isothermally. The temperature at which the first martensite is formed is termed the M_s temperature and the temperature for 100% martensite formation is called the M_f temperature. The M_s temperature depends upon the composition of the steel and can be estimated from the following formula:

$$M_s(^\circ \text{F.}) = 1{,}000 - (650 \times \%\ \text{C}) - (70 \times \%\ Mn) - (35 \times \%\ \text{Ni}) - (70 \times \%\ \text{Cr}) - (50 \times \%\ Mo)$$

The M_f temperature cannot be calculated from the composition of the steel.

The transformation of austenite to martensite does not depend upon nucleation and diffusion, as is the case for pearlite and bainite formation, but solely on reaching a temperature level where the face-centred cubic lattice tends to transform to a more stable type of lattice. The lattice formed is a tetragonal body-centred type with the carbon atoms trapped as an atomic dispersion in the interstices of this lattice.

The primary purpose of quenching a steel is to produce martensite. Therefore it is necessary to employ cooling rates fast enough to prevent the steel from dwelling in the higher temperature ranges where ferrite, pearlite and bainite will form. Alloying elements shift the T-T-T diagrams to the right; *i.e.*, to longer times for the beginning of transformation, which permits slower rates of cooling for the formation of 100% martensite.

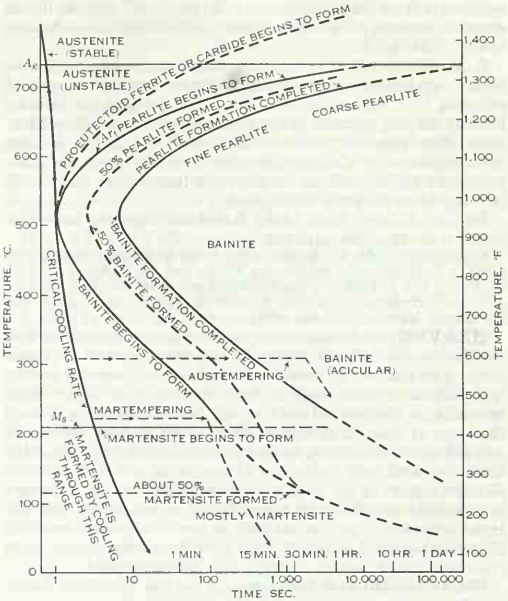


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FIG. 8.—SCHEMATIC T-T-T DIAGRAM FOR CARBON-STEEL SHOWING CRITICAL COOLING RATE CURVE, M_s TEMPERATURE, AND TEMPERATURES FOR AUSTEMPERING AND MARTEMPERING

The above type of reactions illustrated with the iron-carbon alloys are also found in some of the nonferrous systems. Among these are the copper-aluminum alloys, the copper-zinc alloys and the titanium-chromium alloys.

SOFTENING PHASE CHANGES

Upon heating, the martensitic structure (discussed above), which is usually associated with a small amount of retained austenite, undergoes changes which result in softening of the material. The iron carbide-austenite ratio of the body-centred tetragonal structure of martensite (*see* ALLOYS: *Structure of Alloys*) is a function of the carbon content of the steel, increasing with increasing carbon content. The progressive changes which occur for an 0.8% carbon steel are as follows:

1. At 0° to 400° F. formation of epsilon carbide, a coherent precipitate usually assigned the formula $Fe_{2.4}C$ (as compared with Fe_3C for iron carbide, or cementite), occurs. In this temperature range the iron carbide-austenite ratio of the tetragonal lattice decreases from that corresponding to 0.8% carbon to 0.25% carbon. The hardness is little affected in this temperature range remaining at approximately 65 R.C. (Rockwell C scale).

2. At 400° to 600° F. the retained austenite is decomposed to bainite and at approximately 500° F. the epsilon carbide begins

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FIG. 9.—BAINITE FORMED AT ABOUT 700° F. (MAGNIFIED 2,000 ×.)

to separate from the parent lattice and form Fe_3C, and the lattice structure becomes body-centred cubic. The hardness after heating to 600° F. is 56 R.C.

3. At 600° to 1,330° F. the precipitated particles of Fe_3C continue to agglomerate with increasing temperature with a gradual softening to a final value of 5 R.C. The presence of carbide-forming alloying elements in the steel will cause a secondary hardening effect in the temperature range of 900° to 1,150° F. because of the formation of a coherent precipitate of alloy carbides. This results in a higher hardness for any given temperature than would be obtained on the plain carbon steel.

See also ALLOYS; CAST IRON; HARDNESS TESTING; IRON AND STEEL INDUSTRY; METALLURGY.

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HEAVEN, the firmament or vaulting arch of spatial expanse surrounding the earth in which the sun, moon, planets and stars seem to be placed. In most of the religions of mankind heaven is considered to be the abode of deity, for as deity is "higher" than humanity, so the home of deity is high "above" the earth which is the home of man. Likewise, as the presence of deity exposes all evil and deceit, so heaven, being the eternal abode of deity, is the place of eternal light in contrast to the partial and total darkness of other regions in the cosmos. Consequently, heaven is thought to be forbidden territory for human beings except as they meet the terms set down by deity or are granted special admission by deity. Such humans are then said to have been "born from above" or to have been called "out of darkness into marvelous light."

Old Testament and Judaism.—In the Old Testament understanding of the structure of the universe, the heavens, *shamayim,* referred chiefly to the upper half of the universe in contradistinction to the other half, the earth. The phrase in Gen. i, 1, "the heavens and the earth," literally comprehended the whole of creation. The earliest traditions of the Israelites associated Yahweh with the sky, but while Yahweh's abode was the heavenly regions, not even the heavens' heavens could contain him. It was he who created the firmament and placed the heavenly bodies in it; from the heavens he looks down upon the inhabitants of earth and directs the destinies of men and nations, and therefore men pray toward the heavens.

It was not until late Old Testament times that the Israelites began to regard heaven as being also the final abode of the righteous. Throughout most of the Old Testament period (*c.* 1750 B.C. to *c.* 587 B.C.) the Israelites thought of Sheol as the great democracy of all the dead. Sheol was located somewhere "under" the earth. When "the breath of life" had gone out of a man and returned to Yahweh from whom it originally came, and when his buried body had decomposed, the residue of his individuality slept in Sheol. The state of the dead was one of neither pain nor pleasure. Neither reward for the righteous nor punishment for the wicked was associated with Sheol. The good and the bad alike, tyrants and saints, kings and orphans, Israelites and gentiles—all slept together without awareness of one another in the lifeless existence of Sheol. The devout Israelite dreaded death and Sheol because these marked the end of his fellowship with Yahweh and not because they would confront him with a final judgment upon the quality of his life.

It was not until the 3rd or 2nd centuries before Christ that Jews in any number came to think of heaven as the destination of the righteous after death. As the hope increased and was formulated for the resurrection of the righteous and unrighteous to another bodily life of reward or punishment befitting the mortal life already lived. Jewish thought fixed on life with God in the heavens as the destiny of the righteous and external torture or second death as the destiny of the unrighteous. Jewish rabbinical and apocryphal literature occasionally refer to seven or ten heavens, with paradise being the third of seven or the seventh of ten. This paradise was thought to house all the treasures intended for the righteous, and some rabbis taught that the righteous dead themselves lodged there until the Last Judgment when God would resurrect them and translate them into his presence in the highest heaven. With reference to the unrighteous, consideration of natural death, during this period, was lost sight of in the greater consideration given to the final judgment of the human spirits subsequent to physical death. The horrors of this spiritual death are suggested in Jesus' figures of "outer darkness" and "weeping and gnashing of teeth" used to describe the lot of the unrighteous.

New Testament and Christianity.—In the New Testament heaven derives its significance and engages the attention of the writers from the fact that it is believed to be the place from which Christ came and to which he returned (Mark xvi, 19; Acts i, 11). Heaven is therefore the scene of his present life and activity. There, in the presence of God, he works in behalf of his followers (Heb. ix, 24) and there his glory is already apparent (John xvi, 24), whereas on earth his followers only dimly apprehend that glory (I John iii, 2). Heaven, however, is the destination of all his followers (John xiv, 2). In heaven the Holy Spirit, in company of the angels, searches out "the depths of God" and is sent to earth to reveal these mysteries to men (I Cor. ii, 10; I Pet. i, 12). In the New Testament there is also a current of thought that speaks of a renewal of the heavens as well as of the earth in the consummation God will bring about for his creation (II Pet. iii, 12–13; Rev. xxi, 1).

The New Testament uses the word paradise (*e.g.,* Luke xxiii, 43). This was originally a Persian word for a nobleman's park or garden, but coming as it does to the New Testament through Jewish and especially rabbinic usage, its use there reflects the influence of the Old Testament story of man's pristine innocence and community with God in the Garden of Eden. (E. PE.)

The Christian idea of heaven never achieved great explicitness. As the early church resolved the meaning of its existence as a historical body with the realization that Christ's return to consummate the messianic promise would be delayed, sacramental acts, particularly the eucharistic mysteries, came to symbolize the union of the church with Christ in heaven. In the Eucharist and the other sacraments Christians already felt themselves to be partaking in the life above.

Nevertheless, in the Christian community in the post-apostolic period there may be found cosmological speculation, seeking to penetrate the unknown upper world, at the same time resisting the temptation to go as far as the Gnostics with their imaginative but unbiblical cosmologies. In the east Origen (for example in *Contra Celsum,* vi, 21 and *De Principiis,* ii, iii, 6), St. Basil (*Homiliae* I, 5; *Patrologia Graeca* XXIX, 13) and other writers made comments about the number of "heavens"; on the belief that Christians, following the pattern of Christ, ascend to heaven; and about the relation of heaven to the observable upper world—stars, planets, etc. St. Augustine in the west attempted to avoid the pitfalls of the cosmological approach in conceiving of the heavenly city, the New Jerusalem. In the Old Testament this was prefigured in the vision of Ezek. xl ff. In the high middle ages the old science and the rediscovered tools of ancient logic were united to devise, together with Christian revelation, St. Thomas Aquinas' monolithic edifice of ideas about the hierarchy of being. The poetic realization of Dante's *Divine Comedy* is a similar medieval expression. Piled layer upon layer, the reality of the material world, for them, blended into the splendours of the celestial realm and into the terrors of the inferno.

Since the scientific revolution, cosmological theories about heaven have tended to be discredited as science has pushed the limits of space to an incomprehensible distance. In their place personalistic understandings of heaven, such as prevail in literature or common parlance, have often obscured the meaning of heaven in a religious sense. In the modern idiom heaven has come to signify various types of personal fulfillment. However, for Christians, emphasis upon the Bible and church tradition continues to help maintain the symbolic meaning of heaven as the counterpart of the liturgical and historical experience of the revelation of Christ. In essence the Christian view of heaven means the state of life with Christ. Since this ideal is believed to be reflected in the church, it has been difficult to conceive of its transcendent meaning in other terms. (C. S. J. W.)

Other Religions.—A notion similar to that of the New Testament paradise is found in the Greek mythological Elysium or Elysian field. This latter, the home both of the gods and of those mortals upon whom the gods chose to confer a life of bliss, was thought to be located in the western ocean or in the lower world.

In Chinese religion, specifically the Confucian tradition, heaven, *T'ien*, is synonymous with the Divine Will. Heaven is the head of the cosmic family, of which nature and human society are the other two members. The popular Buddhism of China (Pure Land Buddhism) offered the Chinese a heavenly abode after death as alternative to the notion of the disembodied spirits of the ancestors remaining near the haunts of their mortal days. The literature of Pure Land Buddhism describes in vivid language the "western paradise" which is available to all those who receive the saving grace of Amitabha, the man who became a Buddha through his vow of salvation for every living creature.

Orthodox Buddhism does not regard paradises and heavens as ultimate, precisely because these notions preserve the conditions of distinctive existence. By definition, orthodox Buddhists maintain, any existence is conditioned and not ultimate and is therefore not capable of expressing unconditioned bliss; hence the monks in this tradition must strive for something beyond the life of the heavens. Nevertheless, these Buddhists believe that there are heavens and that men may be born into them. But emancipation from existence, nirvana, is something other than birth into either the sensual heaven where sexual pleasures exist, or the material heavens inhabited by gods liberated from sensual desires, or even the indescribable life of the nonmaterial heavens.

In Hinduism the conceptions of heaven are numerous and varied. Generally speaking, the heavens are conceived as distinct regions in a complex configuration of worlds, sometimes said to be 3 in number, and again 14. The three worlds are the earth, which is the land of mortals; the sky, which is the playground of the luminaries; and the heavens, the residence of divinities and other immortals. The 14 worlds are believed to rise to seven tiers above the earth and descend to seven distinct depths below the earth. Whether 3 or 14, the intent is to represent the innumerable degrees of proximity to and distance from the perfection which is the destiny of every creature.

In the worship of Vishnu, the god of the masses of Hindus, heaven is understood in terms very similar to those of biblical religion. It is a locale or condition in which suffering, fear and death are completely absent and in which the glory of Vishnu is the eternal light.

The extremely explicit descriptions of heaven in Islam run the entire gamut of human aspiration. Suffice it to say that heaven is conceived as the Garden or Mansion of Eternity in which humans enjoy abundant fulfillment of all the physical, mental, moral and spiritual desires of mortal men. *See* also EDEN; MILLENNIUM.

(E. PE.)

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HEAVISIDE, OLIVER (1850–1925), English physicist who, independently but shortly after A. E. Kennelly of Harvard, suggested the presence of a conducting layer in the upper atmosphere which prevents electromagnetic waves from spreading out into space. This layer, for many years called the Kennelly-Heaviside layer, became more commonly known as the ionosphere (*q.v.*). Heaviside was born in London on May 13, 1850. He was employed by the Great Northern Telegraph company, Newcastle. Increasing deafness forced him to retire in 1874, when he went to live in Devonshire and devoted himself to theoretical investigations on electricity.

Heaviside had some difficulty in getting his papers accepted for publication, probably because he made use of unusual methods of his own in solving his problems. Consequently, in 1892 he published his collected papers in two volumes under the title of *Electrical Papers.* In these papers he dealt with the theoretical aspect of a number of practical problems, such as quadruplex and multiplex telegraphy, electrostatic and electromagnetic induction between parallel wires, and the high-frequency resistance and inductance of a coaxial cable.

His work on the theory of the telephone made long-distance telephony practicable. His *Electromagnetic Theory* also dealt with a number of important problems. He worked out the theory of an electric charge moving with uniform velocity and predicted the change in the mass of such a charge when the velocity is large.

He died at Torquay on Feb. 3, 1925.

HEAVY WATER: *see* DEUTERIUM AND TRITIUM.

HEBBEL, (CHRISTIAN) FRIEDRICH (1813–1863), German poet and one of the greatest of German dramatists, was born, a Danish subject, March 18, 1813, in Wesselburen, Dithmarschen (Schleswig-Holstein). The son of a builder, he and his brother were brought up in great poverty, which in later life deeply influenced Hebbel's outlook. After his father's death in 1827 he spent seven years as clerk and messenger to a tyrannical parish bailiff. He founded a literary circle, and a local paper published the first of his poems. Others were printed by a Hamburg fashion magazine whose editor, Amalie Schoppe (1791–1858), a popular journalist and writer of nursery tales, invited him to Hamburg in 1835 to enable him to prepare for the university. In March 1835 he started a diary which was to become a most revealing and valuable literary document. At this time Elise Lensing, a seamstress nine years his senior, provided Hebbel with both spiritual and material support. She sacrificed herself entirely for him in the difficult years that followed.

In 1836, with a small income provided by his patrons, he went to Heidelberg and studied law, but soon finding this uncongenial moved on to Munich, where he devoted himself to philosophy, history and literature. No one would publish his poems or stories and in 1839, without money or means of livelihood, he was forced to return to Hamburg on foot. Ill and exhausted, he was nursed by Elise. Although he lived with her and she bore him two children (b. 1840 and 1844), neither of whom lived long, he could not make up his mind to marry her.

His personal conflicts, however, did not affect his creative power. In 1840 the prose play, *Judith* (Eng. trans. 1914), was performed in Berlin and Hamburg. Its theme—a woman struggling for her rights—was to obsess him from this time. In 1841 he finished the broadly conceived poetic drama *Genoveva.* In 1844 *Maria Magdalena* was published, with a critical and philosophical preface. This realistic tragedy of lower-middle-class prejudice was first performed in 1846. Meanwhile need had driven Hebbel to Copenhagen, where he procured a traveling grant from the king which allowed him to spend one year in Paris and one in Italy.

On his return at the end of 1845 he met in Vienna the well-known actress Christine Enghaus. His marriage to her in 1846 was the turning point in his life which now ran a more tranquil course, though as a result of his privations he was permanently weakened by rheumatic fever. Through Christine's intervention he became reconciled with Elise. His marriage brought him a daughter and the theatrical tours on which he accompanied his wife gave him new stimulus.

After his marriage, besides some slighter plays of social criticism (*Ein Trauerspiel in Sizilien* and *Julia,* 1847) and the fairy tale comedy *Der Rubin* (1849), which was as unconvincing as the earlier *Der Diamant* (1841), Hebbel wrote the verse play *Herodes und Mariamne* (1848; performed 1849). This depicts the conflict between the oriental despot and his wife, who believes in the dignity of man. The prose tragedy *Agnes Bernauer* which he wrote in 1851 (performed 1852; Eng. trans. 1909) contains the central problem of Hebbel's philosophy—the clash between the necessities of the state and the rights of the individual. The poetic drama *Gyges und sein Ring* (1854), which praises the purity of woman and the dauntlessness of man, is probably the poet's most mature work. From 1855 to 1860 he worked on the dramatization of the Nibelung epic. The trilogy (performed in Weimar in 1861) consists of *Der gehörnte Siegfried, Siegfrieds Tod* and *Kriemhilds*

Rache. In 1855 he published a volume of Novellen and stories and in 1857, following the 1842 and 1848 collections of poems, his collected lyrics appeared. In many of these a fine balance is reached between feeling and reflection; the night poems and some of the more sombre ballads are among the best German lyrics. In 1859 came the narrative poem *Mutter und Kind*, a social and deeply human document.

Newspaper articles, notably those written in 1848 (he was a liberal conservative and a supporter of constitutional monarchy), many essays of literary criticism and an unfinished play on Demetrius complete the picture of Hebbel's achievement. On his 50th birthday he received many honours, including the Schiller prize. He died at Vienna on Dec. 13, 1863.

Hebbel's speculative ideas—the expression of the tensions of his own personality—circle round the relationship between the Ego and the universe. He depicts the tragic lot of the individual who, in the necessary process of world evolution, sets himself against the existing state of affairs in order to make possible further progress toward a humane system of morality.

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HEBE (Gr. "young maturity," "bloom of youth"), daughter of Zeus and his consort, Hera. In Homer this divine princess, in accordance with the simple northern manners of the Achaean nobles, does housework. She harnesses her mother's horses, bathes her brother Ares, the god of war, and pours the wine at table. It is in her capacity as cupbearer to the gods that she is oftenest mentioned, and she is sometimes said to have been superseded by Ganymede (*q.v.*). As goddess of youth, she is generally worshiped along with her mother, of whom indeed she may be regarded as a sort of emanation or specialized form. She is also combined, both in cult and in mythology, with Hercules (*q.v.*), whose bride she became when he was received into heaven. The most important seats of her worship were Phlius and Sicyon, where she was called Ganymeda and Dia.

A Latin deity with whom Hebe is sometimes identified is Iuventas, whom, however, the historian Dionysius of Halicarnassus calls Neotes, not Hebe. According to Livy, the hellenized cult of Iuventas-Hebe dates from 218 B.C.

See G. Wissowa, *Religion und Kultus der Römer*, 2nd ed. (1912); L. Preller, *Griechische Mythologie*, 4th ed. rev. by C. Robert (1887–1926); and the classical dictionaries.

HEBER, REGINALD (1783–1826), English bishop, who made a distinctive contribution to the development of Anglican hymnody. Born at Malpas, Cheshire, April 21, 1783, he entered Brasenose college, Oxford, in 1800 and won prizes for a Latin poem (1800), an English poem, *Palestine* (1803; publ. 1807, set to music by W. Crotch, 1812) and an essay, *The Sense of Honour* (1805). Elected a fellow of All Souls (1805), he took orders in 1807 and was presented to a family living at Hodnet, Shropshire. A moderate high churchman of scholarly interests, he showed the direction of his sympathies by his concern at his own equivocal position as parish priest and lord of the manor, his provision of more and better services, and his attention to education, as well as by his Bampton lectures on *The Personality and Office of the Christian Comforter* (publ. 1816) and his edition of Jeremy Taylor (1822). At Hodnet he planned his collection, *Hymns Adapted to the Weekly Church Services of the Christian Year* (1827), writing 57 of them himself. This anticipated the work of John Keble (*q.v.*) in providing hymns suited for use in liturgical worship adapted to the plan of the Christian year.

His own hymns,—*e.g.*, "From Greenland's Icy Mountains," "Brightest and Best of the Sons of the Morning," "God that Madest Earth and Heaven" and "The Son of God goes Forth to War"—show vivid pictorial imagination, free treatment of rhythm and a loftiness of conception which indicate a real, if minor, poetic gift, and ensure their continued popularity.

In 1823 Heber became bishop of Calcutta. His conscientious care of a vast diocese hastened his sudden death (at Trichinopoly, April 3, 1826), but he had made a deep impression by his gentleness and courtesy. His introduction of prayers for the rajahs into church services, his insistence that the clergy learn Hindustani and his attempts to improve relations between missionaries and ministers to European congregations set the trend for future developments and his death from overwork led to much-needed administrative reforms.

HÉBERT, JACQUES RENÉ (1757–1794), French political journalist who under the pen name of "le Père Duchesne" made himself the spokesman of the sans-culottes and of popular extremism during the French Revolution, was born in Alençon in Normandy of a good bourgeois family. His youth was rowdy, and he fell into trouble in 1776. Going to Paris in 1780, he was for many years destitute or existed from hand to mouth (from 1786 to 1788 he was employed in the box office at the Théâtre des Variétés) and so became familiar with the conditions in which the common people lived.

Early in 1790 Hébert, enthusiastic for the Revolution, began his career as a journalist by collaborating on a pamphlet, *La Lanterne magique, ou Fléau des aristocrates*. This was followed by *Le Petit Carême de l'abbé Maury*, and, in June, by *Vie privée de l'abbé Maury*, lively and ribald satires on the future cardinal (*see* MAURY, JEAN SIFFREIN). Having found his vocation, Hébert next took for himself a name which was already common property among publicists, that of "le Père Duchesne," a comic figure of the popular imagination, sententious, outspoken and coarse in his expressions but at the same time candid and jocular. His paper, *Le Père Duchesne*, first appeared in Nov. 1790, and by June 1792, when he broke with the original printer, Denis Tremblay, to work with J. C. Marquet, it had become an established success; Hébert was able to live in comfort with Françoise Goupil, the unfrocked nun whom he married on Feb. 7, 1792.

After Louis XVI's flight to Varennes (June 1791), Hébert, who had previously concentrated his vituperation on the aristocracy, began to aim farther, and in the spring of 1792 he launched a virulent campaign against the court and the monarchy. Already an influential member of the club of the Cordeliers (*q.v.*), he represented the Bonne Nouvelle section of Paris in the insurrectionary commune of Aug. 10, 1792, which led to the fall of the monarchy; and he was elected acting procurator general of the Paris commune on Dec. 22.

A member also of the Jacobin club, he made his paper the mouthpiece of the sans-culottes, demanding the death sentence for Louis XVI, the elimination of the Girondins and the establishment of the Revolutionary government. In the last-named cause he did so much that the events of Sept. 4–5, 1793, which brought the Reign of Terror into full vigour and inaugurated the state-controlled economy, have been described as an "Hébertist" movement. The anti-Christian campaign of autumn 1793 was also largely inspired by Hébert. Once the Revolutionary government was in power, however, it found Hébert dangerous. *Le Père Duchesne* represented the opposition of the Cordeliers and had, moreover, too strong an appeal to the people.

In the winter of 1793–94 the popular movement for which Hébert had fought was brought to a halt. The committee of public safety strengthened its hand; and the "Indulgents," led by Danton and Camille Desmoulins, attacked the extremism of the Hébertists, now described as "Exagérés." When a food shortage was stimulating popular discontent, Hébert on 14 Ventôse (March 4, 1794) denounced the *modérantisme* of the Dantonists at the Cordeliers club, which declared itself for insurrection; but the sans-culottes did not respond, and on 24 Ventôse the Hébertists were arrested. Brought to trial on 1 Germinal (March 21), Hébert and his friends

were convicted of conspiracy and executed three days later.

See F. Braesch, *Le Père Duchesne d'Hébert* (1938); L. Jacob, *Hébert, le Père Duchesne, chef des sans-culottes* (1960). (A. So.)

HEBRA, FERDINAND VON (1816–1880), Moravian physician who founded the so-called New Vienna school of dermatology and whose concepts and teachings became the basis for modern dermatology, was born in Brünn, Moravia. Czech., on Sept. 7, 1816. He received his medical degree from the University of Vienna in 1841. He was a disciple of Karl Rokitansky (1804–1878), the outstanding Austrian pathologist of the 19th century. Hebra applied his training in pathology to the classification of all skin diseases. This classification, published in 1845, gave a clarity to the understanding of the processes of diseases of the skin that compelled universal recognition. Basically this classification is still in use.

Von Hebra was a voluminous contributor to medical literature and his textbook of dermatology, *Lehrbuch der Hautkrankheiten*, published in 1860, is even now one of the most stimulating books in dermatology.

He died in Vienna on Aug. 5, 1880.

BIBLIOGRAPHY.—Victor Robinson, *Pathfinders in Medicine* (1929); Ferdinand von Hebra, *Diseases of the Skin*, trans. by Hilton Fagge (1866); W. A. Pusey, *The History of Dermatology* (1933). (S. J. Z.)

HEBREO, LEÓN (LEONE EBREO; JUDAH ABRAVENEL) (*c.* 1460–*c.* 1521), Spanish philosopher, physician, and writer of the *Dialoghi di amore*, the fullest Renaissance exposition of a doctrine of love, which had great influence on Spanish literature and has been rediscovered in the 20th century as an important source for Spinoza's philosophy. The eldest son of Isaac Abrabenel (*q.v.*), he was born in Lisbon, *c.* 1460, and in 1483 fled to Seville with his father, who had been implicated in the duke of Braganza's conspiracy. In 1492, when the Jews were expelled from Spain, the family went to Naples, where León Hebreo, who had become a doctor, was appointed personal physician to the viceroy (1505). He became acquainted with the humanist and philosopher Giovanni Pontano, and, later, in Florence, with members of the Platonic academy. He is last heard of in 1521 and probably died soon after then, in Naples.

The *Dialoghi* (publ. Rome, 1535) reveal the synthesizing tendencies of the time in the effort to harmonize Mosaic, Aristotelian and Platonic viewpoints. Being cast in dialogue form, not embedded in a learned commentary, and more profound and far-reaching than other *trattati di amore*, the work appealed as both literature and philosophy. It was translated into Latin, French, Spanish and Hebrew, and every succeeding writer of a *trattato di amore* showed its influence, which was most fecund in the mystical and religious writers of Spain.

BIBLIOGRAPHY.—Editions of the *Dialoghi* by C. Gebhardt, "Bibliotheca Spinozana," vol. iii (1929) and by S. Caramella, "Scrittori d'Italia," vol. 114 (1929); Eng. trans., *The Philosophy of Love*, with introduction by C. Roth, Soncino Jewish Publication Society (1937). *See* also J. de Carvalho, *Leão Hebreu* (1918); C. Gebhardt, "Spinoza und der Platonismus," *Chronicon Spinozanum*, vol. i (1921); G. Saitta, "La filosofia di Leone Ebreo," *Giornale critico della filosofia italiana*, vol. v, fasc. i (1924), vol. vi, fasc. ii and fasc. iii (1925); H. Pflaum, "Der Renaissance-Philosoph Leone Ebreo," *Soncino Blätter*, vol. i (1925–26); H. M. J. Loewe and J. B. Trend (eds.), *Isaac Abravanel, Six Lectures* (1937). (A. R. Mi.)

HEBREW LANGUAGE. In the Old Testament, Hebrew is called *śᵉfat Kĕnaʿan*, "the lip of Canaan," or *Yᵉhûdît*, "Jewish"; the later Jews designated it *lᵉšôn haqqōdeš*, "the sacred tongue"; the term *ʿibrît*, "Hebrew," was coined by the rabbis of Palestine. The English name comes from the Greek ἑβραῖος, "Hebrew," whose adverb ἑβραϊστί, "in Hebrew," is applied to biblical Hebrew in the prologue to Ecclesiasticus (*c.* 130 B.C.), being a transliteration of the Aramaic *ʿibrāy*, "Hebrew."

The earliest monuments in Hebrew date from the 12th century, and the language has had a continuous history down to the present day.

Hebrew shares certain peculiarities with most of the other Semitic languages (*q.v.*): it has a purely consonantal alphabet (at any rate in its original form) and only two genders; the numbers from 3 to 10 stand in the opposite gender to that of the nouns which they qualify; in the genitival relation both the governing word and the word governed are inflected; the tense-forms, of which there are only two, are inflected in the one case by postfixing and in the other by prefixing pronominal elements to the roots; moods and voices are expressed by mostly internal modification of the stem; and the imperfect, not the imperative, form must be used in prohibitions. That the two tense-forms, which serve also as aspects, appear superficially to express past, present and future time alike is a peculiarity which can perhaps be explained on the assumption that elements of the East Semitic and West Semitic languages have been combined in Hebrew.

Related Languages.—Elements from several Semitic languages contributed to the composition of Hebrew; further, a few primitive words may have come from a non-Semitic people who, archaeology shows, once inhabited Palestine. Egyptian and Babylonian documents prove that a West Semitic (Canaanite) language resembling Hebrew was current in Canaan before the coming of the Hebrews. Egyptian documents from the 16th century B.C. onward reveal over 1,200 Semitic words, some common to various Semitic languages, others peculiar to the Syro-Canaanite branch; *e.g.*, Eg.-Can. *ʿnb* (Hebr. *ʿēnāb*), "grape," occurred in Aramaic and Arabic, but Eg.-Can. *brt* (Hebr. *bᵉrît*), "covenant," was confined to Hebrew. The feminine nouns preserved the primitive ending *-t*, which had already normally become *-h*, in the Old Testament; *e.g.*, Eg.-Can. *išpt* (Hebr. *ʾašpāh*), "quiver." In the earlier words the plural and dual took *-n*, as in Aramaic, but later *-m*, as in classical Hebrew; thus the Eg.-Can. *krmyn* (*c.* 1200 B.C.) gave place to *krmym*, which was closer to the Hebrew *kᵉrāmîm* than to the Aramaic *karmin*, "vineyards" (*c.* 1100 B.C.). The form in *-n* survived in the north Palestinian dialect of Hebrew, as *ṣîdônin* for *ṣîdōnîm*, "Sidonians"; similarly the Eg.-Can. *ǯ-* corresponded to the dialectical Hebr. *še-* (cp. Bab. rel. *ša*), "who," "which." Many terms describing common objects, either in composition or independently, appear early in these Egyptian texts; *e.g.*, Eg.-Can. *rš* (Hebr. *rōʾš*), "head," and Eg.-Can. *kmḥ* (Hebr. *qemaḥ*), "flour." Others, having changed their meanings or not having survived in Hebrew literature, emphasize the fact that much has disappeared from the Hebrew vocabulary. The cuneiform correspondence found in Egypt, chiefly between the Egyptian kings and their vassals in Syria and Palestine (*c.* 1400 B.C.), also exhibits a language similar to, but older than, biblical Hebrew. These letters were written in a Babylonian exhibiting western peculiarities closely approximate to Hebrew idiom: for example, the first person singular of the permansive (perfect) was closer to Hebrew than to Babylonian; *e.g.*, Bab.-Can. *naṣrâti* (Hebr. *nāṣartî*, not Bab. *naṣrâku*), "I have kept"; and a passive is formed by the internal modification of the vowels; *e.g.*, Bab.-Can. *yudan* (Hebr. *yuttan*), "is given." This passive type, though unknown in Babylonian, is found sporadically in Hebrew and regularly in Arabic. But the principal evidence lies in the Canaanite glosses which, more than 100 in number, were added in this correspondence to explain Babylonian terms; for they closely resemble pure Hebrew. Thus the Bab. *elippu* is explained by the Can. *anaya* (Hebr. *ʾônîyāh*), "ship," and so on. Again, the language of these glosses is earlier than Hebrew; *e.g.*, Bab.-Can. *yakwun*, "is," in which the half-vowel *w* is retained, is older than a form like the Hebr. *yāqûm*, "he arises," in which the *w* has been assimilated to the *u* (*cf.* Punic *ichon*, "he is"); it preserved also the old feminine ending *-t* for the 3rd person singular of the verb, as in *abadat* (*cf.* Hebr. *ʾābᵉdāh*), "is ruined," which rarely survived in biblical Hebrew. These glosses prove the pronominal suffix *-mô*, which is a late poetical variety of the usual *-m*, "their" in biblical Hebrew, to be a genuine archaism; for example, Bab.-Can. *panimu* corresponds with the archaistic Hebr. *pānêmô*, not the classical Hebr. *pᵉnêhem*, "their face." Most place names, many of them afterward found in the Old Testament, and some personal names exhibit purely Canaanite forms; and divine names like the Bab.-Can. *baʿalu* or *dagan*, contained in various proper names, are identical with the Hebr. *baʿal*, "Baal," and *dāgôn*, "Dagon." Clearly, Canaanite, as reflected in these ancient Egyptian and Babylonian texts, though not merely a form of Hebrew, contributed much to it.

The central group (Aramaic) made some contribution to Hebrew. This is illustrated by certain differences in the vowels:

where old Aramaic prefers *a*, Canaanite and Phoenician prefer *u* (*o*), while the alternations in Hebrew betray its composite origin; for example, *rō'š*, "head," goes back to the Can. and Phoen. *rush*, but *rā'šîm*, "heads," to the Aram. *rā'š*. Again, in certain weak verbs Hebrew prefers the Aramaic *a* in the active but the Canaanite *u* (*o*) in the reflexive (passive) voice; for example, the active *naḥti* agrees with the Aram. *nāḥt* against the Can. *nuḥti*, "I rested," while a form like the passive *nākôn*, "was established," reflects the Canaanite vocalization. The vocabulary, however, exhibits few words which are undoubtedly old Aramaic.

Another element comes from the eastern (Akkadian or Assyro-Babylonian) branch of the Semitic family. Through this Hebrew obtained a few Sumerian loanwords, like *hēkāl*, "temple," through Akkad. *ēkallu*, "palace," from Sum. *E.GAL*, "great house." Those weak verbs whose last two consonants are identical show this Akkadian (and Aramaic) element; for example, the alternatives *qāṣaṣ* and *qaṣ* represent the Akkad. *qasiṣ* and the Aram. *qaṣ*, "cut," respectively. Similarly the alternatives *mîšōr* and *mêšār*, "justice," represent the Phoen. *mîsor* and the Akkad. *mišāru*, respectively.

A number of alternative words confirms this view. The Hebr. *'ānōkî and 'ănî* ("I") reflect, the first the Bab.-Can. *anuki* (*cf.* Akkad. *anâku*) and the second the Aram. *'ănâ* (*cf.* vulgar Arab. *'anî*); the Hebr. *'ēl* and *'ĕlō'ah* ("God") reflect the Bab.-Can. *ilu* and Phoen. *el* (*cf.* Akkad. *ilu*) and the Aram. *'ĕlāhâ* (*cf.* Arab. *'ilâh*), respectively. There are even occasionally three synonyms, each from a different source, in current use.

Hebrew, therefore, has drawn upon Assyro-Babylonian, old Aramaic (Amorite) and Canaanite. So tradition asserts that Abraham came from Babylonia by Haran, through Hittite and Amorite territory, into Palestine. The analysis, too, of the Hebrew language shows that those who spoke it borrowed elements from, and therefore in all probability passed through, lands whose inhabitants spoke the Babylonian, Amorite (or Aramaic) and Canaanite languages.

Dialect.—Hebrew retained but few traces of dialect; the reason lay probably in the Masoretic editing of the sacred text, which obliterated all local peculiarities. The Amorites substituted *s* for *š*, and a trace of this is seen when the Ephraimites said *sibbōleth* for *šibbōlet*. Another mark of dialect was the Gileadite use of *šōmēa'* (*cf.* Ass. *šāmeānu* and Ethiopian *samā'ī*), "hearer," for *'ēd*, "witness." Again, the North Palestinian narratives preferred *'atti* to *'att*, "thou" (fem.), *zōh* to *zō't*, "this" (fem.), and exhibited a few other aramaicizing peculiarities, notably in certain pronominal suffixes. This explanation probably accounts for certain infinitives, like *hālōk* for *leket*, "to go," used by the Elohist; the Ugar. *hlk* confirms this form. The use of *m'lôkāh* for *molkāh*, "rule," *'ālaz* for *'ālaṣ*, "exulted," and *'al*, "upon," for *'el*, "unto," may also be dialectical. But certainty on this point, in view of the lack of sufficient evidence, is unattainable.

Writing and Pronunciation.—Hebrew was written in the common Semitic alphabet, used alike by Moabites, Hebrews, Phoenicians (who transmitted it to the Greeks) and Aramaeans. The earliest Hebrew examples occur on the calendar from Gezer (*c.* 10th century B.C.) and on the inscription in the Pool of Siloam (*c.* 700 B.C.); there are, however, earlier instances in Phoenician texts. The characters remained longest unaltered in Hebrew and Phoenician. The transition to the "square script" was effected by way of Aramaic and so into Hebrew, undoubtedly in consequence of the growing influence of Aramaic immediately before the Christian era. It was called the "Assyrian script" on the assumption that it was the hand of the eastern Aramaeans, which the Jews adopted about the 5th century B.C. Tradition ascribed this change to Ezra; but inscriptions, ostraca and papyri prove that it was a gradual process which was not completed in Hebrew by 400 B.C. Another form of this hand is found in Egyptian Aramaic in the 5th and 4th centuries B.C. From these were developed the "square" characters used in biblical manuscripts, important texts and most printed books; the "rabbinic" script, used in every kind of treatise, and the "cursive" writing of letters and informal documents, which was not generally printed. Hebrew paleography is not sufficiently advanced to determine accurately the date of a manuscript, but the country of its origin can be recognized. The clearest distinctions are between Spanish, French, Italian, Maghrebi, Greek, Syrian and Egyptian, Yemenite, Persian and Karaite hands. This alphabet numbered 22 letters, whose order certain acrostic poems prove not always to have been precisely that which afterward prevailed; and there are signs that it was not definitely fixed even when the Greek version of the Old Testament was made. In default of figures the consonants served also as numerals, the earliest traces of which are found on Maccabaean coins.

The ancient Hebrews may, like the Phoenicians and the Jews in Egypt in the 5th century B.C., have used special signs as numerals, but no trace of such a usage survives. They employed the letters of the alphabet, as on coins of the first revolt (A.D. 66–70), for this purpose; thus *'ālef* to *ṭēt* served for 1 to 9, *yôd* to *ṣādê* for 10 to 90 and *qôf* to *tāw* for 100 to 400. Traces of this system have been detected in the Old Testament; *e.g.*, the number of Abraham's "trained men" is 318, which is the numerical value of the letters of the name of his steward Eliezer when added up (Gen. xiv, 14; xv, 2); and the 390 days for which Ezekiel is bidden to lie on his left side equals the numerical value of the letters in *ymy mṣr* ("days of siege," Ezek. iv, 4–9). Here, however, the Septuagint has different (and intelligible) figures, which must represent the original number; the 390 may have been obtained by ingenious tampering with the text.

This alphabet was purely consonantal, except that *w* and *y* could denote *u* and *i*, while *'* (*'ālef*) sometimes represented *a* and more rarely *o*, and *h* supported various final vowels; the first two also indicated the diphthongs *au* (*ô*) and *ai* (*ê*). In inscriptions these helping consonants were only sporadically written and were inserted in the Scriptures only by later scholars, often wrongly.

Hebrew Alphabet and Transliteration

Hebrew letter	Transliteration	Simplified transliteration for some letters	Hebrew vowel	Transliteration	Simplified transliteration
א	'	' or a	◌	e	
ב	b				
ב	bh, v	v	◌	ē	
ג	g		◌	ê	e
ג	gh		◌ '	ĕ	
ד	d				
ד	dh		◌	e	
ה	h	h or omitted			
ו	w	w or omitted			
ז	z		◌	a	
ח	ḥ	h			
ט	ṭ	t	◌	ā	a
י	y	y or omitted			
כ	k		◌	ă	
כ	kh	kh			
ל	l				
מ	m		◌	î	
נ	n				ī
ס	s		◌	ī	
ע	'	' or a			
פ	p				
פ	ph, f		◌	ô	
צ	ṣ	z			
ק	q		◌	ō	
ר	r				o
ש	ś	s	◌	o	
ש	š	sh		ŏ	
ת	t		◌	û	
ת	th	th	◌	u	u

That this alphabet was imperfect, apart from the absence of vowels, is evident; for, firstly, the ancient Versions prove that *ḥ* and *ʿ* (*ʿayin*) each represented a harder and a softer sound, which Arabic distinguishes by diacritical points; secondly, the Masoretes inserted a point in *b, g, d, k, p* and *t*, to distinguish their unaspirated from their aspirated sounds. Yet it was overrich in the possession of five sibilants: *z*, a strongly articulated *ṣ*, two forms of *s* which were so alike that one of them fell into desuetude, and *sh* (*š*).

The writing was from right to left. On the earliest inscriptions the words were divided by a point; but this was not so on seals and coins, and separation of the words was probably irregular in early manuscripts of the Scriptures; for the Versions not infrequently imply a different division. Separation seems, however, to have been completed, like the introduction of special final forms of *k, m, n, p* and *ṣ*, before the time of the Masoretes. As Hebrew became ever more the language solely of the learned, the need of preserving the original pronunciation in the reading of the Scriptures was increasingly felt; for this the vowel-less text was a very imperfect instrument. The insertion of *w* and *y*, of *ʾ* (*ʾālef*) and *ḥ* to mark long vowels and diphthongs was the first step; that of *ʾ* (*ʾālef*) and *ḥ* was very early; but, since the Greek Version often implies a reading without such a *w* or *y*, these had probably not been generally introduced till after the 2nd century B.C. The system of vowels found in modern Bibles was a much later invention, having been gradually developed by Jewish grammarians in the 6th and 8th centuries A.D., in imitation of the Syriac vocalization. Three main systems were invented: the Babylonian with mostly supralinear signs; the Palestinian having them chiefly under the line; and the Tiberian as shown here. The Palestinian, as elaborated by the scholars of Tiberias, is that found in modern Bibles. It was so exact as to show all the vowel-changes occasioned by lengthening, by tone, by gutturals, and so on, which other languages seldom indicate in writing. This vocalization, which was little used except in Bibles, represented the traditional pronunciation observed in reading the Scriptures in synagogues and schools; but doubts have, on good grounds, been raised whether it represents the true pronunciation of ancient Hebrew. This can be shown by the Assyrian writing of Hebrew names and by the Greek and Latin transcription of Hebrew names and words. Thus "Dibon" (Hebr. *Dibôn*) should probably be pronounced "Daibon" (Hebr. *Daibôn*) if the Greek Δαιβων is to be trusted. It is also noteworthy that the punctuation often exhibits a later *i* or *e* where the Septuagint preserves an *a* which comparative philology proves to be original. Yet caution is necessary; for the alphabet into which a word is being transcribed may not possess any means of representing the necessary sound; for example, the Assyrian transcription *Ausi'* and *Usi'* for "Hoshea" (Hebr. *Hôšēaʿ*) does not imply any different pronunciation, since Assyrian had no signs for *h, o* and *e;* the Greek Ωσηε, as far as it can, here confirms tradition. Further, the scrolls from the Dead sea afford clear hints of a divergence in pronunciation. Yet, although the Masoretic vocalization might sometimes be wrong, internal reasons as well as the analogy of the cognate languages testify to the general faithfulness of the tradition. In the Masoretic period, or soon afterward, other signs, such as a complicated system of accents, different in the prose works and the poetical books, were added. (*See* also ALPHABET.)

Accidence.—Hebrew was in many respects more fully developed even than classical Arabic, which only took several centuries after Hebrew had ceased to be spoken. Classical Arabic, like early Babylonian, had case-endings (sing. nom. *-u*, acc. *-a*, gen. *-i*). Of these there are traces in Hebrew of a nom. *-û* found only with a following genitive case, as in the Old Testament in names like "Methushael" (Hebr. *Mᵉtûšāʾēl; cf.* Bab. *mutu ša ili*, "man of God"). The acc. *-āh* survived sporadically, though without meaning, in poetry. No genitive ending is found in Hebrew; for the termination *-i*, sometimes attached to nouns governing the genitive case, was probably a binding vowel, like the *-i* of early Babylonian. The locative *-āh*, "toward," which is found also in the Ugaritic dialect, must be carefully distinguished from the accusative termination. The plur. *-im* and dual *-ayim* were properly accusative endings, as is shown by Babylonian (plur., nom. *-û* and acc.-gen. *-i;* dual nom. *-ân* and acc.-gen. *-ên*) and Arabic (plur., nom. *-ûna* and acc.-gen. *-ina;* dual nom. *-âna* and acc.-gen. *-aina*). The Canaanite glosses *šamuma* and *šamema* (*cf.* Hebr. *šāmayim*), "heaven," show two plural cases; of these the alternative forms of the name "Penuel" (Hebr. *Pᵉnûʾēl*) and "Peniel" (Hebr. *Pᵉnîʾēl*), "face of God," of which the plur. *pānîm* (*cf.* Bab.-Ass. *pânû*), "face," is an element, were the sole surviving trace in Hebrew. The earliest Hebrew, then, was on a level with modern Arabic, for the accusative had become the only case.

Syntax.—Classical Hebrew construction was almost exclusively paratactic, subordinate conjunctions being extremely rare. In pre-exilic writings many verses and even whole chapters can be found, exhibiting no conjunction other than *û-* or *wᵉ-*, *wa-*, "and." Yet there is no monotony; for extraordinary skill is displayed in varying the tenses and the order of the words, often with good effect; *e.g.*, Hebrew says graphically "this do and live" for the ordinary English "if you do this, you will live." Further relief was provided by "*wāw*-consecutive," or rather "*wāw*-conservative," a construction almost confined to biblical Hebrew; elsewhere it is found only in one Moabite and one Aramaic inscription and in the Sabaean (south Arabic) dialect, and it died out before Mishnaic Hebrew arose. This construction was the normal method of connecting each fresh verb in the narration of a series of events with the preceding clause. The two Hebrew tenses were used to indicate not past or future action but complete or incomplete action; by the *wāw*-consecutive construction, therefore, in past time only the first verb stood in the perfect and the narration was continued in the imperfect; in present or future time, the first verb stood in the imperfect and the subsequent verbs in the perfect. This progress in the sequence of time was indicated by a variety of the ordinary conjunction *wᵉ-* or *û-* "and," which either had a heavier vocalization or altered the accent of the verb; for example, *kālāktā wat-tiqṭōl* meant "thou hast gone and killed"; similarly, *tēlēk wᵉ-qāṭaltāʾ* meant "thou wilt go and kill." Here the tense-forms exemplified in *tiqṭōl* and *qāṭaltā* retain the (possibly primitive) sense of the corresponding forms in the East-Semitic (Assyro-Babylonian) speech; and the various uses of this construction afford a relief to the monotony of a long string of clauses co-ordinated rather than subordinated to one another. But this idiom began to die out under Aramaic influence after the exile, and the simpler constructions, like *hālaktā wᵉ-qāṭaltā*, "thou hast gone and killed," and *tēlēk wᵉ-tiqṭōl*, "thou shalt go and kill," become a mark of later Hebrew; here, contrariwise, the same tense forms are conformed to West-Semitic (Aramaic and Syriac; Arabic) usage. The participle also in all periods was freely used to eke out the inadequacy of these two tenses; this too was an Aramaicizing use. Another device was the "circumstantial clause," whereby a clause introduced by "and" served as a secondary predicate; *e.g.*, the Hebrew said "he found him, (and) he plowing" instead of "he found him plowing," using the participle and not a finite verb in a parallel, in place of a subordinate, clause.

Qualities of Biblical Hebrew.—The material for forming a judgment on biblical Hebrew is itself scanty and inadequate. Even so, the smallness of the vocabulary and the paucity of adverbs, adjectives and abstract nouns are noticeable. The first difficulty was obviated by prepositional phrases, auxiliary verbs and similar devices, the second by apposition or a descriptive genitive case. The lack of abstract nouns, which only became frequent after the exile, was circumvented by the feminine singular or plural adjective; thus *rāʿāh* (fem. sing.) stands for "wickedness" and *qāšzt* (fem. plur.), "harsh things," for "harshness." Another feature was the expression of the abstract under a concrete form; thus *kābēd*, "was heavy," meant also "was honourable," and from it both *kābēd*, "liver" (as the "heavy" organ), and *kābōd*, "abundance" and "honour," were derived. It is, on the contrary, a sign of lateness when an abstract noun like *môdaʿ*, "acquaintance," designated a concrete person.

Hebrew was less suited for the definite expression of studied thought and the treatment of abstract subjects than for poetry. There was a great lack of particles to express the more subtle connection of ideas; there were few words or inflections to indicate slight modifications of meaning, although possibly Hebrew, like

other Semitic languages, formerly distinguished verbal moods in a way now obscured by the Masoretes. The use of the tenses was largely determined, especially in poetry, by the imagination, which regarded things unaccomplished as accomplished, the past as present and the future as fulfilled. It must, however, be remembered that living Hebrew never had to express abstract ideas; Ecclesiastes, which alone grappled with an abstract subject in plain prose, was composed when classical Hebrew was already dying out.

Postexilic Developments.—The language of the Old Testament must have undergone considerable changes during its long history; but the leveling work of the Masoretes has made it very difficult to follow its prolonged historical development in detail. In prose, especially of the pre-exilic period, considerable differences of form and style can be detected, due partly to the time and place of composition, partly to the individuality and talent of the authors. Through them especially the various documents woven into the text can be disentangled. Yet the structure and, except in isolated cases, the vocabulary and phraseology, were much the same. The postexilic literature shows a constantly closer approximation of the language to the cognate western Aramaic idiom. The process was very gradual, for literary Hebrew was still understood, if not spoken, by the people at least in the 2nd century B.C.; and its extensive use in religious literature, in the scrolls from the Dead sea (*c.* 1st–2nd centuries A.D.), in the liturgy and in poetry proves that it was not entirely forgotten for many centuries thereafter. The poetical language employed peculiar words and meanings, forms especially of prepositions and pronominal suffixes, inflections and constructions; but these distinctions were not so marked as in Greek. Many of them, being found in ordinary use in the cognate languages, notably in Aramaic, were often probably archaisms from the common Semitic vocabulary, surviving in Hebrew only in poetry. In other cases, possibly, Hebrew poets deliberately embellished their language with Aramaisms, for there is evidence that Aramaic was known to educated Hebrews in the latter part of the 8th century B.C. Apart from Aramaisms, there was a definite poetical vocabulary; for example, *'ôraḥ* for *derek*, "way." There was, particularly, a tendency to substitute adjectives for nouns; for example, *lᵉbānāh*, "the white one," for *yārēaḥ*, "moon." The article and *'ēt*, the sign of the accusative, were frequently omitted; the relative particle was freely dropped; the governing power of prepositions was extended; the greater scope allowed to the imagination in the use of the tenses frequently obscures the sequence of events to a western reader; and a forceful brevity of expression was affected. Poetry was accentual and was distinguished from prose by rhythm and parallelism.

At first foreign words were rare. There are occasional Egyptian words like *'āḥû* (Eg. *ḥw*), "reeds," and *qeset* (Eg. *gsty*), "inkhorn," and Assyrian words like *sē'ôn* (Ass. *šēnu*), "boot," learned probably from invading soldiers. The Babylonian *pûru*, "lot," was introduced in the plural *pûrîm*, "lots," to designate a postexilic feast. Persian words also, like *dāt* (Pers. *dâta*), "law," came in. But late Aramaic, as closely resembling Hebrew, exerted, especially after the exile, an ever increasing influence. Aramaic words and forms appeared: the Hebr. *-āh* began to be displaced by the Aram. *-â* in feminine nouns, and the Hebr. *dābār* to yield to the Aram. *millᵉtâ* in the Hebraized form *millāh*, "word," which even has two plural forms (Hebr. *millîm* and Aram. *millîn*) in the same book. Hebrew words were sometimes Aramaicized in form, as when the Hebr. *nāṣar* became *nāṭar* like the Aram. *nᵉṭar*, "kept," or in meaning, as when the Hebr. *ṭa'am*, "taste," came to mean "decree" like the Aram. *ṭe'ēm* (*cf.* Ass. *têmu*), "command." Abstract nouns in *-ût*, like *malkût*, "kingdom," became common and were even formed from infinitives, like *hašmā'ût*, "proclaiming," on the Aramaic model.

This postexilic Hebrew showed also great simplicity and uniformity of style, again largely due to Aramaic influence. For several centuries the Jews must have been bilingual, still understanding Hebrew but speaking Aramaic, the official language of the western provinces of the Persian empire; by the time of Christ, however, Aramaic versions of the Scriptures, called *targûmîm*, were becoming necessary. Meanwhile Hebrew, without dying out, became gradually a *lᵉšōn ḥăkāmîm*, "language of scholars," as indeed it had begun to be in the later Scriptures. For the period from *c.* 100 B.C. to *c.* A.D. 100 little was known about this language until the discovery of the scrolls hidden in caves off the northwest end of the Dead sea (*see* DEAD SEA SCROLLS); but after that it was greatly developed in the Mishnāh (*c.* A.D. 200).

MISHNAIC HEBREW

Mishnaic Hebrew was still a living language, though mainly confined to the schools and clearly distinct from biblical Hebrew. In the Scriptures the range of subjects was limited; in the Mishnāh it was much extended. Matters of daily life were minutely discussed and words and phrases were adopted from the earlier and presumably popular speech; further, since the language was no longer in the same sense familiar, greater definiteness of expression was required in the written style.

The first alteration noticeable was the confusion of consonants, especially of the gutturals, which classical Hebrew had kept distinct. This change shows that the writers were accustomed to the daily use of Aramaic. Greek and Latin words, relating to the affairs of ordinary life, for whose writing the rules of classical orthography were violated, crept in. For example, biblical Hebrew almost universally required that initial *w* should become *y*, as in *yeled* for the very rare *wālād* (*cf.* Arab. *waladu*), "boy"; but barbarisms like *wetas* (Gr. *ἐνθύς*), "at once," and *wilôn* (Lat. *velum*), "curtain," were admitted, and henceforward the objection to forms like *wa'ad* (biblical Hebr. *mô'ēd*), "meeting," was less strongly felt.

Biblical Hebrew, having lost the case-endings, used *'ēt* to mark the definite accusative case; but Mishnaic Hebrew employed *'ēt* not only to introduce the direct object, but also to serve with a pronominal suffix, as a pronoun meaning "that" or "the same." Fresh pronouns, too, were coined by combining those already existing into compound forms or by adopting or adapting many from Aramaic. New adverbs, prepositions and conjunctions, especially subordinating conjunctions, were freely invented or imported from Aramaic.

The vocabulary was greatly enriched. Many biblical words remained, although some nouns changed their meaning; thus biblical Hebr. *gôlem*, "embryo," became the mishnaic Hebr. *gôlem*, "lump," "mass." New nouns were coined from biblical roots; so besides the biblical Hebr. *ḥemed*, "desire," there arose the Mishnaic Hebr. *ḥimmûd*, "desire," from *ḥāmad*, "desired." Especially noticeable are the numerous quadriliteral and quinqueliteral formations, which were rare in biblical Hebrew. Lastly, good Hebrew words appear which, though unknown in the Scriptures, must have belonged to the old spoken language. Besides the numerous Greek and Latin words, a few Persian (or Arabic) words crept in. These generally retained their original appearance, while one Greek word passed over in the genitive case (Mishnaic Hebr. *'andrîantôs* = Gr. *ἀνδριάντος*, from *ἀνδριάς*, "statue"); only rarely were they furnished with Hebrew terminations. The inflection of nouns remained unchanged; but many masculine nouns acquired feminine endings, and the Aramaic masculine plural ending *-în* was much commoner than the Hebrew *-îm*, although the Hebrew feminine ending *-ôt* was regularly retained. Finally, the "construct state," whereby a noun followed by a dependent noun in the genitive case undergoes phonetic modification, survived sporadically; but a periphrasis with *sel-* ("which is to"), "of," with the preposition *lᵉ-*, "to," or with the Aram. *dĕ-*, "of," tended to displace it. This relative particle *še-*, which belonged to dialect in biblical Hebrew, completely ousted the classical *'ăšer*, "who," "which," from Mishnaic Hebrew.

The supply of verbs also was much enlarged. Foreign verbs, being ill suited to the Hebrew conjugations, were rarely adopted, but a few were formed from nouns; *e.g.*, *sāfag*, "absorbed," from *sᵉfôg* (Gr. *σπόγγος*), "sponge." The imperatives *ḥîrî* (Gr. *χαῖρε*), "hail!" and *wîwî* (Lat. *vive*), "live," are exceptions. But Aramaic verbs, which closely resembled Hebrew verbs, were readily assimilated, while some classical verbs received new meanings; *e.g.*, *zākāh*, "was innocent," acquired the sense of "succeeded." Others, used originally in the simple theme, afterward affected a derived

theme. Many roots known only from derived nouns or quite unknown in biblical Hebrew became general. Additional verbs were coined from derivative nouns such as *miškēn,* "took a pledge" (Mishnaic Hebr. *miškōn*), "pledge." Quadriliteral and quinqueliteral verbs, rare in biblical Hebrew, became common. The conjugations remained substantially unchanged; but the third person feminine singular took *-et* (*-at*) in place of *-āh* in the reflexive theme. Certain weak verbs also deviated slightly from the classical norm.

The themes underwent some slight changes. Canaanite had marked the active and passive voices by modifying the vowel (*cf. laqaḥu,* "they took," but *laqiḥu,* "they were taken"), and biblical Hebrew sporadically preserved this difference between transitive and intransitive verbs (*cf.* between *zākar,* "remembered," and *šākēn,* "dwelt"). Of an internally formed passive the only certain survival is the participle; *e.g., zākûr,* "remembered"; but other traces are probably concealed under certain forms which the Masoretes obscured. In its place, biblical Hebrew used the passives of the derived themes. These (according to the paradigm of *pa'al,* "did") were the reflexive *nif'al,* the intensive and causative *pi'ēl,* the causative *hif'il* and the reflexive *hitpa'el.* The *nif'al* easily acquired a passive force; the *pu'al,* less often the *hof'al* (the passives of the *pi'ēl* and *hif'il* respectively), were often also so used. But in later Hebrew the *nif'al* and even more the *hof'al* tended, because of ambiguity in their meanings, to become less frequent, whereas the *hitpa'ēl* became extremely common, both with a reflexive and less often with a passive force. Simultaneously a new form, the *nitpa'ēl,* of which biblical Hebrew offers but three possible examples, became extremely common with a purely passive sense. Of the active themes the *pi'ēl* served extensively in forming new verbs from nouns and replacing the simple theme customary with many classical verbs and the *hif'il* extended its usage. An Aramaic causative theme, formed by prefixing *ša-* or *sa-,* instead of *hi-,* was not unknown.

The old tense-system was inadequate, and the loss of "*wāw*-consecutive" made it even more so. The perfect expressed only completed action in past time; and more than the old imperfect was required for incomplete action in the past, present and future. Various periphrases were therefore devised. Past incomplete action was denoted by the verb *hāyāh,* "was," with the participle; *e.g., hāyāh 'ômēr,* "he was saying," was distinguished from *'āmar,* "he said," while the imperfect *yômēr* was left with a jussive force, meaning "he should say." The present participle alone connoted present time. As describing what one did, it came to indicate also what one ought to do; but a pronominal subject, being no longer implicit or explicit in inflection, had to be expressed; *e.g., 'ănî 'ômēr* or *'ômēr 'ănî,* "I say." This gave rise to a completely new Aramaicizing tense, formed by combining the participle with the following pronouns; for example, *'ômĕranî,* "I say." The future was expressed by the adjective *'ātîd,* "ready," or the noun *sôf,* "end," with a pronominal suffix referring to the subject, followed by the infinitive introduced by *l^{e}-,* "to"; *e.g., 'ănî 'ātîd lômar,* "I am ready to say," or *šôfî lômar,* "my end (is) to say," viz., "I will say"; or by *l^{e}-* and the infinitive alone, as sometimes in biblical Hebrew, denoting rather what ought than what will happen; *e.g., 'anî lômar,* "I am to say." To express obligation, for which biblical Hebrew had no regular phrases, Mishnaic Hebrew used the adjective *ṣārîk,* "needed," with the infinitive; *e.g., 'ănî ṣārik lômar,* "I must say." At the same time it acquired a few vivid new idioms; *e.g.,* "he has put his money on the horns of a deer" for "made an unwise investment." Thus Hebrew, with its archaic stiffness, lost also the austere beauty and stately dignity of its prime. In exchange it acquired simplicity and flexibility and adapted itself better to the needs of every day, though the disappearance of much that is characteristically Hebrew before the invasion of Aramaic cannot but be regretted.

MEDIEVAL AND MODERN HEBREW

The medieval language underwent development, however spasmodic, in various directions. The cult of the liturgical poem called a *piyyût* (itself a Greek word) in the 6th–9th centuries enriched the vocabulary by giving fresh meanings to old words and coining new ones, especially in the so-called Kalirian style; and the Spanish-Hebrew poets *c.* 900–1250 followed suit (*see* HEBREW LITERATURE). This period saw also the addition of about 2,000 or 3,000 scientific, philological and philosophical terms; some of these were formed by making new use of old roots, as in the case of *geder,* "fence," which served also for "definition." Some were based on existing Hebrew words like *kammût,* "quantity," from *kammāh,* "how much?", and others were adapted from foreign languages, chiefly Greek and Arabic, such as *'aqlîm,* "climate," and *tibʿî,* "natural."

The language then became sterile until the revival of the 18th century, when M. H. Luzzatto (*q.v.*; 1707–47) reverted to a pure and simple biblical style; but the *Haskālāh* "enlightenment" (1784–1881), which was started by Moses Mendelssohn (*q.v.*), with its interest on worldly knowledge and universal culture, brought a fresh renaissance. Only a few masters caught the old biblical spirit; their followers forced their ideas into an artificial mold, not infrequently with ludicrous results; *e.g.,* in "one who declares unto man what his thoughts are" (Amos iv, 13) for "parrot." The next modernizing impetus was Zionism (*q.v.*), coming in the wake of nationalist movements in Europe; this tended to drive out Yiddish and Ladino (the Judaeo-Spanish dialect) as despised foreign jargons, leaving the way open for Hebrew. Lastly, the *'āliyāh* or emigration to Palestine from both Europe and the east, especially Arabic-speaking countries, made imperative the need for a common language, which would naturally be Hebrew. At this point Ben Yehudah (1858–1922) resolved, against the wishes of many Zionist leaders, to make Hebrew once again a spoken as well as a written language.

The language as thus re-created is essentially that of the Bible, Mishnāh and Midrash, though with numerous and ever-increasing innovations, some accidental but most intentional, designed to meet modern needs; thus it is the only colloquial speech based on a written language (for the reverse is normally what happens). The pronunciation is a modification of that of Sephardim (Hispano-Portuguese), not of Ashkenazim (east European) Jews; and the old guttural and so-called "emphatic" (*ṭ, q*) sounds are not clearly distinguished or are even lost, except by oriental Jews. In the same way the ancient aspiration, except of *b* and *p* which are pronounced respectively as *v* and *f* after vowels in native Hebrew words (as in *Negev* for *Negeb*), is disregarded. In vocabulary, accidence and syntax, the standard is now of a mixed Ashkenazim-Sephardim type, with an ever increasing oriental element showing clear deviations from it; and the influence of the immigrants' European language is almost everywhere noticeable. Few immigrants are educated or scholarly, and they import many errors even into the biblical idiom which they suppose themselves to be using. Thus a constant battle is being waged between classicists and modernists, with the Hebrew Language academy serving as a more or less impotent arbiter. It cannot prevent many solecisms, even those due to the misuse of corrupt words in the Old Testament; *e.g., hăki,* "very," and *hăqāfat bāzāq,* "lightning attack" or blitzkrieg. Some neologisms, too, are malformations violating Semitic usage, such as *ṣad-lôḥēm,* "cobelligerent," or barbarous hybrids such as *'ôtô-maśśâ,* "motor truck." Mostly, however, the neologisms, including some of European origin, fit into the language well enough, whether old words with new meanings (*e.g., ḥašmal,* "amber," "brass" and now also "electricity"), or new formations based on old roots (such as *'ittôn,* "newspaper," from *'ēt,* "time," and *šiqqûm,* "reconstruction") and compound terms (such as *biltî-rašmî,* "unofficial," and *'adkānî,* "up to date," from *'ad-kān,* "till now"), which were very rare in the classical period; one of the most ingenious of these is *tappûz,* "orange," formed from a combination of *tappûaḥ,* "apple," and *zāhāb,* "gold." A fair number of foreign words have also appeared, some properly Hebraized (*e.g., 'irgēn,* "organized," and *ṣiṭṭēṭ,* "cited") but others left virtually unchanged (*e.g., ṭarîṭôriyāh,* "territory"). The supply of adjectives, very inadequate in the old language, has been greatly increased. The syntax is basically that of the Mishnāh (codified *c.* A.D. 200), though in some ways still further simplified. Clarity, too, is increased by the introduction or invention of new connecting links, adverbs and especially subordinating conjunc-

tions, so that the old paratactic style of construction, which though superficially simple often left the sequence of thought obscure, has largely disappeared. The language has also enriched itself by verbal imitations of foreign expressions (such as *sifrût yāfāh*, "beautiful writing," for belles-lettres; *lō' yāda' gᵉbûl*, "he did not know a boundary," for "was immoderate"; and *gillāh 'inyān bᵉ-*, "he showed interest in"); and *hit'asseq*, "got busy," has nearly as many usages as the English "got."

The new language, therefore, has lost much of the variety of the classical speech, often falls flat and seems stilted or artificial; and the absence of adequate means of indicating the vowels, the use of the letters of the alphabet as numbers beside the European figures (these read in the opposite direction to the text in which they stand) and the almost complete failure of a native scientific vocabulary make it in many respects unreal and unpractical. It has, however, been revived not for practical but for political reasons. *See* also references under "Hebrew Language" in the Index volume.

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HEBREW LAW: *see* ISRAELI LAW; TALMUD.

HEBREW LITERATURE. Literature in the Hebrew language has been produced uninterruptedly from the early 12th century B.C. If, as is believed, the Canaanite population living in Palestine at the time of the Israelite conquest spoke in part an earlier form of Hebrew, then the translations of fragments from Canaanite psalms which appear in the Tell el-Amarna letters are evidence of a Hebrew literature existing in the 14th century B.C. During part of this literary history (*c.* 1200 B.C.–A.D. 200) Hebrew was a spoken language in Palestine, first in the dialect called biblical Hebrew and later in the form of Mishnaic Hebrew. A second period (200–1880) shows Hebrew as a literary language only, the writers of which spoke, and sometimes also wrote concurrently, a variety of other languages. Hebrew literary centres existed throughout the Mediterranean area and consecutively in northwestern Europe, central and eastern Europe and, since the mid-19th century, in America. The last period (1880 onward) coincides with the revival of Hebrew as a spoken language and saw the gradual shift of its centre to Palestine. (*See* also HEBREW LANGUAGE.)

Hebrew literature is not synonymous with Jewish literature. Some Hebrew writing was produced by the Samaritans and in the 17th century by Protestant enthusiasts. Jews also produced important literatures in Greek, Aramaic, Arabic, Judaeo-Spanish, Yiddish and a number of other languages. Apart from the Aramaic writings, however, such literatures always served only that part of Jewry which used the language in question. When that community ceased to exist, the literature produced in languages other than Hebrew was forgotten (or, in the case of Greek Jewish literature, became part of Christian tradition) except for whatever part of it had been translated into Hebrew and thus became part of Hebrew literature.

The Hebrew language, whether spoken at the time or not, has always adapted itself to the needs of changing literary tastes. In the Bible it develops from a simple and earthy idiom to a language suitable for the expression of sophisticated religious thought without losing the poetic force and rhythmic fullness which characterizes it. Mishnaic Hebrew is pedestrian, exact and yet can reach heights of irony or of warmth. In medieval poetry Hebrew allows the most extravagant displays of verbal artistry, but also, in northwestern Europe, a fervent simplicity equal to that of the spoken languages of its milieu. One generation of translators in the 12th century created a scientific Hebrew which is not inferior to contemporary Arabic or Latin in precision or syntactic refinement. The 17th–19th centuries saw the formation of a stately, rigid, classical style based on biblical Hebrew, but at the same time eastern European mystics made the language serve the expression of their fervid love of God. Since literary Hebrew in the 20th century draws upon ancient literature to a marked degree, different styles and needs of expression are often modeled upon predecessors in the distant past, so that the grammatical and vocabulary differences between different literary genres in modern Hebrew exceed those customary in western European languages. The modern period has also evolved a new type of language for newspaper and other nonliterary writing, while in novels the style is often based upon the spoken language.

BIBLICAL TIMES THROUGH THE AMORAIC PERIOD

Pre-Exilic Period, c. 1200–586 B.C.—All that is preserved of the literature of this period is slightly more than 20 of the 39 books included in the Old Testament (the remainder being from the next period). The titles of more than a dozen other books are mentioned in the Bible. Many others have no doubt been lost without trace. In all probability poetry preceded prose.

Biblical poetry, like that of most of the ancient near east, is based on the principle of parallelism—*i.e.*, the two halves of a verse express the same idea, either by repeating it in different words or by stressing different aspects of it (*e.g.*, thesis and antithesis or cause and effect). Examples are found in the Book of Psalms: "but they flattered him with their mouths; they lied to him with their tongues" (lxxviii. 36); "we will not hide them from their children, but tell to the coming generation the glorious deeds of the Lord" (lxxviii. 4); "he turned their rivers to blood, so that they could not drink of their streams" (lxxviii. 44). Sometimes three units are parallel. They may then form a kind of crescendo, as in Ps. i, 1 or xxix, 1–2. To this "rhyme of meaning" is added a simple rhythm, consisting mainly in having in each half line an equal, or almost equal, number of stressed words (particles, words preceding a genitive, or verbs may be counted as unstressed if the rhythm demands it). Attempts to establish more detailed principles for the rhythmic alternation of stressed and unstressed syllables have failed, probably partly because the exact state of the development of the Hebrew vowels in the pre-exilic period is not known. There are instances of folk songs (*e.g.*, Isa. v, 1–7) to which belong perhaps large parts of the Song of Solomon; dirges (*e.g.*, Isa. xvi, 7–11; Book of Lamentations); epic chants (Ex. xv; Judg. v), perhaps remains of a large-scale Israelite epic of the Exodus and conquest; and psalms. The use of various forms of poetry in the work of the prophets appears to be a later literary development.

The earlier prose texts are still very close to poetry in structure and language. Possibly the Pentateuch is a reworking in prose of original narratives in poetic form. The wisdom of proverbial literature is expressed in poetical form. The first real prose may well have been some of the laws recorded in the Pentateuch. It is probable that a standard prose style was created by the royal chancelleries and from there, via official chronicles, penetrated into the writing of history. Form criticism has shown the close connection between style, content and the circles from which vari-

ous types of literary material issued. In Jeremiah and Deuteronomy a high standard of rhetoric is achieved. Finally, some of the conversations in the historical books are attempts to reproduce in writing the style of ordinary talk.

Period of the Second Temple, 539 B.C.–A.D. 70.—The literary output of this period was large (*cf.* Eccles. xii, 12). Only part of it was included in the biblical canon: the prophets Haggai, Zechariah, Malachi and Jonah; the historical books of Ezra, Nehemiah and the Chronicles; and the books of Daniel, Esther and Ecclesiastes. The postexilic date of other books, such as the Song of Solomon, Job and much of Psalms, is disputed. Other works written during the same period in Hebrew and Aramaic were, for reasons sometimes not quite clear, excluded from the Jewish biblical canon, though some were included in the canonical Scriptures by the Christian church (*see* APOCRYPHA, OLD TESTAMENT). These works are for the most part known only from translations, but the rediscovery of large portions of the original Hebrew text of Ecclesiasticus in the 19th century and of small fragments of other such works, including some hitherto unknown, among the Dead sea scrolls, shows that, like the postexilic books of the Bible, they were written in a degenerate biblical Hebrew, sometimes consisting of phrases culled from older works. Those parts which are in poetry strictly follow the conventions of biblical poetry. The style is mostly pedestrian, but occasionally soars to heights of feeling, somewhat awkwardly expressed, in the visions of apocalyptic literature (*see* APOCALYPTIC LITERATURE).

The same style is used for the original sectarian works included among the Dead sea scrolls. These apparently do not include the narrative genre so typical for the Apocrypha and Pseudepigrapha, but apart from many legal and liturgical texts provide evidence of a new kind of writing, the homiletic commentary to the Bible, called Midrash ("searching") by both the Qumran sectarians and the rabbis. The only work of real literary merit among the scrolls is the fervent personal poetry of the Thanksgiving hymns.

Talmudic Literature.—The artificiality of the biblical Hebrew in these writings is due to the fact that biblical Hebrew ceased to be spoken near the beginning of the period of the Second Temple. Its place was taken in Galilee and other parts of Palestine by Aramaic, in Judaea by Mishnaic Hebrew, a later dialect of Hebrew which does not derive directly from the biblical. During the Hellenistic and Roman periods, both these languages were also strongly influenced by Greek. The Bar-Cochba letters discovered in 1960 and 1961, which are partly in Mishnaic Hebrew, partly in Hebraized Aramaic and partly in Greek, clearly exhibit the state of affairs *c.* A.D. 130. Biblical Hebrew was thus at that time a purely literary idiom. The Pharisees began early in the 2nd century B.C. to employ Mishnaic Hebrew in their teaching and thus gave literary status to this popular speech. Their practice was followed by the rabbis after the fall of Jerusalem in A.D. 70.

In contrast to the works of the Bible and the Second Temple period, which are lengthy writings bearing the imprint of their authors or editors, earlier rabbinic literature consists entirely of collections of individual statements loosely strung together. While the whole is amorphous, the individual paragraphs are often built up with consummate art and exhibit the influence of Hellenistic rhetoric. Collections which follow the arrangement of biblical books are called Midrash, as opposed to works such as the Mishnāh, where the material is arranged according to subject. In both cases the text often strays far from the verse or subject discussed. Statements which deal with legal or ritual practice are called *halaka;* those which deal with theological or ethical matters, or merely tell a story, are called *haggadah.* The *haggadoth* freely reshape biblical history. (*See* MIDRASH; TALMUD: *The Mishnah.*)

Tannaitic Period, *c.* 100 B.C.–AD. 200.—The main work of this period, which grew apace until it was codified early in the 3rd century, is the Mishnāh, a corpus of Jewish law and ritual in 63 tractates arranged in 6 orders. It contains mainly *halaka.* Additional material, including a larger percentage of *haggadah,* is collected in the Tosefta, which exactly follows the order of the Mishnāh. The tannaitic Midrashim to Exodus-Deuteronomy, of which there are two sets corresponding to two schools, contain a large part of the statements found in the Mishnāh and Tosefta and much that is not preserved there. These, too, contain preponderantly *halaka,* but allow more insight into the argument by which laws were derived from the Pentateuch.

Amoraic Period, A.D. 200–500.—The two main innovations of this period are (1) the appearance of an additional literary centre in Babylonia (southern Iraq), where Jewish autonomy and economic life flourished under the Sassanids in contrast to the oppressive rule of Rome and later Byzantium in Palestine; and (2) the literary use of Aramaic (in each country the local dialect) alongside Hebrew. The Talmuds produced by Palestine and Babylonia comprise discussions of the *amoraim* (members of the academies) as well as much tannaitic material not recorded in the earlier collections. There is a large proportion of *haggadah.* The Palestinian Talmud (which to the outsider is in some ways the more interesting of the two) remained incomplete; the Babylonian Talmud later became the authoritative work on Jewish law and ritual (*see* TALMUD: *The Talmuds*).

Liturgy.—The Jewish liturgy begins with the Psalms (many of which are incorporated in the prayers of modern Jewish liturgy). The tannaitic and amoraic ages produced a new type of prayer, couched in Mishnaic Hebrew enriched by borrowings from biblical Hebrew. There is no parallelism in the biblical sense, but short lines, often in sets of three or four of similar structure. Simple rhymes occur; this may be the earliest conscious use of the device in poetry (classical Greek and Latin literature abhorred rhyme). While prayers of the tannaitic-amoraic period form the basic parts of the daily prayers in modern Judaism there are many additions of later ages. The prayers are the closest approach of that period to works of real literary merit. Some popular ditties and a few obituary poems have also been preserved.

LITERARY REVIVAL AND GAONIC PERIOD, 500–1000

In Justinian's 146th Novel of A.D. 553, note is taken of the attempt of some Jewish groups to enforce the exclusive use of Hebrew in the synagogue. This tendency was part of a Hebrew revival that began in Palestine and spread westward but did not reach Babylonia till the 10th century.

Midrash.—The haggadic thought of the amoraic age was now built into skilfully constructed sermons. Sayings originally Aramaic are mostly translated into a Hebrew strongly influenced by the style of the liturgy. The earlier works, foremost among them *Genesis Rabba,* are largely concerned with theological controversy against gnostics. In the later collections, represented mainly by the *Tanhuma* cycle, the sermons are given in greater detail and are purely ethical. For the first time real books with a sustained theme appear. Besides a large number of minor Midrashim, two deserve special note: *Tanna de-Be Eliyahu,* a lofty ethical work, and *Pirke de Rabbi Eliezer,* mystical in tone. A whole literature, the *Hekhaloth* writings, describes the mystic's ascent to heaven and vision of God. Their symbolism influenced the numerous additions which were during this period made to the liturgy, as well as the *piyyut* (*see* below). Mystical cosmology is the theme of *Sefer Yezirah* (Eng. trans., *Book of Formation,* by K. Stenning, 1923), which probably dates from the 7th century.

Piyyut.—Synagogues began in this period to appoint official precentors (*hazzanim*), part of whose duty it was to compose poetical additions to various parts of the liturgy on special sabbaths and festivals. The authors of such compositions were called *poytan* (from Greek *poietes;* the more usual form, *paytan,* is Babylonian usage), their poems *piyyutim.* There are many similarities between these and the Byzantine and Syriac hymns of the time.

The keynote is messianic fervour and religious exuberance. Besides employing the entire biblical, Mishnaic and Aramaic vocabularies, the *paytanim* coined thousands of new words, sometimes for new ideas but more often simply recherché and full-sounding synonyms. The poems presuppose a highly educated audience. They abound in recondite allusions to halakic and haggadic literature and contain exhaustive lists of rites and laws, so much so that it was at one time believed that their purpose was to teach the law during periods when the rabbinic schools were suppressed. Persons are rarely mentioned by name but nearly always introduced by ingenious allusions. There are often elaborate strophic

arrangements, with rhymes or refrains. Acrostic poems are known in the Bible (*e.g.*, Ps. ix. x. xxv. xxxiv); in *piyyutim* there are all kinds of clever arrangements involving the beginnings of lines, words in the middle, or even all words. Frequently the initial letters of lines spell out the name of the author. These "signatures" help to establish the history of this literature, which is still largely uncertain. It is known that the most outstanding poets—Phineas the Priest, Yose ben Yose, Yannai and Eleazar ha-Kalir or ben Kalir—lived in that order, but it is not known when or where in Palestine any of them lived. Many *piyyutim* are still used in the synagogue.

Halaka.—Babylonian Jewry took no part in the literary renaissance. During the 6th and 7th centuries the Babylonian scholars called *saboraim* ("reasoners") edited the Babylonian Talmud. After this the *gaonim*—the heads of the Babylonian academies (*yeshibot*) in the cities of Sura and Pumbeditha—worked to spread the influence of the Talmud by encouraging communities everywhere to submit legal problems to them. They answered these in *responsa* (Hebrew *she'eloth u-teshuvoth*, "questions and answers"), which remained a characteristic form of Hebrew literature and are an invaluable source for social history. The *responsa* often deal with controversial points left unsolved in the Talmud. Such problems were discussed in formal set lectures (*she'iltoth*) at the semiannual month-long conferences held at Sura and Pumbeditha. There is a collection of such speeches by Rab Ahai (d. 752). Yehudai Gaon (d. 763) was the first to arrange compendiums of practical rulings, which were important as a weapon in the struggle against Palestinian *halaka*. This activity culminated in complete epitomes of the halakic material in the Talmud. The earliest is by Simon Kayyara (9th century), the latest and most authoritative by Isaac Alfasi (*q.v.*) of Lucena in Spain.

Masorah.—As early as the amoraic period steps were taken to ensure the exact preservation of the authoritative Hebrew text of the Bible. These included counting all the letters, noting irregular spellings, etc. In the gaonic period these studies reached their highest point. Reasons may be found in the rise of the Karaite sect, which claimed that all law had to be derived not from oral sources but directly from the Bible and thus forced their opponents (the "Rabbanites") to concentrate on its study (*see* KARAISM), and also in the impetus provided by Muslim efforts to establish an authoritative text of the Koran by scientific means. The Masoretes not only secured the inherited consonantal text of the Bible by carefully recording all its special features; they also laid down the correct way of reading it aloud by the invention of signs for the vowels and for the various pauses to be made in reading (the latter signs, or "accents," also serve as musical notation for the traditional intonation of the text in the synagogue). In establishing the vowels of the Hebrew Bible, the Masoretes also laid the foundation of Hebrew grammar.

Classicist Revival.—Manuscript fragments found in the 1890s in the genizah of an ancient synagogue in Cairo prove that some atheistic skeptics actually used biblical Hebrew in writing against the Bible. The work of Hivi of Balkh is known through the retort of Saadia ben Joseph (*q.v.*), who wrote several works in biblical style and pointed out the names of other works in this genre in his autobiography. The reason for the choice of biblical Hebrew appears to be the desire to emulate the Arabs' zeal for keeping their language pure, by cultivating the Hebrew equivalent to pre-Islamic Arabic. This was all the easier as Mishnaic Hebrew never had been a living idiom among Babylonian Jews, and they were at this time exchanging their Aramaic speech for Arabic. Saadia had to translate the Bible into Arabic and to add Arabic translations to his compositions in biblical style. At the same time he introduced *piyyut* to Babylonia. His *piyyutim* are much more difficult and artificial than those of the Palestinians.

Metrical Poetry.—Soon after Saadia's death the Arabic system of quantitative metre was adapted for Hebrew, probably by his pupil Dunash ben Labrat (*see* DUNASH). At first the *piyyut* form was retained for religious poems, and the new metres were used only for secular poetry, which closely imitated Arabic models and, like the latter, was chiefly employed for laudatory addresses to prominent people.

Babylonian and Palestinian Influence.—During the Roman period, Jewish communities had settled throughout western Europe and north Africa. They spoke Greek and (in the west later on) Latin and possessed writings in those languages. They came first under the influence of the Palestinian renaissance; soon after, they were affected by the missionary activities of the Babylonian schools. The results differ in each country. On the whole, Italy, southern France and the Carolingian empire remained within the Palestinian orbit but accepted the Babylonian Talmud and some of Saadia's work. Spain and north Africa continued for a while to cultivate *piyyut* but otherwise completely adopted the outlook of the Babylonian centre, including the revived biblical style and the Arabic metres. In the 10th and 11th centuries northern France and Germany (but not Italy or Provence and Languedoc) adopted the Palestinian ("Ashkenazi") pronunciation.

The Jews of south Arabia adopted the Babylonian Talmud and the Babylonian method of vowel notation (though their pronunciation is Palestinian) but retained the Palestinian devotion to Midrash (an important collection, *Midrash ha-Gadol*, exists only among them) and produced *piyyut* until modern times.

With the political and economic decline of the Abbasid empire after 932, oriental Jewry rapidly lost its prosperity and cultural hegemony. The last *gaonim* were among the greatest. Sherira ben Hanina (fl. 968–998) outlined in a *responsum* for the first time the history of halakic studies. His son Hai ben Sherira (*q.v.*) was a philosopher, a commentator of Bible and Talmud along scientific lines, and a poet. With him the Babylonian gaonate ceased; a much-reduced activity continued for a while in Palestine and Syria, but the focus of Hebrew literature shifted to the west. The opposition between Babylonian and Palestinian thought and writing was from then on replaced by that of their spiritual heirs: Spain on the one hand and northwestern Europe on the other. (*See* also GAON.)

EUROPE IN THE EARLY MIDDLE AGES

Palestinian Tradition in Europe, 800–1300.—From Palestine, the Hebrew renaissance soon spread into the Byzantine empire. A remnant of literary work in the Balkans is the *Midrash Lekah Tov* by Tobias ben Eliezer of Kastoria (*c.* 1100). In the 9th and 10th centuries learned Jews from Byzantium or from Byzantine refugee communities on the Black sea coast converted the Khazar princes on the lower Volga (*see* KHAZARS), and Russian heroic ballads contain references to Hebrew singing.

In Sicily and southern Italy (which belonged to Byzantium) a number of important *paytanim* were at work. Their poems are often extremely artificial. Midrash was extensively cultivated. Midrashic commentaries to biblical books outside the Pentateuch and the Five Scrolls were produced there by extracting from the older Midrashim (including some now lost) and the Talmuds incidental comments on verses from those books (*e.g.*, Samuel, Proverbs, Psalms and Job). Compilations of this kind for the whole Old Testament are called *yalkut* ("haversack"): *Yalkut Shim'oni* (Germany, 13th century); *Yalkut Mekhiri* (southern France, 14th century); *Yalkut Talmud Torah* (Sicily, 1331).

Before 1000 there began in Italy a secular literature: the fantastic travelogue of Eldad the Danite (Eldad ha-Dani; *q.v.*); the historical romance *Sefer ha-Yashar*, which deals with the pentateuchal period; and *Josippon*, which is Josephus' *Antiquities* translated from Hegesippus' abridgment and filled up with legendary incident. This last-named book was popular until modern times and translated into many languages including Arabic and Ethiopic. Also mainly for entertainment was the family chronicle of the *paytan* Ahima'az, in rhymed prose and *piyyut* style (1054; Eng. trans. by M. Salzman, 1924). Jews took part in the work of the medical academy at Salerno. The philosopher and mystic Sabbethai Donnolo (913–*c.* 983) wrote a book of *materia medica* in Hebrew, thus indicating that it was possible for a doctor to train himself through Hebrew works. Some contact with the philological scholarship of the Latins is also probable in the case of Nathan ben Jehiel, who in 1101 completed at Rome a dictionary of talmudic Aramaic and Hebrew, the *'Arukh*, which is still used, the best edition being the *Aruch Completum* (ed. by A. Kohut, 1878–92).

Of the literary activity of Provence and Languedoc, which laid the foundations for the high scientific culture which evolved there after 1100, little has been preserved. For instance, only fragments survive of the Midrash on Genesis by Moses ha-Darshan of Narbonne (11th century), and his Bible commentaries together with those of Menahem ben Helbo (11th century) are known only through quotations.

Members of the north Italian family Kalonymos brought talmudic studies and *piyyut* to Mainz in the middle of the 10th century. The academy there became a centre of studies under the direction of Gershom ben Judah (*q.v.*), "the Light of the Exile." As a poet, he established the distinctive style of European *piyyut*—simple language, uncomplicated strophic arrangements and personalized emotion—in poems that read very much like early European popular poetry. The greatest alumnus of the Mainz academy was Rashi (*q.v.*), the author of complete commentaries on the Bible and on the Babylonian Talmud, himself a poet of note. The characteristic contribution of the later Franco-German school to halakic thought was the *Tosafoth*, brief but profound glosses on the Babylonian Talmud. Also, following a practice begun by the last *gaonim*, this school produced works of comprehensive practical guidance on specific legal matters.

The slaughter during the crusades drove large masses of Jews to seek refuge in a new home in eastern Europe, whither they carried their German speech but hardly any literary culture, so that their descendants had to start from a new basis (*see* YIDDISH LANGUAGE AND LITERATURE). In Germany accounts of the disaster were written in a new prose style, permeated with poetry; liturgical poetry became henceforth mainly a chronicle of persecutions. These sufferings inspired an important mystical movement, which was influenced by Saadia (in the old translation) and by contemporary Christian asceticism. Its teachings were largely transmitted through stories; the chief collections are the *Ma'aseh Book* (Eng. trans. by M. Gaster, 1934) and the *Sefer Hasidim;* the latter is attributed to Judah ben Samuel the Hasid of Regensburg (d. 1217), who wrote the *Songs of Unity,* mystical prayer-poems of great force. Another mystic, Eleazar ben Judah of Worms (1176–1238), composed the legal compendium *Sefer Mizwoth Gadol* with a preface on asceticism. (*See* also CABALA: *The Hasidim of Medieval Germany.*)

The Jews of Angevin England formed part of French Jewry, whence they came. They produced some works on *halaka* and a grammatical treatise which betrays acquaintance with work done in Spain. Berechiah ha-Nakdan ben Natronai (13th century), a French Jew who made a summary of Saadia's philosophy (Eng. trans. by H. Gollancz, *Ethical Treatises,* 1902) and wrote *Mishle Shualim* ("Fox Fables"), may have lived for a time in England; he translated Adelard of Bath's *Quaestiones naturales.*

Pethahiah of Regensburg, of the circle of Judah the Hasid, described his travels (*c.* 1175–*c.* 1185) in Russia and in the orient to a professional writer. Benjamin of Tudela in Christian Spain traveled in the years 1159–73 as far as India, and his account of this voyage gained lasting popularity (Eng. trans. by M. N. Adler, 1907). Though living in Toledo, Abraham ibn Daud (*q.v.*) adhered to northwestern European tradition in his histories of Rome, of the Second Temple and of the Oral Law.

"Golden Age" in Spain, 900–1200.—Spanish Jewry began to flourish under the caliphate of Córdoba; the vizier Hasdai ibn Shaprut (*q.v.*) was the first great patron of Hebrew letters. His secretary Menahem ben Saruk (*c.* 910–*c.* 970) wrote a biblical lexicon, which was trenchantly criticized by Dunash ben Labrat when the latter arrived from Baghdad and introduced in Spain the arabicized poetry that he had invented (*see* above). The dispute was continued by their pupils. Samuel ha-Nagid, vizier of Granada (990–1055), himself a poet and philologist, gathered around him a group of poets, most outstanding among whom was Ibn Gabirol (*q.v.*). Moses ibn Ezra of Granada (*c.* 1060–*c.* 1139) was the centre of the most brilliant circle of poets. In his youth he wrote poems full of the joy of life (*Selected Poems,* Eng. trans. by S. Solis-Cohen, 1934); his later works were mainly penitential prayers. Like all earlier poets, he employed the Arabic metres and biblical idiom only for his secular poems, while his religious poetry followed patterns of *piyyut,* though its language, too, had by now become almost purely biblical. Moses' kinsman Abraham ibn Ezra, the poet, philosopher, grammarian and Bible commentator, attacked the language and style of the early *paytanim;* he and Judah ben Samuel Halevi (*q.v.*) were the first to use Arabic metres in religious poems.

This poetry was entirely dominated by Arab standards of taste. It dealt with the themes of Arabic poetry—friendship, love, drinking and self-praise—and often reproduced Arabic phrases. It was court art, written to be appreciated by a small circle of connoisseurs. Except for the *Odes to Zion* of Halevi, they are mainly elegant expressions of conventional sentiments. With the collapse of Jewish prosperity in Muslim Spain, this art lost its *raison d'être.* The last major poet in Spain was Judah ben Solomon Harizi (*q.v.*), who translated the *maqamat* of the Arabic author al-Hariri and various philosophical works into Hebrew. He then composed an original set of equally scintillating *jeux d'esprit* called *Tahkemoni.*

The use of biblical Hebrew was made possible by the work of the philologists. Of great importance was the creation of comparative linguistics by Judah ibn Kuraish (fl. *c.* 900) and Isaac ibn Barun (fl. 1100). Following the advances made by Arab grammarians, Judah Hayyuj, a disciple of Menahem ben Saruk, recast Hebrew grammar. In the form given to it by David Kimchi of Narbonne (*c.* 1160–1235; *see* KIMCHI), the new system was taken over by the Christian humanists and through them by modern scholarship. The first complete Hebrew grammar, *Kitab al-luma',* was written by Ibn Janah of Córdoba (990–1050). Like most of the Spanish grammarians, he wrote Arabic. All of them concentrated exclusively on biblical Hebrew. The philological method was the principal feature of the Spanish Bible commentaries, among which those of Abraham ibn Ezra and David Kimchi are the most important.

Jewish medieval philosophers in Spain wrote in Arabic, not Hebrew, until the 13th century (*see* JEWISH PHILOSOPHY). Apart from Isaac Israeli (north Africa, *c.* 845–*c.* 940), who wrote in Arabic, and Maimonides, few medieval Jews made original contributions to science, but the Spanish Jews shared the best scientific education. Thus, when in the 11th century European scholars flocked to Toledo in order to translate Arabic scientific literature, they found learned Jews able to serve as interpreters. Abraham bar Hiyya Savasorda (*i.e.,* "chief of police"; d. *c.* 1136) of Barcelona was an original mathematician who wrote in Hebrew works on mathematics, astronomy and philosophy, including a scientific encyclopaedia and the *Liber Embadorum,* a geometry textbook which in the Latin translation by Plato of Tivoli (1145) became one of the fountainheads of European mathematics. There is little doubt that Abraham bar Hiyya wrote for the Jewish public of Provence and Languedoc; hence he also employed the late Mishnaic Hebrew current among them, not the biblical style of the Spanish writers. The same style was also used by Abraham ibn Ezra.

When the Almohads expelled the Jews from Muslim Spain in 1148, many learned refugees went to Languedoc and Provence and were there invited by local groups to translate scientific and philosophical works. The most important translators were Judah ibn Tibbon (*c.* 1120–*c.* 1198) and his son Samuel (*c.* 1150–*c.* 1230) at Lunel, near Nîmes, who made Hebrew versions of Maimonides and Averroës. In many cases the Hebrew version survives when the Arabic original has disappeared. The translators coined hundreds of new technical terms but also followed Arabic syntax and idiom rather slavishly.

PERIOD OF RETRENCHMENT, 1200–1750

This is the era of the ghetto, during which the area of western European Hebrew culture shrank to a remnant in Italy, while a new and entirely different culture arose in eastern Europe.

Decline of Philosophy.—The appearance of the Hebrew version of Maimonides' *Guide* (1204) provoked orthodox circles into opposition to all secular studies. Philosophy was defended by Ibn Falaquera (*q.v.*), author of an interesting pamphlet, *Ha-mevakkesh* ("The Searcher"), and by the mathematician Levi ben Gerson (Gersonides; *q.v.*), who wrote philosophical commentaries on the Bible. Hasdai Crescas (*q.v.*) attacked philosophy by its own

methods, using talmudic devices of argumentation. Dogmatic theology was popularized by the *'Ikkarim* of Joseph Albo (1380–1444; Eng. trans. by I. Husik, 1929–30).

Already Abraham bar Hiyya had delivered philosophical sermons in his *Hegyon ha-Nephesh* ("Meditation of the Soul"). Jacob Anatoli (*q.v.*) was the first to write such sermons to the whole Pentateuch. The most popular work of this genre is *'Akedath Yizhak* by Isaac Arama (1440–1505).

Philosophy, Midrash and mysticism are mixed in the ethical collectanea, generally ascetic in outlook, which soon became the "learning" of the semieducated. The oldest is the *Menorath ha-Ma'or* by Israel an-Nakawah (d. 1391). The work is elaborately classified according to virtues. It was overshadowed, however, by an imitation of the same title by Isaac Aboab (14th–15th century). An adaptation by Abraham ibn Hasdai (d. 1240) of the story of Barlaam and Josaphat (*q.v.*) called *Ben ha-Melek we-ha-Nazir* ("Prince and Hermit") remained equally popular. The vanity of all earthly things was preached in elegant biblical Hebrew by Jedaiah of Béziers (Yedaiah Bedaresi, 1270–1340) in his *Behinath Olam* (*Examination of the World;* Eng. trans. by T. Goodman, (1806).

The real reaction to Maimonidism, however, was the return of Neoplatonist mysticism, with an admixture of gnostic elements, in the form known as Cabala. Beginning with the Pentateuch commentary of Moses Nahmanides (1194–1270), it culminated in the theosophy of the *Zohar* (ascribed to Moses de León; *q.v.*), the chief product of the Spanish Cabala, which is chiefly a commentary on the Pentateuch. During the remainder of this period the *Zohar* exercised an influence comparable only with that of the Bible and Talmud. (*See* CABALA.)

Final Codification of Halaka.—Maimonides' code still remains the most systematic digest of Jewish law and ritual ever written. Though some Talmud students condemned the very idea of a code, another compendium, closer to Franco-German practice, was compiled by Jacob ben Asher (*q.v.*), called *Arb a'ah Turim* or simply *Tur*. Joseph Qaro (*q.v.*), rabbi in Adrianople and later at Safad, digested in a commentary on the *Tur* all previous halakic writings and decided all controversial matters; he then published his results in the *Shulhan 'Arukh* ("Well-Laid Table"; 1555), which is always printed with glosses by Moses Isserles (*q.v.*) of Cracow. Qaro also left a diary recording mystical revelations granted to him by the personified Mishnāh.

Artistic Writing.—In Provence and Languedoc much poetry and rhymed prose was written, mostly nugatory displays of linguistic skill. The tradition remained alive until modern times among the Spanish exiles in north Africa and Turkey. Cabalistic sexual symbolism brought back emotional poetry, a fine example of which is the sabbath hymn *Lekhah Dodi* by Solomon Alkabez, who lived at Safad, Palestine, in the 16th century. Israel Najara (1555–1628) used sensuous erotic images to describe Israel's relation to God in rhythms borrowed from popular airs.

Though reduced to miniature scale in keeping with the size of the ghettos, western Hebrew culture was kept alive in Italy after the expulsion of the Jews from England (1290), from France (1306) and from Spain (1492) and remained in contact with contemporary Christian thought. Immanuel ben Solomon of Rome (*q.v.*) exhibits the influence of Dante in his picaresque *Mahbaroth* (partial Eng. trans., *Tophet and Eden*, by H. Gollancz, 1921). Isaac Abrahanel (*q.v.*) was fully conversant with European thought. Others, for example Jacob Mantinus (d. 1549), acquainted the Latin reader with Jewish philosophy and Cabala. Azariah de' Rossi (1513–78) applied historical criticism to Jewish sources. Leon of Modena (*q.v.*) rejected Cabala and perhaps more. Poetry followed the developments of Italian taste. Judah Sommo (1527–92), author of an Italian handbook of drama, wrote the first Hebrew play. The most gifted representative of this tradition was Moses Hayim Luzzatto (*q.v.*), whose play *La-Yesharim Tehillah* was taken as a model by many *Haskalah* authors.

The marranos (*see* MARRANO) who after 1600 returned to Judaism and settled in Amsterdam were often highly educated and, though narrowly orthodox in religious matters, remained in close contact with happenings in general literature. Their own culture is typified by Manasseh ben Israel (*q.v.*). Their artistic writing followed Italian models: for example the allegorical drama *Prisoners of Hope* by Joseph Penço (1650–92). David Franco-Mendes (1713–92) combined Racine's *Athalie* and Metastasio's *Gióas* into one Hebrew play.

Eastern Europe and the Religious Crisis.—In the kingdom of Poland (which then extended from Lithuania to the Black sea) refugees from German persecution mingled with earlier Byzantine *émigrés* to create, by the 15th century, a prosperous Jewry with extensive autonomy. Their culture was not a continuation of western European Hebrew civilization but a new creation. The Bible (except for the Pentateuch) was neglected, while the Babylonian Talmud—hitherto studied only by specialists—became the basis of all intellectual life, particularly since the *pilpul* method of Jacob Pollak (1460–1541) had turned its study into an exciting form of mental gymnastics. The typical literature consisted of *novellae* (*hiddushim*), ingenious discussions of talmudic minutiae written in an ungrammatical mixture of Hebrew and Aramaic. Imaginative literature existed only in Yiddish, for women and the uneducated.

The expulsion from Spain in 1492 produced a wave of messianic emotion. Cabala flourished in Safad, the new Palestinian centre, the meeting place of Spanish, European and oriental Jews. There, in 1570–72, Isaac Luria created a cosmic messianism. Though its formulation, in the writings of his pupil Hayyim Vital (1543–1620), was abstruse and esoteric, its phraseology penetrated the widest masses, as a result of the introduction of cabalistic prayers, and coloured all later Hebrew writing. Luria's teachings were developed by the false messiah Sabbatai Zebi (*q.v.*) in the next century, for and against whom a vast literature was written.

The sufferings of Polish Jewry in the Cossack massacres of 1648—described in a long poem by the talmudist Yomtob Lippmann Heller (1579–1654)—opened their country to Lurianic mysticism. Out of popular cabalistic elements, Israel ben Eliezer, called the Baal Shem-Tob (*c.* 1700–1760), produced Hasidism. His teaching, like that of his successors, was oral and, of course, in Yiddish; but it was noted by disciples in a simple, colloquially flavoured Hebrew. Since they taught mainly through parables, this may be considered to mark the beginning of the Hebrew short story. Indeed these narratives exercised, and still exercise, a profound influence on modern Hebrew writers. (*See* also HASIDISM and bibliography to that article.)

HASKALAH PERIOD, 1750–1880

Hasidism rapidly spread over all eastern Europe except Lithuania. There the *gaon* Elijah ben Solomon (*q.v.*) of Wilna (Vilnius), a writer of unusually wide scope, advocated a better-graded course of talmudic training and a modicum of secular studies; he himself wrote a handbook of mathematics. Shneur Zalman of Ladi (1747–1813) created the highly systematized and elaborate HaBaD Hasidism which was widely accepted in Lithuania. The Mussar movement of Israel Salanter (1810–83) encouraged the study of the medieval ethical writers.

Beginnings of Haskalah.—*Germany.*—In the Berlin of Frederick the Great, young intellectuals from Poland and elsewhere, brought in as teachers by the families of wealthy "privileged" Jews, met the representatives of the European Enlightenment. They came under the influence of Moses Mendelssohn (*q.v.*), but they also met some representatives of Italian-Dutch Hebrew culture. One was the Dane N. H. Wessely (1725–1805), who wrote several works on the Hebrew language and an epic on the life of Moses. Another, the Italian S. A. Romanelli (1757–1814), a much more modern personality than Wessely, wrote and translated plays; he is notable for an amusing account of his stay in Morocco. Out of these contacts grew *Haskalah* (perhaps best translated as "cultivation of the mind"), a moderate tendency toward westernization that retained a somewhat rationalist Jewish orthodoxy and contained as an essential element the veneration of Hebrew and of medieval western Jewish literature. Its ideals were expressed by the periodical *Ha-Me'asef* (1784–1811, with long interruptions). Wessely's program for the paper banned love poems, mention of classical deities and criticism of the Jewish religion. In fact, it

contained principally translations of German poems and book reviews. Among German Jews, then already in a rapid process of germanization, this Hebrew movement had no place. Only in Breslau (Wroclaw)—which until recently had been part of eastern Europe—it continued for another generation. There a young Hungarian student, M. Kunizer, wrote in 1796 a historical character play, *Beth Rabbi*, published in 1805, and David Samosz (1789–1864) published in 1821 and 1829 two short plays about contemporary Jewish life.

Galicia.—To Galicia, a centre of Hasidism, the Enlightenment was somewhat brusquely introduced by the *Toleranzedikt* (1782) of the emperor Joseph II. By supporting some of its aims, the Hebrew writers incurred hatred and persecution. Their chief weapon was satire. The imitation by J. Perl (1773–1839) of the *Epistolae obscurorum virorum* (1515) by C. Rubianus and the essays of I. Erter (1791–1851) are classics of the genre. There was only one poet, M. Letteris (1800–71), and one dramatist, N. I. Fischman (1800–73), who wrote two interesting biblical plays. Galicia's chief contribution was to the *Jüdische Wissenschaft*, a school of historical research with romanticist leanings. Its centre was in Germany (*see* ZUNZ, LEOPOLD), but the Galicians N. Krochmal (*q.v.*) and S. J. Rappoport (1790–1867), the biographer, employed Hebrew, thereby gaining a much wider popular audience for their writings. Several excellent semilearned periodicals appeared in Vienna.

Italy.—The impact of *Haskalah* ideas upon the humanistic Italo-Hebrew tradition produced a short literary renaissance. Its main connections were with the *Jüdische Wissenschaft*, to which I. S. Reggio (1784–1855) materially contributed. S. D. Luzzatto (*q.v.*), a prolific essayist, philologist, poet and letter writer, became prominent by his philosophy of Judaism, which he opposed as a superior form of human life to an amoral and rationalist "Atticism"; this led him to reject also all rationalist forms of Judaism. The poet Rachel Morpurgo (1790–1871) strikes some remarkably modern chords.

Russia.—For the Jews of the Russian empire the Enlightenment may be said to have begun with I. B. Levinsohn (1788–1860) in the Ukraine and with M. A. Ginzberg (Günzburg; 1795–1846) in Lithuania, who spread general knowledge and discussed religious questions in Hebrew. In the 1820s an orthodox reaction against such activities set in, coinciding with the rise of a romanticist Hebrew school of writers. A. D. Lebensohn (Adam ha-Cohen, 1794–1878) wrote fervent love songs to the Hebrew language. His son Micah Joseph (Mikhal, 1828–52), the most gifted poet of the *Haskalah* period, wrote biblical romances and pantheistic nature lyrics. The first Hebrew novel, *Ahabat Zion* (Eng. trans. *The Love of Zion* by F. Jaffe, 1887), by A. Mapu (1808–67), was a romantic idyll, which however had a powerful effect just because of the difference between the conditions it depicted and the squalor of Jewish life. Mapu's second novel, *Ashmat Shomron* ("The Guilt of Samaria") is in the grandiose manner. Like all *Haskalah* writers, he employed the *melizah* style; *i.e.*, phrases culled from the Bible and more or less ingeniously adapted to the thought the writer wished to express.

Realist Movement.—Mapu's third novel, *Ayit Zabua* ("The Hypocrite"; 1857–69), marks a new departure. It deals with contemporary life and attacks its social evils; and it portrays a new type, the *maskil* (possessor of *Haskalah*) in his fight against orthodox obscurantism. His last novel, *Hoze Hezyonot* ("The Visionary"), which intended to expose Hasidism, was banned. The new, aggressive *Haskalah* soon came under the influence of Russian left-wing writers such as N. G. Chernyshevski and Dimitri Pisarev. Literary criticism began.

Leon Gordon (*q.v.*), like Mapu, had started as a romantic writer on biblical subjects. From 1871 onward he produced a series of ballads exposing the injustices of traditional Jewish life. M. L. Lilienblum (1843–1910) began as a moderate religious reformer—his own struggle with orthodoxy is the theme of the novel *Ha-dat we-ha-hayyim* ("Religion and Life") by R. A. Braudes (1851–1902)—but later became absorbed by social problems. In the *Mishnat Elisha ben Abuyah* (1878) he used the figure of the heretic friend of Rabbi Akiba to preach a Jewish socialism. Later Lilienblum became a Zionist. P. Smolenskin (1840–85) created in six novels a kaleidoscope of Jewish life in which he rejects the westernized Jew as much as the orthodox reactionaries.

HEBREW LITERATURE AFTER 1880

After the realists had become impatient with *Haskalah* ideals, the Russian pogroms seemed to demonstrate the futility of its aims. That part of eastern European Jewry that read Hebrew books (*i.e.*, the middle classes) turned to Jewish nationalism. Zionist activity, coupled with the movement for speaking Hebrew that was started *c.* 1880 by Eliezer ben-Jehudah (E. Perlman, 1858–1922), widened the circle of Hebrew readers. Hebrew daily papers began to appear in 1886. Writers abandoned *melizah* for a blend of biblical and Mishnaic Hebrew with extensive borrowings from the medieval translators, as well as from European languages. The new character of Hebrew was symbolized by Ben-Jehudah's lexicon, *Thesaurus totius hebraitatis* (1908–58), which includes words from all periods.

Mendele.—S. J. Abramovich, who wrote under the pseudonym Mendele Mokher Sefarim (*q.v.*; "Mendele the Itinerant Bookseller"), holds a key position in the transition to modern writing. His first novel (1868) was inspired by Ivan Turgenev. He soon became convinced that the biblical Hebrew of the *Haskalah* was unsuitable for modern subjects and turned to writing in Yiddish. From 1886 onward he went back to Hebrew, into which he also translated his Yiddish stories. By extensive use of Hebrew and Aramaic phrases from the Talmud (without abandoning the biblical vocabulary) he matched the homeliness of Yiddish and conveyed the atmosphere of Jewish life to perfection. In his stories life was, for the first time, depicted as it really was, with a warm humour that made the basically critical attitude of the author acceptable. Since the study of the Talmud was the chief education in traditional circles, Mendele's talmudic style and more positive attitude to traditional values attracted a much wider circle of readers than *Haskalah* literature had ever possessed. The fact that the life that Mendele described was rapidly disappearing added a nostalgic appeal. Stories of ghetto life remained the most characteristic and fertile genre of Hebrew literature until the middle of the 20th century.

National Revival.—"Grandfather Mendele" became the spiritual mentor of a galaxy of exceptionally gifted writers at Odessa. Asher Ginzberg wrote from 1889 onward, under the pen name of Ahad Haam (*q.v.*; "One of the People"), a series of articles in which he brought modern sociological thought to bear upon Jewish affairs and evolved a philosophy of secular Jewish nationalism and of a "cultural centre" in Palestine. His style, based largely upon the medieval translators, was European in spirit. In his monthly *Ha-Shiloah* (founded 1897) he applied editorial standards hitherto unknown in Hebrew. During his stay in London (1907–21) he inspired a minor Hebrew renaissance in England. In Tel Aviv from 1921, he devoted his last years to the edition of his correspondence, a valuable documentary of a vital period.

H. N. Bialik (*q.v.*) was much influenced by Ahad Haam, being for a time literary editor of *Ha-Shiloah*. Bialik was an important essayist, editor and anthologist of medieval literature and, during his stay in Palestine (1924–34), an arbiter on linguistic matters. His main role, however, was that of the "national poet," whose poems gave expression to the inner struggles of a generation much concerned about its attitude to Jewish tradition and who, in some of his utterances, reached an almost prophetic intensity.

In sharp contrast with Bialik, Saul Chernikhovsky (*q.v.*) was unconcerned with the burden of tradition. Born in the Crimea, he studied in Germany and, from 1931, lived in Palestine. His poems, in strongly biblical language, deal with the nature of these three countries, with love and with beauty. He was attracted by Greek culture and inspired by the gods of ancient Canaan. Where he touches upon Judaism, his approach is secular and militant, yet he lovingly depicts Russian-Jewish village life in a series of idylls.

The short stories of I. L. Peretz, who wrote both in Hebrew and Yiddish, introduced the hasidic milieu into literature. The emotionalism and simple joy of life of that milieu henceforth exercised a powerful influence upon Hebrew artistic writing, and the language absorbed many hasidic terms.

"New Trend."—The literary historian R. Brainin (1862–1939) discerned the presence of a "new trend" (*ha-mahalakh he-hadash*) and postulated *l'art pour l'art* and concentration on generally human problems. Already Bialik sensed the conflict between the demands of traditional Judaism and the natural instincts and needs of the Jew. This psychological interest dominates the work of a group of short-story writers, outstanding among whom is the literary critic D. Frischman (1865–1922), who did more than anyone to impose European standards on Hebrew literature. In *Ba-Midbar* ("In the Desert") he projects the conflict back into Moses' time. M. J. Berdichevsky (1865–1921), in a neoromantic vein, idealized in his stories the uneducated manual worker, the pariah of traditional society.

Émigre Writers.—With this, Hebrew literature became fully co-ordinated with European tendencies. However, the next generation of writers was uprooted by the two Russian revolutions, emigrated to western Europe and gradually drifted to Palestine. The U.S.S.R. at first favoured Hebrew culture but then banned it; in other eastern European countries the culture decayed with the deterioration of the Jewish position; and many writers were killed by the Germans after the rise of Hitler. The writing of the *émigré* generation is profoundly pessimistic. A hopeless rootlessness is the keynote of the stories of U. N. Gnessin (1880–1913) and I. H. Brenner (1881–1921); the delicate thumbnail sketches of G. Schofmann (1880–) are pervaded by perplexity; Z. Shne'ur (1887–1959) sings of revolt and desperate passion.

Palestinian Literature.—Almost all writers active in Palestine before 1939 were born in the Diaspora. An exception was J. Burla (1888–), an oriental whose novels deal with oriental Jewry. The Palestinian milieu with its colourful types attracted the attention of other writers, too: notably D. Shim'oni (formerly Shimonovitz; 1886–1956), whose idyls describe the agricultural *chalutz* immigrants; and M. H. Smilansky (1874–1953), whose stories are inspired by Arab life.

The majority of Palestinian writers, however, were more concerned with nostalgic descriptions of life in eastern Europe or with the past—as for instance was A. A. Kabak (1881–1944), author of an especially interesting novel on the life of Jesus, *Bamish'ol Ha-zar* ("In the Narrow Path").

The transition from the ghetto to Palestine was achieved by only a few, among them being A. Barash (1889–1952), who after many stories and novels on life in Galicia wrote descriptions of the early struggles of Palestinian Jewry. This preoccupation with the early stages of the new life is also marked in the later work of S. J. Agnon (*q.v.*), the outstanding Hebrew prose writer of his generation. Agnon developed an original Hebrew narrative style by going back to the Midrash and the popular stories and ethical writings of earlier centuries. Whereas his earlier stories were set in Galicia, he began in the 1940s to write about Palestine. At a still later stage the Kafkaesque atmosphere found in some of his early stories became predominant in short sketches set in contemporary Israel.

Although writers were hesitant to grapple with contemporary life, the Hebrew-speaking surroundings exercised an influence upon their style, which became more natural and expressive. The translation of world literature became a pressing need, occupying many first-class writers, and did much to increase the suppleness of the language. Poetry, especially, was profoundly changed by the transition from the Ashkenazi pronunciation with its penultimate stress to the Palestinian pronunciation with its alternation of stress positions.

In contrast with prose, poetry immediately concerned itself with Palestinian life. Among a large number of good writers, mention should be made of Rachel (R. Blovstein, 1890–1931), whose intensely personal poems, many of which have been set to music, are universally beloved; U. Z. Greenberg (1894–), a political poet whose *vers libre* reaches almost prophetic grandeur; and the symbolist school led by A. Shlonsky (1900–).

Hebrew Literature in the United States.—After World War I, United States Jewry began to develop a school of Hebrew writers of its own, including novelists, poets and essayists. At first a scion of the *émigré* school, it drew closer to Israeli style, while at the same time undergoing U.S. influence. There is also a number of important scholarly works in Hebrew. Various literary periodicals and even a Hebrew medical journal exist.

Israeli Literature.—World War II and the Arab-Israeli war of 1948–49 brought to the fore a number of "Sabra" (Palestinian-born) writers who dealt in a racy, colloquially flavoured Hebrew with the problems of their own generation. In the state of Israel literature has developed on a large scale, mainly along contemporary western European and American lines. The extreme diversity in culture and ways of life between parts of the population, and especially the problems of the new immigrant, provide the main theme for fiction, in which the Jews from oriental countries and the new immigrants gradually begin to take an active share. Poetry, which can exploit the immense associative riches of the Hebrew language, flourishes, while in spite of the high level of the theatre original drama is slow in developing.

See also references under "Hebrew Literature" in the Index volume.

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HEBREWS, EPISTLE TO THE, a book of the New Testament. In the oldest manuscripts its title is simply "To Hebrews." Tradition concerning the book, first accessible from about A.D. 200, also knows no other title. It may originally have borne some other title or, more likely, none at all.

Contents.—The author's attitude presupposes that his intended auditors, for lack of true appreciation of the definitive revelation in Christ, are now likely to drift away (ii, 1) from effective faith in the gospel to sluggishness and indifference. The author assumes agreement between the auditors and himself that the oracles of Scripture (*i.e.,* the Septuagint Old Testament) contain the charter of a superb religious system. But that whole system has been rendered ineffectual by the revelation and enactment of the true system which the tabernacle, the high priesthood and the supreme sacrifice on the Day of Atonement had only foreshadowed. With passionate earnestness he sets over against these his claim of the efficacy—the heavenly yet unseen reality—of the definitive "purification of sins" (i, 3) and the perfected access to God's inmost presence vouchsafed to the Christian by Jesus the Son of God (x, 9–22). He traces his hearers' moral debility and slackened zeal to their failure to understand the gospel as a new covenant moving on

a totally different plane of religious reality from the now-antiquated Mosaic covenant (viii, 13).

The plan of the sermon makes clear the author's presentation of Christianity as the fulfillment of Mosaic religion, which is related to it as shadow to reality:

i, 1–iv, 13:	preamble
i, 1–iii, 6:	the superiority of the Son to angels or Moses
iii, 7–iv, 13:	practical exhortation leading up to:
iv, 14–x, 18:	central theme: the corresponding efficacy of the Son's high priesthood
iv, 14–16:	Statement of theme
v, 1–10:	the Son has the qualifications of all priesthood, especially sympathy
v, 11–vi, 20:	exhortation again, raising the auditors' feeling to the height of the thought reached
vii:	the Son as absolute high priest, in an order transcending the Aaronic priesthood and pertaining to a tabernacle and a covenant higher than those of Moses in point of reality and finality
viii–ix:	his sacrifice, then, is definitive (*teteleioken;* x, 14) and supersedes all others
x, 19–xii, 29:	appropriate, then, the benefits of the Son's high priesthood for keeping faith steadfast, which is the Christian's paramount duty
xiii, 1–21:	concluding general exhortation
xiii, 22–25:	personal note appended to the sermon (whether by the author of the sermon or by another)

Since, as the preacher conceived it, lack of appreciation lay at the root of his listeners' malady, it was not enough for him simply to enjoin that loyalty to conviction which, to him, faith (*pistis*) is. (He has no inkling of Paul's conception of faith as an inmost involvement of the will.) He had also to present a positive theory to inspire more strenuous resistance to the influences tending to apostasy from Christ and hence from "the living God," which evidently were already threatening some of them (iii, 12). Such apostasy was not a formal abjuring of Jesus as Messiah but that subtler lapse that occurs when one ceases to rely upon him for daily moral and religious needs, for purity of conscience and peace before God (x, 19–23; xii, 20 *et seq.*).

This "falling aside" or "dropping out," rather than any conscious "turning back," is what is implied in the ever-recurring exhortations that indicate how practical the intent of the sermon is. Indeed, the whole sermon can be convincingly interpreted as an exhortation to (certain) Christians to be steadfast pilgrims, not to fall out of their appointed march through this alien world, in which they have no abiding place, to their true city, their resting place, God's heaven. These exhortations are directed chiefly against the dullness of spirit that hinders progressive appreciation of the genius of the new covenant (v, 11–vi, 8). The antidote to such "profane" negligence (xii, 12–17) is an earnestness animated by a fully assured hope and sustained by a faith marked by patient waiting (*makrothymia*) for the inheritance guaranteed by God's promise (x, 11–18). The outward expression of such a spirit is "bold confession" and mutual encouragement therein (iii, 6, 12 *et seq.*). The sign of the spirit's decay is neglect to assemble together for mutual stimulus, as if it were not worth the odium called forth by a markedly Christian confession (x, 23–25; xii, 3)—a far different evaluation of the new bond from that once shown by readiness to suffer for it (x, 32–34).

The congregation's special danger, then, as conceived by the writer of this sermon, was a latent and subtle apostasy. This is the sin that deceived (iii, 13) the more easily because it followed the line of least resistance, this being perhaps the best paraphrase of "besetting [*euperistaton*] sin" in xii, 1 (King James Version) or of "easily distracting [*euperispaston*] sin" as the Beatty papyrus has it in the same passage. This sin is the direct opposite of what the author means by faith, of which, to the Christian, Jesus himself was both the example and the inspiration (xii, 2). To quicken faith in this sense, by awakening deeper appreciation for faith's real objects, the author wrote this sermon.

Literary History.—*Classification.*—Opinions, past and present, vary widely as to the category of literature to which the book belongs. Some typical views are: it is (1) a true letter, (2) an "epistle" but not a letter, (3) a theological treatise with an appended letter (xiii, 22–25 or 1–25), (4) a verbatim record of a sermon actually delivered plus a note, or (5) a written sermon somehow prevented from being delivered orally and therefore dispatched, with a note, to the intended hearers to be read aloud by one of them. Views (1) and (2) are unlikely because of the lack of any salutation or address; (3) overlooks the fact that the interspersed exhortations are more important to the author than his theoretical reasonings. Views (4) and (5) are varieties of the same view, but (5) more reasonably accounts for the appended note.

Authorship.—Many learned guesses have been made concerning the identity of the author. The earlier manuscripts name no author in the title; and somewhat later the church at Rome—where, about A.D. 96, in I Clement the first traces of the Epistle occur—was sure only that it was not by Paul (Eusebius, *Ecclesiastical History*, iii, 3). Tradition at Alexandria, however, dwelt upon its affinities to Paul's thought. Origen implies that "the men of old" regarded it as Paul's. But he recognizes that the language is un-Pauline, though its "admirable" thoughts are not second even to Paul's. He comes to the opinion that the ideas were set forth orally by Paul but that the written form was attributable to another's free interpretation of Paul's mind. This is approximately the common view of the Roman Catholic Church today. According to some, Clement of Rome was responsible for the written form; others named Luke; but the truth, says Origen, is known to God alone. In spite of Origen, however, the theory of Paul's authorship prevailed in the east. In north Africa the earliest tradition, preserved by Tertullian (in *De pudicitia*) but hardly invented by him, ascribed the book to Barnabas. This may have been only an inference from "word of exhortation" (xiii, 22), which seemed to point to *bar Nabas*, the "son of exhortation" (or "encouragement"; Acts iv, 36; *see* BARNABAS, SAINT).

Thus criticism in the east and tradition in the west agreed that the book was not by Paul but by one of his associates. Following the lead of Erasmus, Martin Luther (who suggests Apollos, the Alexandrian Jew "well versed in the Scriptures," of Acts xviii, 24) and John Calvin added the decisive argument that Paul, who lays such stress on the fact that his gospel was not taught him by man (Gal. i), could not have written Heb. ii, 3. Since about 1800 Protestant scholarly opinion has set irrevocably against Pauline authorship. Paul's central concept—God's gracious justification of the man of faith on the basis of his faith—is missing in Hebrews. And Hebrews' central theme—Christ the definitive high priest of the ultimate heavenly cult—is foreign to Paul. The Mosaic Law is not, as in Paul, a code of "works of righteousness," but is a system of religious rites (vii, 11), the Aaronic priesthood (charged with offering sacrifice to the Lord) shadowing forth the way of access to God in worship, of which shadows the gospel reveals the archetypal realities (ix, 1, 11, 15, 23 *et seq.;* x, 1 *et seq.*, 19 *et seq.*). The old and the new covenants are related to one another as imperfect (earthly) and perfect (heavenly) methods of salvation—differing in point of spiritual reality—each with its own type of sacrifice and priesthood. The Old Testament is quoted almost exclusively after the (Greek) Septuagint, even where the Hebrew original differs. Nor is this accidental. The author, whoever he was, was a Hellenist who lacked knowledge of the Hebrew text and whose exegetical traditions, allegorical method and religious presuppositions are more akin to those of Alexandria than of Palestine.

Undoubtedly Hebrews has Pauline affinities, but that may mean no more than that both writers were early Christians and that some Pauline formulations had reached the author. The Pauline affinities are much reduced if the mooted 13th chapter is held in suspense as possibly an appendix written to suggest Pauline origin. All questions of introduction, then—even the meaning of the title—turn on internal criticism of the book itself, together with such personal allusions as it affords.

Hearers.—The intent of the title, "To Hebrews," is vague. It might mean (1) to men of Jewish faith (but, it would appear, cannot, because it is obviously addressed to Christians; nevertheless this view was presented in 1959 by H. Kózmala in *Hebräer-Essener-Christen*); (2) to Christians of Semitic (Hebrew or Aramaic) tongue (impossible; far from being translation-Greek, this writing constitutes the most elegant Greek in the New Testament and is

clearly intended for men of no small degree of Hellenistic culture). The most popular view in the early 20th century was that the sermon was addressed (3) to Christians of Jewish, not gentile, origin (for the view as set forth by A. Nairne and E. C. Wickham, *see* references cited in the *bibliography*); but the tension between Jew and Greek within the church is never hinted at and seems to be a thing of the past. The title, then, would seem to be due to a mistaken inference of the collector-editor due to the author's preoccupation with Mosaic images, unless it means (4), symbolically, to the new Hebrews (that is, Christians), who, like the Hebrews of old, wander homeless on earth seeking their heavenly home; in this sense it could be the symbol-loving author's own title. Since he makes no direct allusion to it in the text, however, it is probably best to conclude that, like the great majority of New Testament writings, the book was originally titleless.

Martin Dibelius repeatedly warned that exhortatory matter, whether actually worked into a sermon or not, is very unpromising material from which to derive valid deductions about those addressed. In this sermon it can readily be recognized that the preacher is attempting to spur his hearers out of lethargy and to inspire new firmness and eagerness in them by developing the theme of the ultimacy of Christ's service to those who profess him. The purpose of Hebrews, according to A. C. Purdy, is to present "an argument for the finality of Christianity intended to arouse the readers [better, the hearers] from threatening lethargy" (*The Interpreter's Bible*, vol. xi, p. 591, Abingdon Press, New York, 1955). Remembering the homiletical inclination to treat a congregation's evil tendency as if it were an accomplished fact, and consequently to exaggerate and generalize, it is well not to attempt to deduce much about the congregation except that (at least in the preacher's mind) it is in peril of drifting into indifference.

In trying to define the intended auditors, note may be made of the stress laid on suffering as part of the divinely appointed discipline of sonship (ii, 10; v, 8; xii, 7–11), and the way in which the analogy in this respect between Jesus (as messianic Son) and those united to him by faith (as derivative sons) is set in relief. He is both the inspiring example for heroic faith in the face of unbelievers (xii, 3) and the mediator qualified by experience of suffering to sympathize with his tried followers and so to afford them moral aid (ii, 17–18; v, 8–10; *cf.* iv, 15). Evidently suffering as Christians, at least in respect of possessions (xii, 4; *cf.* x, 34), was a possibility for the auditors, but how vivid a possibility there is no way of knowing. At any rate there must have been in their midst at least some men of property and position (xiii, 1–6; x, 34). Such men would presumably also possess a mental culture capable of appreciating this discourse, which, as Adolf Jülicher observed, is far too learned for the average Christian. It was now long since they themselves had seriously suffered for their own faith (x, 32–33), and the detained preacher's impatience to hurry to their side may imply that a new threat of suffering had suddenly arisen.

Provenance and Destination.—Neither about the place of origin of this sermon nor about the place to which it was dispatched can anything definite be deduced, for the only specific datum is ambiguous: *hoi apo tes Italias* in xiii, 24, variously translated in English versions of the Bible. On one interpretation this means "they who are away from Italy." Greetings from such people would make good sense only if addressed to their brethren at home in Italy; hence this note, with the sermon, would be addressed to some place in Italy, though probably not to Rome (how could xii, 4 be written to Rome after Nero's "bath of blood" about A.D. 64?). But the exact opposite is also possible: the phrase may mean "the brethren who live in Italy." If so, the note and the sermon come from somewhere in Italy. Because of the sermon's "Alexandrinism," Alexandria is sometimes deduced for its provenance; but a Christian with a Hellenistic-Jewish education of the Alexandrine type could be living anywhere in the *orbis terrarum*. Rome is in one sense or another the "home" of the book, according to Purdy, for there it is first attested; but this could mean either that it came from Rome and that its ideas remained current there because its writer lived and taught there, or that a copy of it early arrived in Rome and exerted its literary influence there.

Date.—The one reasonably certain fact about its date is that it was written before I Clement (about A.D. 96; *see* CLEMENT: *St. Clement I*), which, while it does not name its source, almost certainly quotes it. The author's preoccupation with "the tabernacle" has misled some to think that the Temple was still standing in Jerusalem and that the book must be earlier than A.D. 70, when the Temple was destroyed. But the author has no interest in the empirical Temple; he is interested only in the divine plans for the tabernacle of the wilderness. Consequently his silence about the destruction of the Herodian Temple is purely neutral: it neither proves nor disproves that A.D. 70 had already passed. But it does not seem possible in the period before A.D. 70 to find room for serious persecution such as x, 32 *et seq.* recalls. Probably A.D. 80–96 is the period within which it was written, but the grounds for selecting the earlier of these limits are weak.

Historical Significance.—The book is of great importance, as recording one direction that Christian exhortation could take among Hellenistic Christians. It is precious as the most ancient extant exemplar of a complete Christian sermon. It is also of high interest theologically, as exhibiting, along with affinities to several types of New Testament teaching, a type all its own, and one that has had much influence on later Christian thought. Within the New Testament only Paul and the great mind behind the Gospel and the Epistles of John have a better right than its author to the title theologian. *See* also BIBLE.

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(J. V. B.; KE. G.)

HEBRIDES, THE, a group of islands off the west coast of Scotland, between 55° 35′ and 58° 30′ N. and 5° 26′ and 8° 40′ W., also known as the Western Isles. They have been broadly classified into Outer and Inner Hebrides, North Minch and Little Minch dividing them. The chief islands of the crescentic chain of the Outer Hebrides are Lewis-and-Harris (*q.v.*), North Uist, Benbecula, South Uist (*see* UIST, NORTH AND SOUTH), Barra, St. Kilda (*qq.v.*), the Shiants, and the Flannan Isles or Seven Hunters, about 20 mi. N.W. of Gallan head in Lewis. Of these the Lewis portion of Long Island, the Shiants and the Flannan belong to the county of Ross and Cromarty, and the remainder to Inverness-shire. The total length of this group, from Barra head to the Butt of Lewis, is 130 mi., the breadth varying from less than 1 mi. to 30 mi. The Inner Hebrides include Skye, Small Isles (Canna,

AUTHENTICATED NEWS

THE CUILLIN HILLS ON SKYE IN THE INNER HEBRIDES. THEY ARE COMPOSED PRIMARILY OF IGNEOUS GABBRO AND RISE TO A HEIGHT OF 3,309 FT. ABOVE THE ISLAND'S VOLCANIC BASALT BASE

Sanday, Rhum [Rum], Eigg and Muck), Tiree, Lismore, Mull, Staffa, Iona, Colonsay and Oronsay, Jura, Islay (*qq.v.*), Gigha, Coll, Ulva, Kerrera, Scarba and the Slate Islands (Seil, Easdale, Luing, Shuna, Torsay). Of these Skye and Small Isles belong to Inverness-shire, and the rest to Argyllshire. The Hebridean islands exceed 500 in number, of which fewer than one-fifth are inhabited. The population of the islands is unevenly distributed and depopulation has been variable in onset and progress. The 1961 census gave the following figures: Lewis (1954 est.) 16,700; Harris (1961) 3,285; Skye 7,765; Mull 1,674; Tiree and Coll 1,143; Jura and Colonsay 420; Islay 3,866. Several small islands have been evacuated.

The Hebrides are extremely interesting geologically. The stupendous cliff scenery of St. Kilda, 40 mi. W. of the main chain of the Outer Hebrides, is formed of igneous gabbro, which also forms the Cuillin hills of Skye (3,309 ft.), the most spectacular and awe-inspiring massif in Britain. The Outer Hebridean chain is of Lewisian gneiss, among the oldest rock formations in the world; Skye, Mull, Canna and Eigg are largely of volcanic basalt, a formation which gives the columnar scenery of Staffa and the Shiant Isles. Jura is almost wholly metamorphic quartzite.

The islands are hilly or mountainous and only the basalt islands are intrinsically and potentially fertile; the middle area of Lewis is covered by deep peat and a tundralike herbage of limited pastoral value; but the Atlantic side of the southern Outer Hebrides, North Uist, Benbecula, South Uist and Barra is a low platform of gneiss overlaid by shell sand from the Atlantic ocean. The whole of Tiree and the western sides of Coll and Colonsay are similarly affected. These sand-covered grassy plains (the *machair*) with their high soil content of calcium carbonate are fertile cattle-raising areas and support a predominantly agricultural population. The rocky, peaty, much-indented eastern side of the Hebrides is infertile and the inhabitants of this more sheltered coast are mainly fishermen and weavers.

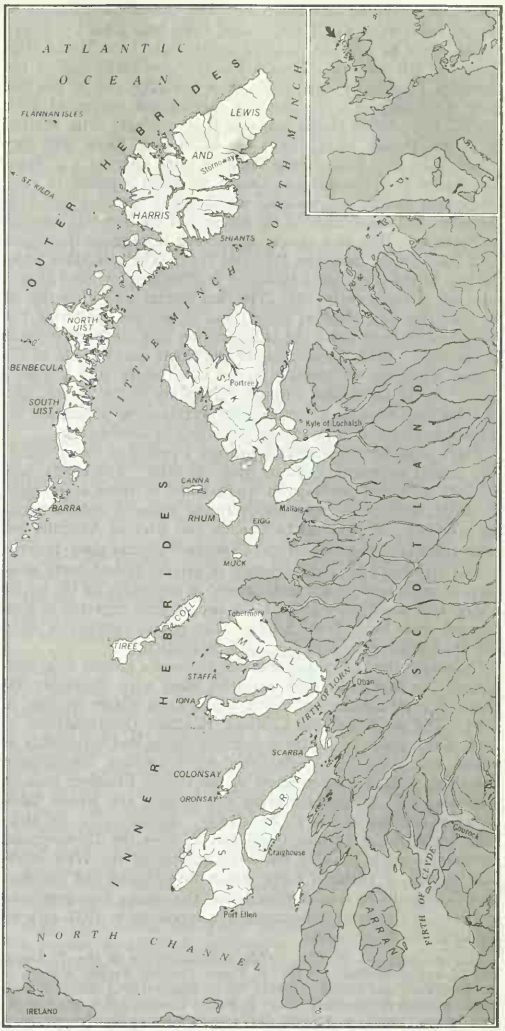
The shell-sand *machair* greatly increases the cultivable area of the Outer Hebrides and Tiree and differentiates them from the Inner Isles. Nevertheless, it must not be plowed for many years in succession or the organic matter is lost and the sand blows disastrously. The *machair* is particularly interesting in Highland economy because of the adaptation of husbandry to the special conditions. The primitive four-rowed barley or bere was the bread grain until recently, a cereal fitted to such highly calcareous soil. The common oat does not grow in such soil, and its place is taken by the bristle-pointed oat, *Avena strigosa*, which would be considered a weed anywhere else. This crop is used entirely for cattle feed, garnered as hay. Potatoes are an important arable crop on both *machair* and peaty land. Cultivation of turnips has almost completely declined because of the high incidence of finger-and-toe disease. Great quantities of seaweed or tangle (*Laminaria*) are used on the *machair* land, while on the east side of the Outer Isles, wrack (*Fucus*) is cut from the rocky shores and carried to the lazy beds or terracelike peaty cultivated ground.

The manufacture of the so-called Harris tweed (*q.v.*) of the Outer Hebrides provides part-time occupation for the crofters, *i.e.*, the small landholders. The tweed is of ancient origin, the wool being vegetable-dyed, hand-spun and hand-woven in the crofters' own homes. The earl and countess of Dunmore, who had a sporting estate in Harris, developed the crofters' marketing of the tweed during the 1860s to 1880s. Thus the name "Harris" tweed. The old type of tweed is now mostly produced in the Uists, but a much greater quantity of aniline-dyed, machine-spun, hand-woven tweed is produced in Lewis.

Stornoway (*q.v.*) in Lewis is still a herring-fishing centre, but most of the local fleets of herring boats have sadly declined. Many men from the Outer Hebrides join the merchant navy.

There are regular steamer services from Glasgow to Islay and Jura from Oban to Lismore, Mull, Coll, Tiree, Barra and South Uist; from Kyle of Lochalsh to Skye, Harris and the Uists. There are also services, augmented in summer, from Kyle of Lochalsh and Mallaig to the smaller isles. Air services from Glasgow and Inverness serve the Outer Hebrides and Tiree.

The wildlife of the Hebrides is particularly rich. There are



MAP OF THE HEBRIDES SHOWING CHIEF TOWNS AND MAINLAND FERRY PORTS

red deer in Lewis, Harris, North Uist, Skye, Mull, Jura and Islay, the Atlantic gray seal is numerous, with considerable nurseries on North Rona, the Treshnish Isles, Haskeir (North Uist), Sound of Harris and Oronsay. There are several pairs of golden eagles, and many spectacular sea-bird cliffs. On the island of Soay there is a race of primitive sheep of moufflon type.

The fine Megalithic stone circle at Callanish (Lewis) is the Hebrides' largest prehistoric monument and is well preserved. There is a long barrow as far afield as Hirta (St. Kilda) and chambered cairns, duns and standing stones are of frequent occurrence. Early Christian cells are found on many small and remote islands, and Iona, Oronsay, Rodil (Harris), Inchkenneth (Mull) and Islay are rich in early medieval Christian carved stones and architectural remains.

History.—The origin of the name is popularly believed to have been derived from Ptolemy's Eboudai, latinized as Hebudes by

Pliny and corrupted into Hebrides. The Goidelic inhabitants of the 1st millennium A.D., Christianized from Iona after Columba's voyage there in A.D. 563, suffered increasingly from Norse raids from the 8th century. Harald Fairhair eventually placed the Hebrides (Sudreyjar) under Norse sovereignty and it was not until the treaty of 1266 that the Norwegians renounced their claim. The present Gaelic language is surprisingly little affected by Norse, though place names are often pure Norse and may predominate over Gaelic place names in some districts, *e.g.*, Skye. The fusion of Norsemen and Goidel produced a period of relatively high culture and material well-being in the 11th and 12th centuries, and the dynasty of the lordship of the isles was founded by Somerled. The clan system was strong throughout the region until the Jacobite risings of 1715 and 1745. The hereditary jurisdictions of the chiefs were abolished in 1748 and forfeited estates were not restored until 1784. The clan system with its notion of *jus sanguinis* (the right of blood) was at bottom egalitarian but disruption brought about the feudal notion that the land belonged to the chief. With the merging of the chiefs into the life of the United Kingdom, the culture moved much more onto a money basis. At the same time, through cultivation of the potato, vaccination and cessation of internecine warfare, the population increased rapidly and came against the ceiling of subsistence.

There began in the later 18th century a period of social unrest. The central government did or could do little. The chiefs were put into awkward positions in which some of them acted highhandedly, while others were impoverished trying to order a bursting economy. Emigration to Canada and later to Australia became common. The infiltration of Southern Upland sheep farmers paying high rents for large acreages of ground caused many evictions of small tenants and resettlement in townships on the coasts where, with small plots of land, the people were expected to supplement their living from fishing. The potato famines of 1846 and 1847 were responsible for much destitution.

Gradually, the central government assumed a greater role, ponderously, in that urban administrative ideas were unsuitably applied. A royal commission (1883) under Lord Napier reported in 1884. The result was the Crofters' Holdings (Scotland) act of 1886, which gave the crofter security of tenure and heritability of tenure, fair rents being established by a crofters' commission. From this point, the government of the United Kingdom took an increasing part in administration and became the largest landowner of crofting estates in the islands. Economically, the Hebrides continued in parlous state, and in 1944 the Development commission made possible the establishment of the West Highland survey, a research body which investigated the problem sociobiologically in considerable detail; the results were published in 1955. A Crofters' commission was appointed in 1951 with its headquarters in Inverness.

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HEBRON (Al Khalil), a city of Jordan, in Arabic Khalil Ar-Rahman ("friend of God"), a designation for Abraham, lies in the Judaean hills in a valley (identified with the biblical Eshcol) 18 mi. S.S.W. of Jerusalem. The modern town, about 3,000 ft. above sea level, is stone-built, with small winding streets and vaulted markets, situated in the midst of orchards and gardens. Pop. (1961) 37,911. It is the centre of the Hebron *qada'* (district), a considerable refugee area with a population of 119,861, and is an important road junction in the highland area of western Jordan. Hebron is what is called a *qaysi* (north) town, as it is aligned with the north in the old north-south Palestinian controversy, which has led to disputes with its northern neighbour, Nazareth. It has an important tanning industry, and produces sheepskin cloaks and a form of blue blown glass. Both the men and the women wear a distinctive headdress, the men an orange-brown headcloth and the women figured veils.

History.—Hebron is reputed to be an ancient city and the site of Kirjath Arba, "The City of the Four." It is said to be the burial place of Abraham and Sarah. Hebron was defeated by Joshua (Joshua x, 5–10) and from this city David ruled over Judaea for 7½ years after the death of Saul. Abner was killed by Joab at the gate of the town, and by its pool the murderers of Ishbosheth were hanged by David. The town is also associated with the Anakin, whose chieftains Caleb is said to have driven out (Joshua xv, 14). It was fortified by Rehoboam, but was later captured by the Edomites, recovered by Judas Maccabeus and, in consequence, destroyed by the Romans.

Hebron revived, however, and became under the Muslims a place of pilgrimage after their conquest in A.D. 636. In 1099 the town was taken by the crusaders and was strongly fortified; its name was changed to St. Abraham, and it served as a base for excursions against the Muslims to the south and east. Under the Turkish administration Hebron became a *kaza* (district) in the sanjak of Jerusalem, and in 1922 when the mandate was established it became a *nahiyat* (subdistrict) of the Southern department of Palestine. Since 1948 it has been part of the Hashemite Kingdom of Jordan and an important centre on the west bank.

The most important monument is the Haram, which encloses and covers the cave of Machpelah. The outer wall is built to a height of 40 ft. of large stone clocks, probably of Herodian date. The mosque, which occupies the southern side of the Haram, has been adapted from a 12th-century crusader church built on an earlier structure. The cenotaphs of Abraham and Sarah are outside the mosque; those of Isaac and Rebecca, inside; and those of Jacob and Leah, to the north of the Haram.

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HECATAEUS of Miletus (6th–5th century B.C.), Greek author of an early history and of a book of travels. The son of Hegesander, he flourished during the time of the Persian invasion. He tried to dissuade the Ionians from revolt against Persia, and in 494, when they were obliged to sue for terms, he was one of the ambassadors to the Persian satrap, whom he persuaded to restore the constitution of the Ionic cities.

Of his two known works, the *Genealogia* or *Historiai* seems to have been a systematic account of the traditions and mythology of the Greeks, but the surviving fragments of it are comparatively few. Much better represented (by more than 300 fragments) is the *Ges periodos* or *Periegesis* ("Tour Round the World") in two parts, one on Europe the other on "Asia" (which included Egypt and north Africa). Although its authenticity was questioned in antiquity and was in doubt even at the beginning of the 20th century, modern scholarship is convinced that the book used and cited by the ancients was genuinely the book of Hecataeus. The extent of his debt to Anaximander, the pupil of Thales who constructed the first map of the world, cannot be known for certain. But he was in general the pioneer in those geographical and ethnographical fields that remained always attractive to the Greek historians and their public: and that his work was used freely by Herodotus, who acknowledged it only when he found occasion to complain, is widely recognized. Though Strabo, and others in antiquity, found him uncritical, yet there is great independence in his opening sentence, "The tales told by the Greeks are many and ridiculous, in my view," as there is, too, in his political advice to the Ionians. That his literary style was good, though simple, was allowed by Dionysius of Halicarnassus and other experts.

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HECATE (Greek *Hekate*, "she who works from afar"), a goddess early accepted into Greek religion but probably derived from the Carians in southwest Asia Minor. Her name may not be Greek in origin. She is not mentioned in the *Iliad* or the *Odyssey*, but in Hesiod she is the daughter of the Titan Perses and of the nymph Asteria. Hesiod represents her as having power over heaven, earth and sea; hence she bestows wealth and all the

BY COURTESY OF THE TRUSTEES OF THE BRITISH MUSEUM

THE GODDESS HECATE, IN SINGLE FORM, CROWNING A HORSE. VOTIVE RELIEF IN MARBLE FROM CRANNON IN THESSALY, GREECE; *c.* 350 B.C. IN THE BRITISH MUSEUM, LONDON

blessings of daily life. This was perhaps her status in Carian religion. In Greece she is usually subordinate or confined to private cults.

Hecate is the chief goddess presiding over magic and spells (occasionally she is referred to as the mother of the enchantress Circe), and her name is very common in charms. She is closely connected with the grain-goddess Demeter; she it was who, with the sun-god Helios, witnessed the abduction of Demeter's daughter Persephone to the underworld and, torch in hand, assisted the search for her. On moonlight nights Hecate was seen at crossroads, accompanied by ghosts and hell-hounds. There, on the last day of each month, eggs and fish were offered to her, as well as black puppies (unusual victims) and black she-lambs. Pillars called Hecataea (like herms; *see* HERM) stood, especially in Athens, at crossroads and doorways, perhaps to keep away evil spirits. Hecate was also identified with Artemis as a goddess of night and of hunting, but she plays little or no part in legend.

In early art Hecate is represented as single-formed, clad in a long robe, holding burning torches; later she becomes triple-formed, with three bodies standing back to back—probably so that she may look all ways at once from the crossroads—and in her six hands are various emblems.

See M. P. Nilsson, *Geschichte der griechischen Religion,* 2nd ed., vol. i, pp. 722–725 (1955).

HECATOMB (Greek *hekatombe* from *hekaton,* "a hundred"), originally, perhaps, the sacrifice of a hundred victims, then of any large number. Hence, in modern languages, the destruction of a multitude of living or even of inanimate things.

HECKELPHONE, a woodwind instrument resembling the baritone oboe (*see* OBOE). It was perfected by Johann Adam Heckel in 1904 as a result of a request from Wagner about 20 years earlier for an instrument of low register combining the qualities of the oboe and the alphorn. It is an instrument of conical bore with a bent metal crook and a wooden bell. The commonest form is built in C an octave below the oboe with an extended lower register. Other forms are the smaller terz-heckelphone in E♭ and the piccolo heckelphone in F. It was most effectively used by Richard Strauss in his opera *Salome.*

HECKER, FRIEDRICH KARL FRANZ (1811–1881), German revolutionary who spent the latter half of his life mainly in the United States, was born at Eichtersheim in the grand duchy of Baden on Sept. 28, 1811. He qualified as a lawyer and in 1842 became a member of the Baden second chamber, where he supported the opposition. He was an effective speaker, and a speech in Feb. 1845 on the Schleswig-Holstein question, denouncing the projected incorporation of the duchies with Denmark, made him known beyond his own state. In the agitation of 1847–49 for more popular government Hecker, with Gustav Struve, led the radical, republican wing. In 1847 he and Struve called together at Offenburg a "popular assembly" which passed a republican resolution. When in the following year the preliminary parliament at Frankfurt refused to pass a similar resolution, Hecker attempted a rising in the Black Forest and in the Lake Constance area, but this was only feebly supported and was defeated at Kandern on April 20 by troops from Baden and Hesse. Hecker escaped first to Switzerland and then to the United States. In the spring of 1849 the party which had overthrown the government in Baden recalled him, but he was met at Strasbourg by the news that the insurgents had been crushed by Prussian troops. He therefore returned to the United States, where he farmed at Summerfield, Ill., and fought as a colonel on the Union side during the Civil War. After 1871 he became a warm admirer of Bismarck and of the newly founded German empire. Hecker died at St. Louis, Mo., on March 24, 1881.

HECKER, ISAAC THOMAS (1819–1888), U.S. Roman Catholic priest, founder of the Paulist Fathers, was born of Protestant German immigrant parents in New York city, Dec. 18, 1819. His early education came chiefly from private reading and activity in local politics. Later, at Brook Farm, he made contact with Brownson, Emerson, Dana, Alcott, Ripley and Thoreau. Baptized a Catholic in 1844, he became a Redemptorist priest in 1849 and with four other convert priests gave the first organized missions in English by the Redemptorists, who were chiefly Germans. The enthusiastic response of the people in New York and in many other places along the eastern coast suggested the need of an English-speaking house, and Hecker was delegated to urge this upon the rector major in Rome. He was expelled from the order for having come to Rome without permission; but on appeal, Pope Pius IX dispensed him and his four associates from their vows, encouraging them to work under local bishops. Four of them, with Hecker as superior, founded the Paulist Fathers, a diocesan organization for missionary work in New York.

Hecker wrote three books—*Questions of the Soul* (1855), *Aspirations of Nature* (1857) and *The Church and the Age* (1887)—and established the Catholic Publication society and two magazines, the *Catholic World* and the *Young Catholic.* He addressed the bishops at the Second Plenary Council of Baltimore, and accompanied Archbishop Spalding to the first Vatican council as theologian. After Hecker's death on Dec. 22, 1888, Cardinal Newman declared, "We had begun a work of the same kind, he in America and I in England." The French translation of Hecker's biography occasioned a controversy on "Americanism" which Leo XIII settled in 1899 by the encyclical *Testem Benevolentiae.*

The Paulist Fathers became a papal institute in 1940, and by that time they had houses in the United States, Canada, Rome and South Africa. (*See* AMERICANISM CONTROVERSY.)

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HECTOR, eldest son of the Trojan king Priam and his queen Hecuba and husband of Andromache. In Homer he is the chief warrior of the Trojan army. He is an especial favourite of Apollo, and later poets even describe him as son of that god. After Achilles (*q.v.*) had killed him, Aphrodite and Apollo preserved his body from corruption and mutilation. Priam, guarded by Hermes, went to Achilles and prevailed on him to give back the body, which was buried with great honour. Hector was afterward worshiped in the Troad and also at Tanagra, east of Thebes.

HECUBA, in Greek Hekabe; principal wife of the Trojan king Priam, mother of Hector and daughter, according to some accounts, of the Phrygian king Dymas. When Troy was captured and Priam slain, she was made prisoner by the Greeks. Her fate is told in various ways, most of which connect her with the promontory Cynossema ("dog's monument") on the Hellespont; *i.e.,* on the east side of the Gallipoli peninsula. According to Euripides (in the *Hecuba*), her youngest son, Polydorus, had been placed during the siege of Troy under the care of Polymestor, king of Thrace. When the Greeks reached the Thracian Chersonese on their way home she discovered that her son had been murdered, and in revenge put out the eyes of Polymestor and murdered his two sons. (*See* EURIPIDES: *The Extant Plays: Plays of Psychology and Passion.*) Later, she was turned into a dog, a legend variously rationalized by later writers, and her grave became a mark for ships.

HEDA, WILLEM CLAESZ (1594–1680/82), one of the earlier Dutch 17th-century still-life painters, was born probably in Haarlem, where he worked and died. Early in his career he produced some figure subjects, but nearly all of his known works are still lifes, of which the earliest dated example is a "Vanitas" of 1621. His most characteristic compositions are of glass and metal vessels delicately arranged on a table with oysters, a half-peeled lemon or other motifs that display his precise draftsmanship and his skill in imitating the varied qualities of different light-reflecting surfaces. His colour range is a subdued one of silvery grays and browns, the naturalistic effects being achieved by accurate tone values. Heda's pictures are not uncommon in public and private collections. (R. E. W. J.)

HEDGEHOG, a mammal of the order Insectivora (*q.v.*), remarkable for its armature of spines and its short tail. The common hedgehog (*Erinaceus europaeus*), the type of the family Erinaceidae, extends over nearly the whole of Eurasia to the northern limits of deciduous forests but is found nowhere in the new world.

JOHN MARKHAM

COMMON HEDGEHOG (ERINACEUS EUROPAEUS), NATIVE TO EUROPE

The upper jaw is longer than the lower, the eyes small, the snout long and flexible and the claws long but weak. The animal is about 10 in. long, the lower surface covered with coarse hair. The brain is remarkable for its low development.

When startled during its nightly foragings the hedgehog rolls itself up into a ball, from which the spines stand out in every direction; these are sharp, hard and elastic and form an efficient defense. The moment it is touched, or even hears the report of a gun, it rolls itself up by the action of four muscles beneath the skin, while the same contraction effects the erection of the spines. Though insectivorous, the hedgehog will devour mice, frogs, snakes, birds' eggs and young, and toads, as well as plants and fruits.

The hedgehog does not emerge from its retreat, a hollow stump or rocky crevice, during the daylight unless urged by hunger or by the necessities of its young. During the winter it passes into a state of hibernation, rolled up in a nest of dry leaves.

In July or August the female brings forth four to eight young; at birth the spines—which in the adult are brownish-black with yellowish tips—are white and soft, but soon harden, attaining their full size in the succeeding spring. The spines of the hedgehog are not barbed like those of the porcupine (*q.v.*), but they are still sharp enough to dissuade attackers. The fox, however, often rolls the prickly ball into water, where it immediately opens up to swim thus exposing its vulnerable parts to the predator.

The family is represented by about a score of species among which are the moonrats and gymnures ranging over Europe, Asia except the Malay countries, and Africa.

HEDGE SPARROW, small old-world birds belonging to the family Prunellidae, related to the thrushes, old-world warblers and finches, also called accentors from their sweet accented songs. The most common is the European hedge sparrow (*Prunella modularis*), also called dunnock or shufflewing, common about hedges. It has a reddish-brown back, iron-gray head and under parts, and the wing coverts are tipped white. The sexes are similar in appearance.

In England it is one of the earliest breeders in spring. The warmly built nest, in which the hedge sparrow lays its greenish-blue eggs, is often chosen by the European cuckoo as a place to leave its egg for the hedge sparrow to incubate, as noted by Shakespeare in *King Lear*.

Other species occur in Europe and northern Asia to China and Japan. A few of these are similar to the European hedge sparrow in habitat, but most species occupy rocky regions and higher mountain ranges. A Siberian species (*P. montanella*) is known as the mountain accentor. The Alpine accentor (*P. collaris*) is plumper and more brightly coloured than the dunnock. (G. F. Ss.; X.)

HEDGING, a method of reducing the risk of loss caused by price fluctuation. It consists of the purchase or sale of equal quantities of the same or very similar commodities, approximately simultaneously, in two different markets with the expectation that a future change in price in one market will be offset by an opposite change in the other market. An example would be that of a grain elevator operator who buys wheat in the country and at the same time sells a futures contract (*see* FUTURES) for the same quantity of wheat, probably on the Chicago Board of Trade. When his wheat is delivered later to the terminal market or to the processor in a normal market, he buys back his futures contract. Any change of price that occurred during the interval should have been canceled out by mutually compensatory movements in his cash and futures holdings. The hedger thus hopes to protect himself against loss resulting from price changes by transferring the risk to a speculator who relies upon his skill in forecasting price movements. Selling futures is called a short hedge; buying futures is called a long hedge. Although the concept of hedging is regarded by many as pure speculation, experience has shown that the practice of buying and selling futures contributes to stability of prices in commodity markets to the ultimate advantage of the consumer. (O. R. G.)

HEDIN, SVEN ANDERS (1865–1952), Swedish explorer, famous for his expeditions to Asia, was born in Stockholm on Feb. 19, 1865. The son of Ludwig Hedin, architect of Stockholm, he was educated at Uppsala university, Berlin and Halle. At the age of 20 he traveled in the Caucasus, Persia and Mesopotamia and in 1890 was appointed interpreter to the Swedish-Norwegian mission to the shah of Persia. These were the beginnings of a life of exploration of central Asia. In 1891 he visited Khurasan, Russian Turkistan and Kashgar; between 1893–98 he traversed Asia from Orenburg via the Urals, the Pamirs and Lop Nor to Peking; during 1899–1902 he followed the Tarim river and crossed the Gobi desert; and during 1905–08 he explored the Trans-Himalayan ranges. For these journeys he received many honours: in 1902 he became a Swedish noble; in 1909 the Indian government created him an honorary knight commander of the Indian Empire; and he received the highest awards of the leading geographical societies of Europe.

His political activities during World War I lost him many influential friends and the trust of the Indian, Russian and Chinese governments, but, overcoming all difficulties, at the age of 63 he led an elaborate Chino-Swedish scientific expedition from 1928 to 1932 into inner Mongolia, western Kansu and Sinkiang and in his 69th year surveyed part of the ancient "silk-route" in central Asia. The records of his travels were controversial, but his many books reveal the courage, determination and often ruthlessness, and, in later years, the bitterness, of his character. He died on Nov. 26, 1952, in Stockholm. (K. M.)

HEDJAZ: *see* HEJAZ.

HEDMARK, a *fylke* (county) in the eastern part of southern Norway, borders on Sweden from the district of Kongsvinger in the south to that of Lake Femund in the north. Pop. (1961 est.) 177,210. Area 10,635 sq.mi. The county includes most of the valley of the river Glomma and the relatively low, undulating land with sedimentary bedrocks of schist and limestone east of Lake Mjösa. To the south and east Pre-Cambrian bedrock is exposed, but to the north the bedrocks are covered by quartz-sandstone and similar Sparagmitic rocks, forming several high mountains, including part of the Rondane range, which reaches 7,162 ft. In the northernmost part of the county metamorphosed Cambro-Silurian schist and intrusive granite contain pyrite which is mined in Folldal. The districts near Lake Mjösa and of the lower Glomma valley, which are covered by sandy loam, are important agricultural areas. More than two-thirds of the population of the county live in them, including 13,493 in the lakeside city of Hamar, the administrative centre. Hedmark, much of which is densely forested, provides nearly one-quarter of the timber production of Norway, most of it being floated to the industrial region at the mouth of the Glomma and the rest used by sawmills and pulp factories within the county. Railways and main roads between Oslo and Trondheim pass through the county. (L. H. Hg.)

HEDON, a municipal borough in the Bridlington parliamentary division of the East Riding of Yorkshire, Eng., 6 mi. E. of Hull and 2 mi. from the Humber river. Pop. (1961) 2,338. Standing on Hedon haven, it was formerly a considerable port, but it lost its importance with the growth of Hull at the end of the 13th century; it is now largely agricultural. The manor formed part of the lordship of Holderness which William the Conqueror granted to Eudes, count of Aumale. An undated charter of Henry II contains the first certain evidence of settlement. By it the king granted to William, count of Aumale, free borough rights in Hedon. In 1200 King John granted a confirmation of these liberties, and for this second charter the burgesses themselves paid 70 marks. In 1272 Henry III granted to Edmund, earl of Lancaster, and Avelina his wife, then lord and lady of the manor, the right of holding an eight-day fair at Hedon. After the countess' death the manor came to Edward I. In 1280 it was found by an inquisition that the men of Hedon "were few and poor" and that if the town were demised at a fee-farm rent, the town might improve. Apparently the grant was not made until 1346. Hedon was incorporated by Charles II in 1661, and James II gave the burgesses the charter, granting, among other privileges, that of holding two extra fairs. The church of St. Augustine is of Early English, Decorated and Perpendicular styles, with a 15th-century central tower 130 ft. high. The west front is particularly fine, and there is a lofty clerestory. The corporation possesses a remarkable mace of 15th-century workmanship. The borough sent two members to parliament from 1295 to 1832. Hedon is said to mean "the rise covered with heather."

HEDONISM, in ethics, a general term for all theories of conduct in which the criterion is pleasure of one kind or another (Greek *hedone*, "pleasure," from *hedys*, "sweet," "pleasant"). Hedonistic theories of conduct have been held from the earliest times. They have been regularly misrepresented by their critics because of a simple misconception, namely, the assumption that the pleasure upheld by the hedonist is necessarily purely physical in its origins. This assumption is in most cases a complete perversion of the truth. Practically all hedonists recognize the existence of pleasures derived from fame and reputation, from friendship and sympathy, from knowledge and art. Most of them have urged that physical (or "lower") pleasures are not only ephemeral in themselves but also involve, either as prior conditions or as consequences, such pains as to discount any greater intensity that they may have while they last. (*See* ETHICS; ETHICS, HISTORY OF.)

The earliest and most extreme form of hedonism is that of the Cyrenaics (*q.v.*) as stated by Aristippus, who argued that the only good for man is the sentient pleasure of the moment. Since, as Protagoras maintained, knowledge is solely of momentary sensations, it is useless to try to calculate future pleasures and to balance pains against them. The true art of life is to crowd as much enjoyment as possible into each moment.

No school has been more subject to the misconception noted above than the Epicurean. Epicureanism is completely different from Cyrenaicism. For Epicurus (*q.v.*) pleasure is indeed the supreme good, but his interpretation of this maxim is profoundly influenced by the Socratic doctrine of prudence and Aristotle's conception of the best life. The true hedonist will aim at a life of enduring pleasure, but this is obtainable only under the guidance of reason. Self-control in the choice and limitation of pleasures with a view to reducing pain to a minimum is indispensable. "Of all this, the beginning, and the greatest good, is prudence." This negative side of Epicureanism developed to such an extent that some members of the school found the ideal life rather in indifference to pain than in positive enjoyment.

In the late 18th century Jeremy Bentham (*q.v.*) revived hedonism both as a psychological and as a moral theory. Each man has no other end than his own greatest pleasure. Each man ought to pursue the greatest pleasure. It would seem to follow that each man inevitably always does what he ought. Bentham sought the solution of this paradox on different occasions in two incompatible directions. Sometimes he says that the act which I do is the act which I *think* will give me most pleasure, whereas the act which I ought to do is the act which *really will* give me most pleasure: calculation is salvation, sin is shortsightedness. Alternatively he suggests that the act which I do is that which will give me most pleasure, whereas the act I ought to do is that which will give *all those affected by it* most pleasure. (*See* UTILITARIANISM for further developments of this second solution.)

The psychological doctrine that a man's only aim is pleasure was effectively attacked by Joseph Butler (*q.v.*). He pointed out that each desire has its own specific object and that pleasure comes as a welcome addition or bonus when the desire achieves its object; hence the paradox that the best way to get pleasure is to forget it and to pursue wholeheartedly other objects. Butler went too far in maintaining that pleasure cannot be pursued as an end. Normally, indeed, when I am hungry or curious or lonely, I desire to eat, to know or to have company; and these are not desires for pleasure. But I can also eat sweets when I am not hungry, for the sake of the pleasure that they give.

Moral hedonism has been attacked by most moralists since Socrates, though they too have tended to go to the extreme of holding that I never have a duty to bring about pleasure. It does seem odd to say that I have a duty to give myself pleasure, but the pleasures of others certainly seem to count among the factors relevant in making a moral decision. One particular criticism which may be added to those usually urged against hedonists is that whereas they claim to simplify ethical problems by introducing a single standard, namely pleasure, in fact they have a double standard: "Nature has placed mankind under the governance of two sovereign masters, *pain* and *pleasure*" (Bentham). Hedonists make the mistake of thinking of pleasure and pain as if they were, like heat and cold, degrees on a single scale, when they are really different in kind.

See further G. E. Moore, *Principia Ethica* (1903). (J. D. M.)

HEDWIG, JOHANN (1730–1799), German botanist, was the first scientist to interpret correctly the microscopically small sex structures of mosses and to exploit the spore-distributing mechanism of the capsule to classify those plants. Born at Kronstadt, Rumania (Transylvania), on Dec. 8, 1730, he studied in Leipzig and practiced medicine there and in Chemnitz. At the University of Leipzig he became professor of pharmacology in 1786 and professor of botany in 1789. Six volumes by Hedwig, published in Latin between 1782 and 1798, are highly regarded because of their hand-coloured plates of mosses and other plants. Hedwig followed the binomial system of naming plants instituted by his contemporary Linnaeus, and identified more mosses than any other man of his day, owing to his skill with the microscope.

Hedwig died on Feb. 18, 1799, while working on his greatest contribution to the knowledge of mosses—*Species Muscorum Frondosorum* . . . Published in 1801, and later followed by four supplements, this posthumous treatise has been designated by international botanical congresses as the beginning point in the naming of mosses. (P. D. V.)

HEEM, JAN DAVIDSZ DE (1606–1683/84), Dutch painter, was born at Utrecht. He was, if not the first, perhaps the greatest painter of still life in Holland. Sometimes De Heem painted alone or in company with men of his school, Madonnas or portraits surrounded by festoons of fruit or flowers, but his most numerous and characteristic works are still-life subjects. These are sometimes arrangements of fruits, metal dishes, wineglasses, etc., in the manner of the Haarlem school, but they include also compositions of books and of musical instruments and some examples of the popular "Vanitas" theme, with a skull, hourglass and other suitably symbolic articles.

At one time Jan de Heem signed with initials, at others with Johannes, at others again with the name of his father (DAVID I DE HEEM, *c.* 1570–*c.* 1632) joined to his own. He entered the Antwerp guild in 1635–36 and became a burgher of that city in 1637, maintaining his residence there until 1667, when he moved to Utrecht. His death is recorded in the guild books of Antwerp.

CORNELIS DE HEEM (1631–95), the son of Jan Davidsz, was in practice as a flower painter at Utrecht in 1658, and was still active in 1671 at The Hague. His pictures are not equal to those of his father, but they are all well authenticated, and most of them are

in the galleries of The Hague, Dresden, Cassel, Vienna and Berlin. In the Staedel at Frankfurt is a fruit piece, with potherbs and a porcelain jug, dated 1658; another, dated 1671, is in the museum of Brussels.

DAVID II DAVIDSZ DE HEEM, David I's second son, entered the guild of Utrecht in 1668 and that of Antwerp in 1693. The best piece assigned to him is a table with a lobster, fruit and glasses in the Rijksmuseum, Amsterdam; others bearing his signature are in the museums of Florence, Leningrad and Brunswick.

(R. E. W. J.)

HEEMSKERCK, MAARTEN VAN (MAARTEN VAN VEEN) (1498–1574), Dutch Mannerist painter, was born at Heemskerck in Holland. He spent a period (*c.* 1528) in the Haarlem studio of Jan van Scorel, then lately returned from Italy. Heemskerck's earliest works—a portrait of his father (New York), "Ecce Homo" (Ghent), "Judah and Thamar" (formerly Potsdam) and "St. Luke Painting the Portrait of the Virgin" (Haarlem), all dated 1532—while adhering closely to the Romanist style of Scorel, seek to outdo it by dramatic lighting and illusionistic effects of plasticity which do, indeed, achieve an effect of surprise, but fail to conceal a certain spiritual vacuity which was to remain characteristic of Heemskerck's painting.

From 1532 to 1535 he was in Rome recording in innumerable sketches, some of which are preserved in Berlin, the architecture and sculpture of classical antiquity and the painting of the High Renaissance. Of the latter he directed his attention particularly to the frescoes of Michelangelo in the Sistine chapel and those of Raphael in the Villa Farnesina.

Throughout the rest of his long career, which was spent almost exclusively in Haarlem (where he died), he drew liberally on this garnered store of Roman motifs. Among the more notable of the religious paintings of his maturity are a great "Crucifixion" altar (1538–43, Linkoping cathedral, Sweden), a "Crucifixion" (1543, Ghent), an "Annunciation" and "Adorations of the Kings and Shepherds" (1546, Haarlem), two triptychs with Passion subjects (1559–60, Haarlem and Brussels), the "Story of Momus" (1561, Berlin) and the "Baptism of Christ" (1566, Brunswick). He also painted portraits, among them a self-portrait with the Colosseum (1553, Fitzwilliam museum, Cambridge), and from 1548 onward he produced many designs for engravings.

Heemskerck was one of the leading Dutch artists of his day and a painter of undoubted ability, yet it is hard to avoid the conclusion that his native force was stifled by his Mannerist practice of imitating and reproducing the most admired models. Relying on these, and neglecting nature, he evolved a style which, though not without originality, remains inexpressive and second-hand. The tendency to reduce the forms, textures and colours of nature to arid, abstract formulas extends even to his portraits, though these are perhaps his most attractive work. (D. KG.)

HEEMSTEDE, about 6 km. (4 mi.) S. of Haarlem in the province of North Holland, Neth., is chiefly a residential town for Amsterdam businessmen. Pop. (1962 est.) 26,302. Among the country houses, established in the 17th and 18th centuries, is the De Hartekamp estate, where the Swedish botanist Carolus Linnaeus (*q.v.*) worked in 1736–38. In the vicinity the dunes have been leveled and the land is used for bulb cultivation.

HEEREN, ARNOLD HERMANN LUDWIG (1760–1842), German historian, a pioneer in the movement for the economic interpretation of history, especially with respect to the ancient world, was born at Arbergen, near Bremen, Oct. 25, 1760. In 1787 he became professor of philosophy, and in 1801 of history, at Göttingen. His chief work, *Ideen über Politik, den Verkehr und den Handel der vornehmsten Völker der alten Welt* (3 vol., 1793–96; Eng. trans., 1833), ran into several editions and was translated into other languages. Its favourable reception in Germany and abroad encouraged Heeren to pursue his ideas (influenced by Adam Smith and Montesquieu) on the importance of the economics, commerce and constitution of states for their historical development. His other works include *Handbuch der Geschichte der Staaten des Altertums* (1799), *Handbuch der Geschichte des europäischen Staatensystems und seiner Colonien* (1800) and *Versuch einer Entwickelung der Folgen der Kreuzzüge* (1808). With H. Ukert he founded in 1829 a famous historical series, *Geschichte der europäischen Staaten.* He died at Göttingen, March 6, 1842.

HEERENVEEN, a town in Friesland, one of the most northerly provinces of the Netherlands, lies 64 km. (40 mi.) N. of Zwolle and 30 km. (19 mi.) S. by E. of Leeuwarden, the capital of Friesland. Pop. (1962 est.) 26,230. Important buildings are the town hall (1648), a museum of local history and a large windmill. Established in 1551, Heerenveen was at first a peat-producing town; it is now industrial and produces bicycles, mopeds, motor buses, plastics, etc. Nearby are the woods of Oranjewoud and the Nannewiid lake. Heerenveen has many schools and shops and is an "Ontwikkelingskern," a nucleus with special facilities for industrial development. It lies on the Leeuwarden-Zwolle railway and the Leeuwarden-Zwolle and Groningen-Afsluitdijk motor roads.

(Go. S.)

HEERLEN, the second town of Limburg province, Neth., is in the southeasterly Maastricht appendix, 22 km. (14 mi.) N.E. of Maastricht and 15 km. (9 mi.) N.W. of Aachen, Ger. Pop. (1962 est.) 73,946. It is the site of the Roman Coriovallum and next to the town hall are the remains of a Roman bath. St. Pancras church (early 12th century) has a tower that was formerly part of the Herle fortress (1300).

There are geological and archaeological museums, the latter in the modern town hall (1938–48). Heerlen is the headquarters of the Netherlands coal-mining area and an important industrial and shopping centre. It is linked by rail and road with Amsterdam via Sittard (15 km. N.), and via Maastricht with Liège, Belg., and with France, and by bus service with Aachen.

HEFELE, KARL JOSEPH VON (1809–1893), German Roman Catholic theologian and church historian, was born at Unterkochen, Württemberg, on March 15, 1809, and was educated at Tübingen, where, after minor appointments elsewhere, in 1840 he became professor of church history and patristics. From 1842 to 1845 he sat in the national assembly of Württemberg, and in 1869 was enthroned bishop of Rottenburg. Previous to this appointment, Hefele had won a reputation for scholarship by his early publications: *Patrum Apostolicorum Opera* (1839), *Der Kardinal Ximenes* (1844) and *Chrysostomuspostille* (1845). His best-known work is his history of the ecclesiastical councils, nine volumes, the last two volumes by J. von Hergenröther (*q.v.*) (1855–90; English translations of the earlier volumes, 1871). He opposed the decrees of papal infallibility at the first Vatican council of 1870, and did not submit until 1871. Hefele died at Rottenburg on June 6, 1893.

HEGEL, GEORG WILHELM FRIEDRICH (1770–1831), German philosopher, was born at Stuttgart on Aug. 27, 1770. His father was a revenue officer. He learned the elements of Latin from his mother before he went to the Stuttgart grammar school, where he remained until he was 18. As a schoolboy he made a collection of extracts, alphabetically arranged, comprising annotations on classical authors, passages from newspapers, treatises on morals and mathematics from the standard works of the period.

In 1788 he went to Tübingen as a student with a view to taking orders, as his parents wished. He studied philosophy and classics for two years and took his Ph.D. in 1790. Thereafter he took the theological course; but he was impatient with the orthodoxy of his teachers, and the certificate given to him when he left in 1793 states that while he had devoted himself vigorously to philosophy, his industry in theology was intermittent. He was also said to be a poor orator, and this deficiency in oral exposition was to dog him throughout his life. His fellow students called him "the old man" but he liked cheerful company and a "sacrifice to Bacchus" and he enjoyed kisses too. His chief friends were J. C. F. Hölderlin, the poet, his contemporary, and F. W. J. Schelling, the philosopher, five years his junior. Together they read the Greek tragedians and celebrated the glories of the French Revolution.

On leaving college, he did not enter the ministry. He wished to have leisure for the study of philosophy and Greek literature and became a private tutor. For the next three years he lived in

Berne, with time on his hands and the run of a good library where he read Edward Gibbon and Montesquieu, as well as the Greek and Roman classics. He also studied Kant and was stimulated by his essay on religion to write certain papers which remained unpublished until 1907 (*see* below). Kant had maintained that, while orthodoxy requires a faith in historical facts and in doctrines which reason alone cannot justify and while it imposes on the faithful a moral system containing many arbitrary commands alleged to be revealed, Jesus had originally taught a rational morality, reconcilable with the teaching of Kant's ethical works, and a religion which, unlike Judaism, was adapted to the reason of all men. Hegel accepted this teaching but, being more of a historian than Kant was, brought it to the test of history by writing two essays: first, a life of Jesus in which he attempted to reinterpret the Gospel on Kantian lines; and secondly an answer to the question of how Christianity had ever become the authoritarian religion that it was if in fact the teaching of Jesus was not authoritarian at all but essentially rationalistic.

Hegel was lonely in Berne and was glad to move, at the end of 1796, to Frankfurt am Main, where Hölderlin had been able to get another tutorship for him. His hopes of more companionship were unfulfilled: Hölderlin was engrossed in a love affair with his employer's wife and shortly afterward lost his reason. Hegel began to suffer from melancholia and, to cure himself, worked harder than ever, especially at Greek philosophy and modern history and politics. He read and made cuttings from English newspapers, wrote about the internal affairs of his native Württemberg and studied economics. This immersion in studies which had had little effect on Kant enabled Hegel to free himself from the domination of his master's influence and to look with a fresh eye on the problem of Christian origins.

It is impossible to exaggerate the importance which this problem had for Hegel. His early theological writings contain plenty of hard sayings about Christianity and the churches, but the object of his attack is orthodoxy, not theology itself. All that he wrote at this period throbs with a religious conviction which is totally absent from Kant and his other 18th-century teachers. Above all, he is inspired by a doctrine of the Holy Spirit. The spirit of man, his reason, is the candle of the Lord and therefore cannot be subject to the limitations which Kant had imposed on it in the *Critique of Pure Reason*. This faith in reason, with its religious basis, animates the whole of Hegel's work henceforward.

His outlook has also become that of a historian, and this again distinguishes him from Kant, who was much more influenced by the conceptions of physical science. Every one of Hegel's major works is a history, and indeed it was among historians and classical scholars rather than among philosophers that his work mainly fructified in the 19th century.

When in 1798 he turned back to look over the essays he had written two or three years earlier in Berne, he saw with his historian's eye that under Kant's influence he had misrepresented the life and teachings of Jesus and the history of the Christian church. His new-won insight found expression then in his essay on *The Spirit of Christianity*, likewise unpublished until 1907. This is one of Hegel's most remarkable works. Its style is often difficult and the connection of thought not always plain, but it is written with passion, insight and conviction.

He begins by sketching the essence of Judaism, which he paints in the darkest colours. The Jews were slaves to the Mosaic law, leading a life unlovely in comparison with that of the ancient Greeks and content with the material satisfaction of a land flowing with milk and honey. Jesus taught something entirely different. Men are not to be the slaves of objective commands: the law is made for man. They are even to rise above the tension in moral experience between inclination and reason's law of duty, for the law is to be "fulfilled" in the love of God wherein all tension ceases and the believer does God's will wholeheartedly and single-mindedly. A community of such believers is the Kingdom of God.

This was the kingdom which Jesus came to teach. It is founded on a belief in the unity of the divine and the human. It is one life which flows in them both, and it is only because man is spirit that he can grasp and comprehend the Spirit of God. Hegel works out this conception in an exegesis of passages in St. John. The kingdom, however, can never be realized in this world: man is not spirit alone but flesh also. "Church and state, worship and life, piety and virtue, spiritual and worldly action can never dissolve into one."

In this essay the leading ideas of Hegel's system of philosophy are rooted. Kant had argued that we could have knowledge only of a finite world of appearances; if reason attempted to go beyond this sphere and grapple with the infinite or with ultimate reality, it became entangled in insoluble contradictions. Hegel, however, found in love as a union of opposites a prefigurement of spirit as the unity in which contradictions, such as infinite and finite, were embraced and synthesized. His choice of the word *Geist* to express this his leading conception was deliberate: the word means "mind" as well as "spirit" and is commonly so translated; but the English word "mind" has no religious overtones and therefore does not convey Hegel's meaning adequately. Contradictions in thinking at the scientific level of Kant's "understanding" are indeed inevitable, but thinking as an activity of spirit or "reason" can rise above them to a synthesis in which the contradictions are resolved. All this, expressed in religious phraseology, is contained in the manuscripts written toward the end of Hegel's stay in Frankfurt. "In religion," he says in the paper which his editor unfortunately called *Fragment of a System*, "finite life rises to infinite life." Kant's philosophy has to stop short of religion because it rests on an opposition between thought and its object and must place the true infinite beyond its confines. But there is room for another philosophy, based on the conception of spirit, which will distill into conceptual form the insights of religion. This was the philosophy now within Hegel's grasp, and he felt himself ready to expound it.

Fortunately his circumstances had changed for him at this moment, and he was at last able to embark on the academic career that had long been his ambition. His father's death in 1799 had put him in possession of an inheritance, slender indeed, but sufficient to enable him to surrender a regular income and to take the risk of becoming a *Privatdocent*. By the end of 1800 he was ready to burn his boats, and in Jan. 1801 he arrived in Jena, where Schelling had been a professor since 1798. The golden age of Jena was over. J. L. Tieck, Novalis and the Schlegels, who had made it the headquarters of their fantastic mysticism, and Fichte, who had developed certain aspects of Kant's ethics rather onesidedly in the direction of revolutionary idealism, had all left the place. The precocious Schelling, who was but 26 on Hegel's arrival, had several books behind him already, for he was apt to "philosophize in public" and was fighting a lone battle in the university against rather dull followers of Kant. It was suggested that Hegel had been summoned as a new champion to aid his friend, and this impression received some confirmation from the Latin dissertation by which Hegel qualified as a university teacher and which betrays the influence of Schelling's philosophy of nature, as well as from Hegel's first publication, an essay on the difference in the philosophical systems of Fichte and Schelling (1801), in which preference is given to the latter. Nevertheless, even in this essay, and still more in its successors, Hegel's difference from Schelling is clearly marked; they had a common interest in the Greeks, they both wished to carry forward Kant's work, they were both iconoclasts, but Schelling had too many romantic enthusiasms for Hegel's liking, and all that Hegel took from him, and then only for a very short period, was a terminology.

Hegel's lectures, in the winter of 1801–02, on logic and metaphysics, were attended by about 11 students. Later, in 1804, we find him with a class of about 30, lecturing on his whole system; but his average attendance was rather less. Besides philosophy, he once at least lectured on mathematics. As he taught, he was gradually able to work out his system, and notice after notice of his lectures promised a textbook of philosophy—which, however, failed to appear. After the departure of Schelling from Jena (1803), Hegel was left to work out his own views untrammeled. Besides philosophical and political studies, he made extracts from

books, attended lectures on physiology and dabbled in other sciences. As a result of representations made by himself at Weimar, he was in Feb. 1805 appointed extraordinary professor at Jena; and in July 1806, on Goethe's intervention, he drew his first stipend—100 thalers. Though some of his hearers became attached to him, Hegel was not yet a popular lecturer.

Hegel, like Goethe, felt no patriotic shudder when Napoleon won his victory at Jena (Oct. 14, 1806); in Prussia he saw only a corrupt and conceited bureaucracy. Writing to his friend F. I. Niethammer (1766–1848) on the day before the battle, he speaks with admiration of the "world-soul," the emperor, and with satisfaction of the probable overthrow of the Prussians. Hegel's fortunes were now at the lowest ebb. Yet at this time he finished and published his first great work, the *Phenomenology of Mind* (*Phänomenologie des Geistes*, 1807). He was, therefore, glad to become editor of the *Bamberger Zeitung* (1807–08). This, however, was not a suitable vocation, and he gladly accepted the rectorship of the Aegidiengymnasium in Nürnberg, a post which he held from Dec. 1808 to Aug. 1816. There Hegel inspired confidence in his pupils and maintained discipline without pedantic interference in their associations and sports.

In 1811 Hegel married Marie von Tucher (22 years his junior), of Nürnberg. The marriage was entirely happy. His income at Nürnberg amounted to 1,500 gulden and a house (in Heidelberg, as professor, he was to receive about the same sum; in Berlin, about 3,000 thalers, more than twice as much). His wife bore him two sons: Karl (1813–1901), who became eminent as a historian; and Immanuel (1814–91), whose interests were theological. The family circle was joined by Ludwig, a natural son of Hegel's from Jena.

At Nürnberg in 1812 appeared *Die objektive Logik*, being the first part, in two sections, of his *Science of Logic* (*Wissenschaft der Logik*), which in 1816 was completed by the second part, *Die subjektive Logik*. This work, in which his system was first presented in what, with minor alterations, was its ultimate shape, earned him the offer of professorships at Erlangen, at Berlin and at Heidelberg. He accepted the chair at Heidelberg, in succession to J. H. Fries (1816). For use at his lectures there he published his *Encyclopaedia of the Philosophical Sciences* (*Encyklopädie der philosophischen Wissenschaften im Grundrisse*, Heidelberg, 1817), an exposition of his system as a whole.

In 1818 Hegel accepted the renewed offer of the chair of philosophy at Berlin, which had been vacant since Fichte's death. There his influence over his pupils was immense, though his expectation of other government employment was not fulfilled. After the publication of his *Philosophy of Right* (*Naturrecht und Staatswissenschaft im Grundrisse*, alternatively entitled *Grundlinien der Philosophie des Rechts*, (1821), he seems to have devoted himself almost entirely to his lectures. Between 1823 and 1827 his activity reached its maximum. His notes were subjected to perpetual revisions and additions. We can form an idea of them from the shape in which they appear in his published writings. Those on *Aesthetics*, on the *Philosophy of Religion*, on the *Philosophy of History* and on the *History of Philosophy* have been published by his editors, mainly from the notes of his students, under their separate heads; while those on logic, psychology and the philosophy of nature are appended in the form of illustrative and explanatory notes to the sections of his *Encyclopaedia*. During these years hundreds of hearers from all parts of Germany and beyond came under his influence. His fame was carried abroad by eager or intelligent disciples.

Three courses of lectures are especially the product of his Berlin period: those on aesthetics, on the philosophy of religion and on the philosophy of history. In the years preceding the revolution of 1830, public interest, excluded from political life, turned to theatres, concert rooms and picture galleries. At these Hegel became a frequent and appreciative visitor and made extracts from the art notes in the newspapers. In his holiday excursions, his interest in the fine arts more than once took him out of his way to see some old painting. This familiarity with the facts of art, though neither deep nor historical, gave a freshness to his lectures on aesthetics, which, as put together from the notes of 1820, 1823, 1826, are among his most successful efforts.

The lectures on the philosophy of religion are another application of his method. Shortly before his death he had prepared for the press a course of lectures on the proofs for the existence of God. In his lectures on religion he dealt with Christianity, as in his philosophy of morals he had regarded the state. On the one hand he turned his weapons against the rationalistic school, who reduced religion to the modicum compatible with an ordinary worldly mind. On the other hand he criticized the school of Schleiermacher, who elevated feeling to a place in religion above systematic theology. His middle-way attempts to show that the dogmatic creed is the rational development of what was implicit in religious feeling. To do so, of course, philosophy becomes the interpreter and the superior.

The lectures on the history of philosophy are especially remarkable for their treatment of Greek philosophy. Hegel worked mainly with the Renaissance editions of Plato and Aristotle and without the indexes and annotated editions which are at the disposal of modern scholars. In these circumstances his grasp and understanding of these authors is astounding, and it is only just to recognize that it was from Hegel that the scholarship lavished on Greek philosophy in the century after his death received its original impetus.

A Hegelian school began to gather. The flock included intelligent pupils, empty-headed imitators and romantics who turned philosophy into lyric measures. Opposition and criticism only served to define more precisely the adherents of the new doctrine. Though he had soon resigned all direct official connection with the schools of Brandenburg, Hegel's real influence in Prussia was considerable—even if largely exaggerated in popular estimate. In the narrower circle of his friends his birthdays were the signal for congratulatory verses. In 1831 he received a decoration from Frederick William III. In 1830 he was rector of the university.

One of the last literary undertakings in which he took part was the establishment of the Berlin *Jahrbücher fur wissenschaftliche Kritik*.

The revolution of 1830 was a great blow to him, and the prospect of mob rule almost made him ill. His last literary work, the first part of which appeared in the *Preussische Staatszeitung* while the rest was censored, was an essay on the English Reform bill of 1831, considering its probable effects on the character of the new members of parliament and the measures which they might introduce. In the latter connection he enlarged on several points in which England had done less than many continental states for the abolition of monopolies and abuses.

In 1831 cholera entered Germany. Hegel and his family retired for the summer to the suburbs, and there he finished the revision of the first part of his *Science of Logic*. At the beginning of the winter session he returned to his house in the Kupfergraben. On Nov. 14, after one day's illness, he died of cholera and was buried, as he had wished, between Fichte and Karl Solger.

Hegel in his classroom was more impressive than fascinating. You saw a plain, old-fashioned face, without life or lustre—a figure which had never looked young and was now prematurely aged; the furrowed face bore witness to concentrated thought. Sitting with his snuffbox before him and his head bent down, he looked ill at ease and kept turning the folios of his notes. His utterance was interrupted by frequent coughing; every sentence came out with a struggle. The style was no less irregular: sometimes in plain narrative the lecturer would be specially awkward, while in abstruse passages he seemed specially at home, rose into a natural eloquence and carried away the hearer by the grandeur of his diction.

PHILOSOPHY

Hegel took seriously Plato's saying that the philosopher is "the spectator of all time and all existence." His philosophy is a systematic whole, an attempt to comprehend the entire universe; he tried to do for the modern world what Aristotle had done for the ancient. The system is grounded in faith. In the Christian religion God has been revealed as truth and as spirit. Since spirit alone can comprehend spirit, it is only because man is spirit that

he can receive this revelation. In receiving it, he knows God; *i.e.,* he knows absolute truth. In religion this truth is veiled in imagery; but in philosophy the veil is torn aside. The task of philosophy is thus to know the infinite and to see all things in God. Hegel's system is a spiritual monism, but it is a monism in which differentiation is essential; i.*e.,* it accords with the Christian faith in God as triune, not with Islam.

Hegel accepts from Aristotle the conception of God as pure thought thinking itself and from his predecessors in modern philosophy the central importance of mind's knowledge of itself as mind. In these instances thought and the object of thought are identical, and in that identity alone does thinking attain the through-and-through intelligibility which is the goal of all its endeavour as thinking. The identity is reached, however, only through an experience of difference. Truth is the absence of error, but it is known to be true only because error has been experienced and truth has triumphed. God, in Hegel's view, is infinite only because he has assumed the limitations of finitude and triumphed over them. Adam and Eve were innocent in the Garden of Eden, but their fall was necessary if man was to attain moral goodness. Only if the universal particularizes itself can it come to know itself as universal. Spirit knows itself as spirit only by contrast with nature. Spirit must always give itself forms through which it can work; it must objectify itself in a creed or in an institution if it is not to wither away. The letter killeth, yet the letter is spirit's indispensable expression and self-manifestation.

The infinite spirit's eternal enjoyment of himself as spirit thus necessitates the existence of the finite in the form of nature, finite spirits and all the imperfection and evil of the world. But Hegel's system finds room for all these and yet remains monistic because it seeks to show that the truth, the essential substance, of the finite is the infinite whose manifestation, in varying degrees, the finite is: there is a heart of goodness in evil, and this heart is all the reality that it has; the rest perishes and passes away into nothingness. The system is monistic too in having a single theme. What makes the universe intelligible is to see it as the eternal cyclical process whereby absolute spirit comes to knowledge of itself as spirit (1) through its own thinking; (2) through nature; (3) through finite spirits and their self-expression in history and their self-discovery, in art, in religion and in philosophy, as one with absolute spirit itself.

Hegel's terminology presents difficulties to those who approach his works for the first time, even if German be their native language. He prided himself in having taught philosophy to speak German instead of Greek or Latin, but on some of the German words that he uses he imposes his own technical meaning. But he uses them consistently and it is not difficult to learn them, especially if their ancestry in Proclus and in Martin Luther is borne in mind. Hegel was a master of language, whichever of his differing styles he chose.

The early theological writings and the *Phenomenology of Mind* are packed with brilliant metaphors. In his later works, which were produced as textbooks for his lectures, the *Encyclopaedia of the Philosophical Sciences* and the *Philosophy of Right,* he compresses his material into relatively short, numbered paragraphs. It is only necessary to translate them to appreciate their conciseness and precision. The common idea that Hegel's is a philosophy of exceptional difficulty is quite mistaken. Once his terminology is understood and his main principles grasped, he presents far less difficulty than Kant, for example. One reason for this is a certain air of dogmatism. Kant's statements are often hedged around with qualifications; Hegel had, as it were, seen a vision of absolute truth and he expounds it with confidence.

The Phenomenology of Mind.—This, perhaps the most brilliant and the most difficult of Hegel's books, describes how the human mind has risen from mere consciousness, through self-consciousness, reason, spirit and religion, to absolute knowledge. The native attitude of consciousness toward existence is reliance on the evidence of the senses; but a little reflection is sufficient to show that the reality attributed to the external world is as much due to intellectual conceptions as to the senses and that these conceptions elude us when we try to fix them. If consciousness cannot detect a permanent object outside itself, so self-consciousness cannot find a permanent subject in itself. It may, as in Stoicism, assert freedom by holding aloof from the entanglements of real life; or it may sceptically regard the world as a delusion; or finally, as the "unhappy consciousness" (*unglückliches Bewusstsein*), it may be a recurrent falling short of a perfection which it has placed above itself in the heavens. But in this isolation from the world, self-consciousness has closed its gates against the stream of life. The perception of this is reason. Reason, convinced that the world and the soul are alike rational, observes the external world, mental phenomena and specially the nervous organism as the meeting ground of body and mind. But reason, finding much in the world that recognizes no affinity with her, turns to practical activity and seeks in the world the realization of her own aims. Reason abandons her efforts to mold the world and is content to let the aims of individuals work out their results independently, intervening only to lay down precepts by the rules of formal logic.

So far we have seen consciousness on one hand and the real world on the other. The stage of *Geist* reveals the consciousness no longer as critical and antagonistic but as the indwelling spirit of a community, as no longer isolated from its surroundings but the union of the single and real consciousness with the vital feeling that animates the community. This is the lowest stage of concrete consciousness—life, and not knowledge; the spirit inspires, but does not reflect. It is the age of unconscious morality, when the individual's life is lost in the society of which he is an organic member. But increasing culture presents new ideals, and the mind, absorbing the ethical spirit of its environment, gradually emancipates itself from conventions and superstitions. This emancipation prepares the way for the rule of conscience, for the moral view of the world as subject of a moral law. From the moral world the next step is religion: the moral law gives place to God. But the idea of Godhead, too, as it first appears, is imperfect, and has to pass through the forms of nature worship and of art before it reaches a full utterance in Christianity. Religion in this shape is the nearest step to the stage of absolute knowledge; and this absolute knowledge—"the spirit knowing itself as spirit"—is not something which leaves these other forms behind but the full comprehension of them as the organic constituents of its empire; "they are the memory and the sepulchre of its history and at the same time the actuality, truth and certainty of its throne." Here, according to Hegel, is the field of philosophy.

The Hegelian System and Dialectic.—The compendium of Hegel's system, the *Encyclopaedia of the Philosophical Sciences,* is in three parts: "Logic," "Nature" and "Mind" (or "Spirit"). The relation between these is dialectical and the method of exposition within each of them is dialectical again. The notion of dialectic Hegel took both from the Greek philosophers and from Kant; it means, originally, "discussion." In a discussion between two people who are both seeking the truth of the topic which is being discussed, diametrically opposed points of view may be advanced in the first instance. Each party, however, may gradually come to understand the other's position, and ultimately both of them may come to agree to reject their own partial views and to accept a new and broader view which does justice to the substance of what each of them had begun by maintaining; the original opposition has been reconciled in a higher synthesis.

Hegel believed that thinking always proceeded according to this pattern: it begins by laying down a positive thesis which is at once negatived by its antithesis; then further thought produces the synthesis. But this in turn generates an antithesis and the same process continues once more, but not indefinitely, for it is circular. Ultimately thinking reaches a synthesis which is identical with its starting point, except that all that was implicit there has now been made explicit.

What is it that drives thinking on in this way? Hegel answers: the power of the negative. Any process of development has two inseparable aspects: (1) the positive aspect of growth, the emergence of something new; and (2) the negative aspect of rejection, the discarding of the old. We become men by putting away child-

ish things, but not by that alone; there must be growth as well. Hegel's point is that thinking itself, as a process, has negativity as one of its constituent moments. In a discussion, the positive thesis advanced by one party is negatived by the other party, so that negation comes from the outside. But thinking, as the discourse of the soul with itself, is dialectical because it carries the negation within itself. Or, to give Hegel's doctrine its theological background, the infinite and the finite are not set over against one another, for if the finite were outside the infinite, the infinite itself would not be all-embracing and would only be another finite; on the contrary, the finite is part and parcel of the infinite itself—its implicit negative moment, to which explicit reality must be given, as God's self-manifestation, in order that spirit's knowledge of itself as a unity of opposites may be complete.

The presence of this element of negativity within thinking itself is, in Hegel's view, the clue to development of all kinds. Suppose a man to be capable of intellectual advance; there is then a clash between his achievement and his potentialities; but the potentialities are actually his and there thus arises for him, as self-conscious mind, a tension between them and his achievement; if they are to be realized the achievement must be rejected, and yet the achievement and a series of achievements are necessary to the realization of the potentialities. The power of mind is infinite, but mind in thinking must think something definite and so something finite; but the finite thing thought is in contradiction to the infinity of thinking and must therefore be rejected in favour of some thought less inadequate to that infinity. This is the sort of dialectical process of which Hegel's system provides an account in three phases.

"Logic".—The system begins with an account of God's thinking "before the creation of nature and finite spirit"; *i.e.,* with the categories or pure forms of thought, which are the structure of all physical and intellectual life. *The Phenomenology of Mind* has already described the process by which the philosopher has come to occupy the vantage ground from which such an account can be given. Throughout we are dealing with pure essentialities, with spirit thinking its own essence; and these are linked together in a dialectical process which advances from abstract to concrete.

If we try to think the notion of pure being (the most abstract category of all), we find that it is simply emptiness; *i.e.,* nothing. Yet nothing *is*. The notion of pure being and the notion of nothing are opposites; and yet each, as we try to think it, passes over into the other. But the way out of the contradiction is at once to reject both notions separately and to affirm them both together; *i.e.,* to assert the notion of becoming, since what becomes both is and is not at once. The dialectical process advances through categories of increasing complexity and culminates with the absolute idea, or with the spirit as objective to itself.

"Nature".—Nature is the opposite of spirit. The categories studied in "Logic" are all internally related to one another; they grow out of one another. Nature, on the other hand, is a sphere of external relations. Parts of space and moments of time exclude one another; and everything in nature is in space and time and thus finite. But nature is created by spirit and bears the mark of its creator. Categories appear in it as its essential structure, and it is the task of the philosophy of nature to detect that structure and its dialectic; but nature, as the realm of externality, cannot be rational through and through, though the rationality prefigured in it becomes gradually explicit when man appears. In man nature rises to self-consciousness. It is clear that the theory of the evolution of species fits in admirably with Hegel's conception of nature, but he rejected it because it had no justification in the science of his day.

"Mind".—Here Hegel follows the development of the human mind through the subconscious, consciousness and the rational will; then through human institutions and human history as the embodiment or objectification of that will; and finally to art, religion and philosophy, in which finally man knows himself as spirit, as one with God and possessed of absolute truth. It is thus then open to him to think his own essence; *i.e.,* the thoughts expounded in "Logic." We have returned to the starting point of the system but en route have made explicit all that was therein implicit and discovered that "nothing but spirit is, and spirit is pure activity."

Hegel had an eye for detail; his system is not developed *a priori* or *in vacuo* but depends throughout on the results of scientific, historical, theological and philosophical inquiry. No reader of his lectures can fail to be impressed by the penetration and breadth of his mind or by the immense range of knowledge which in his view had to precede the work of philosophizing. "The owl of Minerva spreads her wings only with the falling of the dusk"; *i.e.,* a civilization must be mature and indeed in its death throes before, in the philosophic thinking which has implicitly been its substance, it becomes conscious of itself and its significance. When philosophy comes on the scene, some form of the world has grown old; and it rises into self-consciousness in the philosophy which it produces. The business of philosophy is to comprehend, not to construct.

Philosophy of Right.—Although Hegel's works on politics and history merely elaborate part of his system—that part in which human mind objectifies itself in its endeavour to find an object identical with itself—and are unintelligible in isolation, they deserve separate treatment because they have become so famous, if not notorious. The *Philosophy of Right* (or *of Law*) falls into three main divisions. In the first, Hegel is concerned with law and rights as such: persons, not individuals, are the subject of rights, and what is required of them by law is mere obedience, no matter what the motives of obedience may be. The law or a right is thus an abstract universal and therefore, though it is an embodiment of the human will, does justice only to the universal element in that will; all persons are equal before the law. My will, however, though universal as will and rational, is also mine, and this element of individuality demands recognition. The individual cannot be satisfied unless the act which he does accords, not merely with law or custom, but with his own conscientious convictions. Hegel points out that the claims of conscience are what distinguishes the modern world from, for instance, Plato's *Republic*. This distinction has its origin in Christianity. Thus the problem in the modern world is to construct a social and political order which satisfies the claims both of the universal law and of the individual conscience. This is a hard task, because conscience is intimately linked with freedom, the freedom of the rational will as vindicated by Kant. No political order in the modern world can satisfy the demands of reason unless it is organized so as to avoid on the one hand a centralization which would make men slaves or ignore the individual conscience and on the other hand an antinomianism which would allow freedom of conviction to any individual, no matter what the conviction was, and so produce a licentiousness that would make social and political order impossible.

Hegel proceeds to describe a state in which this synthesis of universal and individual claims is achieved. It rests on the family and on the guild, two institutions in which, in personal and in communal life, the individual is taught to find in co-operation with others the full satisfaction of his individual needs. Thus schooled, the individual can recognize the state not as something alien and oppressive but as something which, in so far as he participates in it, does satisfy him as an individual while at the same time it maintains peace and order.

The state so described is unlike any existing state in Hegel's day. It is a form of limited monarchy, with parliamentary government, trial by jury and toleration for Jews and dissenters. In all these respects it differed from the contemporary Prussia. It has often been said by Hegel's detractors that his book was written on the "dunghill of servility" and that his ideal state is identical with the monarchy of Frederick William. Little historical knowledge and little study of Hegel is required to see that this is nonsense.

Philosophy of History.—Hegel presupposes that the whole of human history is a process through which mankind has been making spiritual and moral progress; it is what human mind has done in the course of its advance to self-knowledge. In other words, history has a plot, and the philosopher's task is to discern it. Many eminent historians have been unable to discern any plot and

have contented themselves with recording what has happened; others have found the key to history in the operation of natural laws of various kinds. Hegel's attitude rests on the faith that history is the carrying out of God's purpose and that by the beginning of the 19th century man had advanced far enough to descry what that purpose is. The purpose in question is the gradual realization of human freedom.

The first step was to make the transition from a natural life of savagery to a state of order and law. States had to be founded, and the heroes who founded them had to use force and violence. There is no other way to make men law-abiding before they have advanced far enough mentally to apprehend and to accept the rationality of an ordered life. This process cannot succeed all at once: there will be a stage at which some men have accepted the law and become free, while others must perforce be slaves. In the modern world we have come to appreciate that all men, as minds, are free in essence, and our task is to frame institutions under which they will be free in fact.

Hegel is careful to leave room for developments in the future. He did not believe, despite some critics, that history had ended in his lifetime. In particular, he maintained against Kant that to eliminate war was impossible. Each nation state was an individual, sovereign in its own sphere; and, so long as this remained true, disputes between sovereigns could be settled by violence alone. As Hobbes had said of relations between individuals in the state of nature, pacts without the sword were but words. Students of the history of Europe since Hegel's day may be the last to think him wrong. His reverence for fact prevented him from accepting Kant's idealism.

The Fate of Hegelianism.—Hegel's system is avowedly an attempt to unify opposites—spirit and nature, universal and particular, ideal and real—and to be a synthesis in which all the partial and contradictory philosophies of his predecessors are alike contained and transcended. It is thus both idealism and realism at once, and hence it is not surprising that his successors, emphasizing now one and now another strain in his thought, have interpreted him variously. Conservatives and revolutionaries, believers and atheists have professed alike to draw inspiration from him. In one form or another his teaching dominated German universities for some years after his death and spread to France and to Italy; but its very success produced, as he would himself have foretold, a reaction. Its influence, indeed, was almost dead when in the later part of the 19th century it blossomed anew in England and Scotland in the work of such writers as Benjamin Jowett, T. H. Green, John and Edward Caird, J. M. E. McTaggart and Bernard Bosanquet (*see* NEO-HEGELIANISM). This success led to a reaction in its turn; but when Hegelianism was dying in Great Britain, interest in Hegel suddenly revived in Germany under the influence of Georg Lasson, a clergyman, and of Wilhelm Dilthey (*q.v.*). These two studied Hegel's manuscripts in the University of Berlin; and on the basis of this study Lasson began a new critical edition of Hegel's works while Dilthey wrote *Die Jugendgeschichte Hegels* (Berlin, 1905) on the development of Hegel's thought prior to the date of his first publications. The manuscripts on which Dilthey's work is based were then published as *Hegels theologische Jugendschriften,* ed. by H. Nohl (Tübingen, 1907).

Hitherto Hegel's philosophy had won either enthusiastic disciples or bitter opponents; in the 75 years since his death, however, passions had had time to cool, and, thanks to Dilthey and to Lasson and also to Benedetto Croce (*Ciò che è vivo e ciò che è morto della filosofia di Hegel,* Bari, 1907), the critical study of Hegel began. The early theological writings gave rise to an immense body of literature in Germany, in Italy and in France between 1925 and 1950, and an English translation of the more important of them appeared in Chicago in 1948. Interest in these writings and in the *Phenomenology* was increased by the rise of existentialism during the same period. At the same time the growing importance of Communism encouraged political thinkers to study Hegel's political works, as well as his "Logic," because of their influence on Karl Marx. *See* also references under "Hegel, Georg Wilhelm Friedrich" in the Index volume.

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HEGEMONY, leadership, predominance and preponderance —originally the leadership of one particular state in a group of federated or loosely united states. The term was first applied in Greek history to describe the predominance, at different times, of individual Greek city-states; *e.g.,* Athens, Sparta and Thebes, over other city-states. Philip of Macedon claimed for Macedonia the "hegemony" of Greece. In the 19th century, hegemony, as leadership within a confederation, was similarly applied to the position of Prussia vis-à-vis the other German states. The term has come to assume a more general meaning as the predominance of a nation or group of nations within a given area. Thus, Great Britain is said to have enjoyed a position of over-all hegemony from the end of the Napoleonic Wars (1815) to the advent of World War I. With 20th-century advances in communications, making the remotest areas of the globe accessible to conquest, the "drive for hegemony" denotes the attempt by any nation to dominate. Hitler, for example, with the support of Italy and Japan, made a bid for global hegemony. (R. S.-HE.)

HEGESIAS OF MAGNESIA in Lydia (*c.* 250 B.C.), Greek orator and historian, was a prominent figure in the history of the long controversy on prose style which was inherited by the Romans and had important consequences in Latin as well as in Greek literature. He was among the first to give currency to the so-called Asianic style characterized by avoidance of the period and preference for short rhythmical phrases coupled with extravagant metaphors, unusual word order and artificial conceits. The style

has resemblances to that of Gorgias of Leontini and its features recur in later writers. In consequence of the victory of the atticizing theorists and writers, ancient references to his style are uniformly hostile. His works survive in fragments only.

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HEGESIPPUS, SAINT (fl. *c.* 150–180), early Christian writer, wrote in Greek five books of *Hypomnemata* ("memoirs"), extant only in a few fragments, intended to prove that so long as the apostles and the kinsfolk of Jesus remained alive the church was uncorrupted by heresy, but that after their demise the baneful influence of the Jewish sects introduced false doctrine and division. He traveled (it is not known from where) via Corinth to Rome, taking special interest in the preservation of orthodoxy by the due succession of bishops from the time of the apostles. His interest in the kinsfolk of Jesus and in the mother church of Jerusalem led him to include an embroidered account of the martyrdom of St. James, the "brother" of Jesus, and of the persecution endured by the holy family's descendants under Domitian, *c.* 95. His importance consists less in any historical information he may convey about the 1st-century church than in his own theological position and his arguments to vindicate the church against heretics. His feast is celebrated April 7.

See edition of fragments by T. Zahn, *Forschungen zur Geschichte des neutestamentlichen Kanons*, vol. vi (1900); *see* also W. Telfer, "Was Hegesippus a Jew?," *Harvard Theological Review*, vol. liii, pp. 143–153 (1960). (HY. C.)

HEGESIPPUS, the supposed author of a free Latin adaptation of the *Jewish War* of Josephus under the title *De bello Judaico et excidio urbis Hierosolymitanae*. The seven books of Josephus are compressed into five, but much has been added from the *Antiquities* and from the works of Roman historians, while several entirely new speeches have been introduced to suit the occasion. Internal evidence shows that the work could not have been written before the 4th century A.D. The author, who is undoubtedly a Christian, describes it in his preface as a kind of revised edition of Josephus. Some authorities attribute it to Ambrose, bishop of Milan (340–397), but there is nothing to settle the authorship definitely. The name Hegesippus itself appears to be a corruption of Josephus, through the stages Ἰώσηπος, Iosippus, Egesippus, Hegesippus, unless it was purposely adopted as reminiscent of Hegesippus, the father of ecclesiastical history (2nd century).

See edition by C. F. Weber and J. Caesar (1864); E. Schürer, *History of the Jewish People* (Eng. trans.), i. 99 *seq.*

HEGIRA (HEJIRA; Arabic HIJRA, "emigration," not "flight"), the starting point of the Muslim era. Its years are distinguished by the initials A.H. (Lat. *anno hegirae*).

In the year A.D. 622 Mohammed (*q.v.*), intent on escaping the persecution of his kinsmen of the Quraish (Quraysh or Kuraish) tribe, emigrated from Mecca to Medina (then called Yathrib). Mohammed himself dated his correspondence, treaties and proclamations after other events of his life, such as the battles of Badr, Uhud and the conquest of Mecca or *hijjat al wada'* (his last pilgrimage). The Hegira era was introduced by Omar, the second caliph. As Muharram was the first lunar month of the year that had been in use in the pre-Islamic Hejaz, Omar started the first year of the Hegira with the first day of that month, which corresponded to July 16, 622. This introduction took place in the year 639 = A.H. 17. It is very likely that Omar was influenced in the introduction of a new era by the Arabs of the south (the people of Yemen).

In a more general sense the term *hegira* is also applied to other "emigrations" of the faithful: that to Abyssinia and that of Mohammed's followers to Medina before the capture of Mecca (Omar himself was among the first to arrive there); these latter are known as Muhajirun. Muslims who quitted lands under Christian rule were also emigrants (*muhajirun*). In the year A.H. 1088 (A.D. 1677–78) the Ottoman government, keeping the Hegira era, began to use the solar year (following the Julian calendar), which came to be known as the *marti* year (Mart means March). Eventually, two different Hegira dates came to exist, one the older Mohammedan era, the other the Ottoman Hegira year. The difference comes from the fact that the Muslim (lunar) year is about 11 days shorter than the Christian (solar) year. *See* also CALENDAR; *Muslim Calendar*.

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HEGIUS, ALEXANDER (*c.* 1433–1498), German humanist schoolmaster, was born at Heek (from which his name, in Latin form, is derived) in Westphalia. He was associated with the Brethren of the Common Life (*q.v.*) in the revival of learning in northern Europe. His long teaching career included the headship of schools in Wessel, Emmerich and Deventer, where Erasmus, Butzbach and the future pope Adrian VI were among his pupils. At Deventer, Hegius put into practice the humanistic ideas of his youthful friend and teacher, Rodolphus Agricola, who brought from Italy the new learning, stressing the liberal arts and the art of conduct. To this end Hegius reformed instructional methods to make Latin and Greek grammar subordinate to the appreciation of classical literature. New textbooks were introduced and the school was divided into eight classes. Hegius died at Deventer on Dec. 7, 1498. His writings were published in 1503 by his pupil Jacob Faber.

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HEHE, a Bantu-speaking agricultural people, occupying the Iringa district of southern Tanganyika and numbering about 195,000. They are a cluster of small tribes of similar language and culture which were amalgamated into a single polity by Muyugumba, head of the Muyinga family, in the mid-19th century. After long and severe fighting they were subdued by German forces in 1898, after Muyugumba's son Mkwawa had committed suicide to avoid capture. The paramountcy was restored in 1926, the heads of the formerly independent tribes being mostly subchiefs under the paramount.

The Hehe are divided into dispersed patrilineal exogamous clans, each of which has a clan name, a praise name and its own avoidance tabu. Their religion is centred upon the cult of ancestors, but Christianity and Islam have made many converts. A feature of Hehe life is the tembe, a long, wooden-walled building roofed with clay and partitioned into separate chambers for families. A village may consist of a single tembe or of a number of large ones arranged into a single settlement.

The district contains about 250,000 ac. of European farms, most of this land having been alienated under German rule. The farms grow much tea, and the Hehe themselves grow maize (corn) and work as farm labourers for Europeans to obtain a cash income. *See* also TANGANYIKA: *The People*.

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HEIBERG, JOHAN LUDVIG (1791–1860), Danish dramatist and man of letters, originator of the Danish vaudeville, or ballad opera, was born in Copenhagen, Dec. 14, 1791, son of the playwright and political writer P. A. Heiberg (1758–1841) and his wife Thomasine, later Baroness Gyllembourg-Ehrensvärd (1773–1856), the novelist. He matriculated at Copenhagen university in 1809, and his first publication, *Marionettheater* (1813; dated 1814), comprising two romantic dramas, showed independence of outlook, elegance and clarity of thought. In 1817 he took his doctorate with a thesis on Calderón, to whose work he was attracted, though not himself a mystic, by its blend of sublime and "folk" elements. In 1819 he went to Paris with a government grant, and in 1822 was appointed lecturer in Danish at Kiel university. There he wrote the treatise *Om den menneskelige Frihed* ("On Human Freedom," 1824) that introduced Hegelian philosophy to Denmark.

He returned to Copenhagen in 1825 and his *Kong Salomon og Jørgen Hattemager* was produced there, with great acclamation, on Nov. 28. It was the first Danish vaudeville, with songs set to well-known melodies, and although derived from Parisian and Viennese models, the subject and the humour were national and topical. Heiberg exploited the new genre with verve and versatility in *Aprilsnarrene* (1826), *De Uadskillelige* (1827) and many others, and defended it on sound Hegelian principles in the treatise *Om Vaudevillen som dramatisk Digtart* ("On the Vaudeville as a Dramatic Form," 1826). More serious and poetical in intention and execution were the romantic dramas *Elverhøi* (performed 1828), *Alferne* (1834), *Fata Morgana* (1838) and *Syvsoverdag* (1840), which blend fantasy and realism and contain much of Heiberg's best lyrical poetry.

From 1827 to 1830 Heiberg edited the *Kjøbenhavns flyvende Post,* which, with its successors, exerted considerable influence by introducing new authors and criticizing Öhlenschläger and other romantics for deficiencies in taste, form and intellectual content. His polemics and his gift for pointed satire, of which the apocalyptic poem "En Sjæl efter Døden" (included in *Nye Digte,* 1841) and the satyr play *Nøddeknækkerne* (1845) are supreme examples, made Heiberg many enemies and he never fully recovered his popularity. From 1849 to 1856 he had some success as the director of the Royal theatre, but the last 20 years of his life were mainly spent in studying physical science. He died at Bonderup near Ringsted, Aug. 25, 1860. His prose works appeared in 11 volumes (1861–62), and his poetical writings in 11 volumes (1862).

In 1831 Heiberg married Johanne Luise Pätges (1812–1890), the foremost Danish actress of her day and herself author of some good vaudevilles and of interesting memoirs (*Et Liv,* 4 vol., 1891–92).

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HEIDEGGER, JOHANN HEINRICH (1633–1698), Swiss Reformed theologian, was born at Bärentschweil, in the canton of Zürich, Switz., on July 1, 1633. After studying in Germany he settled in 1665 in Zürich, where he was successively professor of moral philosophy and of theology. He died there on Jan. 18, 1698.

Heidegger was the principal author of the *Formula Consensus Helvetica* in 1675, which was designed to unite the Swiss Reformed churches, but had an opposite effect.

Heidegger's autobiography appeared in 1698, under the title *Historia vitae J. H. Heideggeri.*

HEIDEGGER, MARTIN (1889–), German philosopher who exercised a major influence on 20th-century existentialism, was born at Messkirch in the Black Forest on Sept. 26, 1889. He studied philosophy at Freiburg, coming under the influence of Edmund Husserl, the founder of phenomenology. He was appointed professor of philosophy at Marburg in 1923. In 1927 he published *Sein und Zeit,* part i, the work on which his reputation chiefly rests. Having succeeded Husserl as professor at Freiburg in 1928, he was made rector of that university in 1933; in his rectorial address he expressed his hope for "a complete revolution of German existence." In 1934 he resigned this post and resumed his teaching.

While the second part of *Sein und Zeit* was not forthcoming, Heidegger published numerous essays and lectures, of which the following are particularly noteworthy: *Was ist Metaphysik?* (1929); *Vom Wesen des Grundes* (1929); *Hölderlin und das Wesen der Dichtung* (1937, previously printed in *Das Innere Reich,* 1936); *Vom Wesen der Wahrheit* (1943); *Brief über den Humanismus* (1947); *Holzwege* (1949); *Einführung in die Metaphysik* (1953); and *Vorträge und Aufsätze* (1954).

In *Sein und Zeit* Heidegger sets out to discover "the meaning of being" (*Sein*). He holds that a necessary preliminary is an investigation of human being (*Dasein*), carried out, not in terms of sophisticated theoretical conceptions such as "substance" or "cause," but in terms of the tools with which men are practically concerned and of men's basic situation, aims and moods. When considered in this way human existence is seen to be grounded in care and dread and to consist in projects brought to nothingness in death. Although Heidegger acknowledges the influence of Sören Kierkegaard, he denies that he himself is an existentialist, but nevertheless *Sein und Zeit* was important in the development of the atheistic form of existentialism. Heidegger continued to employ the method, prominent in *Sein und Zeit,* of basing metaphysical assertions on the literal meanings of the roots of German words and amplified it with parallel discussions based on the etymology of Greek philosophical terms. He holds that the basic metaphysical question is "Why is there something rather than nothing at all?", emphasizes fate and destiny and asserts that although Christian faith exists "here and there," in the 20th-century world "God is no longer a living God" ("Nietzsche's Wort 'Gott ist tot'" in *Holzwege,* pp. 234–235). Nevertheless he also says that in poetry the holy beings or the gods are "named" and communicated to the people.

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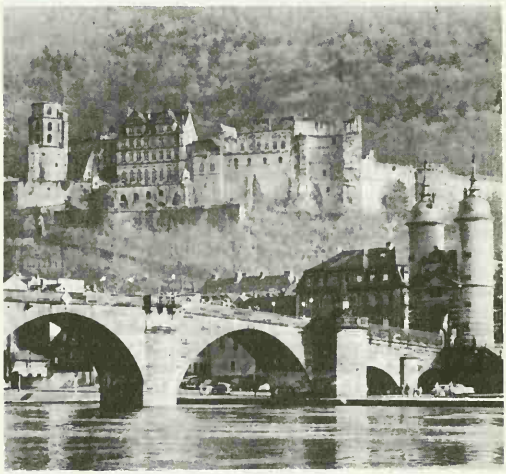
HEIDELBERG, a town of Germany which after partition of the nation following World War II was incorporated in the *Land* (state) of Baden-Württemberg, Federal Republic of Germany. It lies mainly on the south bank of the Neckar river, at the point where it emerges from the forested hills of the Odenwald into the Rhine plain. Pop. (1961) 125,264; in addition there were large numbers attached to the U.S. military headquarters in Europe, which was established in Heidelberg in 1947.

There has been settlement in the area from earliest times and the town is first mentioned in 1196. The narrow Neckar valley determined the development of Heidelberg. From the beginning there was one main street parallel with the river; and this remains, though the Hauptstrasse is now paralleled by the Friedrich-Ebert Anlage, which runs into a broad two-way road (Kurfürsten Allee) bordered by gardens leading to the new station (1955). The town, which has grown enormously during the 20th century, expanded into the Rhine plain so that the layout of the old town remains basically unchanged. Heidelberg's charm lies less in individual buildings than in its setting, with wooded hills (white



BY COURTESY OF THE GERMAN TOURIST INFORMATION OFFICE

THE TOWN OF HEIDELBERG FROM THE NECKAR RIVER. IN THE FOREGROUND IS THE KARL-THEODORE BRIDGE (ERECTED IN 1786) WITH ITS TWO-TOWERED GATE; IN THE BACKGROUND IS THE CASTLE (CONSTRUCTION BEGUN IN THE 13TH CENTURY)

with cherry in spring; red, gold and black in autumn) sloping down to the river and, 330 ft. up, the misty, rose-red ruin of the castle. The river is spanned by three bridges. The oldest of them, the Alte Brücke with its gatehouse, dates from 1786–88 and is the fifth to be built there. It was destroyed by the German army in 1945 and was rebuilt after World War II. The only private house in the town to survive the razing by Louis XIV's troops in 1693 (*see* PALATINATE) is the Renaissance Haus zum Ritter (1592), now a hotel. Much building is 18th-century; *e.g.*, the Rathaus, Karlstor and the Kurpfälzisches museum. Of the churches, the Heiliggeistkirche and the Peterskirche are originally 15th century. The Jesuitenkirche is a fine, austere baroque hall church begun in 1712.

The castle is, however, the chief focus of interest historically. The earliest building there was 12th-century; the first of which much is known dates from Rupert III (d. 1410). Otto-Heinrich (Ottheinrich; d. 1559) built the beautiful early Renaissance wing; the fine late Renaissance wing (the Friedrichsbau) was added (1601–07) under Frederick IV. On the west side the Elisabethenbau or Englischen Bau (1618) was built by Frederick V, the "winter king of Bohemia," and named after his wife, daughter of James I of England, the "eclipse and glory of her kind," according to Sir Henry Wotton. For her too was built the Elisabethentor, a gateway which, the story goes, Frederick had built overnight for his wife's birthday. The fountain in the central courtyard is decorated with four granite columns from Charlemagne's palace at Ingelheim. In a cellar is the vat built in 1751 with a capacity of 49,000 gal. After being despoiled by the French in the 17th century, the castle was struck by lightning and reduced to ruin in 1764. The Friedrichskau was elaborately restored and rendered habitable between 1897 and 1903.

Heidelberg university was founded by Rupert I (1386) and is the oldest university in Germany. Its two main buildings are the old university (1712) and the new university (1930–32). In the old university is the Karzer, formerly a student prison, and in the new the Hexenturm, originally part of the medieval town fortifications.

Heidelberg is connected by *Autobahn* with Mannheim (13 mi. N.W.) and is a road and railway junction. Since World War II the number of small- and medium-sized factories has greatly increased. Goods produced include suitcases (by the largest German firm of its kind), metalware, protective clothing for X-ray and atomic work, electrical appliances and floor and wall coverings. The town's main business, however, is the tourist trade. The castle is visited by over 2,500,000 people every year. (M. KL.)

HEIDELBERG CATECHISM, the most widely used confession of faith among the Reformed Churches, was drafted as part of an attempt by the elector Frederick III the Pious of the Palatinate to complete the religious reformation of the domains he had inherited in 1557 and yet to conciliate as many as possible of the contending Protestant parties. The extreme Lutheran party was ranged against both the milder Melanchthonian-Lutheran and Reformed parties. Frederick gave the lead to the Reformed but sought to make of it a conciliatory party. Under his guidance, a group of scholars led by Caspar Olevianus, the superintendent of the Palatinate church, the theological faculty of the University of Heidelberg—Pierre Boquin, Emmanuel Tremellius and Zacharias Ursinus—together with the court physician Thomas Erastus, the court preacher Michael Diller and others, drew up a four-point program: certain practical reforms, the Heidelberg Catechism (1563), the Palatinate Church Order (1563) and the Palatinate Consistory Order (1564).

The Heidelberg Catechism seems to have been drawn up initially by Olevianus and Ursinus on the basis of earlier catechisms or catechetical works written by themselves. Borrowings from a catechism (1552) by Martin Micronius (himself dependent on Johannes a Lasco), another by the preachers of Embden (1554) and from works by Calvin, Bullinger and others are evident. The elector, a careful student, was an active participant.

The irenic character of the Heidelberg Catechism was due to the elector's hope that it might form the basis of a conciliation among the contending Protestant parties. Only on the matter of the sacraments was it a Reformed document. However, even in this the authors sought to bring their Reformed statements as near to the moderate Melanchthonian-Lutheran position as they could. This was accomplished by using general rather than precise language on these topics. The doctrine of predestination, much controverted, was very mildly stated. Positively, the strength and the appeal of the catechism lay in its orientation. The whole thrust of the work was practical and devotional rather than intellectual, dogmatic or polemical.

The Heidelberg Catechism failed to conciliate the warring groups in Germany, but it was accepted and used far beyond the borders of the Palatinate. It has been translated into more than 25 languages and dialects, and is still regarded as the most appealing and perceptive Reformed statement of the Christian faith.

See also CATECHISM: *Reformed;* CONFESSIONS OF FAITH, PROTESTANT: *Reformed Churches.*

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HEIDELBERG JAW, the name given to a prehistoric hominid mandible found in 1907 in the great sand pit at Mauer, near the Elsenz river, 6 mi. S.E. of Heidelberg. The fossil fauna indicated a warm climate, with elephant, rhinoceros, horse, bison, lion and many other species typical of Middle Pleistocene interglacial deposits. The mandible is probably between 300,000 and 400,000 years old.

Description.—The mandible, almost perfectly preserved, has 15 teeth (one was lost in 1945); the crowns of four are broken away. The jaw is large and massive. The horizontal rami are heavy and thick (23 mm.) in cross-section. There is no chin, but the bone recedes below the anterior alveolar region. The ascending rami are nearly as broad (60 mm.) as they are high (66 mm.), the mandibular notch is shallow, the coronoid process blunt and rounded. Though the jaw looks apelike, the teeth are clearly human. The dental arch is parabolic, without diastema; the incisors, canines and premolars not far removed from those of modern man. Only the molars are markedly larger, but still small for the large jaw, though their pulp cavities and curtailed roots are reminiscent of the later Neanderthal man.

Comparison.—Remarkable for being simian in form and human in dentition, the fossil is difficult to place; it is virtually a lone representative of a type of man distinct from both Neanderthal and Peking man. (Such individual fossils may be misleading, since heavy thick bones survive better than lightweight bones but need not be typical of their kind.) They are the nearest known fossil hominid species, though mandibles recently discovered at Montmaurin (S.W. France) and Ternifine (Algeria) have features in common with the Heidelberg fossil. Heidelberg man was probably a forebear of Neanderthal man; anatomy and chronology support this view. The fossil, kept at Heidelberg university, was named *Homo heidelbergensis* by O. Schoetensack. *See* also PLEISTOCENE EPOCH: *Life of the Pleistocene Epoch;* MAN, EVOLUTION OF: *Pithecanthropus.*

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HEIDENHEIM, a town of Germany which after partition of the nation following World War II was located in the *Land* (state) of Baden-Württemberg, Federal Republic of Germany, lies on the Brenz river, 50 km. (31 mi.) N.E. of Ulm. Pop. (1961) 48,790. The town, which received municipal privileges in 1356 and is the centre of an administrative district, is overlooked by the ruined castle (with museum) of Hellenstein, standing on a hill 1,985 ft. high. Its industrial products include turbines, paper-making and electrical machinery, cotton goods, woolen blankets, rubber goods and cigars. Heidenheim is also the name of a village 11 km. (7 mi.) S. of Gunzenhausen, Bavaria, famous for the Benedictine abbey which formerly stood there. Founded in 748 by the bishop of Eichstätt, the abbey was plundered by the peasantry in 1525 and closed in 1537; the church was restored.

HEIDENSTAM, (KARL GUSTAF) VERNER VON (1859–1940), Swedish poet and prose writer, who won the Nobel prize for literature in 1916 and whose reputation rests on his lyrical poetry, was born, July 6, 1859, at the manor house of Olshammar, in the province of Närke, which inspired much of his poetry. A delicate boy, in 1876 he was sent to the middle east and after his first marriage (of three), in 1880, lived in Italy, France and for several years in Switzerland, where he had an important meeting with Strindberg. On return to Sweden, he published *Vallfart och Vandringsår* (1888), richly coloured poems based mainly on impressions of the east; early study of painting gave all his literary work a strong sense of colour. Original and imaginative, it formed a protest against naturalism and marked the beginning of the literary renaissance of the 1890s. Similar in effect were *Endymion* (1889), a novel set in Damascus, and *Hans Alienus* (1892), a fanciful epic describing a pilgrimage in search of beauty through various ages and countries, partly suggested by *Childe Harold*. Travel sketches, full of wit and psychological observation, were collected in *Från Col di Tenda till Blocksberg* (1888).

Heidenstam's second collection of poems (1895), expressing personal feelings with great richness of texture, marks a transition to love of home and nationalism, which culminated in the famous *Karolinerna*, 2 vol. (1897–98; Eng. trans. *The Charles Men*, 1920), impressionistic stories of Charles XII and his followers. His historical writings were continued with *Heliga Birgittas pilgrimsfärd* (1901); *Folkungaträdet*, 2 vol. (1905–07) a powerful story of ancient and medieval Sweden; and a book for schools, *Svenskarna och deras hövdingar*, 2 vol. (1908–10; Eng. trans. *The Swedes and their Chieftains*, 1925). His third and greatest collection of poetry, *Nya Dikter* (1915), contains lyrics comparable with those of Goethe. For the rest of his life he did not publish anything; after his death, at Övralid, May 20, 1940, some of his literary remains were edited, the most notable being *När kastanjerna blommade* (1941), charming evocations of the Olshammar of his childhood. His collected works were edited by F. Böök and K. Bang, 23 vol. (1943–44).

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HEIJERMANS, HERMAN (1864–1924), the greatest Dutch dramatist of his day, a realistic writer and a political radical. Of Jewish origin, he was born in Rotterdam, Dec. 3, 1864. He failed in business, became a journalist in Amsterdam and wrote a few naturalistic novels, expressive of his social sympathies, *e.g.*, *Diamantstad* ("Diamondtown," 1904), which was set among the Amsterdam diamond cutters. He also depicted the joys and sorrows of poor Amsterdam Jews in countless sketches, often humorous, signed by "Samuel Falkland." He became an important playwright and brought to the theatre a sharply naturalistic view of society.

Heijermans first came to realize the theatre's potential while working in Berlin and founded his own company when he returned to the Netherlands. His plays were performed in many countries: though for the most part no longer topical, they are still worthwhile because Heijermans was a true playwright. No other Dutch dramatist has known how to achieve such dramatic climaxes. Plays often staged include *Ghetto* (1898; Eng. trans. 1899); *Het Zevende Gebod* ("The Seventh Commandment," 1899); *Op Hoop van Zegen* (1900; Eng. trans. *The Good Hope*, 1912, 1926); *Allerzielen* ("All Souls," 1904), *De Opgaande Zon* (1908; Eng. trans. *The Rising Sun*, 1926); and *De Wijze Kater* ("The Wise Tom-Cat," 1918). Like many of his contemporaries, Heijermans joined the socialists, and he often wrote very tendentiously. He died in Zandvoort, Nov. 22, 1924.

See Seymour L. Flaxman, *Herman Heijermans and His Dramas* (1954). (Gd. W. Hs.)

HEILBRONN, a town of Germany which after the partition of the nation following World War II was in the *Land* (state) of Baden-Württemberg in the Federal Republic of Germany, lies on the Neckar, 50 km. (31 mi.) N. of Stuttgart by road, surrounded by vineyards and roads. Pop. (1961) 89,100. It occupies the site of an old Roman settlement; it is first mentioned in 741, and the Carolingian princes had a palace there. Its name—originally Heiligbronn, or holy spring—refers to a spring of water which issued from under the high altar of the church of St. Kilian.

The older streets are narrow and contain a number of high turreted houses with quaint gables. The principal public buildings are the church of St. Kilian (restored 1886–95) in the Gothic and Renaissance styles, begun about 1019 and completed in 1529, with a tower 210 ft. high, a beautiful choir and a finely carved altar; the town hall (*Rathaus*), founded in 1540 and possessing a curious clock made in 1580; the house of the Teutonic knights (Deutsches Haus); the Roman Catholic church of St. Joseph, formerly the church of the Teutonic Order; and the tower (Diebsturm or Götzenturm) on the Neckar. The town is highly commercialized, being a transloading point on the Rhine-Neckar shipping route. Principal manufactures include gold, silver, steel and ironware; lead, chemicals, paper and leather. There is an important foodstuffs factory.

HEILUNGKIANG (Hei-lung-chiang sheng), northernmost of the three Manchurian provinces of China. It is named for the Amur river, which is known as Hei-lung-chiang (Black Dragon river) in Chinese, and forms the northern border of the province. Heilungkiang has an area of 178,996 sq.mi. and a population of (1957 est.) 14,860,000. Its capital is Harbin.

The black chernozem soils of Heilungkiang favour the growing of wheat, which is planted to a large extent in large mechanized state farms established by new settlers in the northern virgin lands of the province. Other important crops are sugar beets, soybeans and flax. Timber is felled in the Little Khingan mountains around the lumber town of Ichun. The principal mineral resources are coal, which is mined at Hokang, Shwangyashan and Kisi, and gold, which occurs in placers along tributaries of the Amur river.

Most of the province's large cities are situated along the Chinese Eastern railroad, which crosses Heilungkiang from northwest to southeast, and along the Sungari river, a navigable tributary of the Amur. Harbin, with a population of (1957 est.) 1,552,000, is the principal manufacturing and transportation centre, with machine building and agricultural processing industries. Other cities and their 1953 population are Tsitsihar (344,700), Mu-tan-chiang (Mutankiang; 151,400) and Chia-mu-ssu (Kiamusze; 146,000). (T. Sd.)

HEIM, ALBERT (1849–1937), Swiss geologist, whose *Mechanismus der Gebirgsbildung* is a classic study of the dynamics of mountain building, was born at Zürich on April 12, 1849. He was educated at Zürich and Berlin universities, and was a pupil of Arnold Escher von der Linth, one of the founders of Swiss geology, whom he succeeded in the chair at the Zürich polytechnic (1873). He became director of the Swiss Geological commission, serving in this capacity for 30 years. With E. Schmidt he prepared the geological map of Switzerland (2nd ed. 1912). Heim's researches on the structure of the Alps threw light on the structure of mountain masses in general. He traced the Alpine folds from minor to major stages, and illustrated the remarkable foldings and overthrust faultings with the aid of drawings. He died at Zürich on Aug. 31, 1937.

Besides *Mechanismus der Gebirgsbildung* (1878), Heim's major contributions include *Hanbuch der Gletscherkunde* (1885) and *Geologie der Schweiz* (1916–22). (C. E. T.)

HEIMDALL (Heimdallr), in Norse mythology, the watchman of the gods. Called the shining god, he dwells at the entry to their world. He needs less sleep than a bird, can see a hundred leagues and can hear grass growing on meadows and wool on sheep. An obscure myth says that he was born of nine mothers. Heimdall keeps the "ringing" horn, Gjallarhorn, which may be heard throughout heaven, earth and the lower world; he will sound it to summon the gods when their enemies the giants draw near at the Ragnarök, the end of the world of gods and men. *See* also Germanic Mythology and Heroic Legends. (G. T.-P.)

HEINE, HEINRICH (originally Harry) (1797–1856), one of the greatest German lyric poets and an outstanding satirist and publicist, was born at Düsseldorf on Dec. 13, 1797, the eldest of the four children of Jewish parents, Samson Heine and Betty

(Peierche) van Geldern. He took the name Heinrich at his baptism in 1825. Owing to the French occupation of the grand duchy of Berg (1806–13), his education inspired in him an ardent love of liberty and hero worship for Napoleon (*Die Grenadiere, Das Buch Le Grand* and *passim*). Destined for a commercial career, he made a bad start at Frankfurt am Main and was sent to his millionaire uncle, the banker Salomon Heine, at Hamburg (1816–19), for his father's health had declined and his business had failed. Heine was set up on his own, but the firm Harry Heine & Co. went bankrupt within a year and thereafter relations between the millionaire and the poet were often strained. The latter's sufferings at Ottensen, his uncle's country seat, are described in the poem "Affrontenburg," written 30 years later; they were intensified by his unrequited passion for "Molly," presumably his cousin Amalie Heine. Being unfit for commerce, Harry was sent to Bonn to read law; but he preferred to study literature under A. W. Schlegel, moving on to Göttingen in 1820. Rusticated for six months because he had challenged a fellow student to a duel, he went to Berlin where he sat at the feet of Hegel and the classical scholar Friedrich Wolf. He frequented the *salon* of Karl August and Rahel Varnhagen von Ense and other literary and intellectual circles, and belonged to the Society for the Culture and Learning of the Jews. In 1821 he published a volume of *Gedichte* and in 1823 *Tragödien nebst einem lyrischen Intermezzo*. The tragedies, *Almansor* and *Ratcliff*, showed no great promise; but the lyrical sequence contained a number of those songs made famous by the settings of Schubert, Schumann, Mendelssohn, Liszt, Brahms, Wagner, Hugo Wolf and others. Yet already in this collection the pure melodies of the love lyrics were mingled with ironical, flippant and even cynical strains in a deliberate effort at emotional truth.

In 1823 the civil disabilities against the Jews were again enforced; rather than accept baptism Heine decided to become a journalist in Paris. He went to Hamburg to obtain his uncle's consent, and found passion overwhelming him again, "grafting a new folly on to the old," as he put it. This has been plausibly interpreted by E. Elster to mean that he had fallen in love for the second time with a daughter of Salomon Heine, Amalie's younger sister Therese. He fled from Hamburg to Cuxhaven, where his first sight of the sea and his first experience of a storm aroused that feeling of kinship to which we owe his magnificent *Nordsee* cycles. An incensed letter from his uncle, threatening to cut off his meagre allowance because it had been anticipated, added to his emotional turmoil. The Paris scheme was dropped and Heine returned to Göttingen in January to prepare for his final examination. His excursion to the Harz mountains that autumn was to bring him fame, but his visit to Goethe in Weimar on Oct. 2 resulted in a snub and he was in very low spirits when, having passed the written examination, he was baptized privately on June 28, 1825, in order to proceed to the public disputation on July 20, at which he obtained the degree of doctor of laws. He felt this "apostasy" keenly, although he was neither a practising nor a professing Jew, and it never procured him any practical advantage; but the striking success of *Reisebilder I* (*Heimkehr, Harzreise, Nordsee I*) in 1826, followed by *Reisebilder II* (*Nordsee II, Nordsee III, Ideen oder das Buch Le Grand, Briefe aus Berlin*) in 1827 and *Buch der Lieder* in the same year opened up literary prospects.

Buch der Lieder, which ran through 13 large editions in Heine's lifetime, placed him in the first rank of contemporary poets. As a ballad poet he is unrivaled; and the best of his love lyrics crystallize in a few short, exquisite verses his poignant personal emotions, combining the charm and simplicity of the folk song with informal, modern speech. Musical and magical, they are, as Benedetto Croce was to say, "pure and transparent as a dew-drop." The *Nordsee* cycles in free rhythms echo the stormy splendour, the ceaseless ebb and flow, the gentle murmuring and the breathless calm of the sea which harbours Heinesque Homeric divinities. A new note too was struck in the prose sketches in the *Reisebilder*, written in a flexible, vivid and racy style. They are intensely subjective and multiple in mood, witty, captivating, exasperating, challenging, daring and provocative. Heine, who needed a courageous publisher for such works, had found one in Julius Campe; but this best-selling author was never remunerated adequately; so that, between his uncle and his publisher, the poet was perpetually on the rocks.

Things were rather easier in 1827, however, and Heine, attracted by the fame of George Canning, was in London from April to August. "Never send a poet to England," he moaned, aghast at English materialism. He saw all the sights and assiduously frequented the house of commons, admiring English liberal institutions and continuing to revere Canning. But what with England's treatment of Napoleon and Byron, its stiffness and coldness, its cooking and its climate, he returned to Germany a full-blown Anglophobe. Worse still, he returned in very bad odour with Salomon, having cashed a letter of credit on the London house of Rothschild which had been entrusted to him merely to serve as an introduction. Fortunately Baron J. F. Cotta, the well-known liberal publisher, offered him the joint editorship of *Neue politische Annalen*, and Heine went to Munich in the autumn of 1827 to take up this work. He found it uncongenial, and the news of Therese's marriage increased his depression. It was somewhat lightened when the minister for the interior, Eduard von Schenk, proposed him for the chair of German literature in Munich university. He left for a holiday in Italy in July, fully expecting to hear in Florence that Louis I of Bavaria had approved the appointment. But it did not go through owing to the machinations of the Catholic party in Munich and also, or so Heine believed, to the poet August von Platen, who brought out a vicious lampoon in 1829, *Der romantische Oedipus*, reviling Heine as a "baptised Jew." Heine retaliated in "Die Bäder von Lucca" (*Reisebilder III*, 1829), holding Platen up to ridicule as a pitiable poetaster and a sexual pervert. By this witty but scurrilous retort he incurred widespread odium; and his next book, *Nachträge zu den Reisebildern* (1831), was banned in Prussia as pernicious, blasphemous and obscene, stock epithets at the time for anything liberal and unorthodox. *Persona non grata* in Germany, Heine now turned his eyes once more toward France. He had been profoundly stirred by the July revolution in 1830 and believed that Saint-Simonism, which was daily gaining converts in the French capital, was the religion of the future. He took farewell of Germany in his preface to Robert Wesselhöft's *Kahldorf über den Adel* (1831), in which he voiced his rage against the suppression of the Polish insurrection and against the reactionary governments of Germany, Austria and Russia, and saluted revolutionary France. Having shot this bolt, he left his native land and arrived in Paris in May 1831 for what was to be a lifelong exile.

A curious state of affairs awaited him: the implacable enmity of the German refugees, with Ludwig Börne at their head. The latter, like Heine a baptized Jew, and a witty, singleminded and powerful publicist, was an out-and-out revolutionary, rigid and puritanical. He regarded his more moderate young compatriot as a traitor to the cause, took the darkest view of his private life and pursued him with unrelenting malice, whereas Heine was welcomed with open arms by the French literary and intellectual circles and was on intimate terms with many of the romantic poets. The historian Thiers, then the all-powerful president of the council, apparently tried to persuade him to accept French nationality and place his gifts at the service of France. This would have assured his future; but he declined the offer, although in 1835 he accepted a *pension de secours* of 4,800 francs annually from the secret funds. This did not influence his political opinions, and he criticized the July monarchy sharply sometimes in his articles for Cotta's *Augsburger Allgemeine Zeitung* (1831–32 and 1840–43). These were collected and published under the titles *Französische Zustände* (1832) and *Lutezia* (1854), appearing almost simultaneously in German and French. His account of contemporary German literature (*Zur Geschichte der neueren schönen Literatur in Deutschland*, 1833; expanded into *Die romantische Schule*, 1835) also appeared in French in *L'Europe littéraire* in 1833; and his history of German religion and philosophy, published in *Salon II* (1835) was given in French in *La Revue des deux mondes* in 1834.

The two books about Germany are impregnated with Saint-Simonian ideals and expound the gospel of the new religion which aimed at establishing a perfect harmony between the spirit and the

flesh. Heine preached it with a poetical fervour and an infectious enthusiasm which won him disciples in Germany and helped to precipitate the catastrophe which overtook him and his Young German followers in Dec. 1835, when both federal and Prussian edicts placed the works of the whole school under a perpetual ban. In 1836 this took the somewhat milder form of a special Prussian censorship; but for many years Heine and his fellow victims, Ludolf Wienbarg, Heinrich Laube, Karl Gutzkow and Theodor Mundt, were effectively muzzled by it.

This disaster coincided with Heine's devastating passion for Crescentia Eugénie Mirat, a young assistant in a little glove-and-shoe shop, whom he called Mathilde, and took to live with him. He married her in 1841 on the eve of a duel with Solomon Strauss, the result of a slanderous passage inserted at the eleventh hour into his self-justificatory book on Börne, who had died in 1837. Bitter polemics of one sort or another darkened the years 1836–41, during which Heine was mentally and physically at a low ebb. Mathilde had anything but a soothing influence, and the censorship inhibited free production, although two beguiling prose works, "Florentinische Nächte" and "Elementargeister" (*Salon III*, 1837), managed to slip through. His health, and especially his eyes, gave cause for alarm; he was in dire financial straits and once more estranged from his uncle. Happily a reconciliation was effected in 1838, and an allowance of 4,800 francs annually granted him for life. This, with his government pension, eased the situation, and a visit to Cauterets in the Pyrenees brought about a poetical resurgence which produced in 1843 the enchanting, half-romantic, half-satirical epic poem, *Atta Troll*, published in book form in 1847.

Heine was a devoted son and brother; and in 1843, risking arrest, he traveled to Hamburg after a 12 years' absence to see his mother and his sister Charlotte, returning for another visit in 1844. The renewed contact with his native land inspired *Deutschland, ein Wintermärchen* (1844), a scintillating, hard-hitting, topical and yet visionary satire, applauded by the liberal-minded and banned throughout Germany.

In Dec. 1844 Salomon Heine died. His will contained no mention of the pension he had promised his nephew; and the ensuing conflict with his son and heir, Carl Heine, aggravated the spinal disease which was already incapacitating the poet and which for the last eight years of his life (1848–56) confined him, half-blind and paralytic, to his "mattress-grave."

His mental and physical anguish resulted in an extraordinary flow of poetical inspiration, producing *Romanzero* (1851), *Gedichte 1853 und 1854* (1854) and some remarkable posthumous poems. The prose works of the period also witness to unimpaired intellectual and imaginative powers: *Doktor Faust, ein Tanzpoem* (1851), the *Nachwort* to his *Romanzero* (1851), "Geständnisse" and "Götter im Exil" (both in *Vermischte Schriften*, 1854). But his fiercest energies were bent on the revision and completion of his *Memoiren* which had occupied him at intervals most of his life. Only a mutilated but charming fragment has survived, and it is generally believed that the Salomon Heines destroyed what had been for many years a *casus belli* between the poet and his rich relations. The last months of Heine's life were lightened by Camille Selden (Elise Krinitz) whom he called "La Mouche." They were passionately attached to each other, and she inspired some wonderful poems, the last and one of the loveliest he ever wrote being based on a dream. She called it *La Fleur de la Passion;* Alfred Meissner, who first published it, called it *Für die Mouche.*

Heine's life was torn by conflicts, and his personal satire often overstepped the bounds of decency; but he fought tyranny both in verse and in prose with such kindling wrath and such annihilating laughter as to justify his proud claim to have been a good soldier in the war of liberation. A passionate sense of justice and a deep prophetic instinct inform his political works; and in his mature prose his brilliant wit and poetical imagination counteract the innate tendency toward self-pity and self-display also apparent in his poetry. Religiously disorientated, he depicted in many striking mythological poems, prose monographs and sudden flights of fancy the conflict between paganism and Christianity in his own breast; these passages greatly influenced the English Neo-Hellenists, in particular Swinburne and Pater, while his more satanic moods were echoed in Baudelaire's *Les Fleurs du Mal.* His unfinished novel, *Der Rabbi von Bacherach,* as well as "Jehudah ben Halevy," in *Romanzero,* and several other poems, not to mention his short-lived mattress-grave "conversion," show him groping vainly after a shattered faith.

Heine's later poems are greater than those in *Buch der Lieder,* although they are more diffuse on the whole and suffer from lack of inner harmony to an even greater extent. The themes are often macabre; the satire is more searing, the tone is more tragic, the laments are more piercing, the compassion is profounder, the hatred more demonic, the love deeper and more intense. As for the humour, it is, said Havelock Ellis, "a modern development of the humour of the mad king and the fool in *Lear*—that humour which is the last concentrated word of the human organism under the lash of fate."

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HEINEMANN, WILLIAM (1863–1920), British publisher who introduced an international outlook into British publishing, was born in Surbiton, Surrey, on May 18, 1863. In 1890 he set up in London without any previous experience and immediately made available for the first time direct English translations of Dostoevski, Turgenev and, in part, Tolstoi. Thus were the Russian masterpieces first adequately presented to the English reading public.

Heinemann also introduced to the English theatre the plays of Ibsen, translated by William Archer, and launched such series as the Ars Una and the surviving Loeb Classical Library. His literary activities did not only concern translations; at one time or another he published works by R. L. Stevenson, Henry James, H. G. Wells, Joseph Conrad, George Moore and many others and he "discovered" John Galsworthy, Sir Max Beerbohm and Somerset Maugham. Heinemann died in London on Oct. 5, 1920.

HEINRICH JULIUS: *see* BRUNSWICK, HEINRICH JULIUS, duke of.

HEINRICH VON MORUNGEN (d. 1222) was one of the few notable courtly poets from east central Germany. A native of Thuringia, he spent much of his later life in the service of Duke Dietrich of Meissen. He died in the monastery of St. Thomas, near Leipzig, in 1222. His poems, of which some 33 are to be found in the Heidelberg manuscript, are all devoted to the fashionable cult of love. While his outlook was influenced both by the classical schooling, consistent with his upbringing near the court of Hermann of Thuringia, and by courtly manners from Provence, his poems show more originality and spontaneity than those of his

contemporaries, through his vivid imagination and the intensity of his emotion. As a result his poems appeal to the modern reader more than those of any other *Minnesänger* with the exception of Walther von der Vogelweide.

See C. von Kraus (ed.), *Des Minnesangs Frühling*, 31st ed. (1954). (W. W. Cs.)

HEINRICH VON VELDEKE (*fl.* 1185) Middle High German poet, whose *Eneide* was the first German court epic to attain an artistic form worthy of the elevated subject matter, was born near Maastricht, Holland, of a noble family, and served at the court of Cleves. He attended Frederick I's famous *Hof-fest* at Mainz in 1184 and subsequently joined the court of the landgrave of Thuringia, in whose service he completed his greatest work *Eneide*, modeled on the French *Roman d'Énéas*. *Eneide* was written not in Veldeke's native Flemish but in the Franconian literary language of such works as Eilhart von Oberge's *Tristan*. Both Gottfried von Strassburg and Wolfram von Eschenbach testify to the value of the *Eneide* as an example. The language of the poem is simple and direct, if somewhat cramped and conventional, and the verse flows smoothly.

Veldeke also wrote a religious epic, *Servatius*, and a number of lyric poems. In these, as in his epics, he appears as the ideal transmitter to Germany of the new literary fashions of Romance courtly civilization.

See G. Ehrismann, *Geschichte der deutschen Literatur bis zum Ausgang des Mittelalters* II, 2, 1, pp. 79–95 (1954); and many articles by T. Frings and G. Schieb in *Beiträge zur Geschichte der deutschen Sprache und Literatur* (1945 ff.). (Rd. J. T.)

HEINSE, JOHANN JAKOB WILHELM (1746–1803), German novelist and art critic who had a considerable influence on the romantic school. He was born near Ilmenau, Thuringia, Feb. 15, 1746. As a law student at Erfurt he met C. M. Wieland and through him J. W. L. Gleim (called "Father" Gleim because of his patronage of young poets), who in 1772 procured him the post of tutor in a family at Quedlinburg. In 1774 he went to Düsseldorf, where he helped J. G. Jacobi in editing the periodical *Iris*. He traveled in Italy between 1780 and 1783, and after returning to Germany became librarian to the archbishop of Mainz at Aschaffenburg. He died there on June 22, 1803.

Heinse's *Über einige Gemälde der Düsseldorfer Galerie* (1776–77) stressed the dependence of artistic production upon historical and national circumstances and appreciated Rubens. His famous novel *Ardinghello oder die Glückseeligen Inseln*, 2 vol. (1787) glorified eroticism in a kind of Utopia; *Hildegard von Hohenthal* (2 vol.; 1795–96) contained stimulating musical criticism. He also translated Tasso (1781). His *Sämtliche Schriften* were ed. by H. Laube, 10 vol. (1838) and by C. Schüddekopf, 10 vol. (1902–25), and a selection by R. Benz (1944).

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HEINSIUS, ANTONIUS (1641–1720), grand pensionary of Holland from 1689, the friend and supporter of William III of Orange, was born at Delft on Nov. 23, 1641, into the urban patriciate. He studied law in France at Orléans and practised as a lawyer in Delft until 1679. In that year he became pensionary of Delft and entered a political career which he did not desire but of which he could not free himself. He was first critical of the foreign policies of the stadholder William of Orange (the future king of England; *see* William III), but during the early 1680s he became convinced of the necessity to fight France and thenceforth actively supported the stadholder. At William's instance he was in 1689 appointed grand pensionary of Holland, a function which he held until his death. He was an excellent and intelligent collaborator of William III (*see* Grand Alliance, War of the), but after William's death in 1702, during the second stadholderless period, his modesty and his lack of independence paralyzed his initiative. Though the Dutch republic had carried so heavy a burden in the War of the Spanish Succession (*q.v.*), it was England that achieved the greatest successes, and Heinsius was severely criticized in the estates of Holland. After the disappointing peace of Utrecht (1713) he remained suspicious of the British foreign policy. His last years were darkened by difficulties over the Barrier treaty (1715) and over the British desire to bring about a better understanding with France. He approved of the triple alliance of 1717 between England, France and the Dutch republic, but failed to secure the republic's ratification of the abortive quadruple alliance of 1718, in which Austria as well as the members of the triple alliance were to be included. Heinsius' domestic policy was without vigour and he did nothing to improve the desperate situation of the public finances. He died at The Hague on Aug. 3, 1720.

See H. J. van der Heim (ed.), *Het archief van den raadpensionaris A. Heinsius*, 3 vol. (1867–80); B. van 't Hoff (ed.), *The Correspondence of John Churchill and Anthonie Heinsius* (1951). (E. H. K.)

HEINSIUS (Heins), **DANIEL** (1580–1655), Dutch poet, famous in his day as a classical scholar, was born at Ghent on June 9, 1580. The favourite pupil of Joseph Scaliger at Leiden, he produced classical editions, verses and orations from an early age. He annotated many Latin poets and Greek writers from Hesiod to Nonnus, and the popularity of his lectures dazzled his colleagues. By 1614, he was professor of history, librarian and secretary to the senate, while his advice determined the publishing policy of the Elzevirs. At the Synod of Dort he supported the condemnation of the Remonstrants, who included his close friend, Grotius, and earned the official good will of the victorious Calvinists. Attacked by Salmasius after three decades of success, he failed to parry the criticisms evoked by his New Testament commentary (1639). His arrogance, vanity and avarice increased as his faculties declined. He published little after 1640 and died at Leiden on Feb. 25, 1655. U. von Wilamowitz-Moellendorf allows him no more than an average competence as a scholar, and his literary productions, which include the Dutch tragedy *Herodes infanticida* (1632), reveal him as a skilful craftsman without originality or taste. But he deserves to be remembered for his edition of Aristotle's *Poetics* (1611), his *De tragoediae constitutione* (1611) which exercised a decisive influence on the French classical theatre, and for his Dutch poetry (1616) which was indebted to the French Pléiade.

See E. G. Kern, *The Influence of Heinsius and Vossius Upon French Dramatic Theory* (1949); D. Ter Horst, *Daniel Heinsius* (1948). (R. R. Bo.)

HEIR, in modern usage, tends to be synonymous with the term "next of kin," that is, he who succeeds to property of a person who dies without a will. In Scotland and other countries whose law derives from Roman law, heir has always had this meaning. Technically, in Anglo-American law, heir refers to the person who succeeds by descent to an estate of inheritance in land in contradistinction to the person to whom personal property is distributed by the executor to the next of kin. A few U.S. jurisdictions retain some vestiges of this distinction, which has been abolished in England and elsewhere in the United States. (*See* Inheritance; Intestate Succession.) An heir apparent is he whose right of inheritance is indefeasible provided he outlives the ancestor; *e.g.*, the eldest son in such matters as titles (*see* Peerage). An expectant heir or heir presumptive is he whose right of inheritance is defeasible by the birth of a nearer heir or by the owner executing a will or by his death before that of the owner; *e.g.*, the brother of an owner childless but capable of having children. (A. Dm.)

HEIRLOOM, in English law, strictly a chattel, or item of personal property, which by immemorial usage is regarded as annexed by inheritance to a family estate. The owner of such an heirloom may dispose of it during his lifetime, but he cannot bequeath it by will away from the estate. If he dies intestate it goes to his heir-at-law, and if he devises the estate it goes to the devisee. Such heirlooms are now almost unknown in both England and the United States, and the word has acquired a secondary and popular meaning and is applied to furniture, pictures, etc., vested in trustees to hold on trust for the person temporarily entitled to the possession of a settled house. Such things are more properly called settled chattels. An heirloom in the strict sense is made by family custom, not settlement. By the English Law

of Property act, 1925, settlements of realty and personal property were assimilated.

HEISENBERG, WERNER KARL (1901–), German physicist, who was awarded the 1932 Nobel prize for physics "for the creation of quantum mechanics," is best known as the formulator of the Uncertainty Principle (*q.v.*). He was born on Dec. 5, 1901, at Würzburg, where his father was a professor. He studied theoretical physics at the University of Munich under Arnold Sommerfeld and obtained his doctor's degree in 1923. In the same year he became assistant to Max Born at Göttingen and was appointed lecturer there in 1924. He then worked for three years with Niels Bohr (*q.v.*) at Copenhagen, and from 1927 to 1941 he was professor of theoretical physics at Leipzig. From 1942 to 1945 he was director of the Max Planck Institute for Physics at Berlin and from 1946 was director of the Max Planck Institute for Physics at Göttingen. Heisenberg's work on the quantum theory profoundly influenced the development of atomic and nuclear physics. He wrote *Die physikalischen Prinzipien der Quantentheorie* (1930) and many other books and papers on quantum mechanics, atomic physics and cosmic rays. (W. J. Bp.)

HEJAZ (Hedjaz; Al Hijaz), so-called from the great mountain barrier separating the Red sea coastal plain of Tihamah from the inland desert plateau, is a provincial area of Saudi Arabia, constituting the holy land of Islam (*q.v.*). In it are Mecca, the city of God, and Medina, the city of the Prophet. Formerly the northern border of Hejaz marched with the At Tafilah district of Transjordan, but in 1925 the Ma'an province was occupied by British forces on behalf of Transjordan and the present *de facto* (though unrecognized by Saudi Arabia) administrative frontier thus runs from a point 3 mi. S. of Aqaba to Mudawwarah and thence to the southernmost agreed point of Jordan's east frontier. Hejaz is bounded west by the Gulf of Aqaba and the Red sea and east by Najd and the southern districts of Al Khurmah, Ranyah and Bishah. The southern boundary with 'Asir (*q.v.*) is the line of Wadi 'Amq, separating 'Asir from Al Qunfudah district. (For physical features *see* Arabia: *Regional Geography.*)

History.—(For earlier history *see* Arabia: *History.*) The northern part of Hejaz (down to the latitude of Wajh) formed part of the Nabataean kingdom 100 B.C.–A.D. 200, with its centre at Mada'in Salih (Egra), famous for its tombs carved in the sandstone rocks, as at Petra (*q.v.*). In Midian (Madyan) also there was a similar Nabataean settlement. At Tabuk and Qurayyah (to its north) there are clear signs of Nabataean enterprise, mainly agricultural. At Rawafa and near the mouth of Wadi Hamd there are charming specimens of small Nabataeo-Roman temples (*c.* A.D. 160–170), dedicated (in a Greco-Nabataean inscription) to the emperors Marcus Aurelius Antoninus and Lucius Verus. There are no remains of greater antiquity on the surface in Midian but, besides the Nabataean ruins, the well of Moses (near Bada, or Al Bayda) and the spring near Al Maqnah (which he was said to have created by striking the rock) are shown to pilgrims. In the mid-6th century B.C. Tayma' was the summer capital of Nabonidus, king of Babylon, the remains of whose city cover a large area near the oasis irrigated from the famous spring of Al Haddaj, which could water 100 camels at a time. The castle of the Jew Samaual, celebrated in Arab poetry for his loyalty, is also there. The area from Khaybar through the now empty Wadi Al Qura' (valley of villages) to Medina is dotted with evidence of ancient Jewish enterprise. All these historic places still await the revelations of archaeological excavation (*see* also Arabia: *Archaeology*).

The nominal rule of the Hejaz remained in the hands of the Sharifan rulers of Mecca until the religious upheavals at the beginning of the 19th century, when the holy cities were raided by the Wahhabis, who were forced to submission (1818) by Ibrahim Pasha, the viceroy of Egypt. Hejaz came under direct Turkish control after 1845, and to improve communications and to strengthen Turkish control Sultan Abdul-Hamid II began (1900) the construction of the railway from Damascus to Medina. During World War I, Sharif Husain ibn Ali, a lineal descendant of the Prophet, revolted against the Turks in 1916 with the help of Great Britain, which wanted to protect its sea route to the east, vulnerable to attack so long as the Hejaz railway was in Turkish hands. Jidda (Juddah), after bombardment by British ships, was taken, then Mecca and later At Ta'if. A successful guerrilla campaign was carried out by T. E. Lawrence and Amir Faisal against the railway and the northern Turkish positions. Husain assumed the title of king in 1916, and in 1919 Hejaz was admitted as an original member of the League of Nations. Husain's reign ended in 1924 when he abdicated in face of Wahhabi invasion, and in 1925 his son and successor Ali also abdicated and left the country. Ibn Sa'ud, the sultan of Najd, assumed the title of king of Hejaz in Jan. 1926 and in 1932 Hejaz, Najd and other districts under his control united to form the kingdom of Saudi Arabia (*q.v.*) with its capital at Riyadh (*q.v.*; An Riyad), while Mecca remained as the spiritual capital of the Islamic world. A constitution for Hejaz issued in 1926 bound the king to govern by the laws of the *Shari'a*, and since the unification of the country and its administration as a unit the *Shari'a* has continued to be a basic element of the king's government.

Population and Economy.—The total population of the province including the nomad tribes is approximately 2,000,000 and its area about 134,600 sq.mi. The only modern port is Jidda, equipped with a steel deep-water pier to receive four ocean-going ships at a time and with other amenities for the efficient handling of goods and passengers. Most pilgrims to Mecca land at Jidda, while those going first to Medina can use the port of Yenbo (Yanbu'), which takes small vessels. Al Wajh, to the north, was formerly a port with a considerable export of sheep and charcoal, prohibited in the interests of Saudi economy. Other ports, suitable only for small vessels, are Al Maqnah (on the Gulf of Aqaba), Dhaba (Ziba'), Umm Lajj, Rabigh, Al Lith and Al Qunfudah. Apart from Mecca (pop. 200,000), Medina (60,000) and Jidda (200,000), the principal centres are At Ta'if (20,000), a summer resort (5,500 ft.), Khaybar, Tabuk and Tayma'. The vegetation is limited and agriculture is possible only in the few inland wadies; the chief crops are dates, millet, wheat, fruit and barley.

The economy of the country in ancient times (Solomon and the Abbasids) depended on the gold mines of Midian and the passage of the incense road from southern Arabia to the Mediterranean. Al 'Ala (ancient Daidan) and Mada'in Salih (Egra, Al Hijr) were important centres on this road which has long ceased to operate. The name Ophir would seem to be identical with that of Epher (Arabic 'Afar), the son of Midian (Gen. xxv, 4). The only workable trace of gold found in modern times is at the mine of Mahd adh Dhahab, between Mecca and Medina, where the exploitation of ancient tailings produced a net profit of $20,000,000 in 20 years (1934–54). There are no minerals in the whole area except iron ore, of good quality and of vast extent, in the mountains between Tabuk and Mahd adh Dhahab, but not yet exploited. The building of the Hejaz railway from Damascus to Medina (1900–08) seemed to promise a new era of prosperity for northern Hejaz but it was destroyed during World War I. The population of Medina (about 80,000 in 1915) dropped to 15,000 in 1925 but the general prosperity of Saudi Arabia since the exploitation of its oil from 1938 on has given the city a new hope. It is connected with Jidda and Mecca by a metaled road, and its population is approaching its former level. The construction of a metaled road was undertaken from Medina northward (parallel with the derelict railway) to Khaybar, Tayma' and Tabuk, with Ma'an in south Jordan its ultimate aim. In general, the future economic prospect of Hejaz is reasonably bright, largely because of the wealth and opportunities created by developments in eastern Arabia.

(H. St. J. B. P.; X.)

HEL, in Norse mythology, was originally the name of the world of the dead; it came to be personified as the goddess of death. Hel was one of the children of Loki, and her kingdom was said to lie downward and northward. It was called Niflheimr, or "the world of darkness," and appears to have been divided into several sections, one of which was Náströnd, the shore of corpses. There stood a castle facing north and filled with the venom of serpents, in which murderers, adulterers and perjurers suffered torment, while the dragon Níðhöggr sucked their bodies. Mention is made in an early poem of the nine worlds of Niflheimr. It was said that

those who fell in battle did not go to Hel, but to the god Odin, in Valhalla, the hall of the slain. The name Hel is probably related to the verb *hylja*, "to cover, to hide." (G. T.-P.)

HELDENBUCH, DAS, the title under which a large body of German epic poetry of the 13th century has come down. The main subjects of the individual poems were drawn from sagas based on the struggles and conquests of the Germanic tribes during the epoch of the migrations (*Völkerwanderung*), although many other themes, doubtless based on the traditional allegorical interpretations of natural forces and phenomena, became, in the course of time, associated with the historical events. The poems of the *Heldenbuch* belong to two cycles: the Ostrogothic saga of Ermanrich, Dietrich von Bern (*q.v.*) (*i.e.*, Theodoric the Great) and Etzel (*i.e.*, Attila); and the cycle of Hugdietrich, Wolfdietrich (*q.v.*) and Ortnit (*q.v.*), which was probably of Franconian origin. Dietrich von Bern, the central figure of the more important group, was the ideal type of German medieval hero. Of the romances of this group, the chief are *Biterolf und Dietlieb*, *Der Rosengarten* and *Laurin und der kleine Rosengarten*. Other episodes of the Dietrich saga are recounted in *Alpharts Tod*, *Dietrichs Flucht*, and *Die Rabenschlacht*. Of these, the first is the finest poem of the cycle. The other two, by an Austrian, Heinrich der Vogler, date from the end of the 13th century and show the decay that had by this time set in in Middle High German poetry. The second cycle of sagas is represented by several long "popular" romances, notably *Ortnit*, *Hugdietrich* and *Wolfdietrich*, but their literary value is not very high. *See* also GERMANIC MYTHOLOGY AND HEROIC LEGENDS.

BIBLIOGRAPHY.—This collection of romances was one of the first German books printed. The date of the first edition is unknown, but the second appeared in 1491. A reprint of 1590 forms the basis of the edition by A. von Keller for the Stuttgart *Literarische Vercin* in 1867. In 1472 the *Heldenbuch* was remodeled in rough *Knittelvers* and this version was printed by F. von der Hagen and S. Primisser in their *Heldenbuch* (1820–25). A critical edition was published in 5 vol. by O. Jänicke *et al.* (1866–73). A selection, ed. by E. Henriei, appeared in J. Kürschner's *Deutsche National-literatur*, vol. 7 (1887). All the poems have been translated into modern German by K. Simrock and others. The literature of the *Heldensage* is very extensive. *See* especially O. L. Jiriczek, *Deutsche Heldensage*, vol. i (1898); and H. Schneider, *Germanische Heldensage*, 2 vol. (1928). (W. W. Cs.)

HELDER, DEN, a seaport in North Holland province, Neth., stands opposite the island of Texel on the Mars Diep, leading to the Wadden Zee, 81 km. (50 mi.) N.N.W. of Amsterdam by road and rail. Pop. (1962 est.) 50,785. Helder, the terminus of the North Holland canal from Amsterdam, has a harbour with wet and dry docks. It is the main Dutch naval base with the Royal Naval institute, and there are also fishery, zoological and meteorological institutes, a museum and an open-air theatre. Industries include shipbuilding, fishing, the production of foam plastic and clothing, and catering for tourists. The 3-mi.-long sea dike, descending 200 ft. at 40°, stretches from Nieuwe Diep to Fort Kijkduin.

Off Kijkduin, in Aug. 1673, a Dutch fleet under Adm. M. A. de Ruyter fought against a combined English and French fleet. The unsuccessful Anglo-Russian attempt in 1799 to cause the downfall of the Batavian republic, set up by the French, is sometimes referred to as the Helder campaign. Helder's fortifications were begun by Napoleon Bonaparte in 1811, and the province can be flooded from this point.

HELEN (Greek Helene), in legend the most beautiful woman of Greece and indirect cause of the Trojan War. She was daughter of Zeus (either by Leda, the wife of Tyndareus, king of Sparta, or by Nemesis) and sister of the Dioscuri (*see* CASTOR AND POLLUX). She was sister also of Clytemnestra, who married Agamemnon, and wife of Menelaus (*q.v.*), Agamemnon's younger brother. As a child she was carried off from Sparta to Attica by Theseus but was fetched back by her brothers; when she grew up, she chose Menelaus from among her princely suitors. But during her husband's absence she fled to Troy with Paris (*q.v.*), son of the Trojan king Priam; and when Paris was slain she married his brother Deiphobus, whom, according to the *Aeneid*, she betrayed to Menelaus when Troy was captured. Menelaus and she were then reconciled and returned to Sparta, where they lived happily together until their deaths. A variant of the story says that Helen, in widowhood, was driven out by her stepsons and fled to Rhodes, whose queen, Polyxo, her erstwhile friend, hanged her on a tree in revenge for the loss of her husband Tlepolemus in the Trojan War. After death, Helen was said to have lived in wedlock with the shade of Achilles. The poet Stesichorus, who possibly was forced by those who revered Helen as a goddess to deny that she ever went to Troy, says, in his second version of her story (which is a recantation of the first), that she and Paris, on their way thither, were driven ashore on the coast of Egypt and that Helen was detained there by King Proteus. The Helen carried on to Troy was thus a phantom, and the real one was recovered by her husband from Egypt after the war. This version of the story is used by Euripides in the *Helen* (*see* EURIPIDES: *The Extant Plays: The Romantic Plays*).

Helen was worshiped and had a festival at Therapnae in Laconia; she also had a temple at Rhodes, where she was worshiped as Dendritis (the tree goddess). Like her brothers, the Dioscuri, she was a patron deity of sailors. Her name is pre-Hellenic and in cult may go back to pre-Greek periods. *See* also references under "Helen" in the Index volume.

See M. P. Nilsson, *Geschichte der griechischen Religion*, 2nd ed., vol. i (1955).

HELENA, SAINT (*c.* 248–*c.* 328), mother of the emperor Constantine I the Great, was the reputed discoverer of Christ's cross. She served in an inn at Drepanum in Bithynia before marrying Constantius I Chlorus, who in 293 divorced her so that he might on becoming Caesar marry Theodora, stepdaughter of the emperor Maximian. When Constantine became emperor at York in 306, he made his mother empress-dowager. She later became a Christian. Her devotion to her eldest grandson, Crispus, and grief at his execution in 326, perhaps impelled Constantine to execute Fausta, his empress, and the accuser of Crispus. This double tragedy in the imperial family was immediately followed by the aged empress' pilgrimage to the Holy Land. She caused churches to be erected on the sites of the Nativity and of the Ascension. Coins bearing her name or effigy cease from 330. She was buried in Constantinople.

Before 337 it was claimed in Jerusalem that, during the building of Constantine's church on Golgotha, Christ's cross had been found. Later in the century, Helena began to be credited with the discovery. There grew up a crop of legends, of which Ambrose's panegyric on Theodosius the Great in 395 is the earliest witness. The story of the "Invention of the Holy Cross," enhanced by subsidiary romances and confusions with other Helens, became a favourite throughout Christendom (*see* CROSS: *The Cross After Constantine*).

Eastern churches commemorate Constantine and Helena together, on May 21, as "equal to the Apostles." In the west, only St. Helena, popularized by the cross legend, is commemorated, on Aug. 18. Geoffrey of Monmouth (1147) spread the idea, already extant, that Helena was a British princess. The consequent popularity of her legend in the British Isles is attested by the many medieval church dedications there to St. Helen and to Holy Cross.

See H. Chadwick in *Journal of Theological Studies*, vol. xlix, pp. 32–34 (1948); H. Thurston and D. Attwater (eds.), *Butler's Lives of the Saints*, vol. iii, pp. 346–348 (1956). (W. TR.)

HELENA, a city in Arkansas, U.S., and seat of Phillips county, is on the Mississippi river about 55 mi. (airline) S.W. of Memphis, Tenn.

Hernando de Soto (in 1541) and other early explorers along the Mississippi visited the area, which became a part of the Louisiana Purchase. Settlers began to arrive in 1800 and built a warehouse for barge shipping. In 1811 the steamboat "New Orleans" called at Helena, opening a prosperous era of river traffic. The county was named after an early settler, Sylvanus Phillips (1766–1830), and Helena, which was named for his daughter, was incorporated as a town in 1833 and as a city in 1856. Streets and many homes were laid out in mid-19th century. Helena was the site of a Civil War battle July 4, 1863, and the county sent seven generals to the Confederate army. Long important as an agricultural and river shipping centre for cotton, cottonseed prod-

ucts and lumber, the area became increasingly industrialized after World War II, especially at West Helena (founded 1909, incorporated 1917). Manufactures include tires, sporting goods, luggage, ladies' clothing, wood products and fertilizer. For comparative population figures *see* table in ARKANSAS: *Population.* (K. W. P.)

HELENA, the capital city of Montana, U.S., the seat of Lewis and Clark county, is near the Missouri river and the centre of the western third or the mountainous portion of the state, about 50 mi. N.N.E. of Butte. It is picturesquely situated at the eastern foot of the continental divide, at an altitude of 3,955 ft., in Prickly Pear valley, a rich agricultural region surrounded by rolling hills and lofty mountains. Mt. Helena and Mt. Ascension form a background for the city.

The area was first visited by the expedition of Meriwether Lewis and William Clark (*qq.v.*) in 1805, and in 1862 a wagon train of immigrants wintered in Prickly Pear valley. Gold was discovered in Last Chance gulch, now the official name of former Main street, in July 1864. On Oct. 30, 1864, the town was founded, and named Helena at the instigation of John Somerville for his home town in Minnesota, and within two years had a population of 7,500. Gold to the value of $16,000,000 was taken from the gravels of Last Chance gulch, much of it before 1868. Rich gold and silver deposits were found within a 20-mi. radius, which stimulated Helena's growth. In the 1880s and early 1890s, Helena's prosperity was reflected by a display of ornate mansions, built by the *nouveaux riches,* onetime prospectors. By 1893 when the price of silver dropped, the boom passed. Business waned, and prosperity came in cycles with the building of the Canyon ferry, Hauser and Holter dams on the Missouri river (1900–10), with the renewal of mining activities following the demand for metals in World War I, and with the piping of natural gas from surrounding fields. The damage caused by the series of earthquakes in 1935, 1936 and 1937 was rapidly repaired.

The town continued to be a regional centre for trade, finance and transportation with about 65% of Montana's population and most of the state's mining, agricultural and livestock enterprises located within a radius of 125 mi. Industries include concrete, ceramics, paints, brick and tile, and machine parts. At nearby East Helena there are quartz crushers and smelters and a large zinc reduction works. Helena was made the capital of the territory in 1875, was chartered as a city in 1881, and became state capital in 1894.

The capitol building and the state office buildings lie in the southeast section of the city. The Pioneers and Veterans Memorial building houses the Historical Society of Montana with an excellent library and museum, and a Charles M. Russell art collection valued at $500,000. The Veterans Administration centre and hospital is located at Fort Harrison, 3 mi. from the city. The State Vocational School for Girls is located in Helena, as is the Montana Children's home for crippled children and the Florence Crittenden home. The Deaconess home and St. Joseph's orphanage, both for children, and old people's homes operated by the Masons and the Independent Order of Odd Fellows are nearby. There are state offices of the Montana Education association, the Montana Physicians service, the Montana Stockgrowers association and many other state organizations and institutions.

Carroll college (Roman Catholic) established in 1909, has about 800 students. The Archie Bray foundation provides a nationally known centre for artists interested in ceramics. Helena has a number of buildings which are distinctive for their architectural design, including the Roman Catholic St. Helena cathedral (Gothic, modeled after the Cologne cathedral in Germany), the Episcopal procathedral (English Tudor) and the civic centre, formerly the Algeria Shrine temple (of Moorish design).

For comparative population figures *see* table in MONTANA: *Population.* (M. G. BU.)

HELENIUM, a genus of the composite family (Compositae) comprising more than 30 species of North American hardy annual or perennial herbs, commonly known as sneezeweeds. Their stems are erect, usually branched above, with alternate leaves extending downward and flowers in yellow or brownish heads, either solitary or in flat clusters, opening from early summer to late autumn. All the species may be grown in gardens, but perhaps the most frequently used are the common sneezeweed (*H. autumnale*) and the orange sneezeweed (*H. hoopesii*).

The bitter sneezeweed (*H. tenuifolium*) is a troublesome weed in pastures in many sections of the southern states because when eaten by dairy cows it imparts a bitter flavour to the milk and butterfat. (J. M. BL.)

HELENSBURGH, a small burgh in Dunbartonshire, Scot., on the north shore of the Firth of Clyde, opposite Greenock, 22 mi. N.W. of Glasgow by road. Pop. (1961) 9,605. There is steamer communication from Craigendoran pier with Gourock, Dunoon, the Isle of Bute, Wemyss Bay and other Clyde resorts. After 1776 the town began to develop. In 1802 it was named after Helen, sister of the earl of Sutherland and wife of Sir James Colquhoun of Luss, the ground landlord, and was created a burgh of barony. John Logie Baird (*q.v.*), the inventor and television pioneer, was born at the manse in Helensburgh.

HELENUS, in Greek legend, son of King Priam of Troy and his wife Hecuba; brother of Hector and twin of the prophetess Cassandra. In Homer he appears as a seer and warrior. Later writers relate that he and his sister fell asleep in a temple of Apollo, where snakes cleansed their ears by licking them, so that they obtained the gift of prophecy and could understand the language of birds. Helenus, after the death of Paris in the Trojan War, paid suit to Helen; and, on his rejection by her in favour of Paris' brother, Deïphobus, withdrew in indignation to Mt. Ida, where he was captured by the Greeks. Other accounts make Odysseus capture him by a stratagem or make him surrender voluntarily in disgust at the treacherous murder of Achilles. He informed the Greeks of the three things necessary for the capture of Troy: they must gain possession of the Trojans' image of Pallas Athene (the Palladium); they must obtain the bow of Hercules; and they must have the help of Achilles' son Neoptolemus. Helenus also advised the building of the wooden horse. After the capture of Troy, he and his brother Hector's widow, Andromache, both taken captive by Neoptolemus, went with him to Epirus, where Helenus persuaded Neoptolemus to settle. After Neoptolemus' death, Helenus married Andromache and became ruler of the country. He was said to have been buried at Argos, where his tomb was shown.

HELGAUD (HELGALDUS) (d. *c.* 1048), biographer of the French king Robert II the Pious, was a monk of the Benedictine abbey at Fleury-sur-Loire. This fairly simple-minded friar, ignorant of all secular culture but well versed in Holy Scripture, was more skilled at writing than the majority of his brethren. His *Epitoma vitae Roberti regis,* a long panegyric, makes no precise allusion to the king's politics but furnishes precious information about his personality and private life. The text is printed by J. P. Migne in the *Patrologia Latina,* vol. cxli (1844).

See *Histoire littéraire de la France,* vol. vii (1867); A. Molinier, *Les Sources de l'histoire de France,* vol. ii (1902). (M. PAC.)

HELGOLAND: *see* HELIGOLAND.

HELIAND, a 9th-century alliterative epic poem in Old Saxon, relating the life and teaching of Christ; the name *Heliand* ("Saviour") was given to it in 1830 by J. A. Schmeller, its first editor. The poem totals almost 6,000 lines and has come down in one complete, one virtually complete and two fragmentary manuscripts. The *Heliand,* together with the *Genesis* fragments (*see* below), is all that remains of Old Saxon poetry. The only documentary evidence that bears on the composition of the poem consists of two Latin passages—a prose *Praefatio in librum Antiquum lingua Saxonica conscriptum,* and a *Versus de poëta et interprete huius codicis* in hexameters—included in a collection of documents published in 1562 by the Lutheran reformer Flacius Illyricus, who gave no indication of their origin. Scholars are generally satisfied, however, both that these documents are in all essentials authentic 9th-century records and that they relate to the *Heliand.* The *Praefatio* states that the work was undertaken by an eminent Saxon poet (unnamed) at the instance of Louis the Pious. Since the emperor is referred to in the present tense, the poem must at least have been started during his reign, *i.e.*, between the years 814 and

840. Its precise origin remains uncertain.

The substance of the poem is drawn, not directly from the Vulgate, but from the pseudo-Tatian harmony of the Gospels, with additional matter apparently derived from the Gospel commentaries of Rabanus Maurus, Alcuin and Bede. The particular interest of the work lies in the way in which the religious narrative is assimilated to the form of the Germanic heroic epic. Biblical scenes and characters are portrayed against a Germanic background, cardinal elements in the Germanic code of ethics, such as the bond of service between lord and vassal, are drawn into the motivation, while the poetic language and form are those of Germanic alliterative verse. On the other hand the ideals which sustain the work as a whole are entirely Christian, and the poet's evangelical purpose requires that particular emphasis be laid on the didactic parts of the poem, above all, on the words of the Saviour himself. The most powerful literary influence bearing upon the poet is that of the Anglo-Saxon religious epic, in which certain specific and characteristic techniques used in the *Heliand* are already found.

The fragmentary Old Saxon *Genesis* was once thought to be the work of the poet of the *Heliand*, but it displays different attitudes of mind and different techniques, and is generally of an inferior quality. The relationship between the Old Saxon *Genesis* and the Junian Anglo-Saxon *Genesis* is an interesting and very early example of literary intercourse between Germany and England, for it has been shown that what had long appeared to be a somewhat incongruous passage of some 600 lines in the latter work is in fact a translation from the Old Saxon poem.

The hybrid poetic literature represented by the *Heliand* and the *Genesis* was forced to yield before the pressure of a severe and formal Christianity which denied all concessions to the pagan Germanic forces of history. Yet, for reasons still not properly understood, the High German literature which accompanied this stricter line of thought made no headway in Low German territory, and except for a few insignificant remnants of prose, the *Heliand* and the *Genesis* remain the only literary documents in a Saxon dialect until the end of the 12th century.

BIBLIOGRAPHY.—The most convenient combined edition of *Heliand* and *Genesis* is that of O. Behaghel, 7th ed. (1958). For textual analysis E. Sievers' edition (1878) prints the texts of the complete Munich and Cotton manuscripts side by side. Bibliographies on specific problems are given in G. Ehrismann's *Geschichte der deutschen Literatur bis zum Ausgang des Mittelalters*, vol. i, pp. 150–171 (1918). (RD. J. T.)

HELICON (ELIKÓN), a mountain range in Boeotia, Greece, celebrated in classical literature as an abode of the muses, is situated between Lake Kopais or Copais (now drained) and the Gulf of Corinth.

The highest summit, the present Palaiovouni ("old hill"), rises to the height of 1,748 m. (5,735 ft.). On the fertile eastern slopes (Zagora) stood a temple and grove sacred to the muses and adorned with statues, which, taken by Constantine the Great to beautify his new city, were consumed there by a fire in A.D. 404. Nearby were the fountains Aganippe and Hippocrene, the latter, in legend, created by the tread of the winged horse Pegasus. At the neighbouring Ascra dwelt the poet Hesiod, a fact which probably enhanced the poetic fame of the region.

Pausanias described Helicon as the most fertile mountain in Greece; neither poisonous plant nor serpent was to be found on it, while many of its herbs possessed miraculous virtue. His description (ix. 28–31) makes it possible to reconstruct the classical topography and French excavators have discovered the temple of the muses and a theatre at Thespiae near the east foot of the Zagora. (J. Bo.)

HELICON, a form of both the bass and the contrabass tuba (*q.v.*) built in a spiral circular form and resting on the shoulder. Believed to have been invented in Russia, it was perfected in 1849 by Ignaz Stowasser in Vienna. It is chiefly used in military bands. In the U.S., where the bandmaster J. P. Sousa introduced a removable bell, it is called the sousaphone.

HELICOPTER, a heavier-than-air aircraft with one or more power-driven horizontal propellers or rotors that enable it to take off and land vertically, to move in any direction or to remain stationary in the air. It is often described as a rotary-wing aircraft in contrast to conventional fixed-wing airplanes. A helicopter does not require a runway but can land on, and take off from, small areas inaccessible to fixed-wing aircraft. It can land in a small clearing in the jungle, on the deck of a ship or on suitable flat roofs. Its ability to hover motionless over a given area enables it to deliver or take on personnel or cargo without actually landing. In the event of power failure during flight, the rotor, if disengaged from the engine, will continue to turn freely (autorotation) and provide lift as the helicopter descends, thereby permitting safe landing in an emergency.

Because of its versatility the helicopter is used extensively by the military services for transportation of troops into otherwise inaccessible areas; for rescue and medical evacuation; and for communication, surveillance and search at sea and on land. It proved its military value during the Korean War (1950–53) when it was used to evacuate thousands of wounded men from the front lines. Commercial uses include short-haul transportation between city centres and outlying airports, transportation into undeveloped areas, crop dusting, surveying and exploration.

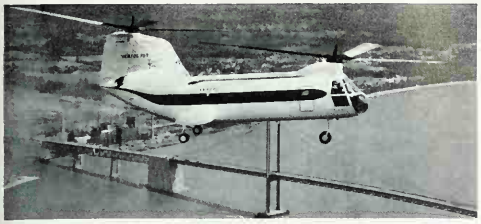
The helicopter gained widespread publicity as a result of its lifesaving activities in civil emergencies, particularly those resulting from floods and earthquakes. With the increasing congestion of ground transportation, there may be a promising future for the helicopter in the field of commuter travel.

HISTORICAL DEVELOPMENT

It is possible that the helicopter toy called the Chinese top originated in the orient. Such toys, with rotor arms, are known to have been in use in Europe by the mid-15th century, before Leonardo da Vinci designed (and probably made) his small helical-screw helicopter model. But all modern helicopter development derives from the twin-rotor model of Launoy and Bienvenu of 1784, through the variant of it made by Sir George Cayley (*c.* 1792) and widely published in 1809 and after. Cayley's contra-rotating rotors were powered by a bowstring. There were many helicopter models in the 19th century that were powered by steam or twisted rubber. There was even a successful model with rotors turned by steam jets at their tips (1842).

Despite the rapid development of the gasoline engine in the 1890s, it was not until 1907 that the first man-carrying helicopter, built by Paul Cornu, made a free vertical flight. But the machine was primitive and the flight brief. The Bréguet machine of the same year also made a brief vertical flight, but it was steadied from the ground. These pioneers never successfully solved the problem of control and were not sufficiently encouraged to continue their efforts. The simpler flight techniques demonstrated by the Wright brothers utilizing fixed wings discouraged further attempts at direct lift, although, in the interests of safety, many further attempts were made to develop aircraft whose lift would be independent of forward speed. Among these early developments was the Petroczy–von Kármán tethered coaxial helicopter intended for surveillance on the front lines by the Germans during World War I; it never progressed beyond the development stage, although flights as long as one hour were recorded. Emile and Henry Berliner in the United States developed first a coaxial and then a side-by-side version with large fixed wings for control which achieved limited flight success during 1923. George de Bothezat developed for the U.S. army signal corps a side-by-side helicopter with four large rotors; it flew in 1923 with three people on board for short distances at moderate heights. However, controlled vertical and forward flight was not officially acknowledged to have been achieved until 1930 when Corradino d'Ascanio (Italian) flew a coaxial helicopter, whose rotors were controlled by means of small tabs on the trailing edges of the blades. Despite the promise of the Dorand machine (French, 1936) the Focke-Achgelis (German) was the first practical helicopter. In 1939 Igor Sikorsky (United States) flew the VS-300, which had only one main rotor; in 1941 he broke all previous records by remaining in flight for 92 minutes and established the practical single-rotor helicopter.

Autogiro.—During this period another type of rotary wing aircraft, the Autogiro or gyroplane, was developed by Juan de la Cierva of Spain. His first successful flight was made in Spain



Vertol 107, turbine powered, the commercial version of the U.S. army YHC-1 helicopter

Alouette II, a French-designed helicopter built by Republic Aviation corporation in the U.S. Powered by a 400 h.p. gas turbine engine

Bell helicopter equipped with spraying apparatus for agricultural use

Kaman H-43 operating as a fire fighter at a crash scene

Hiller ducted-propeller flying platform

Bristol 192 (British) helicopter lifting a guided missile and its launcher

Westland Whirlwinds designed for use by Queen Elizabeth II

Vertol V-76, a tilt-wing aircraft shown converting from helicopter to airplane configuration

TYPES OF MODERN HELICOPTERS

BY COURTESY OF (TOP LEFT, BOTTOM RIGHT) VERTOL AIRCRAFT CORPORATION, (TOP RIGHT) REPUBLIC AVIATION CORPORATION, (SECOND ROW LEFT) BELL HELICOPTER CORPORATION, (SECOND ROW RIGHT) KAMAN AIRCRAFT CORPORATION, (THIRD ROW LEFT) HILLER AIRCRAFT CORPORATION, (THIRD ROW RIGHT) BRISTOL AIRCRAFT LTD., PHOTOGRAPH, (BOTTOM LEFT) CENTRAL PRESS PHOTOS LTD.

HELICOPTER

Sikorsky S-62, amphibious helicopter with flying-boat hull, landing on water

Doak 16, a tilt-duct aircraft shown hovering. Ducts tilt forward 90° for conventional airplane flight

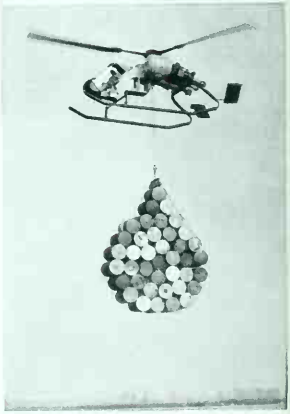
Kaman unmanned drone helicopter which may be operated either by means of a halter as shown, or remotely, by radio control

Vertol H-21 towing an LST at a forward speed of about 4 knots

Fairey Rotodyne convertiplane, a cross between a fixed-wing airplane and a helicopter, capable of operating at higher forward speeds than the true helicopter

Sikorsky S-58 being used to set electric poles in difficult locations

AROE-1 "Rotorcycle," a collapsible one-man helicopter manufactured by the Hiller Aircraft corporation



McDonnell 120 crane-utility helicopter

THE VERSATILE HELICOPTER IN A VARIETY OF OPERATIONS

BY COURTESY OF (TOP LEFT) SIKORSKY AIRCRAFT, (TOP RIGHT) DOAK AIRCRAFT CORPORATION, (SECOND ROW LEFT) THIRD ROW LEFT) KAMAN AIRCRAFT CORPORATION, (CENTRE RIGHT) VERTOL AIRCRAFT CORPORATION, (BOTTOM LEFT) [illegible], (BOTTOM RIGHT) HILLER HELICOPTER CORPORATION, (BOTTOM RIGHT) MCDONNELL AIRCRAFT CORPORATION

in 1923. Development of the Autogiro provided much of the technical background that made the evolution of the helicopter possible. "Autogiro" is a trade name for a type of aircraft that is readily distinguished from the helicopter. Unlike the helicopter rotor, the Autogiro rotor is not powered; the forward movement of the aircraft through the air causes the rotor to turn like a windmill and hence to produce rotor lift. A conventional propeller provides propulsion for forward motions of the machine. The Autogiro cannot hover or land vertically, as the helicopter can, although a technique was developed known as the jump take-off, in which the rotor was brought up to speed on the ground by mechanical means and the energy stored thereby in the rotor utilized to lift the aircraft off the ground to an altitude sufficiently high to permit a short dive and glide into forward speed. The greater utility of the helicopter has favoured its development over that of the Autogiro, although the principle is still used on certain compound aircraft concepts such as the American McDonnell XV-1 and the British Fairey Rotodyne in which the rotor is powered by jets at the blade tips for vertical take-off or landing and the aircraft is propelled in forward flight by a conventional propeller with the rotor unpowered and autorotating. The autorotating rotor in forward flight has a more favourable angle of attack distribution than the powered rotor and consequently can operate at higher forward speeds. Also, by providing fixed wings, some of the lift can be unloaded from the rotor onto the wings and the forward speed further increased over that of the conventional helicopter up to values of the order of 300 m.p.h.

MODERN HELICOPTERS

Hinged Blade.—Juan de la Cierva was responsible for many major contributions of value to later helicopter development, among them the concept of hinging the blade at the root, first put into practice by him. This concept simplified the control problem and made possible the development of lightweight, flexible and structurally reliable rotor systems in which the rotor blades are maintained in equilibrium by centrifugal force. Highly flexible blades adjust readily by bending to the load distribution and its cyclic changes associated with forward speed. This bending allows the vertical loads to be carried by components of the tension in the blade arising from centrifugal force; it minimizes the high stresses that would otherwise be associated with a more rigid blade and thus averts failures due to structural fatigue.

The hinge is located near the root, where the structural material required to carry the tension load makes it difficult to provide sufficient bending flexibility to ensure low stresses. With a hinge located at the root the blade is restrained by centrifugal force but otherwise free to flap up or down as the applied loads change. "Blade flapping" is the basic means of control of the helicopter. Varying the applied load by means of cyclic pitch change or feathering as described below causes the rotor disk to tilt relative to the shaft. The thrust being substantially perpendicular to the rotor disk, tilting the rotor relative to the helicopter produces forces that move the helicopter in any desired direction. This tilt is achieved by changing the pitch of the blades once per revolution thereby forcing them to seek a new plane of rotation in which no cyclic pitch change occurs since, because of the hinge, no cyclic moments can exist. A swash plate, which tilts in response to pilot's controls, is used to change the pitch of each individually hinged blade through a mechanical linkage system. The tilt of the swash plate therefore establishes the tilt of the plane of no cyclic input of the rotor; hence, the tilt of the rotor follows the tilt of the swash plate. The same swash plate is moved up or down to change blade pitch in order to climb or descend.

In general, tilting the plane of rotation of the blades relative to the shaft, which is turning at constant speed, results in a periodic change in rotational speed of the blades once and twice per revolution. These changes in speed would produce large forces causing bending and consequently large blade stresses in the chordwise direction. Since the blade is relatively stiff in the chordwise direction, it is necessary to relieve these stresses by means of a vertical hinge, called the lag hinge, at the blade root. Motion about this lag hinge thus permits the blade to maintain substantially constant speed regardless of the tilt of the rotor disk and, in addition, provides a means of relieving the periodic forces in the plane of rotation due to cyclic changes in drag forces in forward flight.

These changes in drag forces and the periodic changes in lift distribution discussed previously exist because of the changes in velocity across the rotor disk as the helicopter moves forward. On that side of the rotor disk which is advancing, the velocities resulting from blade rotation and from forward speed are combined, while on the retreating side they are subtracted one from the other. The lift at constant pitch setting would therefore vary cyclically around the rotor disk, if the rotor were rigid. Such a lift variation would result in a tendency to roll, which is, however, completely counteracted by the hinge at the root. The blade therefore flaps cyclically, the vertical velocity of flapping combining with the horizontal speed of the blade in such a way as to change cyclically the angle of attack and maintain substantially constant lift and zero moment at the blade root.

Speed Limitation.—This change in angle of attack on the advancing and retreating sides of the rotor disk inherently limits the speed of the helicopter and represents one of the most serious practical limitations to its greater utility. As the forward speed increases, the angle of attack on the retreating side must increase until stalling occurs. The forward speed is thus limited to approximately 0.4 of the rotational speed, or, for typical values of the rotational speed, to approximately 200 m.p.h. Higher speeds may be achieved by increasing the blade area and thereby reducing the mean angle of attack, but there are practical considerations of blade weight and the additional power consumption associated with the increased drag of larger chord blades and the compressibility effects on the advancing side which would appear to set a limit to the high speeds of conventional helicopters.

Other Types.—Other configurations, which operate on the basic principles of the helicopter as described above but overcome the speed limitation, have been developed. These include the many machines covered by the generic term VTOL (vertical take-off and landing) of which the helicopter is the best known example. In one such machine the wings and propellers tilt through 90°, with the axis of rotation vertical for take-off and landing and substantially horizontal in forward flight. In others, the wings and propellers remain horizontal, and the slip stream is deflected down by large flaps for vertical flight. In either case, more thrust must be provided in vertical than in forward flight and the final design is therefore a compromise between the hovering and forward-flight regimes. A typical helicopter is designed to lift approximately 12 lb. per installed horsepower but the smaller rotors suitable for use as propellers would produce only 6 lb. or less per horsepower; high forward speeds are therefore achieved at the expense of hovering efficiency. With the advent of lightweight gas turbine power plants, and since most of the additional power is required anyway for the higher forward speeds, this loss of efficiency becomes of lesser importance.

Aerodynamic Theory.—The increase in power required to produce a given thrust as the rotor diameter decreases is fundamental in the rotor aerodynamic theory. Thrust is produced by imparting a downward velocity to the mass of air flowing through the rotor. The lift is proportional to the change in momentum, $m \times v$, where m is the mass flow of air through the rotor and v is its change in velocity. The energy expended, or induced power, is proportional to the change in kinetic energy, $\frac{1}{2}mv^2$. Additional power is consumed in overcoming profile drag of the rotor blades. Considering only the induced power, which represents the major portion of power expended, the ratio of thrust to power is $\frac{mv}{\frac{1}{2}mv^2}$ or $\frac{2}{v}$. A large rotor handles a great mass of air, hence requires a lower value of v and therefore less power for a given thrust than a smaller rotor.

Similarly, in forward flight the flow of air passing through a rotor is increased when the rotor is inclined forward to propel the helicopter. The amount of power required therefore drops off as the speed increases. It reaches a minimum value of about half that required for hovering at about 50 m.p.h., then increases with in-

creasing forward speed as the drag of the fuselage increases. This minimum power characteristic is of importance in considering the ability of multiengine helicopters to maintain altitude after failure of an engine during takeoff.

Helicopter Types.—Many types of helicopters have been proposed. The single-rotor type, utilizing one main rotor and a small vertical tail rotor, is one of the best known. The tandem type, in which two rotors rotate in opposite directions to provide torque balance, is popular for transportation of personnel or cargo because of its long fuselage and insensitivity to load distribution. Another type that is of interest, particularly for small, compact vehicles, is the synchropter in which two rotors are closely intermeshed.

Extensive engineering effort has resulted in the development of helicopters of great reliability and with useful loads of about 30% of the gross weight, which is still somewhat less than the 40% average for fixed-wing aircraft. The additional weight of the helicopter may be attributed to the necessity of providing reliable mechanical transmission systems, operating at low rotational speeds and hence high torques, to power the rotor.

The stability and control problem of the helicopter is more serious than that of the airplane because of the necessity for control at zero air speed where the usual stabilizing effects of a horizontal tail and wings are nonexistent. The helicopter in hovering flight is essentially neutrally stable and responds to the controls as would any system with inertia only, and with no damping or static stability. The pilot must therefore develop an anticipatory reaction in order to arrest the motion of the machine when it responds to the controls. However, the development of reliable and lightweight electromechanical control systems utilizing gyro signals for increased damping and static stability have provided a satisfactory solution to this problem.

Finally, the cyclic loads to which the rotor is subjected in forward flight, as discussed above, require a careful evaluation of the aeroelastic properties of the highly flexible rotor blades in order to avoid vibration levels in the helicopter above the comfort level. Evidently if one of the natural frequencies of the rotor or fuselage is close to a critical harmonic of the rotor speed, an amplification of these forces will occur. Again, careful engineering design effort can avoid resonances and reduce to a negligible amount such vibratory inputs. *See* AERODYNAMICS; AERONAUTICS; *see* also references under "Helicopter" in the Index volume.

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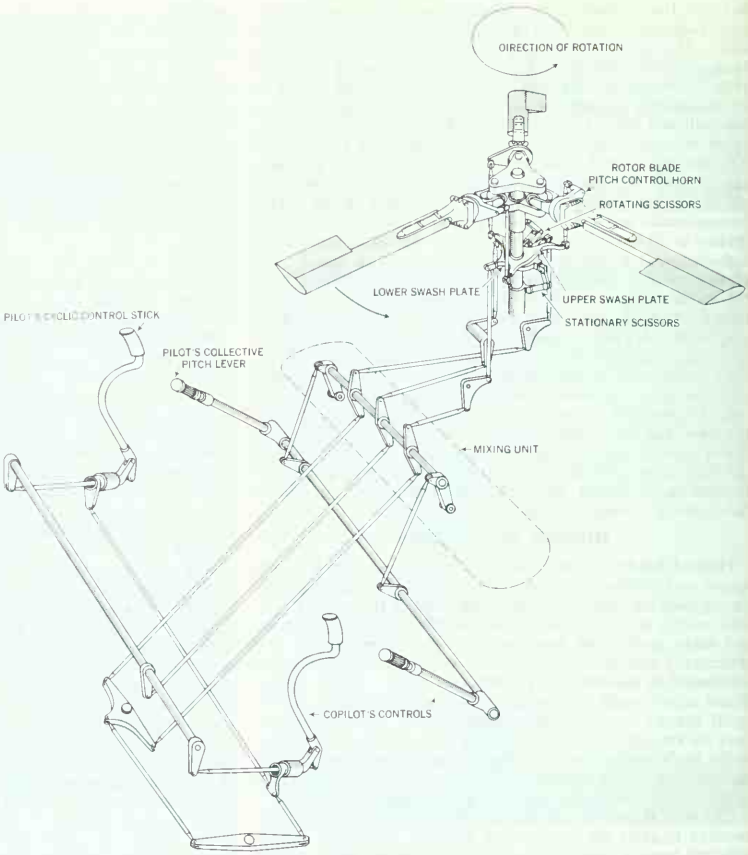

BY COURTESY OF SIKORSKY AIRCRAFT, DIV. OF UNITED AIRCRAFT CORP.

DIAGRAM OF THE CYCLIC AND COLLECTIVE CONTROL SYSTEM ON A SINGLE-ROTOR HELICOPTER

HELIGOLAND (Ger. HELGOLAND), a small, remote island of the German North Frisian group (*see* FRISIAN ISLANDS) lying in the North sea in the angle between the coast of Schleswig-Holstein and the estuaries of the Jade, Weser and Elbe. Pop. (1961) 1,824. It consists of a cliff-girt bastion of red sandstone, 5,249 ft. long and 1,640 ft. at its widest point, with a low sandy island, called Düne, occupying a rocky platform $\frac{1}{4}$ mi. E. Both geological and historical evidence suggest that Heligoland and Düne are the last remnants of a single great island whose periphery in A.D. 800 was about 120 mi. Continuous wave attack on the cliffs, together with a rise in sea level or fall in land level, had reduced the island's periphery to about 45 mi. by A.D. 1300 and to about 8 mi. by 1649. Heligoland's area today is 380 ac. The island is surrounded by a fine wave-cut rock platform above which rise steep cliffs. Most of the island consists of a level plateau, called the Oberland (184 ft. at highest point), but in the southeast a low sandy tract, referred to as the Unterland, has been extended by reclamation. Heligoland has an oceanic climate with notably mild winter temperatures; on the Unterland, sheltered from the strong westerlies, even figs and mulberry trees can be grown out-of-doors.

The human history of Heligoland is no less remarkable than the physical. Occupied originally by Frisian herdsmen and fishermen, the island eventually came under the control of the dukes of Schleswig-Holstein. It was a Danish possession in 1807 when it

was seized by the English fleet and held until it was formally ceded to Britain in 1814. Thereafter it remained a British possession until 1890 when it was ceded to Germany in exchange for Zanzibar and some territory in Africa, British statesmen not then realizing its naval importance. In the years before 1914 Germany developed the island as a great naval base, building an extensive harbour in the southeast with dockyard installations, including a dry dock. A network of underground fortifications with coastal batteries was established in the sandstone, converting the island into what the Germans claimed to be the "Gibraltar of the North sea." During World War I the island was in constant use by German naval forces, and in accordance with the Treaty of Versailles the military and naval works were demolished in 1920–22. However, under the Nazi regime the island, with its peaceful tourist traffic and lobster fishing, was again made a stronghold and was the target for heavy Allied bombing toward the end of World War II. Before its destruction by bombing, the town of Heligoland extended from the Unterland to the Oberland, where the church occupied the highest point of the island. With the defeat of Germany the population was temporarily removed, and in April 1947 the remaining fortifications were destroyed by deep blasting that changed the physical character of much of the island. Thereafter it was again used as a bombing range by the Royal Air Force until it was handed back to Germany on March 1, 1952. The town and harbour were thereafter rebuilt. (Ha. T.)

HELIGOLAND BIGHT, BATTLE OF THE, a British victory at sea in World War I. On Aug. 28, 1914, a plan to trap German naval units as they returned home after night patrols north of Heligoland was put into operation by the British admiralty. Light cruisers and destroyers under Commodore Reginald Tyrwhitt and submarines under Commodore Roger Keyes penetrated deep into the bight to form an interception, while five battle cruisers under Adm. Sir David Beatty and six cruisers under Commodore William Goodenough formed a strong protective screen lest heavy German units should be encountered. Low-lying mist hampered movement, and there was much confusion in the opening stages, during which the German destroyer "V-187" was put out of action and Tyrwhitt's flagship "Arethusa" fought a sharp engagement with the German light cruiser "Frauenlob," much damage being caused to both ships. At 11:30 A.M. Beatty led his battle cruisers toward the sound of fighting, and almost immediately the German light cruiser "Mainz" was caught by Tyrwhitt's destroyers. Shortly afterward the battle cruisers caught and sank the German light cruiser "Ariadne" and the flotilla flagship "Köln." At 1:30 P.M. Beatty broke off the action.

Of the British ships only "Arethusa" suffered much damage and she was successfully towed into port. The destroyer "Laurel" was also towed home, but all other ships returned under their own power and the total British casualties were 35 killed and 40 wounded. The German losses exceeded 1,000 men killed or taken prisoner, 3 ships sunk and at least 2 ships badly mauled. The effects on morale were probably more important, for after this battle the German navy's movements were severely restricted, while for the British the victory helped to counteract the effect that the retreat of the army from Mons was having on public opinion. (B. W. E. P.)

HELIODORUS (? 3rd century A.D.), Greek author who wrote the *Aethiopica*, the longest and best of the extant Greek novels, was born at Emesa in Syria. It is uncertain whether he is to be identified, as the church historian Socrates (5th century) suggests, with the Heliodorus who became bishop of Tricca (mod. Trikkala) in Thessaly. The *Aethiopica* tells the story of Charicleia, daughter of the queen of Ethiopia, who was born white-skinned and consequently abandoned by her mother for fear of the king's suspicions. Brought up by priests, she became herself the priestess of Apollo at Delphi where she met a noble Thessalian called Theagenes. They fell in love, had innumerable adventures (including voyages, battles, abductions, piracy, robbery and torture) and were finally married with the approval of her parents. What makes Heliodorus excel over other Greek romancers is his narrative technique: he superbly masters the development of the plot which in spite of its amplitude and complexity never becomes confused. The reader is plunged *in medias res*, and his attention is immediately and permanently captivated. Through flash backs, appropriate concatenation of accessory episodes and surprises intervening at the right moment, the tension is never relaxed. The work is free from licentiousness and pervaded with sincere faith in Heliodorus' syncretistic religion. The characterization however is weak, the personages being guided throughout by the god Helios (the sun), who is identified with Apollo. The diction is pure Attic, but literary pretensions are evident in the use of daring metaphors and recherché expressions. Apt quotations and allusions show a wide literary knowledge. Since the 16th century the *Aethiopica* has been translated into the chief modern European languages. Tasso modeled the early life of Clorinda in *Gerusalemme liberata* on that of Charicleia and Cervantes' *Persiles y Sigismunda* was inspired by the *Aethiopica*.

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HELIOGABALUS: *see* ELAGABALUS.

HELIOMETER, an instrument originally designed for measuring the variation of the sun's diameter at different seasons of the year. At one time, improved versions were among the most accurate instruments for measuring angular distances between stars, but the heliometer has largely been replaced by photographic methods.

In the standard heliometer the object glass is cut into two semicircular segments which can be displaced by sliding their straight edges over one another, the amount of displacement being measured by a screw. Two images are formed, one by each half lens. If the distance between two stars is being measured, the screw is turned until the image from one star coincides with that from the other. Distances up to 2° can be measured with these instruments.

The first to use a divided object glass to give a double image was Servington Savary in 1743, but his segments were not movable. Pierre Bouguer (1748) invented an instrument which employed two complete movable lenses instead of half lenses to give the double image. In 1754 John Dollond combined Savary's idea of the divided object glass with Bouguer's method and constructed the first really practical heliometer. The heliometer acquired a great reputation through the work at Königsberg of Friedrich Bessel, who used it to measure the parallax of 61 Cygni. Many instruments were made for the transit of Venus expeditions in 1874. The last great heliometer observer was Sir David Gill. His measurements of the parallax of southern stars long remained unsurpassed; he used the instrument also for his important determinations of the solar parallax by observations of Mars and certain minor planets.

HELIOPOLIS, Greek name of one of the most ancient Egyptian cities, IUNU or ONU, "pillar city," the biblical ON, seat of the worship of the sun god Re (Ra). It stood at the apex of the delta, about 7 mi. N.E. of the centre of modern Cairo, of which it is now a residential suburb. Capital of the 15th nome of lower Egypt, its importance was rather religious than political. The great temple of Re was second in size only to that of Amon at Thebes, and its priesthood wielded great influence, particularly during the 5th dynasty (25th–24th century B.C.) when the worship of Re became the state cult and kings, claiming to be sons of the sun, erected large obelisks, symbols of the sun's rays, by their tombs.

In the New Kingdom, the temple of Re-Horakhte (Gr. Harmachis) became the repository of royal records, and Herodotus, who visited the city, states that the priests of Heliopolis were well versed in history. Its schools of philosophy and astronomy are said to have been visited by Plato and other Greek scholars.

Little remains today of this great and learned city. Much of the stone was taken by the Arabs to build Cairo, and even the 12-mi. circuit of the walls is difficult to trace. The sole surviving monument is the obelisk of Sesostris (Senusret) I at Matariya, the oldest obelisk in existence. In ancient times the city must have bristled with these monumental shafts. Of the pair erected by Thutmose III, now known as Cleopatra's Needles, one stands

on the Thames embankment in London and the other in Central park, New York City. (M. S. DR.)

HELIOS, the Greek word for the sun, always a god. He was, however, a minor mythological character and had no original Greek cult. He drove a chariot daily from east to west across the sky and sailed round the northerly stream of Ocean each night in a huge cup. In Homer he is invoked, as the all-seeing god, to witness oaths; his wrath when his cattle are killed by Odysseus'

STAATLICHE MUSEEN OF BERLIN

HELIOS IN HIS CHARIOT. RELIEF SCULPTURE, EXCAVATED AT TROY, 1872

companions, who had sworn to spare them, is one of the minor themes in the *Odyssey*. In classical Greece Helios was worshiped almost exclusively in Rhodes, where from at least the early 5th century B.C. he was regarded as the chief god, to whom the island belonged and from whom its first inhabitants sprang. His worship spread as he became increasingly identified with other deities, often under eastern influence.

From the 5th century B.C. Apollo (*q.v.*), originally a deity of light, was more and more interpreted by thinkers as a sun-god; during the Roman empire the sun itself came to be worshiped as the Unconquered Sun.

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HELIOSTAT, an instrument containing a mirror driven by clockwork so as to reflect sunlight in a fixed direction; *e.g.*, onto the slit of a fixed spectroscope. It is of more complicated design than the coelostat (*q.v.*).

It has the advantage over the coelostat that the instrument fed by it need not be moved from day to day as the declination of the sun changes; the disadvantage is that only one point of the image remains fixed, the remainder rotating around it, so that unlike the coelostat it cannot be used for photographing an extended region.

HELIOTROPE, in botany, a common name applied both to the garden heliotrope (*see* VALERIAN) and the plants described below, which belong to the genus *Heliotropium*. The name indicates a plant that turns its flowers or leaves to receive the most sunlight. In mineralogy, heliotrope refers to bloodstone (*q.v.*).

HORACE M. FARLEIGH

HELIOTROPE (HELIOTROPIUM ARBORESCENS)

Heliotropium is a genus of usually more or less hairy herbs or undershrubs of the borage family (Boraginaceae), having alternate, rarely almost opposite leaves; small white, lilac or blue flowers, in terminal or lateral one-sided simple or once or twice forked spikes, with a calyx of five deeply divided segments, a salver-shaped, five-lobed corolla, and entire four-celled ovary; fruit two- to four-sulcate or lobed, at length separable into four one-seeded nutlets or into two hard two-celled carpels. The genus contains 220 species indigenous in the temperate and warmer parts of both hemispheres, but commonest in the old world. A few species are natives of Europe, as *H. europaeum*. This, as well as four or five other species, is naturalized along the Atlantic seaboard of North America.

The common heliotrope (*H. arborescens*), also popularly known as cherry pie, is a great favourite with florists because of the delicious vanillalike odour of its flowers. It was introduced into Europe by the younger Jussieu, who sent the seed of it from Peru to the royal garden at Paris. About the year 1757 it was grown in England by Philip Miller from seed obtained from St. Germain, near Paris. *H. corymbosum* (probably a native of Peru), which was grown in Hammersmith nurseries as early as 1812, has larger but less fragrant flowers than *H. arborescens*. It is from these two species that most of the cultivated heliotropes have been derived. Some of them are known as turnsole. The species common in eastern Europe and Russia is *H. suaveolens*, which has fragrant white flowers. The fragrant butterbur, better known as sweet coltsfoot (*Petasites fragrans*), a perennial plant of the family Compositae, is sometimes called winter heliotrope because of the perfume of its flowers. (X.; N. TR.)

HELIOZOA, an order of single-celled animals (Protozoa; *q.v.*) mostly spherical in form, distinguished by numerous, somewhat stiff, protoplasmic processes (axopodia), which serve primarily for capturing food and also are of some use in locomotion.

HELIUM (chemical symbol, He), aside from hydrogen the lightest substance known, is a member of a family of normally gaseous elements called the noble gases because they seldom combine with other elements. Helium was first used in large quantities for lifting airships (see *Uses*, below).

History.—Helium was discovered in 1868 in the gaseous atmosphere surrounding the sun. Several scientists, including P. Janssen, a prominent French astronomer, observed in India an eclipse of the sun which occurred on Aug. 18, 1868. They noted a number of bright lines in the spectrum of the solar chromosphere and thus recognized the gaseous nature of the prominences, but they were uncertain as to the exact position of the lines in the spectrum. The number of lines seen by several of the scientists differed from the number of lines noted by others in the group. Janssen continued his observations of the unobscured sun for 17 days after the eclipse and reported his findings by telegram to the French Academy of Sciences. If he observed the helium D_3 line, it made no special impression on him, for it was not mentioned in either the telegram or the letter report that followed.

The following October, J. Norman Lockyer, a brilliant English astrophysicist, observed the chromosphere through a special telescope that he had designed in 1866, and he showed conclusively that the prominences of the sun gave a bright-line spectrum and were, therefore, immense volumes of gas, shooting out from a gaseous solar envelope; and, furthermore, that they were composed in part of hydrogen. Lockyer noted also a yellow line in the spectrum that did not correspond to the two already known D lines of sodium. These findings were reported to the Royal society on the day of their discovery, Oct. 20, 1868. They were reported also to the French Academy of Sciences by Warren de la Rue, who introduced a letter from Lockyer dated Oct. 23. Strangely enough, the announcement by De la Rue of Lockyer's discovery and Janssen's letter report to the academy were received only a few minutes apart.

Thus a problem of proper apportionment of credit for the discovery of the gaseous nature of the prominences was presented. Janssen actually observed the bright lines in the spectrum of the chromosphere two months before Lockyer, but Lockyer conceived the idea of investigating the chromosphere with the spectroscope in 1866 and actually originated the method for doing it. The coincidence of their separate investigations served to cement a close friendship between the two scientists, however, and a medallion bearing the profiles and names of both Janssen and Lockyer was struck by the French Academy of Sciences to commemorate their discovery.

Lockyer continued his investigations and on Nov. 15, 1868, he fixed the yellow line that he had noted previously in the spectrum of the chromosphere at a position which he called D_3. After subsequent exhaustive experiments in co-operation with Edward Frankland, who thought the line might be due to hydrogen at solar temperature and pressure, Lockyer became convinced that the D_3 line was caused by a substance then unknown on earth. He called the substance helium, deriving the word from *helios*, the Greek name for the sun.

Probably the first terrestrial helium was observed in a laboratory by W. F. Hillebrand, of the U.S. geological survey, in 1891, when he experimented with an inert gas which he obtained by heating uraninite, a uranium oxide. This gas consisted mainly of nitrogen, but its spectrum was unusual because it contained strange lines not identifiable with any elements known to exist on earth. Hillebrand attributed the strange lines to variations of pressure in the spectrum tube and failed to investigate the matter further, rejecting the suggestion by one of his colleagues that a new element might be present.

It remained, therefore, for Sir William Ramsay, a London professor, to discover the existence of helium on earth. When informed of Hillebrand's work, Ramsay obtained a sample of the mineral cleveite (a uranium-bearing mineral), and in March 1895 he duplicated Hillebrand's experiments in an effort to produce argon, an element which he and Lord Rayleigh had discovered in the air in the summer of 1894. Upon investigating the resultant gas with the spectroscope, Ramsay found argon as he had hoped; but, to his astonishment, he also found in the spectrum the bright yellow line of helium. At Ramsay's request, Sir William Crookes measured the wave length of the yellow line and confirmed its identity with the line found in the spectrum of the sun. Ramsay's discovery of helium as a constituent of the earth was announced in simultaneous communications to the British Royal society and the French Academy of Sciences on March 26, 1895. In the same year, Ramsay discovered helium in a specimen of meteoric iron from Augusta county, Va., and H. Kayser found helium to be a component of the atmosphere. Later, Ramsay and Frederick Soddy discovered that helium is a product of the spontaneous disintegration of radioactive substances. In 1905 H. P. Cady and D. F. McFarland found that natural gas produced from a shallow well near Dexter, Kan., contained 1.84% helium, and when helium-bearing natural gas was found in other fields large sources of helium became available.

Occurrence.—Although helium occurs in the atmosphere to the extent of 1 part in 186,000, and small amounts occur in radioactive minerals, meteoric iron and mineral springs, by far the greatest volumes of helium are in natural gases produced over widely distributed areas in the United States. In only a few localities, however, is helium present in enough quantity to permit economic extraction.

The best-known sources of supply are in the Texas Panhandle, northwestern New Mexico, Kansas and Utah. The Cliffside gas field near Amarillo, Tex., is perhaps the best-known source because it supplies helium-bearing natural gas to the U.S. bureau of mines Amarillo helium plant where most of the world's supply of helium was produced prior to World War II. The helium content of gas produced from the Cliffside field is about 1.8%. A noncombustible gas containing 7.6% helium was found in 1942 in the Rattlesnake field of northwestern New Mexico. The best natural-gas sources in Kansas contain 1% to 1.5% helium, which is slightly higher than the helium content of gas from the Channing area of the large Panhandle gas field, north of Amarillo, Tex.; however, the volume of helium in the Panhandle field is very great. Helium occurs also in several Canadian provinces, but these occurrences, like all others known to exist outside the United States, are of minor importance.

Production.—The production of helium on a large scale was born of military necessity. The use of lighter-than-air craft filled with hydrogen is exceedingly hazardous in military operations because incendiary bullets easily ignite the gas.

The federal government is the only producer of helium in the United States. There has been a tremendous increase in the amount of helium produced by the U.S. bureau of mines since 1938. In that year the government produced 5,830,750 cu.ft. of helium. Production soared during World War II and reached 137,000,000 cu.ft. in 1944. The output amounted to 81,000,000 cu.ft. in 1950 and then rose rapidly. The increase in production after 1950 is mainly due to the use of helium for welding.

The helium contents of natural gases processed in the bureau of mines plants ranged from 1% to 7½%. Carbon dioxide, other acidic gases and water vapour are removed from the natural gas by washing it with a solution of monoethanolamine and glycol, and it is dried further with activated alumina before it is transmitted to the main separation cycle. The gas then is cooled to approximately −300° F. by a nitrogen refrigeration cycle and counterflow heat exchangers. At that temperature, and under a pressure of more than 600 lb. per square inch, all of the constituents of the gas, except helium and some nitrogen, are liquefied. The liquid is drawn off the bottom of the apparatus, and crude helium composed of about 50% helium and 50% nitrogen is removed from the top of the apparatus for further purification. The crude helium is compressed to 2,500 lb. per square inch pressure and cooled by a cycle similar to that used in the initial separation. Most of the remaining nitrogen is liquefied and the purity of the helium is increased to 98.2%.

This is the grade of helium that was produced until later developments in welding and other metallurgical processes required that purer helium be made available. The 98.2% pure helium now is purified further by passage through activated coconut charcoal surrounded by a bath of liquid nitrogen. This helium, which contains only a trace of impurity, is conveyed into clean, dry high-pressure containers for shipment.

Physical and Chemical Properties.—Helium is a colourless, odourless and tasteless gas with a density of 0.1785 g. per litre at 0° C. It is believed chemically inert (zero valence) and forms no compounds. It is a monatomic element with an atomic number of 2, and it exists naturally in two stable isotopic forms, He^3 with an atomic mass of 3.0170 and He^4 with an atomic mass of 4.0039. With the exception of a trace (10^{-5}%) of He^3, all of the naturally occurring helium is He^4. The unstable isotope He^6 with atomic mass 6.0208 is radioactive with a half-life of 0.8 sec. The liquid phases of He^4 and He^3 are quite remarkable fluids and have become of considerable scientific interest as macroscopic demonstrations of quantum effects. The detailed understanding of their unusual properties is still a challenge to science. Both He^4 and He^3 do not solidify without the help of an external pressure of at least 25 atmospheres and they stay liquid to the lowest temperatures attained experimentally, and there is no indication that they will form solid crystals at even lower temperatures. This unusual behaviour is a consequence of the zero point energy postulated by quantum mechanics (*q.v.*) which is intimately related to the uncertainty principle (*q.v.*). The momentum and position of a particle cannot be fixed simultaneously with arbitrary accuracy. If the helium atoms have to be localized on the points of a crystal lattice their momentum and therefore their kinetic energy would be so great that they would overcome the forces holding the crystal together. Nature compromises in this dilemma by letting helium stay liquid where the atoms are not so narrowly confined in space, reducing in this way the zero point energy sufficiently so that a condensed phase can be formed. Zero point energy is also responsible for the extremely low liquid density, boiling points and critical points of helium, as shown in the table.

Boiling Points and Critical Points of Helium

	Boiling point				Critical point	
	°C.	°F.	Absolute temperature, °K.	Liquid density, g. per c.c.	Temperature, °K.	Pressure atmosphere
He^4	−268.9	−452.0	4.2	.13	5.2	2.3
He^3	−269.9	−453.8	3.2	.08	3.4	1.2

Other strange properties of helium are due to more subtle features of quantum mechanics. Liquid He^4 undergoes a transition at 2.19° K. called the λ-point. The modification above 2.19° K. is called He I, the modification below this temperature He II. There

is no change in density or any latent heat connected with this transition, in contrast to the freezing of a liquid. Specific heat and expansion coefficient change abruptly, and especially striking are the changes in transport phenomena. The heat conductivity of He II is about 100,000,000 times that of He I, and more than 100 times better even than that of copper. The viscosity of He II diminishes rapidly with decreasing temperature to fractions of micropoise (the viscosity of water being about 10,000 micropoise) when measured with a viscometer. The flow through narrow channels of less than 0.001 cm. width takes place without any measurable friction at all. A certain amount of liquid He II passes through such a slit in a fraction of a second; the same amount of helium as gas needs several days to pass the slit.

If a temperature difference arises between two chambers filled with liquid He II and connected by such a narrow slit or a diaphragm an appreciable difference in pressure is produced, the warmer side showing the higher pressure. This can be demonstrated by a simple glass tube extending above the level of the liquid, part of which is filled with a fine powder acting as a diaphragm. Heating the powder by shining a light upon it causes the liquid He II to spout out of the top of the tube up to a height of 10 in. due to the pressure differences created by this strange effect, which earns it the name "fountain effect."

All these extraordinary properties of liquid He II are due to superfluidity. Near the absolute zero of temperature, liquid He^4 can move up to certain critical velocities of several centimetres per second without any friction, a state which is called superfluid. At temperatures between absolute zero and 2.19° K., He II is considered as consisting of a mixture of this superfluid and a normal fluid, the latter behaving more or less like ordinary fluids in showing the usual resistance to mechanical motion or heat flow. At 2.19° K. the whole liquid helium consists only of the normal part of the fluid and becomes He I which has properties similar to those of the other condensed rare gases.

The physical properties of isotopes are usually quite similar, but not in the case of the helium isotopes. The relative difference in mass between He^3 and He^4 is considerable, and as the mass determines the zero point energy it causes also the appreciable differences in boiling points, critical points, etc. of the two isotopes. Moreover, liquid He^3 does not show a λ-transition or superfluidity. He^3 consists of an uneven number of nucleons and obeys therefore the Pauli principle which requires that every quantum state be only singly occupied. He^4 consists of an even number of nucleons and is not subject to this restriction; at very low temperatures all particles can condense into the lowest quantum state, a phenomenon often called Bose-Einstein condensation. It seems rather certain that superfluidity is intimately related with the Bose-Einstein condensation and therefore only possible for He^4. Furthermore a liquid mixture of He^3 and He^4 breaks up into two separate phases containing more or less pure isotopes below $\frac{1}{2}$° K.

Uses.—Helium is still used as a lifting gas, the purpose for which it was originally produced in large volumes. It is the ideal gas for this purpose because it will provide 92.64% as much lift as will hydrogen and it is completely safe to handle. Helium-filled U.S. navy blimps played an important part in defeating the axis submarine campaign in the Atlantic ocean in World War II. Smaller, but important, volumes of helium are used by the U.S. weather bureau to carry radiosonde balloons aloft for weather observations.

In addition to this basic use, many medical and industrial applications for helium have been found since the bureau of mines was authorized in 1937 to sell helium for medical, scientific and commercial use. Helium is used to provide inert atmospheres in the welding of light metals and in other metallurgical operations. Because of its low refractive index, helium is used to fill the spaces between multiple optical lenses arranged in series. It is employed as a tracer, especially in the determination of oil and gas migration in underground geologic structures. In 1925 the bureau of mines issued a report by R. R. Sayers, W. P. Yant and J. H. Hildebrand, who recognized that helium is less soluble in body tissues than nitrogen and studied the use of helium-oxygen mixtures in mitigating caisson disease. Resulting developments by the bureau of mines and the navy department proved that divers can go to greater depths and work longer if a breathing mixture of helium and oxygen is supplied to them.

Helium has a low density and can be mixed with oxygen in suitable proportions for medical use. The mixture can be moved through relatively small airways more freely than air. It is useful in partial obstructions and spasms of the air passages. Reports by A. L. Barach, A. R. Benke, P. A. Neal and other physicians state that less effort is required to breathe helium-oxygen mixtures than to breathe air and that such mixtures may be used effectively in the treatment of respiratory diseases, especially acute cases of asthma. G. W. Jones and G. J. Thomas reported also that helium may be used as a diluent with various anesthetics, especially cyclopropane to prevent explosions in operating rooms, and in the treatment of certain operative complications with helium-oxygen mixtures.

See also references under "Helium" in the Index volume.

See H. P. Wheeler, Jr., "Helium," U.S. Bureau of Mines *Bulletin 556* (1955); W. H. Keesom, *Helium* (1946); F. London, *Superfluids*, vol. ii (1954). (H. P. WR.; L. MR.)

HELL traditionally designates the abode of evil spirits, the place where lost souls undergo eternal punishment, or, more generally, any condition of extreme misery. The word is derived from an Anglo-Saxon root meaning "to conceal" or "to cover," indicating that hell was originally thought to be concealed in the torrid regions near the earth's centre. In ancient Norse mythology, Hel (*q.v.*) came to be personified as the ugly goddess of death. Though the punishment of the damned is usually associated with heat and flames, this is not intrinsic to the concept: the lost souls in the Norse Niflheimr suffered in cold and darkness.

The "House of Hades" or underworld, the abode of the dead in Greek mythology, was pictured as either a gloomy subterranean realm or a distant island that no man-made ship could reach (*see* HADES). To this was originally added Tartarus (*q.v.*), a dark abyss as far below Hades as earth is below heaven and the place of punishment in the lower world; but in later times Tartarus lost its distinctness and became almost a synonym for Hades.

Judaism.—Prior to the time of the Babylonian exile (6th century B.C.), the Jews had only indefinite notions about life after death. The Old Testament does include several references to Sheol as a possible abode of the dead, but it is not always clear whether Sheol means simply the grave or something more specific. The early Jews seem to have held, as did many primitive peoples, that departed spirits somehow inhabited their tombs. But Sheol was also pictured as a vast cavern beneath the earth where the shades (spirits) of all men—not only Jews—were gathered. The lot of these shades was generally miserable; deprived of clear consciousness and the joy of living, they dwelt in the dark recesses of the earth.

From the 5th century B.C. onward, the Jews were in close contact with the Persians and the Greeks, both of whom had well-developed ideas of the hereafter. Zoroastrianism, the religion of the Persian empire, taught a judgment of individuals at death, the souls of the good being admitted to the abode of infinite light and the presence of God, while the wicked were hurled down to hell. The Greek Orphic sects, on the other hand, stressed the idea of the immortality of the soul, which Plato developed in considerable detail. By the time of Christ, the Jews had acquired a belief that wicked souls would be punished after death in Gehenna for varying periods of time, not exceeding 12 months except for sins of heresy and perversion of the faith. Gehenna (*gehinnom*) took its name from the valley of Hinnom, a rubbish dump near Jerusalem where as late as Jeremiah's time child sacrifices were made (Rosh Hashono 17a; Jer. vii, 31). (C. R. SP.; H. C. S.)

Christianity.—Christian teaching on hell is contained in Christ's description of the last judgment: "Then he will say to those at his left hand, 'Depart from me, you cursed, into the eternal fire prepared for the devil and his angels' . . . And these will go away into eternal punishment, but the righteous into eternal life" (Matt. xxv, 41, 46). The existence of hell is assumed in these words. It is the abode of the devil and his angels; in hell there is fire. Those who have sinned against charity and, presumably, die

unrepentant are separated from Christ and sent to a punishment that is unending in the same sense as the unending life of the upright. The same eternal destiny is indicated by the Lord for those guilty of the sin of scandal (Matt. xviii, 8–9; Mark ix, 43–49). The category of those who are condemned is extended by Paul to include sinners in general, such as idolaters, adulterers, homosexuals, thieves, slanderers and the like (I Cor. vi, 9 ff.; Eph. v, 5; Gal. v, 21). According to Paul those who refuse to acknowledge God and will not obey the gospel of the Lord Jesus will suffer the punishment of eternal ruin (II Thess. i, 8–9); "the wages of sin is death" (Rom. vi, 23) and "there will be tribulation and anguish for every human being who does evil" (Rom. ii, 9).

Early Christian writers generally took the teaching of the New Testament literally as presenting not merely a warning but also a future historical fact. In the 3rd century, however, Origen called into question not only the eternity of hell but also the existence of the punishment of real fire. The influence of his doubts and denials is seen in Gregory of Nyssa, Ambrose and Jerome. But the majority of the Church Fathers adhered to a more literal interpretation of Scripture.

The Roman Catholic Church teaches that hell is a state of punishment for those who die unrepentant in grave sin. Hell will last forever; its suffering will have no end. There will be no universal restoration of sinners, as Origen thought. Hell, it is believed, consists not merely in the privation of the supreme good but also in some positive suffering, the cause of which is principally the clear consciousness of the loss of the happiness that results from the vision of God. This is the pain of loss (*poena damni*). But there is also a pain of sense (*poena sensus*), which, according to practically all theologians, is chiefly the pain of fire. This is the suffering induced in the spirits of the demons and in the souls and bodies of damned men by some mysterious extrinsic agent corresponding to what Christ called fire.

The traditional Protestant teaching on hell remained until modern times substantially the same as Catholic doctrine and is still held by many, perhaps most, conservative Protestant groups. Many Protestant thinkers, however, and large numbers of believers find the old teaching incompatible with what they conceive to be the goodness and mercy of God. For an eternal vindicative punishment of the unrepentant sinner they substitute a temporary hell, disciplinary and remedial. This doctrinal position supposes a figurative interpretation of the New Testament texts, which sometimes goes so far as to postulate the annihilation of the irredeemable.

Eastern Christians in general profess the belief that after the general judgment the wicked, who were on the left of the Judge, will pass into eternal fire. The torment of hell will consist not only in a privation of all joy and happiness but also in remorse and anguish of conscience as well as some external punishments. In common with other Christians, those of the East insist that this truth is to be accepted on faith, for, though not unreasonable, it is ultimately impervious to reason. (T. J. Mo.)

Other Religions.—All world religions have a theological term for hell that is analogous in meaning to the term used in Judaism and Christianity—*i.e.*, the final state of the unbeliever or sinner.

Islam.—In Islam, which is related historically to Judaism and Christianity, the term used to describe this state is *Jahannam*. No clear conception of *Jahannam* is given in the Koran. At one point Mohammed says that it has seven gates (xv, 43–44). In *sura* lxxxix, 22–23 he describes hell as if it were something animate and portable: "Bring hell, God shall say on the last judgment; the angels will then form their ranks and hell shall be brought nigh." In this conception hell seems to be described in the symbolism of a large grotesque monster that stands ready to devour the damned. This particular conception was given significance in a treatise, *al-Durra al-fakhira*, by the great Muslim theologian al-Ghazzali. Hell is also described in Muslim tradition as a hierarchy of concentric circles in the shape of a crater, above which is a bridge as narrow as the edge of a sword. All souls must cross this bridge to enter paradise, and those who fall are received by the craters of hell below.

Punishment in hell is not of uniform duration in Muslim tradition. In the Koran one passage reads, "They for whom the balance shall be light are those who have destroyed themselves in hell and shall dwell there forever" (xxiii, 103). According to another passage, however, "The damned shall be cast into fire . . . they shall dwell there so long as the heavens and the earth shall last, unless God wills otherwise" (xi, 106–107); and according to a traditional saying of the Prophet, ". . . he shall make men come out of hell after they have been burned and reduced to cinders." The omnipotence and arbitrariness of God in Islam prevents the tradition from making a final statement on this point.

Indian Religions.—The length of time spent in hell has never been a problem in Indian religion, for hell is only one stage in a career of the soul and is therefore never understood as eternal. Generally speaking, the Hindus divide the cosmos into three realms (*lokas*): heaven, earth and the nether worlds. Twenty-one hells lie beneath the nether world. A person enters into hell as a result of evil actions, but hell is not simply the consequence of action; it is rather the result of a complete attachment or identification with a conception of the world that necessitates action. All actions have consequences and thus the actions that lead to hell are only relatively different from those that lead to rebirth in one of the celestial heavens. Neither heaven nor hell is of ultimate significance. Philosophically speaking, all of the realms (*lokas*), whether heavens or hells, are only the superstructure of the divine neutral essence and originate from a deluded consciousness.

Buddhism.—In Buddhism the three realms of the cosmos are *Kamavacara*, the realm in which the five senses may be experienced in a variety of bodies and perceptions; *Rupavacara*, the realm of form in which the senses of taste, smell and touch are absent; and *Arupavacara*, the formless realm in which only the sense of mind is present. The Buddhist hells are found in the realm of *Kamavacara*. There are eight hot hells and eight cold hells plus the realm of the *pretas* (ghosts with small mouths and great stomachs who are tortured by hunger and thirst). A person is reborn in hell as the result of the "ripening" of his evil *karma*. In the Anguttara Nikaya (i, 38), Yama, king of the dead, questions a soul's arrival in hell and explains that he is there as a result of his evil *karma*, which the punishment in hell is designed to exhaust or "burn up." After this, rebirth is possible in another form, though Buddhist doctrine states that it is very difficult for a person to be reborn immediately as a human being.

In the Buddhist doctrine of the Bodhisattva (*q.v.*) the idea of hell is qualified. Bodhisattvas are beings who have accrued great merit from good deeds and long training but refuse to enter Nirvana because of their compassion for those still suffering. Often they enter into the realms of hell, relieve the beings there and through a transfer of merit release them from their suffering.

Jainism.—In Jain cosmology, the underworld is divided into two parts, *Bhumis*, the lower regions, and *Patala*. *Bhumis* is divided into seven different regions, the last of which contains 5 hells and the first 3,000,000. In these hells are demons who torture the victims. There are no human beings in *Patala* and thus the demons there do not inflict torture. The Jains often illustrate their cosmology by a diagram of a man's figure, the legs representing the hells. Though the hells are places of excruciating punishment, it is possible for the victims to be released after their *karma* has been exhausted. Jainism sometimes refers to another underworld, *Nigoda*, lying below the hells, from which it is impossible to be released; only those who have committed the most heinous crimes go to this place. (Ch. H. L.)

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HELLADIC CIVILIZATION: *see* AEGEAN CIVILIZATION.

HELLANICUS OF LESBOS (fl. late 5th century B.C.), Greek historian, whose work marks an advance in the development of historiography. According to the Suda lexicon, he lived for some time at the court of one of the kings of Macedon and died at Perperene, a town in Asia Minor near the gulf of Adramyttium.

Some 30 works (of which only fragments survive) are attributed to him, including *Hiereiai tes Heras en Argei* ("Priestesses of Hera at Argos"), a chronological compilation; *Karneonikai*, a list of the victors at the Carnean festival with notices of literary events; *Phoronis*, a mainly genealogical work covering the period up to the return of the Heracleidae; and *Atthis* which gives the history of Attica from 683 to the end of the Peloponnesian War (404). Thucydides says that in this work the events of 480 to 431 were treated briefly and superficially, with little regard to chronology.

Hellanicus was not content to repeat the traditions that had gained general acceptance through the poets, but tried to give them as they were locally current. By using the few national or priestly lists that presented something like contemporary registration, he attempted to lay the foundations of a scientific chronology, based primarily on the list of the Argive priestesses of Hera, and secondarily on genealogies, lists of magistrates (*e.g.*, the archons at Athens) and oriental dates, in place of the old reckoning by generations. But as his materials were insufficient he often fell back on the older methods. Because he deviated so much from common tradition he was thought untrustworthy by the ancients themselves.

Hellanicus appears to have made no systematic use of inscriptions and, unlike his contemporary Herodotus, never rose to the conception of a single current of events wider than local and ethnical distinctions. A remark of Dionysius of Halicarnassus that Herodotus was not deterred from a theme already handled by Hellanicus and Charon of Lampsacus refers only to their raw material and not to their historical viewpoint.

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(G. T. GR.)

HELLBENDER, common name for the aquatic salamander *Cryptobranchus alleganiensis* of the eastern United States. The hellbender and the giant salamanders (*Megalobatrachus*) of Japan and China are the only survivors of a primitive family (Cryptobranchidae) that was more widely distributed through the northern hemisphere in the Tertiary period, which began about 70,000,000 years ago.

The major part of the range of the thoroughly aquatic hellbender is within the larger, swift-flowing streams of the Ohio river system, but it is also found in other tributaries of the central Mississippi and in the Susquehanna river in New York.

This grotesque salamander has a flat head and body, compressed tail and wrinkled fleshy folds on the sides. Although the adult is lung-breathing, a gill slit persists on each side behind the head. The back colour is gray or brown with darker blotches. Maximum size is 27 in.

The hellbender feeds on small fish, crayfish and other invertebrates and is occasionally caught taking bait off fishing lines.

Mating takes place during August and September. Each female deposits 300–400 eggs in rosarylike strings in a nest scooped out beneath a stone or other shelter in the stream bed. The male fertilizes the eggs as they are laid and guards the nest during incubation, which takes 10 to 12 weeks. Young lose their external gills in a year or two but do not mature until three to four years old. *See* AMPHIBIA.
(G. B. R.)

HELLEBORE, the common name for plants of the genus *Helleborus*, of the buttercup family (Ranunculaceae; *q.v.*), natives of Europe and western Asia. They are coarse, perennial, poisonous-juiced herbs with lobed leaves. The flowers have five persistent petaloid sepals, within the circle of which are placed the minute nectar-containing tubular petals of the form of a horn with an irregular opening. The stamens are very numerous and are spirally arranged. The carpels are variable in number, sessile or stipitate and slightly united at the base; they dehisce by ventral suture.

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BLACK HELLEBORE OR CHRISTMAS ROSE (HELLEBORUS NIGER)

Helleborus niger, black hellebore or Christmas rose (so-called because it blooms in midwinter), is native in southern and central Europe and with other species was cultivated in English gardens as early as the 16th century. Its knotty rootstock is blackish-brown externally, and poisonous.

The leaves spring from the top of the rootstock and are smooth, distinctly pedate, dark green above and lighter below, with seven to nine segments and long petioles.

The scapes, which end the branches of the rhizome, have a loose entire bract at the base and terminate in a single flower with two bracts, from the axis of one of which a second flower may develop. The flowers have 5 broad white or pale rose, eventually greenish sepals; 8 to 13 tubular green petals containing nectar; and 5 to 10 free carpels. There are several varieties, the best being *H. niger altifolius*.

The Christmas rose is extensively grown in many English and American gardens to provide white flowers about Christmas time for decorations. *H. niger altifolius* grows to two feet, half a foot taller than the typical form, has red-spotted stalks and a pink-tinged flower nearly four inches wide. Because its roots are brittle, it should be carefully planted, preferably in the shade where the soil is moist and rich. It may be planted either by roots or seeds. The best time for planting is in August and September.

A related species, *H. orientalis*, blooms in early spring and is usually called the Lenten rose. *H. orientalis* has given rise to several fine hybrids with *H. niger*, some of the best forms being clear in colour and distinctly spotted. *H. foetidus*, stinking hellebore or bear's-foot, is found in England where, like *H. viridis*, it is confined chiefly to limestone districts; it is common in France and the south of Europe. Its leaves have 7- to 11-toothed divisions; the flowers are in panicles, numerous, cup-shaped and drooping, with many bracts and green sepals tinged with purple alternating with the five tubular petals.

H. viridis is probably indigenous in some of the southern and eastern counties of England and occurs also in central and southern Europe. It has bright yellowish-green flowers, two to four on a stem, with large leaflike bracts.

H. viridis is usually, but unfortunately, called green hellebore, and was thought by some to be the black hellebore. Confusion still exists because green hellebore is properly applied to *Veratrum viride*, an equally poisonous herb. White or false hellebore also belongs to the genus *Veratrum* (*q.v.*), of the family Liliaceae.

The rhizome of *H. niger* is a crude drug; it occurs in commerce in irregular and nodular pieces, from about one to three inches in length, white and of a horny texture within. Cut transversely, it presents internally a circle of 8 to 12 wedge-shaped ligneous bundles, surrounded by a thick bark. It emits a faint odour when cut or broken and has a bitter and slightly acrid taste. The drug is sometimes adulterated with the rhizome of baneberry, *Actaea rubra*, which, however, may be recognized by the distinctly cruciate appearance of the central portion of the attached roots when cut across. *H. niger*, *viridis* and *foetidus* contain the glucosides helleborin, helleborem and hellebrin. These compounds are extremely poisonous and in sufficient doses lead to cramps, vomiting, convulsions and sometimes death.

In medical preparations the drug was once employed as a purge in dropsy but is now considered more dangerous than beneficial. It is occasionally used in veterinary medicine.
(N. TR.)

HELLENISTIC AGE. The Hellenistic age, by almost general consent, covers the period from 323 to 30 B.C.; *i.e.*, from the

death of Alexander the Great to the incorporation of Egypt in the Roman empire. The concept of this period as having a character all its own is not older than the early 19th century, when the German historian J. G. Droysen realized the cultural unity behind the history of a number of states. He used the word *Hellenismus* as the name for an age which he regarded as the transitional period between classical Greece and the Christian world; he forgot the part played by Rome, but nevertheless he had discovered a historical truth of the greatest importance.

As with most historical periods, the exact time limits are artificial, but though they may be due to convention they make sense. Alexander's exploits had changed the face of the world, and from the breakup of his empire there arose the numerous monarchies, most of them ruled by Macedonians, which covered the eastern Mediterranean and the near east and were the framework for the spread of Greek culture, the mixture of Greek and non-Greek populations and the fusion of Greek and eastern elements. Thus, though it is possible to speak of men and features as forerunners of the Hellenistic age, the beginning of the new epoch in 323 B.C. can be regarded as established. It is less obvious with the date of 30 B.C. The three centuries of the Hellenistic age were at the same time the period of the glory and decline of the Roman republic. From the beginning of the 2nd century B.C. the Hellenistic world came under increasing pressure from Rome, the interconnection between the two historical worlds grew in intensity and the main Hellenistic powers were entirely absorbed one after another. The conquest of Egypt by Octavian (later the emperor Augustus) was the last of these Roman victories.

On the other hand, it has been maintained that the first three centuries A.D. still belong to the Hellenistic age because many Hellenistic cultural phenomena, especially the intermixture between west and east, continued and in some respects even grew in historical significance. In a sense the Hellenistic age found its final continuation in the civilization of Byzantium. However, the mere fact of the unification of the *oecumene* ("the inhabited world") under Rome, the disappearance of the Hellenistic states, the establishment of the Pax Romana and the influence of the Latin language and of Roman law and administration fundamentally changed the Hellenistic world. It is right to distinguish between the Hellenistic age of the last three centuries B.C. and the Greco-Roman civilization of the imperial age.

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I. INTRODUCTION

1. Definition.—The word Hellenistic derives from the Greek word *hellenizein,* which in ancient times simply meant "to speak Hellenic" (*i.e.,* Greek) or "to act like a Greek." It could be used for either Greeks or non-Greeks in the sense of speaking correct Greek, but it was mainly used with regard to non-Greeks who had accepted the Greek way of life. The corresponding noun could occasionally be used in the sense of "imitation of the Greeks." In modern times Hellenism has become an ambiguous word, implying Greek culture as well as its imitation; in English, its use is not confined to the Hellenistic era, but often refers to enthusiasm for the art, literature and philosophy of classical Greece (sometimes involving lack of sympathy with the Hellenistic age proper), particularly in the 18th and 19th centuries. J. G. Droysen used the word chiefly to indicate the fusion of east and west, and to a large extent this is indeed the essence of the period. Modern research has tended toward the view that the Greeks rather than the east were the contributing side. It will be seen that such a view, however justifiable in many respects, is too sweeping to do justice to the multifarious pattern of Hellenistic life. But at least it makes sense to call an age "Hellenistic" of which the spreading of Greek civilization was a main feature. The *oecumene* was to a large extent hellenized, and while Greek civilization lost some of its unique beauty and originality it lived on in new forms at home as well as on foreign soil among foreign people. It is equally mistaken to speak of the period as that of Greek decadence or to treat Hellenistic history as a mere accompaniment to the simultaneous rise of Rome. It was a new creative period in the history of the human mind, in which Greeks and non-Greeks played their essential though very different parts. It even created a simplified Greek *koine* ("common speech") and a common state of mind whereby a Greek was now a man of Greek education and no longer simply of Greek origin. Greek civilization not only conquered the near east but influenced, however superficially, countries as far apart as Parthia and India on the one hand and Carthage and Rome on the other. There was a far-reaching fusion between Hellenistic civilization and the east; Judaism among others was partly influenced by Greek culture, and the latter had a decisive share in the formation of early Christianity.

2. Division Into Periods.—It will be useful to distinguish various periods within the Hellenistic age, although a clear-cut separation would be mistaken and strict adherence to the dates and meanings put forward might produce a false historical picture. However, the age may be said to fall into the following three main periods: (1) 323–280 B.C., witnessing the disintegration of Alexander's empire and the establishment of a new society of states; (2) 280–*c.* 160 B.C., the creative phase, characterized by balance of power, the progress of Greek culture and the Greek way of life over an ever-widening area, and the supremacy of philosophy and science; (3) *c.* 160–30 B.C., a period of decline under the influence, spiritual and material, of the east and Rome and of political self-destruction, a period in which irrationalism and religion prevailed.

3. Sources.—The sources vary considerably with regard to different periods, both in quantity and quality. They are fairly ample for the wars of the Diadochi (successors of Alexander). Accounts by Diodorus, Plutarch, Arrian (*qq.v.*) and others survive, mainly deriving from the reliable Hieronymus of Cardia. The course of events during the following decades is obscure. Dates throughout are uncertain and often guesswork. The original historians are lost and were anyhow mostly gossipy and biased writers. For the west alone, the work of the Sicilian Timaeus (*q.v.*) provided a solid basis for later historians. From 221 B.C. onward (till 145 B.C.) there is Polybius (*q.v.*). The many missing parts of his work are partly covered by Livy. Most of the later writers largely depend on Polybius. Poseidonius' continuation is lost, and the most important historian for the later period is Appian (2nd century A.D.). Later sources from Polybius onward are or were mainly centred on the relations between Rome and the Hellenistic world. For Hellenistic Judaea I and II Maccabees are essential. Scattered facts of political history throughout are mentioned by many writers. Nonliterary sources (inscriptions, papyri, coins) provide useful evidence, chiefly of constitutional, administrative and economic facts, also of religion and superstition. The papyri tell a very great deal about social and economic life in Hellenistic Egypt;

for many aspects they are the only source, from which it would be dangerous to generalize. It remains to say that most literary sources show the influence of some kind of propaganda; it is often difficult to paint an impartial picture of events.

II. OUTLINE OF POLITICAL HISTORY

1. Struggles of Alexander's Successors, 323–280 B.C.—Alexander's empire, reaching from Macedonia to the Punjab, became after his death the scene of a long struggle among his marshals, some of whom, in accordance with the wishes of the rank and file in the Macedonian army, tried to preserve the unity of the empire, as first represented by "the kings." Alexander's illegitimate brother Philip III Arrhidaeus, a half-wit, and his posthumous infant son by Roxana, Alexander IV. Most of the generals installed by Alexander as satraps aimed however at breaking up the empire and creating realms of their own. The struggles of the "Successors" (Diadochi) can be divided into several phases. The central government was first represented by Antipater, viceroy in Europe; Perdiccas, viceroy of Asia and commander in chief; and Craterus, guardian of the kings. The chief satraps were Ptolemy in Egypt, Lysimachus in Thrace and Antigonus Monophthalmus in Phrygia; Eumenes, the only Greek among the successors, was installed in Cappadocia. A revolt in Greece, the Lamian War (323–322), was crushed by Antipater, and a revolt of Greek colonists in Bactria ended in massacre. The stealthy removal of Alexander's body to Egypt led to a war in which Perdiccas and Craterus perished. By the agreement of Triparadisus (321) Antipater was made sole viceroy, Antigonus commander in Asia and Seleucus satrap of Babylon; the kings were sent to Macedonia. This ended the first phase of the struggle (323–321).

In the second phase (321–316) the central government was decisively weakened, especially after Antipater's death (319); his successor, Polyperchon, had little authority. He and Eumenes were now the champions of unity, but the coalition of satraps, joined by Antipater's ruthless son Cassander, was too strong. While first Polyperchon and later Antigonus and Ptolemy tried to win the Greeks by proclaiming their freedom, Greece was in Cassander's hands and the philosopher Demetrius of Phaleron ruled Athens for him (317–307). (The Macedonian royal house was eventually to meet a catastrophic end; Roxana and her son survived till 310 when they too fell victims to Cassander.) Eumenes was defeated and executed by Antigonus (316).

In the following third phase (316–311) the aim of keeping the unity of the empire was taken over by Antigonus, but now in order to make himself supreme ruler. Supported by his brilliant son Demetrius Poliorcetes and to some extent by Polyperchon but opposed by a strong coalition of satraps, he could not maintain his position. Demetrius was heavily beaten by Ptolemy at Gaza (312); Seleucus, previously expelled by Antigonus, regained Babylon, and in 311 a provisional truce gave all combatants a respite.

The next (fourth) phase saw Demetrius in Athens, which he liberated from Cassander's garrison (307). Ptolemy held Cyprus, the Aegean and Cyrene but was defeated by Demetrius in a naval battle off Cyprus in 306. The latter's attempt to conquer Rhodes in a famous siege (305–304) was in the end unsuccessful, and since the satraps became kings (306/305) all unification of the empire had become impossible. Demetrius had some success in Greece, but at Ipsus Lysimachus and Seleucus finally defeated Antigonus, who fell in battle (301; *see* IPSUS, BATTLE OF); four powers then emerged under Lysimachus, Ptolemy, Cassander and Seleucus.

Even that was not for long. In the fifth and last phase (301–280) Demetrius, who ruled the sea, regained Greece and after Cassander's death Macedonia (294). The coalition against him was joined by Pyrrhus, king of Epirus, who also aimed at the Macedonian throne. Demetrius threw all his gains away in a disastrous campaign in Asia and ended as Seleucus' prisoner, while his son Antigonus Gonatas maintained a precarious position in Greece. New rivalries and new coalitions followed. Lysimachus' strong empire included Macedonia and most of Asia Minor; but his third marriage to Arsinoë, Ptolemy's ambitious daughter, led to the execution of his own son, who soon was avenged by Seleucus; Lysimachus fell in battle (281). Shortly afterward Seleucus was murdered by Ptolemy Ceraunus, half-brother and afterward husband of Arsinoë. For a time king of Macedonia, Ptolemy Ceraunus was killed fighting the invasion of the Celts (279), who were later defeated by the new king of Macedonia, Antigonus II Gonatas, and in Asia by Seleucus' successor, Antiochus I. Arsinoë became queen of Egypt, where her brother Ptolemy II Philadelphus had been sole ruler since 283. Under the second generation of kings the three dynasties of the Ptolemies, Seleucids and Antigonids were established. Further smaller kingdoms existed, especially in Asia Minor, where the Attalids of Pergamum began their career as an important power.

For 40 years Macedonian marshals, men of unbridled passions, ambitions and energy, had battled against the survival of Alexander's empire and for the creation of new states. In these decades the foundations were laid of a new type of ruler and state and a new civilization. The three leading realms maintained a balance of power. Wars and foreign policy were essentially a constant probing of that balance and concentrated mainly on the border areas of Syria, Asia Minor and the Aegean. (*See* also ANTIGONUS I and II; ANTIOCHUS; ANTIPATER; ARSINOE; ATTALID DYNASTY; CASSANDER; DEMETRIUS I (POLIORCETES); DEMETRIUS PHALEREUS; EUMENES; LYSIMACHUS; PYRRHUS; PTOLEMIES; SELEUCID DYNASTY.)

2. Sicily.—During the years of struggle in the east and the emergence of monarchical rule a similar development took place in Sicily. The attempt of Timoleon (d. *c.* 336) at restoring the autonomy of Syracuse and other city-states had only led to increased anarchy. Out of it Agathocles, who came from the ranks as a soldier, usurped power and, fighting against Carthage, soon turned the position of a city tyrant into that of the ruler of the larger part of Sicily. Despite setbacks he made himself king (305/304), as an equal to the eastern kings. He even ruled the seas round Italy, but was unable to secure the succession; he died in 289. Pyrrhus (319–272), who had married one of his daughters, tried in vain to win the realm for his son; he was equally unsuccessful in expanding his power in Italy against Rome. It was eventually only through Roman intervention that in Syracuse a new leader, Hieron II, succeeded in establishing a kingdom after the Hellenistic fashion; after his death (216/215) it soon became part of the new Roman province of Sicily. The rivalry of Rome and Carthage prevented any balance of power in the west. (*See* also AGATHOCLES; HIERON II; TIMOLEON.)

3. Ptolemies.—Among the dynasties of the 3rd century Ptolemy II Philadelphus (283–246) and Ptolemy III Euergetes (246–221) were the richest and the most powerful. Their aggressive policy led to three Syrian wars and to the extension of Ptolemaic influence into the Aegean world. Egyptian money brought about the Chremonidean War (267 or 266–262) in which many Greek states fought against Macedonia; it ended in Antigonus' victory. He was now the absolute master of Greece, and Athens never regained political importance. The Ptolemies conquered parts of Asia Minor and created a protectorate over a league of the islanders, but later lost all Aegean positions, temporarily even the African dominion of Cyrene. Macedonia obtained maritime supremacy in the battles of Cos and Andros (the dates are uncertain). Syria and Palestine, not least because of their importance for trade, remained disputed countries between Seleucids and Ptolemies.

4. Seleucids.—The Seleucid empire, on the other hand, had troubles of its own. Extending over most of Alexander's Asiatic empire, it could not be kept together. The Indian satrapies gained independence, and Asoka founded (*c.* 275) a large Buddhist empire which remained open to Greek cultural influence. Around 250 Bactria became independent under Greek rulers. Farther west a national Iranian movement led to the foundation of the Parthian kingdom of the Arsacids, and Armenia was later lost to a local dynast. Thus the Seleucid empire was thrown back on its central and western parts. There were also troubles inside the Seleucid family and with the Ptolemies, which led to the Third Syrian War (246–241) when Ptolemy Euergetes marched beyond the Euphrates; but he soon lost most of his conquests. New dynastic strife among the sons of Antiochus II caused the loss of Asia Minor to the Galatians (a splinter group of the great Celtic invasion of 279)

until Attalus I, the ruler of Pergamum, defeated them *c.* 230 and became king of an independent state. The Seleucids had lost their Aegean seaboard.

5. Greece and the Leagues.—In Greece the 3rd century saw the rise to power of the Aetolian and Achaean leagues. The former, holding Delphi and dominating central Greece, extended their power by land and by sea. This was the only state in Greece always free from Macedonia; of formidable strength, it was lacking in constructive statesmanship. It was different with the Achaean league under the leadership of Aratus who for almost thirty years was general every other year. In fighting Macedonia and the various tyrants (usually pro-Macedonian) he succeeded eventually by a surprise attack in capturing Corinth, the Macedonian key stronghold. Later the two leagues, though beginning to become rivals, were able to extend their power and further to weaken the position of Macedonia. The Achaean league included the whole Peloponnese except Sparta and Elis, while the Aetolians, by extending their federal citizenship, held central and northern Greece from sea to sea. Antigonus III Doson (229–221) restored peace and royal power in Macedonia but left the leagues alone. The time of the really great kings had passed, though Antiochus III and Philip V were still to show remarkable ability and power. Of the city-states none was important; Athens, the acknowledged cultural centre of Greece, had gained a kind of *de facto* neutrality. Only Sparta still played a part of its own. After Agis IV had tried and failed, Cleomenes III succeeded in carrying through a social revolution (227). Cleomenes, driven by personal ambition, then went to war with the Achaean league. He found allies in Egypt and the Aetolian league. Aratus, between two hostile powers and afraid of social revolts, asked his old enemy Macedonia for help. Antigonus Doson received Corinth back and re-established the Hellenic league. Cleomenes, defeated at Sellasia (222), perished in Egypt. Antigonus Doson entered Sparta, the first enemy to do so, and Sparta became a member of the Achaean league; its political role was finished, in spite of a short aftermath under Nabis (207–192). (*See* Agis; Cleomenes; Nabis.)

6. Antiochus III and Philip V.—A new period began with the accession in 223 to the Seleucid throne of Antiochus III (known as "the Great") and in 221 of Philip V (*q.v.*) to that of Macedonia. It is the epoch when Polybius' *History* opens; it is also the moment when "the clouds from the west" began to threaten the Hellenistic world and its balance of power. Rome, by defeating the Illyrian pirates, ruled the Adriatic sea and became Macedonia's neighbour. The young Philip V, facing a Greece disrupted by war and devastation, accepted in 217 the peace of Naupactus, the last Greek peace before Roman interference. Then he became involved in the Second Punic War in 215 (*see* Punic Wars), though he was unable to support Hannibal against Rome. In this First Macedonian War the Aetolians allied with Rome while the Achaean league, reformed by Philopoemen, supported Macedonia. The war ended in the inconclusive peace of Phoenice (205). Meanwhile Antiochus III succeeded in restoring his almost disrupted empire, though he lost against Ptolemy IV the battle of Raphia (217), in which native Egyptian troops for the first time played an important part. It was a decisive event for the growing Egyptian nationalism and thus indicated the decline of Ptolemaic rule while, rather surprisingly, the Seleucid empire was once again consolidated. Antiochus, having secured most of the western half of his empire, campaigned for eight years (212–205) in the east and forced the kings there to accept Seleucid supremacy. These vassals naturally remained loyal only as long as the central government was strong.

In 205 Ptolemy V, a child, succeeded to the throne of Egypt. Antiochus and Philip immediately attacked the Ptolemaic dominions. By his harsh methods of warfare Philip alienated the Greeks and in 200, when the Romans had their hands free, the Egyptians, Rhodians and Attalus I of Pergamum urged them to intervene. Hence started Roman expansion to the east, and the balance of power among the Hellenistic states was soon to be destroyed.

The Second Macedonian War (200–197) resulted in Philip's defeat at Cynoscephalae; by the peace terms he lost his fleet and his possessions outside Macedonia, was obliged to give hostages and pay an indemnity, and became Rome's ally. The Roman general, the philhellene T. Quinctius Flamininus, solemnly declared all Greeks free (196). This was received with enthusiasm, and though it soon led to disillusionment, it was first a great help for Rome in its dealings with Antiochus, who, having reduced Pergamum, had crossed into Thrace (196). Roman protests were disregarded. The Romans evacuated Greece in 194, but Roman "advice" remained the decisive factor in the internal Greek struggles. In 192 the Aetolian league, dissatisfied with the Roman settlement, invited Antiochus to Greece, but the promised Greek revolt did not materialize, and Philip and the Achaean league actually supported the Romans. Defeated at Thermopylae (191), Antiochus returned to Asia; supported by the fleets of Pergamum and Rhodes, the Romans repeatedly defeated his fleet and crossed into Asia Minor to defeat him on land at Magnesia (winter 190/189). The Aetolians surrendered to M. Fulvius Nobilior (189), becoming subordinate allies of Rome, and in 188 the peace of Apamea was ratified, by which Antiochus lost all his possessions in Asia Minor except Cilicia. Most of these passed to Eumenes II of Pergamum; the Rhodians also profited by the peace and ruled the seas. Many of the Greek cities of Asia Minor were declared free, though others became subject to Pergamum. Next year (187) Antiochus was killed in a local fight. The Seleucid empire was still a great power, but practically confined to Mesopotamia and Syria, with a weak hold on the seven "upper provinces" in the east.

7. Roman Conquest of Macedonia and Greece.—The forcible annexation of Sparta by the Achaean league under Philopoemen (188) provoked repeated Roman intervention, and relations between Rome and the league worsened. Philip's consolidation of his remaining kingdom made him suspect at Rome. After his death (179) his less-gifted son Perseus continued his policy. Further complaints by Eumenes led to the Third Macedonian War (171–168); three years of indecisive warfare ended in the victory of L. Aemilius Paullus at Pydna. Macedonia was divided into four independent republics. Greece was treated severely; the Aetolian league was dissolved; the Achaean league, although it had offered support to Rome, was forced to surrender 1,000 hostages (including Polybius). The Rhodians' offer of mediation cost them their gains by the peace of Apamea, and Delos soon replaced Rhodes as the commercial centre of the Aegean; even Eumenes fell into disfavour, a fact which strengthened his position among the Asiatic Greeks and the Galatians.

In 149 a pretender, Andriscus, gained considerable support in Macedonia but was defeated by Q. Caecilius Metellus the following year. Macedonia, with Illyria and Epirus, became a Roman province. Achaean operations against Sparta led to war with Rome (146): L. Mummius defeated the league and sacked Corinth. Greece was placed under the supervision of the governor of Macedonia (until 27 B.C., when it became the province of Achaea).

8. Pergamum to 129.—The pro-Roman policy maintained by Eumenes II (king 197–159) was continued by his brother Attalus II (159–138), who had not shared his disfavour after 168; under him the realm flourished and prospered. The expansion of Bithynia under Prusias I (king *c.* 230–182) and II (182–149) menaced Pergamene territory, but the Romans intervened in Attalus' favour (159). The last Attalid, Attalus III (138–133), while giving freedom to the city of Pergamum, bequeathed his kingdom and his treasures to Rome. A pretender, Andronicus, fired by Stoic ("socialist") ideas, led a serious revolt (132–129) in Asia Minor, but in 129 Manius Aquilius was able to organize the Roman province of Asia (*q.v.*) which covered the larger part of the Pergamene empire.

9. Later Seleucids.—After the quiet reign of Seleucus IV (187–175) his brother Antiochus IV Epiphanes pursued a more active policy. An Egyptian attack on Palestine (170) was countered by an invasion of Egypt, in which Antiochus captured the young king Ptolemy VI Philometor, whereupon the Alexandrians proclaimed as king his younger brother, Ptolemy VIII Euergetes. Antiochus' second invasion (168) ended in his humiliating withdrawal on the orders of the Roman envoy Gaius Popilius Laenas, leaving the two Ptolemies as joint kings of Egypt, with their sister Cleopatra II as queen of Ptolemy VI. Inside his kingdom Antiochus promoted Hellenism and in pursuance of this policy rededi-

cated the Temple at Jerusalem to Olympian Zeus (168); this provoked great hostility and finally a revolt of the Jews (167–142). (See *Hellenistic Civilization: Hellenism and the Jews*, below; MACCABEES.) On his way to tackle the growing power of the Parthians in the east, Antiochus died (163); the dynastic struggles following his death (*see* DEMETRIUS; ALEXANDER BALAS) led to the disintegration of the Seleucid empire. The last Seleucid to unite Syria, Palestine and Mesopotamia was Antiochus VII Sidetes (139–129); after his death in battle against the Parthians, the children of Cleopatra Thea (daughter of Ptolemy VI) by him and his brother Demetrius II (king 145–139 and 129–126/125) formed rival branches and continued to dispute a rapidly declining kingdom (*see* SELEUCID DYNASTY).

10. Mithradatic Wars and Pompey's Settlement.—From the beginning of the 3rd century the kingdom of Pontus on the southern coast of the Black sea had been growing (*see* MITHRADATES; PONTUS), although the murder of Mithradates V (*c.* 121) led to the loss of Phrygia (joined to Asia *c.* 116) and Paphlagonia. The attempts of Mithradates VI Eupator to extend his rule in Asia Minor led to conflict with Nicomedes III of Bithynia and Roman intervention (*c.* 95 and 92). The First Mithradatic War (88–85) began with a massacre of Italians in Asia. Most of the Greeks in Asia and many in Europe, feeling deep hatred for the Romans, supported Mithradates, but the victories in Greece of L. Cornelius Sulla, who sacked Athens (86), and in Asia of Gaius Flavius Fimbria, obliged him to accept the peace of Dardanus, which was comparatively lenient. Greece, however, suffered badly and never—not even under Augustus—fully recovered. The Second Mithradatic War (83–82) was unimportant, but in 74 Nicomedes IV's bequest of Bithynia to the Romans led to the Third Mithradatic War (74–63), in the course of which Mithradates and his son-in-law Tigranes of Armenia were defeated by the Roman general L. Licinius Lucullus, and Tigranes forced (69) to evacuate Syria, which he had occupied in 83. In 64 Gnaeus Pompeius Magnus (Pompey) disregarded the last Seleucid claimants and annexed Syria as a Roman province; Bithynia with western Pontus also became a province (63), and client-kings were recognized in Armenia, Commagene, Cappadocia and elsewhere. Although the Romans exploited the peoples of their empire, they saved the east from complete chaos and Hellenistic civilization from destruction.

11. Egypt, 168–30.—The joint rule of Ptolemy VI and VIII was not a success; Roman arbitration gave Ptolemy VIII Cyrene as a separate kingdom (163). Ptolemy VI's support of successive Seleucid pretenders brought about his death near Antioch (145); Ptolemy VIII killed his nephew Ptolemy VII, married Cleopatra and became king of the whole realm, but failed to establish a strong national monarchy, partly because of the existence of two queens, Cleopatra II and her daughter Cleopatra III; anarchy was widespread. At Ptolemy's death (116) Cyrene passed to the illegitimate Ptolemy Apion, who bequeathed it to Rome (96), Egypt and Cyprus to Cleopatra III and her sons Ptolemy IX Soter and Ptolemy X Alexander. Although domestic strife continued until Ptolemy IX became sole ruler (88), the kingdom did not disintegrate entirely, but Palestine was finally lost. Egypt, even under bad government, remained a very rich country. In 80 one illegitimate son of Ptolemy IX, Ptolemy XII Auletes (80–58 and 55–51), became king of Egypt, another son became king of Cyprus (annexed by Rome in 58). Auletes saved his throne by bribing Roman senators; on his death his son Ptolemy XIII and daughter Cleopatra VII became joint rulers. During Julius Caesar's visit to Egypt (48–47) the boy-king Ptolemy XIII was killed in battle against him; Cleopatra was then associated with her younger brother Ptolemy XIV and after his death (44) with her son Ptolemy XV, nicknamed Caesarion and said to be Caesar's son. She, the most famous of all Hellenistic rulers, was able even to frighten Rome. For events after 44 *see* ANTONIUS; CLEOPATRA. After the deaths of Antony and Cleopatra, Egypt became a province of the Roman empire (30).

III. THE HELLENISTIC STATES

There was no single type of Hellenistic state. The Greek city-state (*polis*) survived. Athens remained a cultural centre, Sparta went through an inner revolution to become a museum of its own past, old trading centres like Corinth or new ones like Rhodes and Delos flourished at times. A well-preserved example of a small prosperous Hellenistic town in Asia Minor is Priene near Miletus. Many new city-states were created by the new rulers. They all had their officials, councils and assemblies but frequently the *polis* constitution was little more than a façade. In fact, the city-state was no longer a power adequate to the changed conditions of the age, and in most cases it was included in a larger realm.

Attempts by the Greeks themselves to overcome the weakness of the single *polis* were made by the creation of unions and federations. *Polis* autonomy could be subject to a federal body on a tribal or regional basis. Its ultimate form as a true federal state with double citizenship and strong federal authority was achieved, above all, in the Aetolian and Achaean leagues, the two most powerful states of Hellenistic Greece. Their constitutions were adaptations of *polis* constitutions with a primary assembly, a council and annual officials. The council was composed of representatives of the member states; it is the first clear example of the representative system in Greece. These leagues were territorial states and the citizens of the member states were citizens of the federal state. Simply on account of distances, the assembly rarely met and even the council did not sit permanently. The officials therefore, whether a small board or a military leader (strategus), were more powerful than normal *polis* officials, and the leagues were regarded by the kings as powers on almost equal level with their own realms.

Sometimes a league was founded and controlled by one of the rulers; *e.g.*, the islanders' league. The League of Corinth or Greek league, on the other hand, founded by Philip II in 337 and renewed by Antigonus I and again by Antigonus III Doson, retained the character of the earlier Greek form of a federation under a leading power (*hegemon*), in this case the Macedonian king. Monarchy had entered Greek political life even earlier. After the end, in the 5th century, of rule by tyrants in the city-states, the monarchical idea had gained influence again in the 4th century, both in actual politics and in theory. Yet it was not till Alexander that monarchy became the most important factor in Greek political structure. Whatever the differences in the size and character of the states, the territorial monarchy was the essential Hellenistic type of state. Created by Macedonian generals and culminating in the establishment of three large realms, the type was repeated all over Asia in smaller powers which were ruled by Greeks or hellenized orientals. A territorial monarchy could even develop from a city-state as in Syracuse and Pergamum, and the external appearance of Hellenistic kingship was sometimes imitated by *polis* rulers such as Areus and Nabis in Sparta. Of most of the monarchies so little is known that the picture must be drawn mainly from the three great powers and Pergamum.

Only in Macedonia was the king a national leader acclaimed by the army; in Asia and Egypt the kings were foreign rulers who had come as conquerors and established an absolute monarchy over Greeks and non-Greeks. Gradually the Macedonian monarchy too grew much more absolute. The land generally belonged to the king—not in Macedonia or in the city-states, but in the Macedonian dominions just as in Egypt or Pergamum; even in the Seleucid empire private ownership of land was largely due to royal gifts. The Macedonians were the ruling people of the world, but outside Macedonia they were a small minority who upheld Macedonian traditions, though even in Macedonia they accepted Greek culture. Soon it was hardly possible to draw a clear line between Macedonians and Greeks; the numbers of the latter were large in each of the realms. They had mostly emigrated from their poor and overpopulated country, and, serving as officers, officials or military colonists, or working as scholars, artists or engineers, became the chief support of the new rulers. The close proximity of Greeks and orientals led to much intermixture of blood and civilization. Everybody was subject to the king and citizenship had become a purely local affair in the city-states. Most of the native peasants, though in general not deliberately oppressed, remained poor and sometimes exploited and misused. In the long run however their innate nationalism, helped by their large numbers, challenged Greek domination and even Greek language and culture. From the

end of the 3rd century the Greeks were in retreat. In the cities, however, Greeks and hellenized orientals, round the gymnasium as their centre, for a long time maintained their way of life and their social status.

Alexander had tried—not entirely successfully—to combine his Macedonian kingship with the position of Egyptian Pharaohs and Persian kings; that is to say, a people's monarchy with theocratic despotism. His successors, within narrower aims, followed his example and created the ultimate form of Hellenistic monarchy. The consent of the army assembly became a mere formality, even in Macedonia. The king ruled without legal limitation to his power, though he could delegate it to high officials. Land and people, with certain exceptions, were his property; that is why some of the kings could bequeath their states as well as their personal treasures to Rome. Court hierarchy and etiquette gradually developed, with "friends" (*philoi*) as a permanent institution, "kinsmen" (*syngeneis*) as specially honoured courtiers, with "bodyguards" and "pages" and other personal titles. Succession was in the male line and great efforts were made to strengthen the dynasty by claiming descent from respectable ancestors, usually starting from a Greek god, by securing succession through joint rule of father and son and by stressing the role played by the queen. She was the king's "sister," whether actually, as in Egypt, or only nominally. The strongest support both of monarchy and of dynasty was, apart from the army, ruler worship. It could be founded by a city-state, expressing thanks and flattery and fear, or established by the king as an official dynastic cult which usually included the queens. Ruler cult, a particular and important feature of Hellenistic kingship, followed the example of Alexander, but would not have been possible without such Greek traditions as the anthropomorphic nature of religion and myth, the heroization of dead men and the occasional worship of great men even during their lifetime. But the geographical facts (Macedonia had practically no ruler worship) and the peculiar nature of Hellenistic ruler cult point to oriental influence as well. Nowhere but in the east was the soil prepared in a similar degree. The Ptolemies were Egyptian gods like the Pharaohs, and the Seleucids and other eastern dynasties followed earlier kings who ruled "by the grace of the gods." Ruler worship has been called a political religion; though the political side was usually the stronger one, the other must not be forgotten. It is mistaken, for instance, to explain the cult of a ruler by a *polis* as a legal fiction to justify the relation between *polis* and monarch; it is perhaps more to the point to derive them from that innate Greek feeling of the identity of the political and the religious community. At Doura-Europus, a foundation of Seleucus I, the cult of the founder was fully alive as late as A.D. 180. A particular feature of the dynastic cult was the distinction of kings or royal couples by secondary names, some of which indicated divine character (*Soter,* "saviour"; *Theos,* "god"; *Epiphanes,* "god manifest"), others (*e.g., Philopator,* "father-loving") simply the coherence of the dynasty. The cult was intended to serve the unity of the state; the weaker the kings, the more emphatic became their divinity and the greater the number of royal names.

The kings ruled by edicts and it was the main task of the officials to carry them out. Administration varied according to the nature of the different states or their parts, but everywhere royal officials were needed both in the central government and to administer the parts of the realm. Survivals of earlier systems, such as the Macedonian aristocracy, the dynasts and temple states in Asia, or the priests in Egypt, though all not without power, were outside the bureaucracy, while the administrative system, though inherited from earlier empires, was far more thoroughly organized, chiefly because of advanced Greek standards in law, finance and administration. Greeks filled most of the higher posts; the lower offices were left to the natives, though they later rose to the higher grades as well. The new bureaucratic system under the king reached its highest perfection in the overcentralized organization of Egypt. The most important of all officials here was the *dioecetes* who was primarily the finance minister but also the chief deputy for the king and in charge of everything except military and foreign affairs. In the administration outside the central government, the leading officials in most states were the strategi (originally "generals"); they varied in competence and power, but everywhere developed from military into civil officers. In the countryside, especially in Egypt, there was a large body of civil servants, down to the heads and scribes of the villages. In the Seleucid empire the strategi gradually replaced the satraps; within their provinces they could even act as high priests of the ruler cult. Together with dependent kings and dynasts, the Seleucid strategi were a powerful instrument of decentralization. The technical perfection of administration in most states was at first very good indeed, and the king's control during the 3rd and part of the 2nd century usually fairly strict. The Greeks soon learned the paper work of an administration for which they originally were not trained; but from the 2nd century onward corruption and inefficiency grew alarmingly. Weak government, the increase in the number of native officials and the tempting opportunities of bureaucratic power gradually corrupted the system.

Within the framework of the monarchical realms the Greek city-state gained special importance. Old and newly founded cities were the centres of Greek life and for that reason a vital factor in the political and social structure, although standing outside state organization. Alexander, taking up an idea propagated by Isocrates, for instance, founded new cities in the east on a large scale, and he was followed by the early Seleucids; they also founded military colonies (many called Macedonian, though probably mixed with Greeks), some of which developed into full cities. New cities could also be established by synoecism, the union of existing cities or villages. The vast majority, however, of new foundations were heirs to earlier non-Greek towns whose native upper class usually adopted the Greek way of life. Colonization and hellenization went hand in hand; frequently the city population was only partially Greek by origin. The typical *polis* institutions, however, political as well as social, were accepted and adapted everywhere, though city offices of an unpolitical nature, such as the gymnasiarchs and the agoranomi, gained importance, and private associations replaced the bonds of citizenship. The Hellenistic *polis* was little more than a municipal community.

A special part was played by the capital cities. The Ptolemies did not found cities in Egypt except for two of little importance, Ptolemais and Philadelphia. But Alexandria (called "by Egypt," not "in" it), as the capital of an empire, the royal residence and a combination of various peoples and their political bodies (*politeumata*), was no ordinary *polis;* its Greek section, though representative of the whole city, may not even have had a council. Other capital cities were of a similar type, but it is significant for Seleucid decentralization that there were two royal capitals, Seleucia on the Tigris and Antioch, and other provincial capitals of considerable importance such as Sardis. Pergamum, an old Greek *polis,* was turned into a royal capital with hardly any autonomy left.

The relationship between king and *polis* varied widely, and so do modern views on it, mainly because there was no single clear-cut solution for the tension between the king's supremacy and the freedom of the city-state. The kings, trying to keep their realms as coherent as possible, could not accept within their territories any real sovereignty but their own. The cities, regarding their autonomy as essential, claimed to be independent allies of the rulers, a pretense sometimes accepted by the kings. The cities in Greece and the Aegean largely maintained the appearance of autonomy and it was the policy of some of the earlier rulers to proclaim and to guarantee their freedom. This proved to be a piece of valuable propaganda. Autonomy theoretically implied the city's own laws, an independent foreign policy, right of coinage and immunity from tribute and garrison; in practice these rules were frequently broken and hardly any city could maintain independence in foreign affairs. Generally autonomy was replaced by an exchange between king and city of *eunoia,* good will on his and loyalty on the city's part. Local government was usually in the hands of partisans of the king, and a shift of power among the rulers might lead to internal changes. When a royal governor, normally the commander of a garrison, was appointed to administer the city, autonomy had practically gone. The king would convey

to the city, either through the governor or directly, his demands or his favours (as, for example, the grant of the right of asylum, a treasured privilege); he could even interfere in the city's domestic affairs and jurisdiction.

It was less the outdated constitution and the claim for autonomy that counted than the fact that the cities represented Greek urban life in non-Greek surroundings, that they provided for the government's need of officers, officials and experts and that they were a training ground for unpolitical municipal self-government. City life in the monarchies strongly contrasted with the countryside, which was hardly hellenized. With the decline of the central power, this contrast became a conflict which had grave consequences.

IV. SOCIAL AND ECONOMIC CONDITIONS

In this field knowledge is particularly limited and fragmentary; but obviously the differences in the political sphere were reflected in social and economic life. The chief sources of trouble were never removed. There always were tensions between city-states and monarchies, between Greeks and orientals, between rich and poor. There was, on the other hand, a unity behind these tensions which socially and economically was due to the Greek or hellenized city population in east and west. Whatever its political position, the *polis* was the centre of economic and social life, in spite of the general importance of agriculture. Town planning and building, business and trade, language and law, religion and education, entertainment and family life were substantially the same everywhere; the special conditions in Egypt were the exception. The natives however were not included, with the exception of the hellenized upper class; that is to say, the vast majority of the population remained outside Hellenistic society.

1. Social Structure.—This chiefly depended on the "Greek dispersion," the emigration of many thousands of Greeks and far fewer Macedonians from Greece and the Aegean, and the part they played in the new monarchies. A small minority filled the higher ranks of officialdom, of army and navy and of the court; they were in general very well off. Large numbers, on the other hand, served as soldiers and settlers or were merchants and craftsmen, teachers and doctors, artists and engineers. They were Greeks or hellenized Macedonians, increasingly mixed with hellenized orientals. It was they who represented a kind of middle class, united by their education, their moderate wealth, their private associations and their language. Education was essential. A man was a Greek when he had gone to school (mostly private, sometimes endowed by rich patrons or kings), had taken part in the physical and intellectual training of the *ephebi* (*q.v.*; no longer a military service) and belonged to a group based on a gymnasium. On this basis he would be a Greek gentleman or at least a person fit to serve as an official. The financing and supervision of the educational system was in the hands of the local authorities, the *polis* or *politeuma*. Whatever native aristocracy or middle class existed would gradually be drawn into the city society. Greek exclusiveness relaxed more and more and some of the uneducated Greeks must have gone down to the lower classes. The way of life of the upper classes was similar to that of the corresponding classes in the motherland, the upper-class citizens and the prosperous metics (resident noncitizens), who since pre-Hellenistic times had had about the same social standing. Everywhere social and economic life was upheld by the activities of a *bourgeoisie*.

Naturally they could not have had their professional as well as their prosperous life without the labouring class, which in the east was practically identical with the native population (whether freemen, serfs or slaves) while in Greece and the Aegean it was represented by declining numbers of poor free peasants and workers and a large slave population. In east and west the lower classes, especially during the 2nd century B.C., were always on the verge of revolting and often did revolt. But a distinction must be made between the conditions in the old Greek cities and the new monarchies.

2. The Old Greek Cities.—The part played by the Greeks generally made the citizen *bourgeoisie* in the old country more conscious of the common bonds between all Greeks. *Homonoia* ("concord") became a favourite slogan, though that only shows that *polis* individualism was still strong. For instance each city still had its own calendar; on the other hand it was common practice to engage judges from other cities. The prosperity of the 3rd century led to increased trading and traveling and to a widening of the horizons. Philosophy, especially Stoicism (*see* below) helped to undermine the old mentality and to create an atmosphere in which the equality of men seemed no longer an entirely utopian ideal. Yet the *bourgeoisie*, composed mainly of wealthy landowners, of men who owned ships or workshops and of capitalists who employed slaves or hired them out, still clung to the traditions of *polis* life, in particular to those of religion. In general, they led an easy life of leisure and culture. The conflict between rich and poor persisted and toward the end of the 3rd century the social and economic problems of a depopulated country became so pressing that the usual neglect was no longer possible. The *bourgeoisie* itself, apart from a few very rich, felt the decline in purchasing power of the masses for whom they provided as local producers and traders. Emigration had stopped, families were severely restricted by infanticide, interest on money rose, wages remained low, grain was often in short supply and famines were fairly frequent. It was only natural that the lower classes began to revolt against the ruling oligarchies. Best known is the revolution in Sparta, led by two of the kings themselves (Agis IV and Cleomenes III) and directed against the small class of rich landowners. Here as elsewhere the chief demands were cancellation of debts and redistribution of land. Another example is the revolt of Aristonicus in Asia Minor. These revolts threatened the very life of the upper classes, and resistance to them was supported first by Macedonia and later by Rome. That meant that the revolts never succeeded.

3. Professionalism in the East.—Some of the Aegean cities, geographically and politically on the fringe of the Hellenistic world, retained their prosperity as important centres for most of the international trade. The same seems true of some of the cities in Asia Minor, and the *bourgeoisie* there must largely have kept its original character. In the monarchies in general, however, it was a class of trained professionals. The creation of the Greek bureaucracy, however much it owed to its oriental predecessors, was an astonishing achievement. Philosophical treatises were of little help; the success was largely due to hard work and quickly gained experience on the part of the kings and their high officials. It was similar with army and navy, though these were largely Greek in their lower ranks as well. In this field, technical handbooks written by experts (*e.g.*, on siege machines and fortifications) were important. The writers and scholars of Alexandria and Pergamum were in a sense also professionals; on the fringe of this upper class of professionals were entertainers like the Dionysiac *technitae* (traveling religious companies of theatrical performers) and the teachers and physicians, many of whom were employed by city or state.

4. Character of Hellenistic Economy.—In the cities where economic life suffered comparatively little from royal interference, free enterprise in manufacture and trade played an important part; in the monarchies economic organization by the state was decisive. The kings needed large sums to maintain political power and military efficiency. Both civil service and armed forces were very costly. The armies had become larger, and though the kings to some extent used conscription they had to pay for large numbers of mercenaries and the expensive technical equipment of army and navy. State finance and general economy were therefore closely tied together. The king was the state. The king's economic power made of Egypt an enormous household and royal business; other states, though far from showing the same consistency, yet displayed similar trends. A primary reason for the new economic atmosphere of the Hellenistic world was the abundance of money after Alexander had put the Persian treasures into circulation, an additional reason for the fact that up to *c.* 150 B.C. large amounts of capital, assembled in the countries around the eastern Mediterranean, were used for fostering trade and business farther east. The economic prosperity of the first half of the 3rd century was followed by a slow decline which after 200 B.C. led to a dangerous impoverish-

ment of Greece and to inflation in Egypt, while the intervention of Rome particularly affected Macedonia and Asia. There still were periods of prosperity, especially in Asia Minor, but on the whole economic standards were reduced.

Agriculture remained the basis of economic life. New land (obtained for instance by draining swamps like the Fayyum in Egypt), some small improvements in cultivation, intensification of vine growing, introduction of foreign plants and of a few domestic animals were some of the features of Hellenistic agriculture. There was a growing number of large estates, and Greek experience joined hands with the greater possibilities that the east granted in land extension and manpower. The estate of the *dioecetes* Apollonius, known from papyri found in the Fayyum, is the outstanding but not the only example. The king, however, was the greatest landowner. The royal domains were very extensive; arable land and pastures were worked by the king's peasants (in Egypt native tenants who paid rent, otherwise generally native serfs); quarries, mines, forests were exploited on his behalf, partly by slaves. All land not directly owned by the king was liable to heavy taxation (often a tenth). In Egypt, the land given to temples, high officials or settlers (cleruchs) was held as a temporary royal gift, not as a property; a negligible part was private land.

In manufacture small workshops were still the rule; there was no industrialization and little mass production. The king, by taxation and monopolies, had the main share in the profits. Salt was generally an object of royal monopoly and among the Egyptian monopolies those of oil, papyrus and grain were prominent. Production and sale were closely connected, and trade partly in official hands, partly subject to high custom duties covering import and export as well as transit trade. There was some room for private enterprise, but the harbours as well as the caravan routes were officially controlled and protected; brigandage and piracy were largely suppressed. Commerce was generally helped by the unification of coinage. Only two standards existed: the Attic, which since Alexander had been adopted by Macedonia and the Asian states; and the Phoenician, used by the Ptolemies. Trade was probably the one part of economic life that had changed most clearly compared with classical times; its geographical extension was matched by technical improvements.

The most elaborate and best-known system of state economy is that of the Ptolemies, and the apparatus needed for tax assessment and collection, for controlling the officials and for exploiting country and people without destroying their ability to provide grain and money was enormous. It was a system based on strict organization and compulsion and it made the Ptolemies the richest rulers in the world. The ordinary peasants however remained poor and the general standard of living low. Foreign trade was to a large extent in luxury goods and slaves, and, though in times of strong government and economic prosperity conditions were satisfactory for a fairly large section of the population, these conditions never lasted long and never reached the lowest level of the people. Oriental fatalism helped to keep things going, but when the Greeks too began to suffer the decline became general. It was saved from its ultimate consequences by Roman intervention, but in that case the cure was probably worse than the disease.

V. HELLENISTIC CIVILIZATION

"Civilization" is a vague expression, but it would be fair to assume that it implied the standards of life, thought and art of the educated class, in which the lower classes had some share. The unity and essential uniformity of Hellenistic civilization is beyond doubt. It was the civilization of those who spoke the common Greek language (*koine*), a simplified version of the Attic dialect, enriched by new words. If the upper classes almost everywhere, and part of the lower classes as well, were hellenized, that above all meant the use of the Greek language. Without this universal language there would never have been a universal civilization nor a universal religion. Native languages usually were kept alive locally, and the Semitic east even developed a kind of non-Greek *koine*, Aramaic. Jesus Christ spoke Aramaic, but the Gospels were written in Greek.

As mentioned above, the second part and the third part of the whole period must be distinguished. In the former phase rationalism, realism and science prevailed over the forces of irrationalism, religion and superstition, which gained supremacy in the later phase. Such divisions naturally provide only a rough picture and are far too sweeping, but they may help to sort out the main tendencies of the age. Euhemerus (*c.* 300) can be taken as typical of the first phase of the Hellenistic age: he wrote a fantastic travel story to show that the gods were in reality great men of the distant past (*see* EUHEMERUS). This theory may be regarded as a rationalist version of the old Greek feeling that there was no unbridgeable gulf between god and man; it continued at the same time the rationalist explanation of myth of the 5th century. Even so Euhemerus went further and reflected significant trends of his own times. In the long run, however, he could not satisfy any spiritual needs.

1. Education and Literature.—The earlier period was in many respects a continuation of the classical age. It is easy to find forerunners in the 4th century; *e.g.*, in the methods of higher education, either philosophical, as practised by Plato, or rhetorical, as practised by Isocrates. Athens remained the home of philosophy (*see* below). Rhetoric was in fact the predominant element of Hellenistic education. This was so although its principal use in classical times, in politics and the law courts, had lost its importance. It might still happen that orators (or indeed philosophers) were chosen to act as ambassadors, but even then the aim of oratory was less persuasion than to make an impression by a set speech of what the Greeks called the epideictic ("showpiece") kind. To deliver public lectures was the chief activity of a finished orator, apart from teaching rhetoric. The part played by rhetoric in education can hardly be overestimated. The original idea was that good speaking derived from good thinking; but the complex schemes of rhetorical instruction lost sight of that and produced a technical formalism no longer connected with reality. It had a strong and on the whole pernicious influence on every branch of literature, although it certainly contributed to the unity of Hellenistic civilization. Leading to monotony and emptiness or to the artificial and inflated style of the "Asianic" school, it yet must not be regarded as void of educational and cultural values. Even in the last century B.C. there was a school of sound rhetoric in Rhodes which exercised a strong influence on Cicero.

One other legacy of classical Athens should be mentioned, the New Comedy of Menander (*q.v.*) and others. Works of high literary art, the comedies with their conventional situations and stock characters (though these were admirably depicted as individuals) reflect the spirit rather than the actual life of the *bourgeoisie* of the decade after Alexander's death. The real life of that class was still predominantly civic; there is no sign of this in New Comedy; reality could not consist of those always repeated plots built round seduced girls, cunning slaves, cruel fathers, boastful soldiers and the rest. The comedies, following Euripides rather than Aristophanes, displayed a tame eroticism and, like Theophrastus' *Characters*, an intense interest in unusual individuals and human emotions. The same interest is evident in the realism of Hellenistic art, its portraits as well as its genre scenes. While there is no clear influence of philosophy or rhetoric in New Comedy, its authors shared the widespread belief in the rule of Fate (Tyche). (*See* DRAMA: *Greek Drama.*)

The high esteem of rhetoric is one sign among many of the technical character of the age—"technical" not in the modern sense but in the Greek meaning of expert handling, usually based on the knowledge of fixed rules. In literature, learning and playful versatility became more important than creative enthusiasm, experimenting with language and metre or good taste more important than a serious relationship to myth and religion. Literature and literary scholarship developed side by side and influenced one another. For example, Demetrius of Phaleron, pupil of Theophrastus and for ten years the philosophical and aristocratic ruler of Athens, went to Egypt and advised Ptolemy I when he founded the Museum (not a museum in the modern sense but rather a research institute) at Alexandria. This, with its large library, became the meeting place of scholars and writers; from there, ultimately, and not from Plato's Academy, derive modern libraries, universities

and academies. Callimachus, who was a leading poet of the 3rd century, was also responsible for the catalogue of the library. The works of few writers have survived, and what we know is only a small part of a very large production. Writers of all kinds were in demand. There was not only royal patronage but also an increased reading public, including female readers. The papyri that have survived reflect the enormous number of books on all levels, classical as well as contemporary; the papyrus trade must have been largely book trade. Alexandria was the chief centre, but substantial libraries existed at other places as well.

The combination of literature and scholarship, intensified by the seclusion in which the men at the Museum lived, hardly made for great poetry. There were also petty quarrels between the poets, though that may be taken as the birth pangs of a new type of man of letters. With all their learnedness and artificiality the Alexandrian poets maintained a remarkable poetic level (they also greatly influenced the Latin poets, particularly Catullus and Virgil). Newly discovered papyri have heightened the reputation of Callimachus (*q.v.*). Theocritus (*q.v.*), famous as the originator of pastoral poetry, was perhaps an even better poet when, as in his *Mimes* and sometimes in his *Idylls*, he turned to genuine popular material. Apollonius of Rhodes (*q.v.*) in his *Argonautica* made an imaginative attempt to renew the Homeric tradition, while Aratus (*q.v.*) of Soli in his didactic poem on the stars, *Phaenomena*, wrote in the tradition of Hesiod; the book was also intended for practical use by sailors, being based on a 4th-century prose treatise by Eudoxus. Callimachus and other poets wrote hymns, *epyllia* (a kind of mythological short story in verse) and epigrams. The last have been called the characteristic Hellenistic form of poetry; referring no longer to heroic deeds but to the lives and deaths, love and revelry of ordinary people, they reflect the temper of the age. The epigram flourished even as late as *c.* 100 B.C., the date of the *Garland* of Meleager (*q.v.*) of Gadara; but eventually it too was corrupted by rhetoric.

Literature had to cater for the entertainment of an increasing audience. Popular festivals and shows abounded in the Hellenistic world; but apart from the authors of New Comedy the playwrights are practically unknown. There were frequent performances of classical drama, especially Euripides. A kind of dramatic poetry, though not meant to be staged, were the *Mimiambi* of Herodas (*q.v.*), realistic dialogues full of satire and obscenity. It seems that the mimes and pantomimes (ballets), the most popular forms of dramatic entertainment under the Roman empire, also had their origin in the Hellenistic period. They showed what generally can be called significant features of Hellenistic literature and art: a growing display of realism and disharmony, of emotion and exaltation, of eroticism subtle or crude.

2. Historiography.—The same features, combined with the fruits of rhetoric, can be discovered in much of the prose writing. For the historians this involved a conflict, since dramatization and rhetorical writing as a means of raising emotional interest were contradictory to the task of rendering the historical truth. The conflict can first be seen among the Alexander historians. His exploits were the very subject for a romantic and rhetorical narrative; the earliest writer of this school was Aristotle's nephew Callisthenes (d. 328), who wrote a book of fiction and flattery; others took a similar line, the most influential being the 3rd-century Cleitarchus. He, and the popular tradition which followed him, had a far greater influence than the sober and factual works of some men who had served under Alexander, such as Ptolemy who became king of Egypt, Nearchus the admiral, and Aristobulus. Eventually romantic history turned into the Alexander Romance, a fairy tale of the most fantastic nature, a mixture of Greek and oriental elements, whose origins belong to the later Hellenistic age (*see* ALEXANDER ROMANCES).

There were odd mixtures of factual and fictional history, *e.g.*, in the books of the Babylonian Berossus (*q.v.*) and the Egyptian Manetho (*q.v.*), who wrote their native histories for a Greek public. Among Greek historians the contrast between the two types prevailed. The one was again represented by men of sound political or military experience, such as Hieronymus of Cardia, Aratus of Sicyon and Polybius. To the other school, called "tragic history" by Polybius, belonged gossipy writers like Duris and Phylarchus; the latter is expressly criticized by Polybius. He also reproves Timaeus (*c.* 350–*c.* 250), the historian of the western Greeks, because of his bookish pedantry; but Timaeus was a serious historian and the type he represents, that of the armchair historian, was to become more and more common. But the real summit of Hellenistic historiography was Polybius. He firmly believed in the usefulness of history for the practical politician. He relied on rational explanations and maintained a markedly ethical attitude; a son of his time, he also paid tribute to the force of Tyche, thus combining two apparently inconsistent elements. But both served his pedagogic aims: one must not only know the facts but also learn from the way men stood up to the blows of fate. Polybius was a fervent admirer of Rome and of his own Achaean league; he can be very unfair to their enemies. He does not reach his own ideal of unbiased truth and falls short of his own standards of accuracy. He is, however, the only extant example after Thucydides of a reliable Greek historian. In describing the Roman constitution (book vi) he puts forward two at first sight incompatible theories, that of the mixed constitution and that of a cycle of constitutions; it is difficult, though not impossible, to unite the two theories as expressions of the permanent ideal and the ever-changing reality. The expansion of the Roman empire is Polybius' general theme; in writing contemporary history, he wrote universal history as well, in a sense in which nobody had done so before. He was not a great writer but a significant figure in historiography. The same Rome he admired, however, was to crush the very spirit he represented.

3. Scholarship.—Polybius' method of writing history approached historical scholarship. Even more scholarly were some of the antiquaries such as the Atthidographers (writers of Athenian chronicles) or Craterus, who edited a collection of Athenian public decrees. Literature and scholarship were closely connected, and the fame (or the notoriety) of the Alexandrians is even more securely based on their scholarship than on their literature. It was they who were responsible for the preservation of many classical works and the establishment of correct or at least readable texts. Then and there, classical scholarship was born. Its primary object was Homer, whose works were edited by Zenodotus and Aristarchus. The Alexandrians also wrote commentaries which provided most of the material preserved in the *scholia* (commentaries) of later times. We owe to the Alexandrians, among other things, the text and the extant selection of Athenian tragedy and comedy, as made by Aristophanes (*q.v.*) of Byzantium. The scholars of Alexandria and Pergamum also established the study of language and grammar; an Alexandrian of the 2nd century, Dionysius Thrax (*q.v.*), created most of our grammatical terminology. Biography too became a branch of scholarship; a papyrus has preserved part of Satyrus' life of Euripides, written as a dialogue. Many biographies included gossip and scandalmongering; faked letters of famous persons became a popular element in semifiction, and many of the anecdotes in Plutarch or Diogenes Laërtius go back to Hellenistic writers.

4. Fiction.—The beginnings of the novel as a special form of art belong to the Hellenistic era. There were romantic love stories which remained famous for many centuries, such as those of Hero and Leander, Pyramus and Thisbe, Sappho and Phaon; and there were also travel stories. The two together were the formative elements of the novel, though some oriental influence in its creation seems certain; Euhemerus' story (*see* above) probably showed such influence. Other prose books might deal with the lives of *hetaerae* (courtesans) or the art of cooking or the interpretation of dreams. These books were usually not on a high literary level and with their sentimentalism or their special instruction catered for a wide reading public. It was the same with prose as with poetry.

5. Science.—Literature, scholarship and science worked together in various ways. A central position was held by geography. Its progress was based mainly on two facts: the exploration of eastern countries in the course of and after Alexander's campaigns, and voyages of discovery like those of Pytheas of Massilia and the Carthaginian Hanno in the Atlantic ocean; and, on the other hand,

the specialization in scientific research in the Peripatetic school. Alexander's surveyors (the "bematists") had measured a great deal of Asia, and Aristotle's pupil Dicaearchus had made a map of the known world. Eratosthenes (*q.v.*; second half of the 3rd century) had a great comprehensive mind; he studied at Athens and then worked at Alexandria. He established the foundations of Greek chronology (improved by his pupil Apollodorus) and wrote on various subjects, but his fame is based on his achievements in mathematical geography. He measured the perimeter of the earth and reached a result close to the one now accepted. He found out a great deal about the shape of the continents, and he wrote a textbook of descriptive geography which had many successors. Polybius had the historian's interest for this kind of work. Poseidonius (*c.* 135–*c.* 50), among his many activities, made a study of the Atlantic ocean and took up the idea, first expressed as a possibility by Eratosthenes, that a comparatively short voyage west would lead to India; the idea survived antiquity and still prevailed in the mind of Christopher Columbus. Finally, Strabo (under the emperor Tiberius) compiled the results of research and description in his *Geography,* an invaluable collection of material and at the same time a work of high literary standing.

For his mathematics Eratosthenes used the *Elements* of Euclid. The logic of this comprehensive textbook of plane and solid geometry, divided as it was into definitions, postulates and axioms, made it truly a work of genius, although it was mainly based on the work of the Pythagoreans and other predecessors. Euclid also did important mathematical research, and he was probably the first to state the value of "pure science." A greater mathematician, in fact the greatest among the ancients, was Archimedes (*q.v.*), whose work in both pure and applied mathematics and variety and depth of whose thought were outstanding. Several of his books have survived. He solved some problems of quadrature, using methods closely related to integration, and he put the exact value of π between very narrow limits. No later mathematicians were of major importance, except Apollonius of Perga (*q.v.*) with his *Conics* and perhaps Hipparchus, chiefly an astronomer, who first distinguished trigonometry from geometry. In applying his theories to mechanics, Archimedes became the inventor of various clever devices; *e.g.*, the water screw ("screw of Archimedes"). On the whole the technical, compared with the theoretical, achievements of the age were limited, though less so than is usually assumed. One of the reasons for the lack of technical achievement may have been that cheap labour was ample and there was therefore little need for labour-saving machines; the megalomania of Ptolemy IV and Hieron, on the other hand, could lead to great technical achievements in the building of giant ships. Hero of Alexandria constructed and wrote comprehensively on mechanical devices; he probably belongs to the 1st century A.D. but he described Hellenistic mechanics. A complicated gearbox, a surprising example of advanced Hellenistic technology, has been recovered from a ship wrecked early in the 1st century B.C.

In astronomy the Babylonians had prepared the way, and their own astronomy, which had declined into astrology, was revived under Greek influence. There was mutual give and take as in hardly any other matter. Astronomical thought and observation centred on the planetary system. The traditional view had been geocentric; *i.e.*, that sun, moon and planets circled round a stationary earth. Then it emerged that the earth turned on its own axis and also that Venus and Mercury revolved round the sun. Hence Aristarchus of Samos (*q.v.*) claimed that the sun was larger than the earth and the centre of the whole system. This heliocentric theory, hampered by the assumption that the planets revolved in circles, was almost universally rejected and had to wait until in the 16th century Copernicus renewed it. Hipparchus (*q.v.*) restored the geocentric view, basing it on a complicated system of epicycles (smaller circles within a circular movement round the earth). But he was a great astronomer and was able to measure almost accurately the lunar and solar years. That, however, had no more effect than the theory of Seleucus, a hellenized Babylonian (*c.* 150 B.C.), who realized that a relation between earth and moon caused the variations of tides. Several astronomers (among them Poseidonius) tried to estimate the sun's diameter and its distance from the earth; they all widely underestimated the true figures. The work achieved in astronomy was summarized—with many errors avoided by earlier men—in the standard book of Ptolemy (*c.* A.D. 140), who for centuries remained the only authority (*see* PTOLEMY).

In biology Aristotle's works on zoology and Theophrastus' on botany found few followers even in their own school. This is surprising in view of the rich material provided by Alexander and the hunting expeditions of some of the later kings. Ptolemy II founded a zoo, attached to the Museum. Medicine, on the other hand, made great progress, especially in anatomy and physiology. Dissection of dead bodies became fairly common and surgery was practised with some success. It is doubtful whether experiments on live animals took place. The functions of brain and nerves, of the arteries and their connection with the heart, were traced. By the 2nd century, physicians became more interested in the study of drugs and poisons. Moreover, temple cures and the magic miracles of quacks gained ground over and against scientific medicine.

The Hellenistic age knew nothing of chemistry and very little of physics or geology. Experiments were rare, except in mechanics, and these were rarely concerned with instruments for practical use; never for scientific research. This fact and the later intellectual development explain the limits of Hellenistic science. Nevertheless, there has been no period before the modern age with such a wide interest in science and scientists as the first two centuries after Alexander the Great. Observation and reasoning combined and achieved remarkable results. Afterward, partly through the lack of instruments and partly because of the retreat of rational methods, a deterioration set in, which eventually brought to a halt all scientific progress.

6. Art and Architecture.—Hellenistic art was on the whole a continuation of classical Greek art, despite the changed conditions and the new tasks for artists and patrons alike. Elegant craftsmanship and emotional strength were generally just as intensely expressed as in literature; architecture shared in the advances of mathematics and engineering. Town planning entered a new phase. The old 5th-century scheme of Hippodamus (*q.v.*) with its rectangular pattern suited the prevailing rational mind; it was improved and altered according to localities. Water supply and drainage were problems now seriously tackled. Public buildings, usually endowed by a rich citizen or one of the kings, were erected on a large scale; there were fewer temples but theatres, gymnasia, porticos and colonnades were erected in cities old and new. Of the royal palaces practically nothing is known. Hellenistic towns, though closely built up, showed perhaps more splendour than those of classical times. Private houses followed previous types, but with more space and adornments. Real innovations in building were rare; the arch, long known in the east, occurred sometimes, but it was the Romans who really used it and revolutionized architecture. Outstanding in Hellenistic times was the building of city walls and fortifications. On the whole, Hellenistic architecture, with its occasional tendency to build on a colossal scale, was impressive and, for example, the acropolis of Pergamum and the colonnaded market places of some cities must have been striking sights.

No branch of art reveals more clearly the spirit of the age than sculpture, if only because so much of it has survived. Many sculptors followed in the paths of the great masters of the 4th century, but to a growing extent new styles developed which, not without good reason, have been called the baroque and rococo of Greek sculpture. Repose became movement, serenity emotion, idealism turned into realism, loveliness into sensuality, tradition into a search for originality. Complicated groups were quite common in the later phases. The demand for sculpture had much increased, and high prices were paid. Portrait statues abounded, and indeed portraiture was one of the great achievements of the time; starting from Lysippus' "Alexander," statues of kings and statesmen were set up, and also of poets and writers. Fine portraits are also found on gems and coins. Many works showed little more than high craftsmanship; but there were masterpieces such as the "Victory" of Samothrace, the "Dying Gaul" or the "Tyche"

of Antioch (Fortune as the city goddess). They belong to the 3rd century, originating from different schools at Rhodes or Pergamum. Later great works were the "Aphrodite" of Melos (the "Venus de Milo," now in the Louvre), the "Aphrodite" of Cyrene in the Terme museum, Rome, and the heroic so-called "Hellenistic Ruler," also in Rome; the two latter examples show an overemphasis of feminine sensuality or muscular manliness; while the "Laocoon" in the Vatican expresses violence of a rather histrionic kind. A work unique in its colossal size and the exuberance of its style is the frieze of the great altar at Pergamum (in the Pergamon museum, Berlin); the old theme of the battle between gods and giants was probably intended to symbolize the victory of Greek civilization over the barbarians, but with its overcrowding and the turmoil of strange bodies it is almost an example of barbarization itself. The trend toward exaggeration is shown in different ways, for instance in the sweetness of children (Eros is represented as a baby for the first time) or the ugliness of a drunken woman. (*See* GREEK ART.)

Reliefs too grew more naturalistic, partly by the use of perspective to distinguish different levels in depth, partly by the combination of sculpture and painting. Of painting practically nothing purely Hellenistic survives. A copy of an early painting is the wonderful Alexander mosaic found at Pompeii which shows great dramatic power and command of composition. Otherwise there are Pompeian wall decorations and frescoes which derive from Hellenistic models but do not simply copy them. Perspective as well as light and shade were used in Hellenistic times, but what the colour schemes were like is not known. Later Hellenistic painters probably used landscape in the manner of some of the Pompeian works. Portrait painting also has left its mark. Vase painting was of little significance, except for new provincial styles and techniques, especially in Italy, which practically ended in the 2nd century B.C. The terra-cotta statuettes from Tanagra and other places show charmingly realistic scenes of the life of women and children.

So far all Hellenistic art was in the Greek tradition. There is hardly any evidence of eastern influence, apart from the official continuation of the native tradition in Egypt. Works of a much later date, such as the frescoes from Doura, actually display eastern influence, but it is not known to what extent they go back to Hellenistic times. The reverse is true where eastern art is concerned. Many examples show Greek influence on eastern art. Most remarkable are the "Greco-Indian" sculptures, chiefly found in Gandhara (*q.v.*), among them a type of Buddha which clearly shows its Greek ancestry. The date of these is disputed; they may well begin in the 1st century A.D. and derive through Parthia from Roman models. From India this mixed art slowly traveled eastward through Turkestan to China. In the west, Carthaginian architects and sculptors copied Hellenistic models. The story of the impact of Greek art on Rome is well known.

7. Philosophy.—The mental outlook of the 3rd century was optimistic and restless. Men needed guidance in the face of changing conditions. To be no longer the citizen of an independent city-state implied the loss of the traditional bonds of Greek ethics. The aristocratic philosophies of Plato or Aristotle meant very little to the average Greek, and though he still worshiped his old gods they were unable to help him in his daily encounters with the vicissitudes of life. He might believe in fate and be satisfied with a resignation that left his life in the hands of a capricious and inscrutable power. But the demand for new standards of life grew and was met by various kinds of philosophers, all primarily moralists, preaching to the ordinary citizen how to avoid unhappiness and pain. Most spectacular were the Cynics, a sect rather than a school, founded by Diogenes "the dog." He lived and preached a life of primitive self-sufficiency. He wrote nothing, but his followers, many of them itinerant preachers like Crates of Thebes, did write both prose and poetry. They developed new literary forms, especially the *diatribe*, a popular sermon, and the satire, usually in verse and often in the form of a parody. Bion of Borysthenes was famous for the former, Menippus of Gadara for the latter; both had started life as slaves. There was a clear antibourgeois tendency in the Cynics' writings, but their teaching left the individual in a social vacuum. They also indulged in polemics with other philosophers. One school that drew the most radical conclusions was that of the Skeptics, founded by Pyrrho of Elis. They doubted everything and ended in complete nihilism. Plato's Academy took up a similar attitude later and failed to provide any guidance, while the Peripatetics, wavering between isolated scientific disciplines and popular ethics, lost all philosophical originality and influence. (*See* ACADEMY, GREEK; CYNICS; PERIPATETICS.) Two new schools, however, emerged at Athens, the Epicureans and the Stoics, neither any longer concerned with the discovery of truth but with the conduct of the individual in order to reach personal happiness. Their ethics went far beyond the ethics of *polis* society.

Epicurus, in his teaching and writing, covered the whole field of philosophy, but his real aim was the undisturbed peace of man's soul (*ataraxia*). Freedom from fear, from pain and from emotions was essential. The enjoyment of pleasures was part of human happiness, but only if under such restraint that they did not interfere with man's peace of mind. That equivocal rule could easily be misunderstood and misused; it could lead to outright hedonism, but, on the other hand, enjoyment might just as easily turn into asceticism. Basing his philosophy on Democritus' mechanical atomic doctrine, Epicurus had no interest in its scientific side but used it for a materialistic explanation of emotional life and as the foundation for a remarkable insight into psychosomatic facts. He also used it, as it were, to put religion in cold storage. He did not deny the existence of gods; they were to be honoured by the traditional rites, but only as a group of super-Epicureans who lived somewhere outside the world and did not interfere in human life. Epicurus believed in free will as the foundation of morality. The community of "the garden" was based on mutual friendship and the reverence felt for its founder. His doctrines were never substantially altered, and much of it has come down through enthusiastic followers like Philodemus (*q.v.*) and the Roman poet Lucretius (*q.v.*). Though there were a good many Epicureans during the following centuries, not least in Rome, their aversion to active life and lack of interest in politics and rhetoric prevented them from exercising a wide influence. There was, however, a growing desire for retreat from the world and into oneself; Epicurus' teaching, which was really spiritual escapism, made some people very happy. (*See* also EPICURUS; *Philosophy*.)

Of Stoicism, on the other hand, it has been said that it was *the* philosophy of the Hellenistic age. Founded by a hellenized Phoenician, Zeno (*q.v.*), and called after the *stoa* (portico) at Athens where he lectured, Stoicism was to become a truly universal philosophy, though essentially Greek and deeply influenced by Cynic teaching. Subsequent heads of the Stoa were first Cleanthes (*q.v.*) and later Chrysippus (*q.v.*), another oriental, who gave more logical coherence to the existing body of doctrines. Its earliest ancestor was Heraclitus (*q.v.*), whose *logos* was reestablished as Providence or Nature, ruling the universe according to eternal laws. The *logos* was claimed to be a material all-pervading spirit (*pneuma*), a dynamic force which provided an ultimate explanation of physical phenomena. It was also the basis of the rational psychology and ethics of Stoicism. They were both individualistic and cosmopolitan. There were no differences between Greek and non-Greek, man and woman, free and slave. The great idea of the brotherhood of men originated from the Stoics; a modern view that it started with Alexander the Great cannot be accepted. It was in every human being's power to gain complete virtue. This ideal of an entirely self-sufficient man (the "sage") seems almost inhuman; like the Epicurean ideal, it aimed at an undisturbed peace of mind, but without leaving worldly affairs alone. That ideal was to some extent realized when some Romans accepted Stoic teaching.

In any philosophical religion the gods were little more than accessories. Thus in Stoicism myth was incorporated by allegorical interpretation. Moreover, the rational power or *logos* was divine, a nonanthropomorphic deity, addressed as Zeus in a beautiful hymn by Cleanthes. Whatever its name, whether Zeus or Heimarmene ("Destiny") or Nature, it was all-wise and all-embracing; thus the common belief in Tyche was raised to a higher

level. There were inconsistencies in Stoic philosophy, and it is sometimes doubtful to what period of Stoic philosophy certain doctrines belong, for instance whether the idea of a world state (*cosmopolis*) was proclaimed as early as Zeno. In contrast to the Epicureans, Stoic philosophy played an important part in public life; some Stoics advised kings and statesmen; one king, Antigonus Gonatas, was a Stoic, and much social reform was due to Stoic advice. The Stoics took as their embodiment of the highest human potentialities Heracles, who cleansed the world of evil. There was a conflict, never solved in principle, between wisdom and determinism, which only confirms that Stoicism came near to being a religion. With its strict moralism, it offered mankind a guidance which was widely accepted. Rome received it in a watered-down form through Panaetius and Poseidonius (the so-called "Middle Stoa" school). The latter, a forceful and versatile thinker, combined the most various branches of science and scholarship with Stoic doctrine. His books are lost and to what extent they were used by Cicero and others is much disputed. It seems certain that he differed from the school tradition by introducing mystical and eschatological elements. The later Stoics—represented under the empire by Seneca, Epictetus and the emperor Marcus Aurelius—returned to what has been called "a religion of the educated" but was essentially a rather trivial refuge in a disturbed world. (*See* also STOICS.)

8. Hellenism and the Jews.—In this context, on the borderline of philosophy and religion, it seems appropriate to deal with the relations between Greeks and Jews. These relations, though only part of the larger relations between east and west, are of particular importance, first because the Jews were the only people who opposed Greek civilization on principle, and second because their mutual influence was all-important for the origin of Christianity. During the 3rd century the tiny community of Judaea, ruled by a high priest, was under Ptolemaic sovereignty but hardly figured in history. For a long time the Greeks knew very little about the Jews, although the number of Jews living in communities outside Judaea (the Jews of the Dispersion) gradually increased and some Greek writers had a vague concept of Jewish monotheism. A section of the Judaean Jews had begun to adopt Greek ways of life, however, and it was this upper class that turned to the Seleucids when they became masters of Palestine *c.* 200. The Hellenizers were strongly opposed by the mass of the people. The climax came under Antiochus IV Epiphanes (*see* ANTIOCHUS). It is disputed whether he was moved to his interference by a previous revolt and simply acted to recreate a strong Seleucid government, or whether his aim was to spread hellenization. The cult of Olympian Zeus introduced by Antiochus into the Temple was in fact that of a Syrian Baal in Greek disguise. Antiochus certainly sided with the hellenized upper class against the people who were perhaps first led by the *Hasidim* ("pious"; *see* JEWISH SECTS DURING THE SECOND COMMONWEALTH), finally by the Hasmonaean family, also known as the Maccabees. The war of the Maccabees eventually saved Judaism, but the independent state which emerged showed increasingly Hellenistic features and underwent a process of secularization culminating in the rule of the Idumaean Herod (*q.v.*) the Great.

Jewish literature flourished during the 2nd and 1st centuries, showing Greek influence in varying degrees. There are for example the two historical books of Maccabees (*see* MACCABEES, BOOKS OF), witnesses of extreme nationalism, of which the second was originally written in Greek. Others were added either to the canonical or the apocryphal books of the Old Testament. The author of the Book of Wisdom (*see* WISDOM, BOOK OF) knew Greek logical terms and may have read Plato; the skepticism and pessimism of Ecclesiastes (*q.v.*) was hardly possible without Hellenistic philosophy, nor the Song of Solomon (*q.v.*) without Hellenistic love poetry. Yet direct borrowing is doubtful. The decisive factor was that Jews and Greeks were contemporaries in the same world. Much of this Jewish literature was written outside Judaea, and naturally Greek influence was strongest in the Dispersion. Jewish communities with their synagogues could be found all over the Hellenistic world, and in some cities they were acknowledged as a separate *politeuma*. Many Jews took Greek names and imitated Greek ways; some even seem to have worshiped the "Highest God" or Zeus Sabazius, who was identified with the Lord Sabaoth (*see* SABAZIUS). Many no longer knew Hebrew or Aramaic but only Greek, and it was for their sake (though with much more far-reaching effects) that in Egypt the Greek translation of the Old Testament known as the Septuagint was made. Most Jewish books of the time had little influence on the further development of Judaism; they were remembered mainly by the Christian church. The prevailing traditionalism of the Jews in Judaea and the religious customs of Jewish life everywhere excluded close intercourse with the Greeks. No Jew could really worship the city gods. Anti-Semitism began to develop, partly because of economic rivalry but mainly through mutual religious propaganda and because the Jews, though active in all sorts of professions, were different from other people and kept apart. The important Jewish community at Alexandria never gained citizenship as such; only individuals, who more or less gave up their religion, were truly hellenized.

The influence was by no means only in one direction. The Jews of the Dispersion began to win proselytes (as can be seen in the book of Jonah, though that may belong to an earlier period), and even without that some Greeks were prepared to learn from Jewish tradition. In the attempts to make philosophy the handmaid of religion, the revelations of eastern religions, and in particular of Jewish monotheism, were regarded as means of gaining the knowledge (*gnosis*) which would lead man to immortality. Influence of the Old Testament and later Jewish writings can be traced, for instance, in the *Hermetica* (occult writings supposed to derive from Hermes Trismegistos; *q.v.*), especially the *Poimandres*. Quite a different example of a union between Jewish religion and Greek philosophy is provided by Philo (*q.v.*) of Alexandria, who lived under the early empire but whose books are truly Hellenistic. He tried to explain the Old Testament by allegorical interpretation, a method well known in Hellenistic thought. His speculations did not markedly affect the development of Palestinian Judaism but were contributions of primary importance to Christian theology. Other significant developments among the Jews were the teaching of the Essenes, a monastic brotherhood, and the hope of the coming of the Messiah.

9. Religion and Magic.—All this is part of a more general story. Jewish beliefs in the Hellenistic era had much in common with other forms of worship. In a sense the Hellenistic development culminated in the victory of religion. In the term "religion" all sorts of irrational beliefs and superstitions, often hidden in pseudo-scientific disguise, are here included. The ancient Greek religion was by no means dead, but it was not able to serve the needs of people who longed for personal help and happiness and for the security of an afterlife. Fear of death had an integral part in many of the people's beliefs. What a minority found in the teaching of philosophers was looked for by most people in various forms of worship, in astrology or in magic and occult practices. This was not only a spiritual but also a social movement; in the end the uneducated masses, but not they alone, got what they wanted and needed.

Certain forms of religion had always been strong in the east and continued to be so in the Hellenistic age. The Hellenistic rulers with very few exceptions exercised religious tolerance, though they fought the power of the priests. As to Greek religion, there is evidence not only of constant and even intensified public worship, but also of a new importance of some members of the traditional Pantheon. Among these were Asclepius, the healing god, for example, with his cures effected by sleeping in his temple at Epidaurus, and, above all, Dionysus as the god of mystic and ecstatic worship. The door was open for more personal forms of religion, which at the same time were universal. The differences between the gods gradually disappeared and additional names like *Soter* ("saviour") were more important than their real names. Polytheism was on its way toward monotheism. Moreover, the Greeks had always assimilated foreign deities to their own and in this process they frequently changed their nature. During the Hellenistic age, Greek and eastern forms of worship were united in widespread fusion which is called syncretism. It played its part

in the ruler cult and in the belief in Tyche, who was assimilated to Cybele and Isis; it served to reshape oriental cults in order to satisfy Greek believers; it was active in the artificial creation of Sarapis (*q.v.*) by Ptolemy I and in the growing diffusion of the cults of the Syrian and Egyptian gods, none more spectacular than that of Isis (*q.v.*), who, together with Sarapis, became the centre of an organized and truly universal religion.

The deeper reason for this success is probably that the cult of Isis—as of several other deities—included mysteries (*see* MYSTERY) which would bring some certainty of salvation to the initiate. The Greeks had their own mysteries, like those of Eleusis and Orphism, both still going strong. Mysteries of Dionysus flourished. The eastern cults, however, more drastic, more savage, gained ground, though the full impact did not reach Greeks and Romans before the 1st century A.D. The story enacted in the mystery might deal with the death and resurrection of a god, or with a divine marriage, but the real theme was death and afterlife—that is to say, the victory of life over death. By the process of initiation, which might take a long time and could include ascetic life, confession, baptism and sacraments, the individual was gradually raised to higher levels of purity and perfection, and finally reached redemption and immortality; sometimes this meant a kind of rebirth. In the Great Mother of the Gods (*q.v.*) and in Isis the ancient mother goddess of pre-Greek times had a triumphant revival. It can hardly be denied that she lives on in the concept of the Christian Virgin and Child.

Mystery religions were bound to restrict the number of their adherents; besides, the demands made on the individual were not for everybody. There were easier ways to approach the supernatural and to overcome the fear of unguided freedom. One was astrology (*q.v.*), invented centuries earlier in Babylon. It was based on the concept of star worship, and it meant belief in the connection between human life and the laws of the sky. Either the seven planets or the twelve signs of the zodiac governed the lives of men and states alike, and the casting of horoscopes became a means of foretelling the future; but astrologists were not interested in eschatological ideas. Astrology could lead to a disastrous fatalism, and people tried various ways of escape. One of these was magic, which came from the east and in Hellenistic times had its centre in Egypt. All sorts of magic beliefs and practices spread, together with the belief in beings between man and god, who, good or more likely evil, might be induced to serve man. These *daemones* were approached by magic methods as various and plentiful as there were wandering magicians and trusting believers.

Hellenistic civilization, as every great civilization, had very varied aspects. While preserving the Greek heritage, and at the same time spreading it wide and far, Hellenistic man discovered new ways of thought, of belief and of life. State and society, literature, art and science, philosophy and religion, all bear witness to an atmosphère that was different from earlier and later times. At the end of the era, there are two gigantic phenomena, the creation of the Roman empire and the advent of Christianity. Although both drew their main strength from other sources, in many of their features they can be seen as having evolved from the Hellenistic age.

See also references under "Hellenistic Age" in the Index volume.

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(V. L. E.)

HELLESPONT (*i.e.*, "Sea of Helle"; variously named in classical literature Hellespontos, Hellespontum Pelagus and Fretum Hellesponticum), the ancient name of the Dardanelles (*q.v.*). It was so-called from Helle, the daughter of Athamas (*q.v.*), who was drowned there. *See* ARGONAUTS.

HELLMAN, LILLIAN (1905–), U.S. playwright whose dramas bitterly and forcefully attacked injustice, exploitation and selfishness, was born June 20, 1905, in New Orleans, La., attended New York public schools, and received degrees from New York university and Columbia university. Her marriage (1925–32) to the playwright Arthur Kober ended in divorce. After working variously as book reviewer, press agent and play reader, she began writing plays.

Her dramas exposed various forms in which evil appears—a malicious child's lies about two schoolteachers (*The Children's Hour*, 1934); a ruthless family's exploitation of fellow townspeople and of one another (*The Little Foxes*, 1939, and *Another Part of the Forest*, 1946); and the irresponsible selfishness of the Versailles treaty generation (*Watch on the Rhine*, 1941, and *The Searching Wind*, 1944). Criticized at times for her doctrinaire views and characters, she nevertheless kept her characters from becoming merely social points of view by credible dialogue and realistic intensity matched by few of her contemporaries. These plays exhibit the tight structure and occasional overcontrivance of what is known as the "well-made play." In the 1950s she showed her skill in handling the looser structure of Chekhovian drama (*The Autumn Garden*, 1951) and in translating and adapting (Anouilh's *The Lark*, 1955). She returned to the well-made play with *Toys in the Attic* (1960). (Js. T. N.)

HELL'S CANYON, a mile-deep gorge in the central section of the grand canyon of the Snake river, runs along the Idaho-Oregon boundary. Reaching a maximum depth of 7,710 ft. (2,350 m.) on its Idaho wall, it is the deepest canyon in North America. Two 19th-century steamboats sailed down the canyon with extreme difficulty, but the river is navigable only for small craft.

Excellent hydroelectric power sites, including an incomparable one for a high dam, are numerous in the canyon. When the devastating Columbia river flood of 1948 focused attention upon control of the Snake river, the bureau of reclamation and the U.S. army engineers recommended a high Hell's canyon multiple-purpose dam for flood control (4,400,000 ac.-ft. storage), navigation and power. In 1950 the Idaho Power company applied for private development through three lower dams; after a hearing of four and one-half years, the Federal Power commission granted a licence to the company on Aug. 4, 1955. A national controversy, pitting public against private power advocates, grew out of the hearing, and in 1957 the United States senate approved federal construction of a high dam that would flood the Idaho Power sites. The house did not concur, however, and in 1958 power production commenced at the initial private dam. In Jan. 1959 the Brownlee dam unit went into full production of 450,000 kw. Oxbow dam generators, which produce 200,000 kw., went into full production on Nov. 28, 1961. Work began on Hell's Canyon dam in 1962, looking toward total kilowatt production by the three dams of more than 1,000,000. (M. D. B.)

HELMAND (HELMUND; HILMAND; ancient ETYMANDER), a river of Afghanistan, rises in the recesses of the Koh-i-Baba (an outlier of the Hindu Kush), west of Kabul, its infant stream parting the two main passes (Unai and Irak) on the road from Kabul to Bamian. Its length is 870 mi. It is the most important river of Afghanistan next to the Kabul river, which it exceeds in both volume and length. The character of the Helmand, as it flows southwestward, is that of a mountain river. It passes through the valleys which in summer are the resort of nomadic pastoral tribes.

About 50 mi. above the town of Girishk, the Helmand enters the artificial reservoir of Kajakai (built to store water and secure irrigation) and thenceforward it is a well-mapped river to its termination in the Seistan lake depression (*see* SEISTAN). On leaving the reservoir, it enters a flat country and extends over a gravelly bed. It also begins to be used in irrigation, and a diversion dam (just above Girishk) has been built to feed the Boghra canal. The Helmand is crossed at Girishk by the Kandahar-Herat main road. At Qala Bist (Bust), 30 mi. below the town, it receives its principal tributary, the Arghandab, and becomes a considerable river with a width of 300–400 yd. and an occasional depth of 9–12 ft. Even in the dry season it is never without a plentiful supply of water. It continues in a southwesterly direction through a wide alluvial desert, turning nearly north at Chahar Burjak in the extreme southwest of the country and flows on for about 75 mi. till it falls into the Seistan swamps by various mouths. There it forms the Hamun-i-Helmand, a reed lagoon 25 mi. by 100 mi. at the end of spring floods. In this last part of its course, the Helmand forms the boundary between Afghan and Iranian Seistan. The seasonal overflow of the Seistan lake depression spreads southward into the Shelag river, which loses its waters in Gawd-i-Zirrah swamp, near the meeting point of the Afghan, Pakistan and Iran frontiers.

The Helmand valley, from its confluence with the Arghandab up to the ford of Chahar Burjak, is a narrow green belt of fertility with many thriving villages interspersed among the remains of ancient cities. At Qala Bist are the ruins of the once famous commercial centre of Bist, and nearby are the remains of the fortress of Lashkargah which has been excavated by the French archaeological mission. At Lashkargah is the seat of the Helmand Valley authority which controls the extensive irrigation scheme of this area. The entire Helmand valley is under an irrigation scheme (the Helmand River project, one of the largest undertaken in central Asia after World War II). Its purpose is to enlarge the irrigated area, guard against floods by controlling the waters and produce hydroelectric power. The question of the right of the inhabitants of Iranian Seistan to a percentage of the Helmand waters is the subject of a long-standing dispute between Iran and Afghanistan. *See* AFGHANISTAN: *The Economy*.

(J. P. C. N. H.; X.)

HELMET, a defensive covering for the head, one of the most universal forms of body armour. Helmets are usually thought of today as items of military equipment for soldiers, sailors or airmen, but modified types are worn by firemen, miners, construction workers, race drivers and others engaged in hazardous occupations or sports.

Although there were earlier protective head coverings, most studies of helmets begin with those worn in ancient Greece and Rome. Made of hard leather or bronze, these helmets ranged

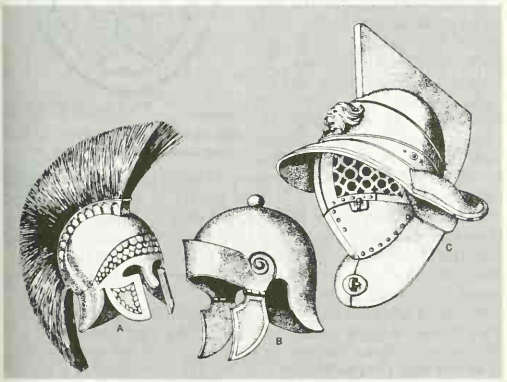
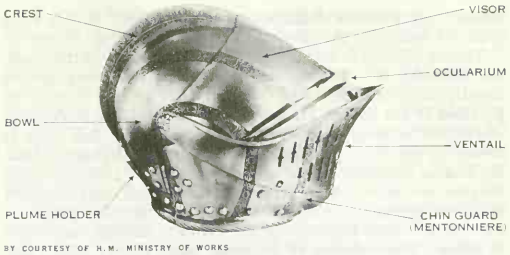


FIG. 1.—THREE CLASSICAL HELMETS: (A) GREEK WARRIOR OF ABOUT 500 B.C.; (B) ROMAN LEGIONARY OF THE FIRST CENTURY A.D.; (C) ROMAN GLADIATOR OF THE SECOND CENTURY A.D.



BY COURTESY OF H.M. MINISTRY OF WORKS

FIG. 2.—PARTS OF THE HELMET (CLOSED HELMET OF SIR HENRY LEE, BY JACOB TOPF, 1530–97)

from simple caps to highly developed forms with crests projecting before and behind. On some of these types the neck was protected in back; on others there were also hinged plates to guard the ears, and even a rudimentary visor. The most effective of the Greek helmets, and perhaps the best in the ancient world, was the so-called Boeotian or Corinthian form, the helmet usually portrayed on statues of Athena. It covered the entire head with only the narrowest of openings in front for vision and breath. A specialized Roman form different from the rest was the gladiator's helmet with its broad brim and pierced visor covering the face.

In northern and western Europe the first helmets were made of leather reinforced with bronze or iron straps. Usually they took the form of conical or hemispherical skullcaps. Gradually the amount of metal increased until entire helmets of iron were fashioned, still following the same forms. About the year 1000 a bar projecting below the rim in front, called a nasal, was added to protect the nose. When the owners could afford it, these helmets were worn over a hood of chain mail which protected the cheeks and neck.

The desire for still further protection led to the development of the helm, or heaume, about 1200. At first almost a straight flat-topped cylinder, it was worn over the iron or steel skullcap and hood of mail, usually being put on at the last minute before the beginning of an engagement. Warriors soon discovered that the flat top and perpendicular sides transmitted the full force of any blow to the wearer and that the loose helm could easily be knocked off. Helms then gradually assumed rounded contours that would cause blows to glance off and were extended downward so that they could be attached directly to the breastplate. As such they became for many years the favoured headpiece for tournaments. (*See* ARMOUR, BODY.)

Meanwhile the skullcap itself was developing. The point grew higher, and the back was extended downward to protect the neck. In this form it became the bascinet (basinet). Shortly after 1300 a movable visor was added to cover the face. Usually these visors were sharply pointed, and the name "dog faced" or "pig faced" has been given to them. A cape of mail, called a camail, was attached to the lower edges of the helmet to guard the neck. About the year 1400 this camail was superseded by additional plates, and the so-called "great bascinet" had appeared.

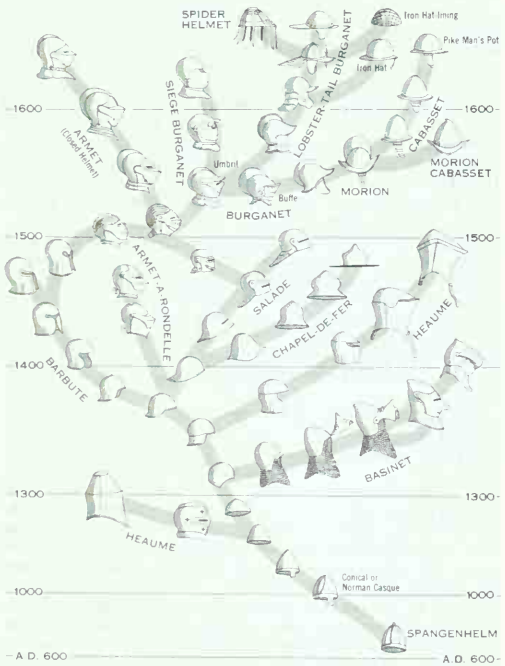
The 15th century, which witnessed the appearance of the great bascinet, also brought forth three other types of helmet, all deriving from the same simple bascinet. These were the salade, the barbute and the armet. In the salade the pointed crown was rounded off, and a long graceful tail protecting the neck was added. As time passed, the rim was lowered in front, covering the upper half of the face with a narrow slot cut through for vision. Still later, the portion below the slot was hinged to provide a movable visor. This helmet protected the upper portion of the head but left the chin and front of the neck bare. If a defense for the chin and neck was desired, it was provided by a separate plate or plates called a beavor, or buffe, that could be strapped around the neck or attached to the breastplate but did not form an integral part of the helmet. The barbute also had a rounded crown, but the tail was missing. Instead, the lower borders were extended almost straight down to protect the neck and cheeks, leaving in some in-

stances only a narrow T-shaped opening in front. In this form it closely resembled the classical Corinthian helmet of Greece.

The real advance in helmet design, however, came with the armet, and later the close helmet. All other helmets had been put on directly over the head, thus requiring that a large opening be provided at the bottom for the head to enter. This made them susceptible to being knocked off and caused many difficulties in protecting the neck. The armet and close helmet changed all that. By hinging the cheek pieces, as on the armet, or pivoting, as on the close helmet, armourers produced a helmet that could fit tightly under the chin and base of the skull. This design fully protected the neck and made it impossible for a blow to dislodge the helmet in battle. The evolution of the armet began shortly after 1400. The close helmet appeared about 1500. Both were truly closed helmets and continued in use as long as full helmets were worn.

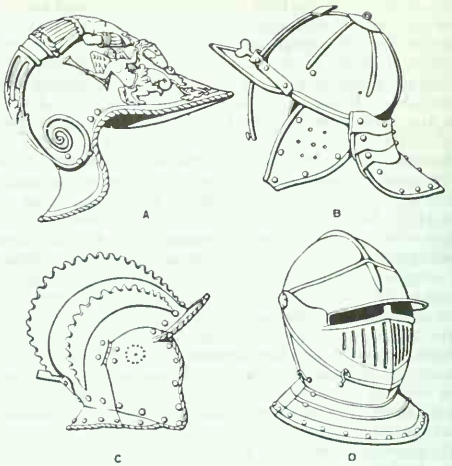
While these closed helmets were being brought to perfection, a series of light open helmets also appeared. As early as the 14th century a broad-brimmed helmet with a domed or pointed howl known as a chapel-de-fer, or "iron hat," had become popular. Aside from the skullcap and small versions of the salade, it was almost the only light open helmet worn throughout the 15th century. About 1550, however, two new types, the morion and the cabasset, became popular. The cabasset had a pointed, keeled bowl or crown and a narrow brim. The morion had a round howl with a high comb and a crescent-shaped brim rising to points at the front and back. Both helmets sometimes had ear defenses of overlapping plates covering straps that could be fastened under the chin; and sometimes the brim of the morion and the crown of the cabasset were combined to form a morion-cabasset. They were worn by nearly all infantry, by ceremonial guards and by almost everyone who desired a light helmet. Their period of popularity lasted roughly a century, until about 1650, though the Papal Swiss guard continues to wear them in the 20th century.

In England a variant form of helmet for pikemen was developed



BY COURTESY OF THE METROPOLITAN MUSEUM OF ART, NEW YORK

FIG. 3.—DEVELOPMENT OF THE HELMET FROM A.D. 600 TO THE 17TH CENTURY



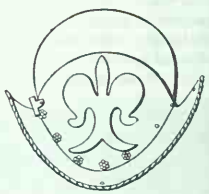
BY COURTESY OF THE "ARCHAEOLOGICAL JOURNAL"

FIG. 4.—(A) ITALIAN BURGONET, *c.* 1545; (B) LOBSTER-TAIL BURGONET, 1625–60; (C) GERMAN BURGONET, *c.* 1550; (D) CLOSED BURGONET, 1600–50

and worn from about 1600 to 1680. It had a broad straight brim, a hemispherical crown with a low comb, and was generally known as a "pikeman's pot."

During the 16th century there appeared also a very versatile helmet known as a burgonet. This helmet was characterized by a peak over the eyes similar to that found on modern baseball caps and by the fact that it protected the nape of the neck. Usually it also had a comb or combs and ear pieces. Sometimes protection for the face was added in the form of a sliding nasal, a pivoted cage of bars, or even a visor similar to those used on armets, though usually flatter. In the 17th century a particular form of a burgonet with a neck defense of overlapping plates became popular and was called a lobster-tail burgonet because of the supposed resemblance to the plates of a lobster's abdomen or "tail." Light-horsemen were particularly fond of the burgonet, and it became almost standard equipment for them throughout Europe until nearly the end of the 17th century. A very heavy bulletproof burgonet was used by engineers besieging fortresses from at least 1600 until well after 1800.

With the decline of the full helmet late in the 17th century, attention was focused on the light metal skullcap that could be worn under the regular cloth hat. Such caps became standard for dragoons, heavy cavalry and for many officers, and were worn throughout the succeeding century. Some infantry officers wore them as late as World War I. About 1750 it became the custom to equip the newly developed light cavalry with helmets of hard leather in both England and America and with brass helmets in England, France and other European nations. During the 19th century, leather, brass and even steel helmets became fashionable for various types of cavalry. Many of these units retained them for dress use long after they ceased to be worn in the field.



BY COURTESY OF THE "ARCHAEOLOGICAL JOURNAL"

FIG. 5.—MORION OF THE MUNICH CIVIC GUARD, 17TH CENTURY

Although some infantry regiments, notably those of Germany, wore leather helmets bound with metal, the steel helmet did not reappear as a regulation item of equipment until the opening years of World War I. The French first adopted the helmet as standard in 1914, the British in 1915, followed quickly by the Germans and then by the rest of Europe and the United States. All were designed to present glancing surfaces so that a bullet or shell frag-

ment would bounce off without imparting its full impact. Many resembled the light helmets of the 15th century, notably the Italian salade and the chapel-de-fer. The performance of these headpieces in action was so successful that they became standard equipment not only for infantry but also for other branches and arms of the service. During World War I, Americans used helmets of British design, but in World War II, after continued research by armour specialists, several new models were brought forth and issued for soldiers, sailors and airmen. By and large, other nations retained the helmets they had used in World War I with only slight modifications.

The helmets described above are only a few of the many types developed and used in Europe and the United States during the last 3,000 years. Other cultures in Asia and Africa have also produced and worn them. The ancient Assyrians and Persians had helmets of leather and of iron before the era of the battle of Marathon (490 B.C.).

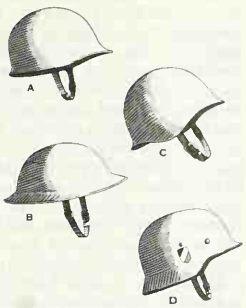


FIG. 6.—WORLD WAR II HELMETS: (A) U.S.; (B) BRITISH; (C) SOVIET; (D) GERMAN

In later years, the conical steel helmets of Persia, Turkey and India have been valued as works of art because of their fine forging and delicate damascening. In Tibet and China helmets of bronze, leather and horn have been made and worn for untold centuries, and the highly developed Japanese helmets with detachable face guards, finely forged and lacquered, have also been recognized as fine examples of the armourer's craft.

The primitive cultures of Africa and the South seas also produced distinctive helmets which cannot even be listed in a brief article.

See also references under "Helmet" in the Index volume.

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HELMHOLTZ, HERMANN LUDWIG FERDINAND VON (1821–1894), German philosopher and man of science, made important contributions in a wide range of scientific areas, but is best known for his statement of the law of conservation of energy. He was born on Aug. 31, 1821, at Potsdam, near Berlin. In 1849 he became professor of physiology in Königsberg. There he remained until 1855, when he removed to the chair of physiology in Bonn. In 1858 he became professor of physiology in Heidelberg, and in 1871 he occupied the chair of physics in Berlin. To this professorship was added in 1887 the post of director of the physico-technical institute at Charlottenburg, near Berlin, and he held the two positions together until his death on Sept. 8, 1894.

His investigations occupied almost the whole field of science, from physiology to mechanics. In 1847 Helmholtz read to the Physical Society of Berlin a famous paper, *Über die Erhaltung der Kraft* ("On the Conservation of Force"), which became one of the epoch-making papers of the century; indeed, along with J. R. Mayer, J. P. Joule and W. Thomson (Lord Kelvin), he may be regarded as one of the founders of the law of the conservation of energy. In 1851, he invented the ophthalmoscope.

Helmholtz' contributions to physiological optics are of great importance. He investigated the optical constants of the eye, measured by his invention, the ophthalmometer, the radii of curvature of the crystalline lens for near and far vision, explained the mechanism of accommodation by which the eye can focus within certain limits, discussed the phenomena of colour vision and gave a clear account of the movements of the eyeballs so as to secure single vision with two eyes. In particular he revived and gave new force to the theory of colour vision associated with the name of Thomas Young, showing the three primary colours to be red, green and violet, and he applied the theory to the explanation of colour blindness. His great work on *Physiological Optics* (1856–66) was by far the most important book to have appeared on the physiology and physics of vision. Equally distinguished was his research in physiological acoustics. He explained accurately the mechanism of the bones of the ear, and he discussed the action of the cochlea on the principles of sympathetic vibration.

Perhaps his greatest contribution in this area, however, was his attempt to account for the perception of quality of tone. He showed, both by analysis and by synthesis, that quality depends on the order, number and intensity of the overtones or harmonics that may, and usually do, enter into the structure of a musical tone. He also developed the theory of differential and of summational tones. His work on *Sensations of Tone* (1862) may well be termed the principia of physiological acoustics. He may also be said to be the founder of the fixed-pitch theory of vowel tones, according to which it is asserted that the pitch of a vowel depends on the resonance of the mouth, according to the form of the cavity while singing it, and this independently of the pitch of the note on which the vowel is sung.

For the later years of his life his work may be summed up under the following heads: (1) on the conservation of energy; (2) on hydrodynamics; (3) on electrodynamics and theories of electricity; (4) on meteorological physics; (5) on optics; and (6) on the abstract principles of dynamics. In all these fields of labour he made important contributions to science and showed himself equally great in all.

Helmholtz continued his study of the phenomena of electrical oscillations from 1869 to 1871, and in the latter year he announced that the velocity of the propagation of electromagnetic induction was greater than 314,000 m. per second. This work is interesting in view of the fact that Heinrich Hertz was a pupil of Helmholtz at this time and that later he demonstrated the existence of electromagnetic waves while studying a problem suggested to him by Helmholtz. This was followed by a series of papers on electrodynamics which were published from 1870 onward. Helmholtz started with a formula of F. E. Neuman for the potential of two current elements, and investigated the terms which must be added to give a general expression which agreed with the phenomena of closed circuits. There followed a controversy on the relative merits of the work of Helmholtz, Weber and J. Clerk Maxwell on this problem. In his paper on the "equations of motion of electricity in conductors at rest" (1874), Helmholtz applied his generalized formula to the propagation of electric and magnetic disturbances through bodies capable of electric or magnetic polarization. He contributed papers on the theory of the electrical double layer and on electrolysis. Toward the end of his life he wrote on the physical meaning of the principle of least action and applied the principle to electrodynamics; he also wrote and lectured on philosophical and aesthetic problems. His position was that of an empiricist, denying the doctrine of innate ideas and holding that all knowledge is founded on experience, hereditarily transmitted or acquired.

See also references under "Helmholtz, Hermann Ludwig Ferdinand von" in the Index.

See L. Königsberger, *Hermann von Helmholtz*, Eng. trans. by F. A. Welby (1906); J. G. McKendrick, *H. L. F. von Helmholtz* (1899).

HELMINTHOLOGY, the study of parasitic worms, especially flatworms and nematodes. *See* FLATWORM; FLUKE; PARASITOLOGY; ROUNDWORM; TAPEWORMS.

HELMOLD (*c.* 1120–after 1177), German chronicler whose narrative provides valuable information on the Christian missions and colonizing activities of the Germans among the Slavs of Holstein and Mecklenburg. Born in Saxony, he lived in or near Segeberg in Holstein from 1134 to 1138, studied at Brunswick under Gerold (later bishop of Lübeck) from 1139 to 1142 and was with the Augustinian canons of Neumünster from 1147 to 1153, being described as a deacon in 1150. At Neumünster he made the acquaintance of Vicelin (Vizelinus), the apostle of Wagria (the

country between the bights of Kiel and of Lübeck), at whose death Helmold was present in 1154. Shortly after 1156 he became parish priest of Bosau in Holstein, where he died some time after 1177.

Helmold began his *Cronica Slavorum* at Gerold's request. The first part was written in 1167–68, the second *c.* 1172. In lucid Latin it presents the history, from Charlemagne's time to *c.* 1170, of the Slavs inhabiting the lands east of the lower Elbe river. Setting out to describe "the conversion of the people of the Slavs," it also pays attention to colonization, as is seen in the author's conclusion that "the whole Slav country has become a Saxon settlement, in which towns and villages are being built and in which there are growing numbers of churches and of Christians." Though the Russian historian D. N. Yegorov impugned it (1915), other historians have stressed Helmold's honesty, which kept him from deliberate falsifications. The chronicle is at its best on matters that Helmold knew from personal experience or from recent tradition. Apart from its main theme, it is thus useful also for the general history of Henry the Lion's time. Abbot Arnold of Lübeck made a continuation of it down to 1209. There is an edition by B. Schmeidler in *Monumenta Germaniae historica*, series *Scriptores rerum Germanicarum in usum scholarum*, 3rd ed. (1937).

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HELMOND, a town in the province of North Brabant, Neth., lies on the Aa river and the Zuid-Willems Vaart (canal) between 's Hertogenbosch and Maastricht, 18 km. (11 mi.) E. of Eindhoven by rail. It is connected by rail with 's Hertogenbosch, Eindhoven and Venlo. Pop. (1962 est.) 43,855.

The castle of Helmond, built in 1402, is the seat of the town hall. Helmond is an industrial centre with factories for textiles, iron founding, soap, margarine, tobacco dressing and chocolate and cocoa processing, and an engineering works. The area has a rich history and tradition based upon the medieval craftsmen's guilds. Around Helmond there are several nature reserves.

HELMONT, JAN BAPTISTA VAN (1577–1644), Belgian chemist, physiologist and physician, identifier of carbon dioxide and discoverer of the existence of gases, was born at Brussels in 1577. He was educated at Louvain and, after ranging from one science to another, turned to medicine, in which he took his doctor's degree in 1599. In 1609 he settled at Vilvorde, near Brussels, where he occupied himself with chemical experiments and medical practice until his death on Dec. 30, 1644.

Helmont presents curious contradictions. On the one hand he was a mystic with strong leanings to the supernatural, an alchemist who believed in the philosopher's stone; on the other hand he was touched with the new learning of William Harvey, Galileo and Francis Bacon, and was a careful observer and an exact experimenter. He was the first to understand that there are gases distinct in kind from atmospheric air. The very word "gas" he claims as his own invention, and he perceived that his "gas sylvestre" (carbon dioxide) given off by burning charcoal is the same as that produced by fermenting must. He believed that water was the chief if not the only ultimate constituent of all matter. He showed that plants could grow though they apparently received nothing but pure water, and so he argued that the wood, bark and roots had been formed from water alone.

Van Helmont considered that digestion, nutrition and even movement are due to ferments, which convert dead food into living flesh in six stages. But having got so far with the application of chemical principles to physiological problems, he introduces a complicated system of supernatural agencies, which preside over and direct the affairs of the body. At the same time chemical principles guided him in the choice of medicines—undue acidity of the digestive juices, for example, was to be corrected by alkalies and vice versa; he was thus a forerunner of the iatrochemical school.

His works were collected and published at Amsterdam as *Ortus medicinae, vel opera et opuscula omnia* in 1648 by his son Franz Mercurius (b. 1618 at Vilvorde, d. 1699 at Berlin), in whose own writings, *e.g.*, *Cabbalah denudata* (1677) and *Opuscula philosophica* (1690), mystical theosophy and alchemy appear in still wilder confusion.

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HELMSTEDT, a town of Germany which after partition of the nation following World War II was located in the *Land* (state) of Lower Saxony, Federal Republic of Germany, lies 36 km. (22 mi.) by road W. of Brunswick. Pop. (1961) 29,560. The principal buildings are the Juleum, the former university, in Renaissance style (late 16th century), the Stephanskirche (12th century) and the Hausmannsturm, a gate tower of the old city wall, erected in 1430. Helmstedt is on the railway from Hanover and Brunswick to Magdeburg and Berlin and on the main *Autobahn*. It serves as a frontier post between East and West Germany. The principal manufactures are brown coal, yarn and machinery. Helmstedt was probably founded about 900 and obtained civic rights in 1050. In 1426 it joined the Hanseatic league, and in 1490 it came into the possession of Brunswick. In 1576 Julius, duke of Brunswick, founded a university there, and throughout the 17th century it was one of the chief seats of Protestant learning. It was closed by Jérôme, king of Westphalia, in 1810. (R. Sc.)

HELOTS, the serfs of the ancient Spartans. Their racial origin is uncertain, probably mixed; their servile status in historical times dates from the conquest of the land by the numerically fewer Dorians. After the conquest of Messenia (*see* Sparta) the Messenians were reduced to the status of helots. They were in a sense state slaves, bound to the soil and assigned to individual Spartiates to till their holdings; their masters could neither free them nor sell them, and they had a limited right to accumulate property, after paying to their masters a fixed proportion of the produce of the holding. Owing to their own numerical inferiority, the Spartans were always preoccupied with the fear of a helot revolt. The ephors of each year on entering office declared war on the helots so that they might be put to death at any time without violating religious scruple, and Thucydides (iv, 80) records an occasion when 2,000 helots were freed as if for service in war and then secretly assassinated. In the alliance with Athens of 421 B.C., and no doubt in other treaties, the Spartans stipulated that their allies should come to their help in case of a helot revolt. Sparta's cautious foreign policy is often attributed to the fear of such revolts.

Helots attended their masters on campaign and served as light-armed troops, sometimes also as rowers in the fleet. During the Peloponnesian War and the Spartan hegemony thereafter, when military detachments were needed overseas or for duties unsuitable for the regular army, a corps of enfranchised helots was formed, trained in heavy infantry fighting and called *neodamodeis*. They are first heard of in 421 and seem to disappear soon after 370. Another special class was called *mothakes* or *mothones*, probably the sons of Spartan fathers and helot mothers. They underwent the full Spartan training but did not become citizens unless specially admitted.

The Messenian helots were lost to Sparta when Epaminondas liberated Messenia *c.* 370 but the system continued in Laconia. It is said that Cleomenes III, in order to raise the number of Spartans, offered freedom and citizenship to helots who could pay 500 Attic drachmas and that 6,000 were thus enfranchised. Nabis is said also to have freed many helots.

See Sparta for bibliography. (A. As.)

HELPER, HINTON ROWAN (1829–1909), U.S. author of an influential book attacking slavery, was born Dec. 27, 1829, in Davie county, N.C. After limited education, employment as a clerk and participation in the California gold rush, he suddenly became famous by publishing, in 1857, *The Impending Crisis of the South: How to Meet It*. The book attacked slavery not because it exploited the Negro but because it victimized the non-slaveholding whites and inhibited southern economic progress. Although sound in depicting a southern economic lag, the book was fallacious in blaming slavery alone for this condition. As almost the only southern protest against slavery since early in the century, the book was widely read in the North, aroused a furor and

became a factor in the antislavery movement. In 1861 President Lincoln appointed Helper consul at Buenos Aires, Arg.

Although Helper opposed slavery, he was not pro-Negro. After the American Civil War he wrote three bitter racist tracts (notably *Nojoque*, 1867), advocating deportation of Negroes to Africa or Latin America. He later developed an obsession for a railroad from Hudson bay to the Strait of Magellan. After many years as a Washington lobbyist and political hanger-on, he committed suicide in Washington, D.C., on March 9, 1909. (D. Pr.)

HELSINGÖR: *see* Elsinore.

HELSINKI (Swed. Helsingfors), the capital and leading seaport of Finland and administrative centre of Uudenmaan *lääni* (county), is situated on the Gulf of Finland, on Vironniemi peninsula. Pop. (1960) 452,777. Built largely of local light-coloured granite and known as the "White City of the North," Helsinki is well laid out, with wide streets (the chief being Mannerheimintie), parks and gardens. The Senate square contains the cathedral (called the Great church), designed by C. L. Engel (completed by E. Lohrmann in 1852), who also created other distinguished buildings in classical style such as the old senate house, now the state council building, and the university. Recent buildings include the parliament house (1931), the railway station (by Eliel Saarinen, 1914), the National Pension institute (Alvar Aalto, 1956), the Olympic stadium (1938), the Institute of Commerce and Business Administration (1950) and Porthania, which houses the research institute and libraries of the University of Helsinki. As the seat of government, Helsinki also contains the president's palace, the administrative offices and the supreme courts of justice. Uspenski cathedral towers above the rocky Katajanokka Island, which is connected to the mainland by a bridge. After 1946 Helsinki acquired a number of modern, rapidly growing suburbs. The fine port, divided into two parts by a promontory and protected at its entrance by a group of small islands, includes five harbours. It accommodates the largest vessels, but is usually closed by ice from January to May except for a channel kept open by an icebreaker. The chief exports are metal goods, paper, butter and cheese, timber, cellulose and pulp. Imports include coffee, automobiles, natural fibres, iron and steel, coal and coke. Helsinki's main industries produce foodstuffs, luxury goods, metal goods, textiles, clothing, chemicals and printed matter. Most of Finland's educational and cultural institutions are located in the capital, including about 60 secondary schools, the university (transferred from Turku in 1828) and 7 other colleges for higher education, the National museum, the National theatre, the Swedish theatre and the opera house.

The city was founded by Gustavus Vasa, king of Sweden, in 1550 as a trading centre on the Vantaa estuary, but in 1640 it was moved to its present site. In May 1713 the inhabitants were evacuated from the town before its capture by Peter the Great's fleet during the Russian campaign against Sweden. Before retreating, Swedish troops razed the town, and after the treaty of Uusikaupunki in 1721 reconstruction was begun only to be destroyed by subsequent Russian invasions. When the fortifications at Suomenlinna islands were begun in 1748, however, Helsinki's trade and shipping flourished. Finland having been ceded by Sweden to Russia in 1809, a decree of Alexander I in 1812 appointed Helsinki the capital city instead of Turku. Helsinki was bombed several times during the Russo-Finnish war of 1939–40 and suffered again in the world conflict which Finland entered in 1941.

(E.-S. Ku.)

HELSTON, a market town and municipal borough in the Falmouth and Camborne parliamentary division of Cornwall, Eng., 13 mi. W.S.W. of Falmouth by road. Pop. (1961) 7,085. Helston is the nearest railway station to the Lizard peninsula. May 8 is Furry (Flora) day, an old festival when church bells are rung early in the morning and couples dance through the streets and in and out of houses and gardens to traditional music. As the capital of the Meneage district of Cornwall, the place was held by Earl Harold in the time of the Confessor and by William I at the Domesday survey. From 1298 to 1885 it returned two members to parliament, although in 1790 the electorate had dwindled to one burgess. The town obtained its first charter (1201) from King John and in the 13th century it was the most important town in west Cornwall, having a harbour on the Cober, which now expands into Loe pool (2 mi. S.W.) banked up by Loe bar at the mouth. In Elizabeth I's time it was one of the four Cornish stannary towns and its main street is still called Coinagehall street. The mining industry is extinct, but agriculture and dairy farming flourish. There is a weekly cattle market. The small port of Porthleven, 3 mi. S.W., was included in the borough in 1934.

HELVETIC CONFESSIONS are two documents officially adopted as expressing the common belief of the Reformed Church in Switzerland. The First Helvetic Confession (less aptly called the Second Confession of Basel), consisting of 27 brief articles, was composed in 1536 by Heinrich Bullinger and delegates from several Swiss cities, with the participation of Martin Bucer of Strasbourg. Viewed favourably by Luther and sometimes criticized as too Lutheran for Reformed tastes, it nonetheless was the first Reformed creed of national authority. In 1562 Bullinger wrote for his private use a lengthy theological statement of 30 articles, which he later revised and attached to his will. This document, known as the Second Helvetic Confession, was published in 1566 as the official creed of the Swiss cantons (superseding the first, except in Basel) and was adopted also in the Palatinate where it had served the elector Frederick III the Pious as a defense against Lutherans. It was recognized in Scotland (1566), Hungary (1567), France (1571) and Poland (1578), was favourably received in Holland and England, and was subsequently recognized as one of the most authoritative statements of Reformed theology.

The Second Helvetic Confession is a comprehensive and detailed statement of the ancient dogmas of the Trinity (art. 3) and Christology (11), as well as more specifically Reformation elaborations of Scripture as the sole norm of belief (1, 2), condemnation of the use of images in worship (4), discussions of law (12), gospel (13) and faith (15, 16). It contains in addition a more especially Reformed (*i.e.*, of the Calvinist rather than the Lutheran type) doctrine of providence (6), predestination (10) and the church, ministry and sacraments (17–21). By constant biblical citation, occasional reference to Augustine and other early writers and repeated assertion, the confession represents itself as at one with the earliest and purest form of Christian theology. Heresies, ancient and contemporary, are condemned by name. *See* also Confessions of Faith, Protestant; *Reformed Churches.*

See Philip Schaff, *Creeds of Christendom,* vol. iii (1919), for the Latin texts of both and the German text of the first. (E. A. Dy.)

HELVETII, a Celtic people who under pressure from German invaders migrated in the 2nd century B.C. from the area later known as Württemberg to occupy what is now northwestern Switzerland, between the Jura mountains, Lake Geneva and the Rhine. In 107 B.C. the Tigurini, one of the four smaller tribes (*pagi*) that made up the Helvetian canton, crossed the Jura mountains and defeated a Roman consul; and in 102 this and another *pagus* joined the Cimbri in invading Italy but retreated after Marius' victory at Vercellae the next year.

In 61 B.C., still hard pressed by the Germans, they decided to migrate to western Gaul. A plan for a great Gallic kingdom was concerted between the chieftain Orgetorix and his friends among the Aedui and Sequani; and though Orgetorix was disgraced when the details were revealed to his tribe, they continued their preparations and set out in March 58 with 263,000 of their own people and 105,000 allies (*see* Boii). Caesar, newly appointed governor of Gaul, refused them permission to enter the Roman provinces; and when they crossed the Jura into Aeduan territory he followed them up the Saône river and utterly defeated them near Bibracte (*q.v.*). According to his figures, 130,000 persons survived to return to Switzerland.

Under Augustus the tribe became part of Gallia Belgica as a *civitas foederata.* Some of their land was taken for colonies at Augusta Rauracorum (Augst) and Noviodunum (Nyon), but the Helvetii maintained a fort garrisoned by their own troops at Zurzach, east of the Aare river. Their capital was at Aventicum (Avenches), and the baths at Aquae Helveticae (Baden in Switzerland) attracted many visitors. In A.D. 69, perhaps through a misunderstanding, the tribe obstructed the invasion of Italy by Vitel-

lius' general Caecina. The threat to his communications with Raetia was alarming and he took severe reprisals. In compensation Vespasian (emperor 70–79), whose father had known the country, treated the Helvetii well. Aventicum became a Roman colony, with an amphitheatre and imposing public buildings, and there are traces of prosperous industry there, notably in precious metals. The legion at Vindonissa (Windisch), with which the tribe's relations had not always been friendly, was removed, the Roman frontier was advanced northward (*see* AGRI DECUMATES) and there was little military activity until an Alamannic invasion about 260 caused the erection of fortifications in the territory once more. The country was occupied by the Alamanni by the mid-5th century.

The name Helvetia or Confederatio Helvetica survives as an official name for Switzerland.

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(G. E. F. C.)

HELVÉTIUS, CLAUDE ADRIEN (1715–1771), French philosopher, noted for his emphasis on physical sensations, was born at Paris on Jan. 26, 1715, the son of J. C. A. Helvétius, chief physician to Queen Maria Leszczynska, the wife of Louis XV of France. In 1738, at the queen's request, Helvétius was appointed farmer-general, a post of great responsibility and dignity. In 1751 he married, resigned his post and retired to his estate at Voré in Perche.

Helvétius proceeded to enjoy his leisure, producing a poem, *Le Bonheur* (published posthumously, with an account of Helvétius' life and works, by C. F. de Saint-Lambert, 1772), and his famous philosophical study, *De l'esprit* (1758; Eng. trans. by W. Mudford, 1807), intended to be the rival of Montesquieu's *L'Esprit des lois*. This attracted immediate attention and aroused the most formidable opposition, especially from the dauphin Louis, son of Louis XV. The Sorbonne condemned it as full of the most dangerous doctrines, and the author's three retractations did not save it from being publicly burned. Voltaire said that it was full of commonplaces and that what was original was false or problematical. Rousseau declared that the very benevolence of the author gave the lie to his principles. Helvétius visited England in 1764 and Berlin, on the invitation of Frederick the Great, in 1765. Returning to France, he passed the remainder of his life at Voré. He died on Dec. 26, 1771. In 1773 was published *De l'homme* (Eng. trans. by W. Hooper, 1777), in which he argues against Rousseau's *Émile* and holds that education can do everything.

The four chief contentions of Helvétius' hedonistic philosophy are: (1) all man's faculties may be reduced to physical sensation, even memory, comparison, judgment, (2) self-interest, founded on the love of pleasure and the fear of pain, is the spring of judgment, action, affection (self-sacrifice is prompted by the fact that the sensation of pleasure outweighs the accompanying pain); (3) all intellects are equal, their apparent inequalities are due to the unequal desire for instruction and this desire springs from passions, of which all men commonly well-organized are susceptible to the same degree ("one becomes stupid as soon as one ceases to be passionate"); and (4) philosophical rulers may achieve an artificial identification of interests by suitably contrived legislation.

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(H. B. A., X.)

HELVIDIUS PRISCUS (d. between AD 70 and 79), a Roman Stoic who, though the son of a centurion, rose to the senate in the reign of Nero. Nero banished him in 66 when his father-in-law, Thrasea Paetus (*q.v.*), was put to death. On Nero's fall (68) he returned and is recorded as demanding the punishment of Eprius Marcellus, who had encompassed Thrasea's death, openly opposing the emperor Vitellius in the senate (69) and later urging that the senate mark out the men it thought worthy of the emperor Vespasian's confidence and assume responsibility for rebuilding the Capitol and meeting the financial crisis of 70. His uncompromising freedom of speech brought him into conflict with Vespasian, perhaps because he opposed dynastic succession, and he was put to death; it later earned the admiration of the Stoics Epictetus and, significantly, Marcus Aurelius.

Helvidius can hardly have been a republican (as is often said); he accepted office as praetor in 70 and spoke of Vespasian with honour. But he was a Stoic and, unlike most Stoics, did not seek refuge in retirement but was strengthened by his creed in adherence to political principles; he clearly held that the senate should discharge in reality the functions that it nominally possessed and that the emperor should act only with its consent and co-operation.

His son HELVIDIUS THE YOUNGER, a friend of the younger Pliny, became consul (date unknown) but in 93 or 94 was executed by order of the emperor Domitian, whose amours he had allegedly burlesqued.

See E. Groag and A. Stein, *Prosopographia Imperii Romani*, H 59, 60, 2nd ed. (1958); C. Wirszubski, *Libertas as a Political Idea at Rome*, pp. 147 ff. (1950). (P. A. BR.)

HELWAN: *see* HULWAN.

HELWYS, THOMAS (*c.* 1550–*c.* 1616), leader of the first General Baptist church in London, was born at Broxtowe hall in Nottinghamshire of a well-connected family and was a student of law at Gray's Inn. On his return home he showed strong Puritan sympathies, which ultimately led to his joining the separatist church in Gainsborough, of which his friend John Smyth (*q.v.*), an ordained clergyman, had become pastor. Helwys took a leading part in the migration of this church to Amsterdam in 1607 or 1608 and in 1609 followed Smyth in opposing infant baptism and in starting the first Baptist church. When Smyth entered into negotiation with the Mennonites, Helwys broke with him, refusing to repudiate the earlier steps they had taken together. Regretting their flight from persecution, he and a small group of followers returned to London in 1611 or 1612 and established themselves at Spitalfields. In Holland Helwys had published in 1612 *A Short Declaration of the Mistery of Iniquity*, which contains the first printed plea in English for complete religious freedom and toleration. Appeal was made to King James I, but Helwys was imprisoned in Newgate and it was probably there that he died about 1616. He and his associates rejected the current Calvinist doctrines of election and original sin and became known as General or Arminian Baptists.

See also BAPTISTS: *History*.

See W. H. Burgess, *John Smith, Thomas Helwys and the First Baptist Church in England* (1911); A. C. Underwood, *A History of the English Baptists* (1947). (E. A. PA.)

HELY-HUTCHINSON, JOHN (1724–1794), Irish politician, was celebrated for his accumulation of offices and for his stormy tenure of the provostship of Trinity college, Dublin. He was the son of Francis Hely of County Cork and was educated at Trinity college, Dublin. Called to the Irish bar in 1748, he built up a large practice. He married Christiana Nickson in 1751 and when his wife inherited the estates of her uncle, Richard Hutchinson, he added the name of Hutchinson to his own. He entered the Irish house of commons in 1759 and remained a member until his death, representing first Lanesborough and then for almost 30 years, Cork city. Hely-Hutchinson held the offices of prime sergeant (1761–74), alnager (1762–75), provost of Trinity college, Dublin (1774–94), and secretary of state (1777–94).

An able debater, self-assured, alert and indefatigable, Hely-Hutchinson possessed a mastery of economic fact and parliamentary procedure. He often had an intelligent approach to political problems, advocating free trade and the removal of disabilities imposed on the Irish Catholics. He was also distinguished for the blatant persistence with which he pressed his personal claims. Immediately after entering parliament he showed his mettle as a critic of the government, but he soon became a supporter of the administration and was for years one of the government's mainstays in debate.

On a few occasions, however, he showed signs of joining the opposition. When Viscount Townshend introduced his unpopular augmentation scheme in 1767, Hely-Hutchinson at first opposed it but was enticed back to the government ranks. In 1779, when nationalist sentiment was mounting, Hely-Hutchinson, who was genuinely concerned for Ireland's economic interests, published *Commercial Restraints of Ireland*, an able pamphlet against the trade restrictions in which he displayed an intelligent awareness of Adam Smith's theory of free trade. Finally he gambled in political futures by supporting the Whigs in the regency dispute of 1788–89. The lord lieutenant urged his dismissal but Hely-Hutchinson joined a strong group of officeholders who had chosen the wrong side in the crisis but who, by hanging together, managed to elbow their way back into the government's ranks.

As provost of Trinity college he was severely handicapped. He had no pretensions to scholarship and his appointment was bound to be resented by many of the fellows. Moreover he used his statutory powers in a very overbearing fashion. He was determined to obtain one of the university seats for his family and at the elections of 1776 and 1790 he put forward a son as one of the candidates. These contests led to bitter electioneering and to some sensational and unedifying episodes. In addition he quarreled with the majority of the fellows over academic policy, contending (in the event unsuccessfully) that he had the right to veto the decisions of the governing body of the college. The controversial dust stirred up by these disputes has obscured his real services to the college. He was anxious to widen the curriculum. He instituted prizes at entrance for composition, was responsible for the foundation of professorships in modern languages, secured the act of parliament which marked the effective foundation of the medical school and obtained the grants which enabled the college to complete Parliament square and erect the public theatre.

He died at Buxton on Sept. 4, 1794, having obtained a peerage for his wife as Baroness Donoughmore, in 1783. His son Richard became Lord Donoughmore on his mother's death in 1788 and 1st Earl Donoughmore in 1800. (R. B. McD.)

HEMANS, FELICIA DOROTHEA (1793–1835), English poet, author of the poem "Casabianca" with the well-known first line "The boy stood on the burning deck . . . ," was born in Liverpool on Sept. 25, 1793, the daughter of George Browne, a merchant of Irish descent. In 1800 the family moved to Gwrych, Denbighshire, where sea and mountain were impressed on Dorothea's developing imagination. By the age of 15 she had published *Poems* (1808). In 1812 she married Capt. Alfred Hemans but they separated six years later. In 1828 she moved to Wavertree, near Liverpool, writing to maintain her five children. Her 24 volumes of verse included *The Domestic Affections* (1812), *The Sceptic* (1820), *Lays of Many Lands* (1825) and *National Lyrics and Songs for Music* (1834). *The Vespers of Palermo* (1823), a drama, failed in London but succeeded in Edinburgh with an epilogue by Sir Walter Scott.

Mrs. Hemans was immensely popular in England and the United States. Admirers and friends included Lord Jeffrey, Scott and Wordsworth, who commemorated her death in his "Epitaph" xvi (lines 37–40). She expresses romantic themes—childhood innocence, liberty, inspiration, nature—but lacks roots in thought and poetic experience. She is diffuse, sometimes falsely sentimental, and survives best in shorter poems such as "The Homes of England," "The Landing of the Pilgrim Fathers" and "Casabianca." She died in Dublin on May 16, 1835.

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(W. L. G. JR.)

HEMATITE (HAEMATITE), a mineral consisting of ferric oxide, Fe_2O_3, containing 70% of iron. Hematite is the most important iron ore, both because of its high iron content and its abundance. The world's greatest production of hematite (nearly 100,000,000 tons in a single year) has been from the Lake Superior district, including Minnesota, Michigan, Wisconsin and Ontario. Enormous deposits of high-grade hematite have been found in Minas Gerais, Braz.; Cerro Bolivar, Venez.; Labrador; and Quebec. Other important localities are Yorkshire, Eng.; Lorraine, France; Birmingham, Ala.; Krivoi Rog, Donets basin, U.S.S.R.; India; Newfoundland; and Cuba.

The crystals of hematite are hexagonal with rhombohedral symmetry. The hardness is 5.5–6 and the specific gravity 5.26. The steel-gray crystals and coarse-grained varieties have a brilliant metallic lustre and are known as specular iron ore. Thin scaly types are called micaceous hematite. Both have a characteristic red-brown streak. Much hematite occurs in a fine-grained earthy form (red ochre) and is nonmetallic in lustre and apparently soft. Intermediate between these types are compact varieties, often with a reniform surface (kidney ore) and many times with a fibrous structure (pencil ore). Red ochre is used as a paint pigment, and a purified form, rouge, is used to polish plate glass. *See* also IRON; IRON AND STEEL INDUSTRY: *Iron Ore*. (L. S. RU.)

HEMATOLOGY is the science of the blood: its nature, function, and diseases. Interest in the blood is ancient, but for a long time progress was very slow. According to a theory which was held by the early Greeks and persisted through the Middle Ages, the blood was considered to be one of the four cardinal humours, the others being yellow bile, phlegm, and black bile. The first step toward scientific knowledge of the composition of the blood was taken by Anton van Leeuwenhoek (1632–1723), who, using a primitive, single-lens microscope, observed red corpuscles and compared their size with that of a grain of sand. The English physiologist William Hewson (1739–74) amplified the description of the red corpuscles, studied the lymphatic system (from which a type of white corpuscle, the lymphocyte, is derived), and demonstrated the role of fibrin in the clotting of blood. The 19th century saw the recognition of bone marrow (*q.v.*) as the site of blood-cell formation and the clinical description of pernicious anemia, leukemia, and a number of other disorders of the blood. Ernst Neumann, Rudolf Virchow, and Georges Hayem were among the important figures of the period. The introduction of a method of staining blood—by Paul Ehrlich at the end of the century—inaugurated the morphologic phase of the science.

In the first quarter of the 20th century the changes in the morphology of the blood in disease engaged the attention of most students. The century opened with Karl Landsteiner's discovery of the blood groups O, A, B, and AB, which made possible the transfusion of blood from one person to another without the serious ill effects which ensue when incompatible blood is given (*see* BLOOD GROUPS; BLOOD TRANSFUSION). The study of the anemias gained impetus from the introduction of the hematocrit (an apparatus for determining the volume of red corpuscles in the blood as compared with the volume of plasma) and M. M. Wintrobe's description of a simple method of measuring the volume and hemoglobin content of these cells (1932).

Another era in hematology, which may be called the physiologic phase, began about 1920 with the systematic investigation by G. H. Whipple of the role of food substances in the production of hemoglobin (*q.v.*). This led to discovery of the beneficial effects of liver extract in treating pernicious anemia by G. R. Minot and W. P. Murphy (1926) and stimulated investigation of factors involved in red cell production—resulting ultimately in the discovery of vitamin B_{12}, the antianemic principle of liver. Parallel discoveries in nutrition, biochemistry, and the use of heavy and radioactive isotopes helped to show how hemoglobin is produced and aided in the recognition of changes which take place in disease. As a consequence, hematology advanced from its largely passive and descriptive phase to become a dynamic and experimental field of medicine.

After World War II the field of hematology broadened. For example, hematological studies of sickle-cell anemia revealed that variation in a normal protein at the molecular level can be the underlying cause of a whole chain of clinical and laboratory abnormalities characterizing a disease. Simultaneous advances in techniques of protein and enzyme chemistry permitted recognition of a large number of disorders of hemoglobin synthesis whose existence had not been suspected before. These were shown to be under genetic control. The work on heritable anemias, in particular, provided anthropologists with important genetic markers. In still another area, electron microscopy made it possible to see

the mechanisms of hemoglobin synthesis and to view structural changes involved in the synthesis of blood cells.

The introduction of various drugs in the treatment of leukemia and the lymphomas was a direct outcome of studies of nitrogen mustard as a possible agent of chemical warfare during World War II. Other research explored the role of radiation, various chemical agents, and viruses in these diseases. The study of blood platelets and the process of coagulation profited greatly from the advances in biochemistry and microscopy. By the 1960s hematology was firmly established as a field of specialization demanding a very broad understanding of the whole range of medical science.

See also BLOOD; BLOOD, DISORDERS OF.

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HEMEL HEMPSTEAD, a market town and municipal borough in the Hemel Hempstead parliamentary division of Hertfordshire, Eng., 23 mi. NNW of London by road. Pop. (1961) 55,270. Settlements in the neighbourhood of Hemel Hempstead, which is on the Gade and Bulbourn rivers near the Grand Junction Canal, date from pre-Roman times, and a Roman villa has been discovered at Boxmoor. The manor, held by the count of Mortain in 1086, was granted by Edmund, earl of Cornwall, in 1285 to the house of Ashridge, and the town developed under monastic protection. In 1539 it was raised by charter to a bailiwick and other charters were granted in 1572, 1609, 1656, 1666, and 1693; it was recreated a borough in 1898. St. Mary's church, of clunch stone and flint, is Norman with Decorated additions. Part of Hemel Hempstead is being developed as a New Town (formed 1947) in the Greater London plan (*see* NEW TOWNS). Quantities of watercress are grown commercially in the rivers. Once a big market for wool and corn, Hemel Hempstead has modern industries including the manufacture of paper, fireworks, and electrical and light engineering products.

HEMEROCALLIS: *see* DAY LILY.

HEMICHORDATE, any of the wormlike, burrowing marine animals belonging to the subphylum Hemichordata of the phylum Chordata, of which the vertebrates constitute another subphylum; the group is sometimes elevated to phylum rank, separate from but closely related to the chordates. The term was introduced by W. Bateson in 1884. Hemichordata comprises two classes, the Enteropneusta and the Pterobranchia (*q.v.*).

Hemichordates possess vertebrate characters in some measure. The notochord is a short tubular diverticulum of the fore-gut. The dorsal nerve cord is tubular for part of its length in the Enteropneusta, but is solid in the Pterobranchia. The gill slits are numerous in the Enteropneusta, few or absent in the Pterobranchia. *See* CHORDATE. (F. W. R. B.)

HEMIMORPHITE. This mineral is a hydrous zinc silicate and an important ore of zinc (*q.v.*), of which it contains 54.4%. Hemimorphite occurs as a secondary mineral formed from the alteration of sphalerite (zinc sulfide) and is associated with other zinc ores (smithsonite and sphalerite) in veins and beds in limestone. It is found in many zinc mines throughout the world. Well crystallized specimens have been found in Siberia, Rumania, Sardinia and Belgium. In the United States fine crystals have come from Sterling Hill, N.J., and Elkhorn, Mont.

The mineral was formerly called calamine or electric calamine in the United States. It is orthorhombic and the name hemimorphite is given because of the hemimorphic development, that is, different terminations at the two ends of the prismatic crystals. Because of this polarity, the crystals, when subjected to changes in temperature, become positively charged at one end and negatively charged at the other (pyroelectricity). There is perfect cleavage parallel to the faces of the vertical prism. Crystals are usually colourless and transparent but may be yellowish or greenish; they have a vitreous lustre. The composition is $Zn_4Si_2O_7(OH)_2.H_2O$. The hardness is 5, and the specific gravity 3.45. The mineral also occurs as stalactitic or botryoidal masses with a fibrous structure, or in massive, cellular or granular aggregates intermixed with smithsonite and clay. It resembles smithsonite (zinc carbonate) but can be distinguished from it by a test with hydrochloric acid. Smithsonite readily effervesces in the cold acid, hemimorphite does not. (C. S. H.)

HEMINGE (HEMING, HEMMINGE, HEMMINGS, etc.), **JOHN** (*c.* 1556–1630), English actor and long-time colleague of William Shakespeare. He was an important and prosperous member of the theatrical company that eventually became the King's Men in 1603, apparently serving as business manager for over a quarter of a century. He was one of the original "housekeepers" of the Globe and Blackfriars theatres. Heminge, Henry Condell (*q.v.*), and Richard Burbage (*q.v.*) were closely associated with Shakespeare throughout his career. They are listed among the 26 "principal actors" in his plays, and he left them token remembrances in his will. Heminge and Condell prepared and oversaw the *First Folio* (1623), and their prefatory letters of dedication make it clear that this was in part a gesture of love and respect toward their dead friend. Heminge died in London on Oct. 10, 1630. (FR. C. B.)

HEMINGWAY, ERNEST MILLER (1899–1961), U.S. novelist and short-story writer whose succinct and lucid style exerted a powerful influence on American and English fiction, winner of the Nobel prize for literature in 1954, was born in Oak Park, Ill., on July 21, 1899. Educated in the local public schools, he skipped college to begin writing as a cub reporter on the *Kansas City Star*. Entering World War I with a U.S. ambulance unit, he was attached to the Italian infantry until severely wounded by shrapnel near the village of Piave in northern Italy on the night of July 8, 1918. Following a period of recuperation in Milan, of trade-journal editing back home in Chicago, and of serious writing practice in northern Michigan, he resumed newspaper work and sailed for France on Dec. 8, 1921, as a foreign correspondent for the *Toronto Star*. Five hard-working apprentice years followed, during which he supported himself by journalism in France, Italy, Spain, Switzerland, Germany and Greece.

Three Stories and Ten Poems (1923) and *in our time* (1924), published in Paris, prepared the way for the short-story collection *In Our Time* (New York, 1925). But his first notable success came in 1926 with *The Sun Also Rises*, a poignant fictional reminiscence of so-called "lost generation" expatriates in and out of a Pamplona fiesta. *The Torrents of Spring*, a parody of Sherwood Anderson's *Dark Laughter*, also appeared in 1926. Two more short-story collections, *Men Without Women* (1927) and *Winner Take Nothing* (1933), advanced Hemingway's reputation in this genre. His fame as a novelist was consolidated by *A Farewell to Arms* (1929) which incarnated his sense of war's immorality through the tragic story of a U.S. officer and a British nurse in wartime Italy and neutral Switzerland.

Experimental works in nonfiction followed: *Death in the Afternoon* (1932), a bible of the Spanish bullfight which had fascinated Hemingway for ten years; and *The Green Hills of Africa* (1935), which employed certain fictional techniques to give a true account of the author's safari of 1933–34 in the big-game region of Tanganyika. *To Have and Have Not* (1937) is a novel about a Caribbean desperado, set against a background of low-class violence and upper-class decadence in Key West, Fla. Despite powerful passages, this is perhaps the least successful of Hemingway's experiments during the period of the 1930s.

Meantime the Spanish civil war attracted Hemingway's interest. *For Whom the Bell Tolls* (1940), his greatest novel, tells of a U.S. volunteer who joins a guerrilla band behind the rebel lines in the vastness of the Guadarrama mountains. The story masterfully embodies Hemingway's sense of the tragic betrayal of the Spanish people by foreign Fascist and Communist forces, as well as by reactionary elements within Spain itself. (A stage melodrama, *The Fifth Column*, written under fire in wartime Madrid, had already appeared with the collected short stories in 1938.) He also edited, with a revealing introduction, *Men at War* (1942), an anthology of war stories both historical and fictional, including

three of his own. *Across the River and Into the Trees* (1950) provides an account of the last three days in the life of a U.S. army officer in Venice and environs; the hero's comments partially summarize the author's sardonic reactions to World War II, in which he had participated at many levels. His short novel, *The Old Man and the Sea* (1952), is the heroic story of an aged Cuban fisherman's lone expedition after a great marlin in the Gulf stream north of the island. Following an extended and spirit-straining struggle, Santiago brings his huge quarry to the gaff, only to have it eaten by voracious sharks during the long voyage home. The novel won the Pulitzer prize in fiction for 1953 and was instrumental in winning Hemingway the Nobel prize.

Hemingway's death, the result of a self-inflicted gunshot wound, took place at his home in Ketchum, Ida., on July 2, 1961. Whether the shooting was intentional or accidental was not determined.

The Nobel prize award committee praised Hemingway's "forceful and style-making mastery of the art of modern narration." Along with his achievement as a stylist, his career as a writer was distinguished throughout by his ability to produce swift-moving narratives of action supported by complex structures of natural symbolism, a fact which, without sacrifice of dramatic verisimilitude, gave his best works the force of parables.

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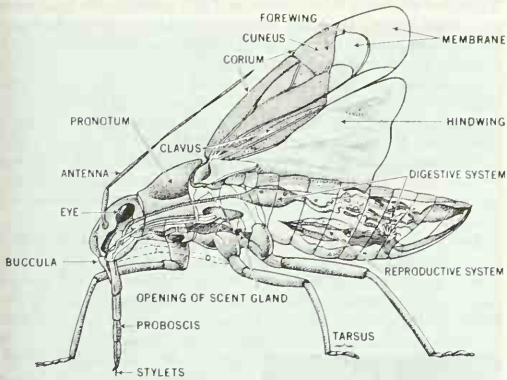
HEMIPTERA, a large order of diverse insects, chiefly characterized by gradual metamorphosis and piercing-sucking mouth parts enclosed in a beaklike proboscis. The name, applied by Linnaeus (1735) in allusion to the half-leathery, half-membranous structure of the forewing (fig. 1), is well suited to the true bugs of the suborder Heteroptera; however, it is not descriptive of the cicadas, leafhoppers, aphids and scale insects, which have forewings of uniform texture and which belong to the remaining suborder, Homoptera. J. C. Fabricius (1775) substituted the name Rhynchota (Rhyngota) for Hemiptera, but though it gained wide acceptance in older literature, it has now been abandoned. Some authorities, particularly in the United States, restrict the name Hemiptera to the portion of the order here treated as the suborder Heteroptera, regarding Hemiptera and Homoptera as separate orders. Such treatment depreciates the basic similarities of habit and structure that relate the two groups much more closely to each other than to any of the other insect orders.



FROM H. WEBER, "GRUNDRISS DER INSEKTENKUNDE"

FIG. 1.—DIAGRAM OF THE BODY PARTS OF HEMIPTERA (BROKEN LINES INDICATE POSITION TO WHICH PROBOSCIS CAN BE RETRACTED)

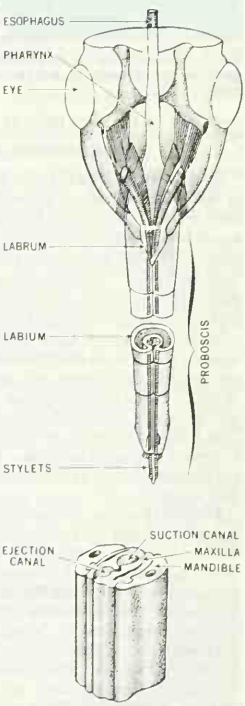
Introduction.—Although differences in wing, head and alimentary tract structure readily distinguish most Homoptera and Heteroptera, these distinctions are not universally applicable. The final criterion for distinguishing the two suborders is presence of a gula (Heteroptera) or its absence (Homoptera). In the Heteroptera the gula is a troughlike area on the underside of the head, between the basal attachment of the mouth parts and the posterior margin of the head. Its absence in the Homoptera is correlated with the posterior location of the mouth parts, which are attached to the base of the head very near or even between the fore pair of legs.

Hemiptera includes about 56,000 described species, and conservative estimates place the actual number of species in excess of 100,000. While many are predaceous on other insects or their eggs, the great majority are plant feeders and rank among the most destructive of insects; some attack man and other vertebrates and serve as vectors of disease. Although most are small or moderate in size, a few, such as the giant water bugs and cicadas, may attain lengths of three to four inches and wing expanses of as much as five inches. Colours are generally inconspicuous, especially among temperate zone forms, but some tropical forms are strikingly patterned.

Geographic and Fossil Distribution.—Hemipterans are known from virtually every land area except Antarctica. One, a shore bug (*Chiloxanthus stellatus*), inhabits the arctic, but the vast majority of the species live in tropical and subtropical regions. A few species, *e.g.*, the stinkbug *Nezara viridula*, are found throughout the warmer parts of the world. Many species are common to North America and Eurasia; however, a few small families and many subfamilies and tribes are restricted to a single continent or major island. A considerable number of ground-dwelling bugs, but surprisingly few economic species, have been moved from one continent to another by commerce.

Geologically the Heteroptera do not appear as early as the Homoptera, which have been found in Lower Permian rocks (about 235,000,000 years old) of Kansas and Germany. Fossil insects resembling stinkbugs and back swimmers are represented in the Upper Triassic of Ipswich, Australia. The Heteroptera were well represented in the Jurassic and are abundant as fossils in the Miocene shales of Florissant, Colorado, and in Oligocene Baltic amber from pine trees that grew 50,000,000 years ago.

General Structure.—The head is variable in form. The antennae usually have 4 or 5 segments, but in exceptional cases may have 10 (Psyllidae) or even 25, as in males of a few scale insects. Mouth parts are exceptionally uniform throughout the order. The mandibles and maxillae are needlelike stylets, tongued and grooved to fit together and function as one organ (fig. 2). The inner faces of the maxillae are grooved to form two tubes: one serves as a suction canal through which food is imbibed, while saliva is ejected into the host tissue through the second. The labium forms a segmented sheath, grooved on the underside to receive the stylets. The tip of the labium, or rostrum, grips and guides the stylets as they penetrate host tissue. The legs have tarsi divided into not more than three segments. Although two pairs of wings are typical for the order, many aphids and all fe-



FROM H. WEBER, "GRUNDRISS DER INSEKTENKUNDE"

FIG. 2.—(ABOVE) DIAGRAM OF HEAD AND MOUTH PARTS OF HEMIPTERA; (BELOW) CLOSE-UP OF CENTRAL COLUMN OF PROBOSCIS

male scale insects are devoid of wings. Male scale insects have only one pair. In many Hemiptera there are varying degrees of wing development within a single species—wingless, short-winged and fully winged individuals being present. Such wing polymorphism has not been fully explained. The abdomen seldom shows more than seven segments, the remainder being modified to form external genitalia. In many families the female has a well-developed ovipositor, but in others it is inconspicuous or absent.

Life History.—Hemipteran life history includes three stages: egg, nymph and adult (fig. 3). Eggs vary greatly in shape, being usually characteristic of each family. Eggs may be inserted into plant tissue, or attached to (in some cases simply dropped on), surfaces. There are generally five instars (growth periods between molts) in the nymphal stage, separable by size and degree of wing-pad development. Nymphs commonly live in the same environment and on the same hosts as their parents.

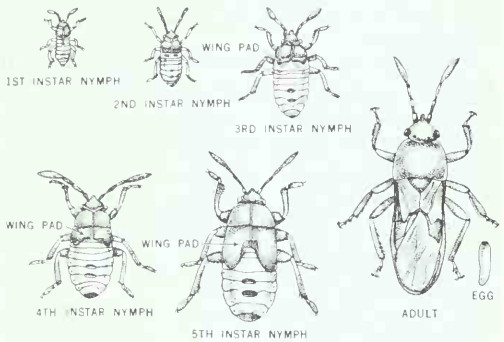


FIG. 3.—CHINCH BUG (BLISSUS LEUCOPTERUS) LIFE CYCLE, ILLUSTRATING GRADUAL OR INCOMPLETE METAMORPHOSIS CHARACTERISTIC OF HETEROPTERA

SUBORDER HETEROPTERA

Special Body Features.—The Heteroptera are the true bugs, in which the wings are generally horizontal and overlap on the body when at rest. The forewings have leathery basal parts and membranous apical parts; the hind wings are entirely membranous. The head projects forward and the proboscis is attached at its anterior end. The maxillary plates meet and fuse to form the gula. The pronotum and scutellum are large, and the tarsi of the legs are generally formed of three segments.

Most families of Heteroptera possess scent glands. In the nymphs they are on the upper side of the abdomen; in adults they are located in the thorax and open near the base of the middle pair of legs. These glands produce the characteristic buggy odour, so well known in the chinch bug, bedbug, squash bug, stinkbugs, etc. This fluid is presumed to be repugnant to enemies and therefore to serve a defensive function. It may also be partially responsible for the use of bugs as items of food in several parts of the world (*see* below).

Diversity.—The Heteroptera comprise approximately 20,000 species, assigned to about 50 families. These exhibit great diversity of habit, some being terrestrial, some semiaquatic and others aquatic. These characteristics are correlated with structure, and form the basis for dividing the suborder into the series Geocorisae, Amphibicorisae and Hydrocorisae. The largest and most important families belong to the Geocorisae.

Geocorisae.—*Plant Bugs.*—The plant bugs (Miridae) include about 6,000 species. Most are plant feeders and some are serious crop pests. Among these are the lygus bugs (*Lygus* species), which attack clover, alfalfa and many other useful plants both in Europe and the United States. In Assam, India, another plant bug (*Helopeltis theivora*) is very destructive to tea. Other members of the family are partially predaceous and one subfamily feeds almost exclusively on aphids, scale insects and similar plant-feeding insects. One species (*Tytthus mundulus*), introduced from Australia to Hawaii in 1920 to aid in the control of the sugarcane leafhopper (*Perkinsiella saccharicida*), is credited with saving the Hawaiian sugar industry. (Fig. 4).

ROCHE FROM NATIONAL AUDUBON SOCIETY

FIG. 4.—FOUR-LINED PLANT BUG (POECILOCAPSUS LINEATUS), FEEDING ON A LEAF

Stinkbugs.—The stinkbugs (Pentatomidae) are a diverse group of more than 3,400 species, divided by some authorities into several families. With a few exceptions, all have five-segmented antennae and most are moderate to large insects with a triangular area (scutellum) on the back. In some species the scutellum is enlarged and forms a shield over the entire abdomen; these forms are called shield bugs, one of which, the Senn pest (*Eurygaster integriceps*), is a serious pest of wheat in the middle east and central Asia. A more typical species, the rice stinkbug (*Oebalus pugnax*), causes severe losses to the rice crop in the United States. The harlequin bug (*q.v.; Murgantia histrionica*) is a pest of cabbage and other crucifers in North America. One subfamily, known as soldier bugs (Asopinae), is predaceous, feeding mainly on larvae of leaf-feeding beetles and lepidopterans.

Lygaeid Bugs.—The lygaeid bugs (Lygaeidae) are small, usually dark brown insects. More than 2,000 species have been described. Most attack plants, a great many feeding mainly on seeds. Several important economic species are included, with the chinch bug (*q.v.; Blissus leucopterus*) qualifying as one of the most destructive (fig. 3). In some years it is very abundant in the central United States and severely reduces the yields of cereals and grasses. A similar chinch bug injures lawns and golf greens in the southeastern United States. However, some representatives are predaceous; the big-eyed bugs of the subfamily Geocorinae prey on pests such as mites, aphids and small caterpillars.

Coreid Bugs.—Coreid bugs (Coreidae) include about 2,000 species. They may be distinguished from lygaeid bugs by the usually more numerous, richly branched veins in the membrane of their forewings. Most species are dull in colour, but a few are bright or even metallically coloured. All are plant feeders and a few are serious pests. The squash bug (*Anasa tristis*) is familiar to American gardeners. In the Orient the rice bug (*Leptocorixa varicornis*) often causes heavy losses.

Red Bugs.—The red bugs or pyrrhocorid bugs (Pyrrhocoridae) are similar to the coreid bugs except that they lack ocelli (simple eyes) and are usually bright red or red and black. It is a small family whose members generally have little economic significance. However, the cotton stainers (*Dysdercus* species) are serious pests of cotton in America and also in India. While feeding on the ripening seed of the cotton boll, the red bug introduces a fungus that stains and otherwise damages the cotton fibres.

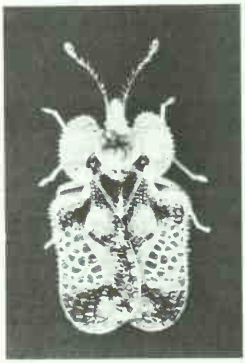


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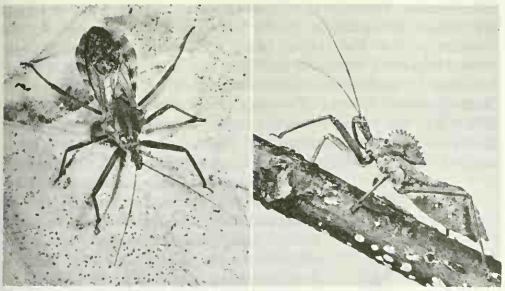
FIG. 5.—LACE BUG (CORYTHUCHA JUGLANDIS)

Lace Bugs.—Lace bugs (Tingidae) seen through a microscope show a delicate lacelike construction of their forewings and of other protuberances that generally characterize the family (fig. 5). A few of the 1,000 or more species are important pests: *Stephanitis pyri* attacks pear and apple in Europe, and *S. pyrioides* is the bane of azalea fanciers in the United States.

Bedbugs.—The common bedbug, *Cimex lectularius*, and its tropical relative *C. hemipterus* (Cimicidae) are well-known blood-sucking pests. *C. lectularius* has accompanied man to



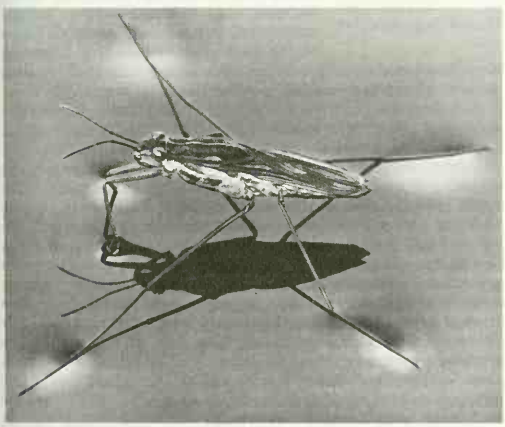
JOHN H. GERARD

FIG. 6.—(LEFT AND RIGHT) WHEEL BUG (ARILUS CRISTATUS), AN UNUSUAL ASSASSIN BUG

virtually every habitable part of the earth. Other species attack bats and birds. (*See* BEDBUG.)

Assassin Bugs.—With one notable exception the assassin bugs (Reduviidae) are predaceous, feeding on other insects and related arthropods. The conenose bugs of the subfamily Triatominae comprise the exception. These bugs feed exclusively on the blood of warm-blooded animals and three species (*Triatoma infestans, Panstrongylus megistus* and *Rhodnius prolixus*) are the principal vectors of Chagas' disease (*see* TRYPANOSOMIASIS), a sometimes fatal but more often chronic, debilitating ailment prevalent in many countries of South America. (Fig. 6).

Amphibicorisae.—The series Amphibicorisae, as the name implies, includes the families that live near or on the surface of water. These are the water striders (Gerridae; fig. 7), marsh treaders



HERMANN EISENDEISS

FIG. 7.—WATER STRIDER (GERRIS) ON THE SURFACE OF WATER

(Hydrometridae), shore bugs (Saldidae) and a variety of other small, inconspicuous insects. One of the few truly marine groups of insects belongs here; this is the genus *Halobates*, which occurs far out on the ocean in warm latitudes. The species belonging to these families mostly prey on other small forms of life and none are known to be economic pests.

Hydrocorisae.—The families of the series Hydrocorisae have also been called Cryptocerata, because of their concealed antennae, a feature characteristic of aquatic bugs. Included here are the giant water bugs or electric light bugs (Belastomatidae; fig. 8), which feed on other insects, small fish, salamanders and tadpoles; the water scorpions (Nepidae), which breathe through nature's version of a snorkel (fig. 9); the back swimmers (Notonectidae), which can inflict stinging bites if handled injudiciously; and a large family known as the water boatmen (Corixidae). Structurally the water boatmen are notable for lacking a segmented beak and in having their mouth parts modified to allow the ingestion of solid foods. They are bottom dwellers and are generally regarded as herbivorous, though in subarctic regions the genus *Callicorixa* feeds on mosquito wigglers. (*See* WATER SCORPION; WATER BOATMAN.)

Use of Heteropterans by Man.—In southern China and southeast Asia a giant water bug (*Lethocerus indicus*) is pickled and eaten in large quantities. In Thailand and Burma only the male bugs are used; they are ground up and added to food as a powder. In Vietnam the middle leg of a large species of stinkbug is pulled out and the fluid that exudes is collected and used as a condiment that commands a high price in local markets. Stinkbugs are also eaten in parts of Africa. In central Mexico they may be purchased by the litre; here they are used in soup as a condiment and a tonic. They may also be ground and used in a sauce.

LYNWOOD M. CHACE FROM NATIONAL AUDUBON SOCIETY

FIG. 8.—GIANT WATER BUG (BENACUS GRISEUS) DEVOURING NEWT

The water boatmen (Corixidae) provide a valued supplement to the diet of many people living in lake areas of Mexico. Bunches of straw are submerged in the shallow water. The water boatmen lay innumerable eggs on this straw, which is then removed from the water, dried and the eggs "threshed" out. The eggs are then mixed with cornmeal and used in many typical Mexican dishes. In addition, tons of the adult and immature water boatmen are seined from the lakes and sold in the United States as fish and turtle food.

Some bugs, principally the bedbug (*Cimex lectularius*), have been used for medicinal purposes. An older pharmacopoeia gives directions for making tincture of *Cimex* for use as a malaria remedy. Reliance on such folk medicine remedies persists in the small villages and rural areas of some countries. (R. I. Sr.)

SUBORDER HOMOPTERA

Special Body Features.—Homoptera are characterized by the forewings, when present, being of homogeneous texture throughout, not basally thickened and apically membranous as in the Heteroptera, and by the rostrum lying close against the anterior part of the thorax. The suborder includes three series: Auchenorrhyncha, in which the rostrum appears to originate from the lower surface of the head, where it joins the thorax; Sternorrhyncha, in which it appears to emerge between the first pair of legs; and Coleorrhyncha, in which it is ensheathed by integumentary plates

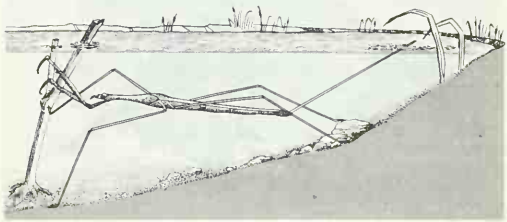


FIG. 9.—WATER SCORPION (RANATRA FUSCA)

extending forward from the anterior part of the thorax. In Auchenorrhyncha and Coleorrhyncha the feet (tarsi) each comprise three segments, but in Sternorrhyncha only one or two.

Diversity.—Homoptera, numbering about 36,000 species, show the utmost diversity of body size and form and of life history. Whether immature or adult, they obtain food by imbibing the sap of plants. Auchenorrhyncha include the cicadas; froghoppers or spittle bugs; treehoppers; leafhoppers and planthoppers or lantern flies. Sternorrhyncha include the plant lice, green flies or aphids; jumping plant lice; white flies; and mealy bugs and scale insects. Coleorrhyncha include only one family, with a few species inhabiting forest litter in the cool regions of the southern hemisphere.

Auchenorrhyncha.—*Cicadas.*—The cicadas (Cicadidae), a family comprising about 3,800 species, are widespread and familiar on account of the shrilling of the adult males, which, in the largest species, is the loudest sound produced by any insect. They are mostly large and have three simple eyes (ocelli) and glassy wings. The life history of the periodical cicada (*Magicicada septemdecim*) of the United States is typical: the female deposits eggs in slits cut in the bark of twigs by the swordlike ovipositor; the young (nymphs), on emerging, fall to the ground, work their way below and feed at the plant roots. In this species 13 to 17 years are spent underground, during which period the nymphs molt about nine times. Finally they ascend to the surface and transform to the winged adult stage. Considered as a group, cicadas are of no economic importance, though the periodical cicada, if locally abundant, may prove a pest to fruitgrowers. (*See* CICADA.)

Spittle Bugs or Froghoppers.—The family Cercopidae comprises about 2,700 species. They differ from cicadas in having only two ocelli and from leafhoppers and treehoppers in having two stout spines laterally on the shin (tibia) of each hind leg. The forewings, normally thick and opaque, fold rooflike in repose over the back. The eggs are inserted in plant stems or, in some species, in moist soil. The nymphs, which, according to species, live exposed on the plant or on rootlets, surround themselves with white froth (cuckoo spit) built up by forcing air (by contraction of a special subabdominal cavity) into the watery excrement that is continually exuded. The nymph (spittle bug or cuckoo spit insect) molts five times during growth and the adult (the froghopper) feeds on stems or leaves of its host. The sugarcane froghopper (*Aeneolamia* species) is a serious pest in sugarcane plantations from Trinidad to Mexico. (*See* CUCKOO SPIT INSECT.)

Treehoppers.—The treehoppers (Membracidae) comprise about 2,600 species of comparatively small insects (about 6 mm.). They are usually recognizable by the face being vertical and by the anterior part of the thorax being grotesquely enlarged and extended backward above the abdomen (fig. 10). This bizarre structure may be wedge-shaped, semicircular or prolonged into two or three diverging spines. The eggs are inserted, in two rows, into slits cut in the bark of young shoots. The nymphs, clustered or lined in a row, feed on stems and shoots. Each is humped, ornamented with spines or pointed flanges extending from the abdomen and either cryptically coloured or powdered with white wax. Though able to walk and leap, they move little if undisturbed and while feeding are often attended by ants. They molt five times before becoming adult. The family is best represented in the tropics and is of little economic importance.

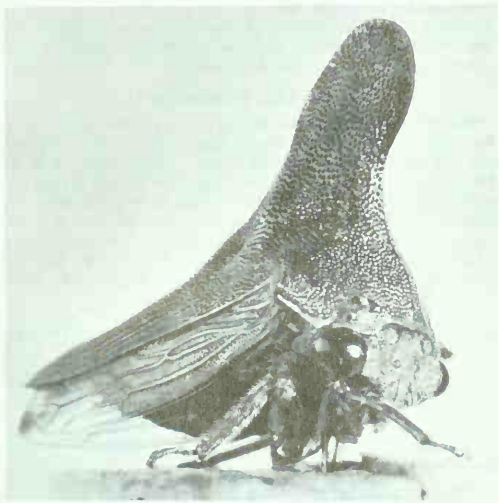
BY COURTESY OF ILLINOIS NATURAL HISTORY SURVEY; ARTIST, C. O. MOHR

FIG. 11.—POTATO LEAFHOPPER (EMPOASCA FABAE)

Leafhoppers.—The leafhoppers, a family (Cicadellidae) of about 9,700 species, are widely distributed. They are usually distinguishable by their slender form, by the "face" being smoothly curved from eye to eye and by the hind tibia bearing slender spines, arranged along its edges in a uniform single or double row (fig. 11). They are mostly small insects, though some species attain 20 mm. The adults leap and fly readily, but both nymphs and adults, if only slightly disturbed, characteristically run sideways. The eggs are ellipsoidal and are inserted in stems; the nymphs, though wingless, generally resemble the adults and molt five times. Although their feeding punctures individually inflict only a minute injury on leaves of the host plant, when very numerous they may cause curling, stunting or browning. Some are serious pests of cotton or cereals; a few transmit plant viruses.

Planthoppers (Lantern Flies).—The superfamily Fulgoroidea comprises about 7,800 species. Planthoppers differ from all the other hoppers in that the eyes are separated from the "face" by the sharp vertical edges of the latter and that the base of each forewing is capped with a small rounded plate (tegula). The adults, when at rest, may resemble moths or leafhoppers, or may look like a piece of tree bark; all leap vigorously if disturbed. As nymphs they feed, according to family, on roots, fungus or stems and leaves. The eggs are deposited in various ways: singly, below ground or in fungal weft; in stems, in small clusters or in rows, with or without a waxy covering; occasionally on leaves or bark in oval masses, covered with powdery wax, or even exposed in two rows, protected only by the toughness of the shell. The nymphs are often cryptically coloured and feed in sheltered positions on their host plant; though agile if disturbed, they move little while feeding. In some species they are entirely covered with white waxy strands; in others they secrete a "tail" of glassy waxen rods. Some species are pests of rice, sugarcane and corn (maize), and a few are vectors of plant viruses.

Sternorrhyncha.—*Aphids.*—The superfamily of aphids, plant lice or green flies (Aphidoidea) comprises about 2,000 species. These tiny insects usually bear two peglike projections (cornicles) dorsally on the abdomen. The wings are delicate and glassy and are usually developed only in males and certain forms of the female. Both adults and nymphs walk slowly. Biologically, aphids are remarkable for the diversity of their alternative modes of development and, in some species, for their seasonal migration from one kind of host plant to another. In a typical life history, eggs laid in autumn by a mated female develop, in spring, into wingless females that produce active young. These young are also viviparous on becoming adult and among their progeny are produced some winged viviparous females, which migrate to other host plants and establish colonies. In early autumn both winged and wingless females produce male and female progeny that sub-



ROSS E. HUTCHINS

FIG. 10.—BUFFALO TREEHOPPER (STICTOCEPHALA BUBALUS)

sequently pair, and the developmental cycle is renewed with the laying of eggs that pass the winter on the host plant. (*See* APHID.)

Jumping Plant Lice.—The superfamily Psylloidea comprises about 2,000 species, which, like aphids and white flies, differ from scale insects in having two segments rather than one in each tarsus. They are further distinguished by the thickened shank (femur) of the legs and by the ten-segmented antennae. They are mostly small and can leap vigorously. The eggs are deposited on leaves or twigs of the host plant; the nymphs, flattened and broadly ovate, usually feed clustered together. When the insects are abundant, the honeydew that they excrete forms a film over leaves and branches: the copious sweet waxy exudate of the Australian sugar-lerp insect has been collected and eaten by aborigines. The apple sucker (*Psylla mali*) and the pear sucker (*P. pyricola*) are injurious, the nymphs damaging blossoms and shoots.

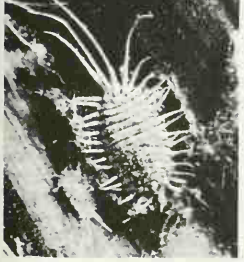
White Flies.—The superfamily Aleyrodoidea comprises about 1,000 species of white flies, very small insects with the wings powdered with wax and appearing white, gray or mottled. The tarsus comprises two equal segments, whereas in aphids the basal segment is relatively shorter. The adults take to flight readily, but immature stages are sluggish or immobile. The eggs, each attached by a slender stalk arising at one end, are laid on leaves, often in curved rows. The nymphs are oval and flattened and at first are capable of movement. After the first molt, however, the legs and antennae degenerate. There are three nymphal stages followed by a pupalike stage in which the insect resembles a waxen seal, with a minute and often characteristic ornamentation of filaments or rods. Of injurious species, the greenhouse white fly (*Trialeurodes vaporariorum*) is familiar (fig. 12); others include the citrus white fly (*Dialeurodes citri*) and the citrus black fly (*Aleurocanthus woglumi*).

WALTER DAWN

FIG. 12.—GREENHOUSE WHITE FLY (TRIALEURODES VAPORARIORUM) ADULTS AND EMPTY PUPAL CASES ON UNDERSIDE OF LEAF

Mealy Bugs and Scale Insects.—In the superfamily Coccoidea, which comprises about 5,000 species, the dissimilarity between males and females is extreme. The males are slender and delicately formed, usually having a single pair of wings, and are active but unable to feed; the females are relatively stouter, wingless, often sessile and usually covered with some kind of secretion. The vernacular names apply to the nymphs and females.

In mealy bugs and in scales of the families Margarodidae and Ortheziidae the covering is of white wax, either powdery or filamentous (fig. 13); in female lac insects it is the resinlike lac of commerce; in the soft scales (Coccidae) it consists merely of a thickening of the skin; and in the armored scales (Diaspididae) of a scale formed of cast nymphal skins and a secretion. Mealy bugs and other less modified forms are able to move about throughout life, whereas soft and armoured scales are active only in the nymphal stages (sometimes merely in the first of these) and, after a brief period of wandering, take up a permanent position on their host plant. The progeny usually hatch from eggs, but in some species the female produces active young. Eggs are produced abundantly and are always protected, being either embedded in a mass of waxy filaments or sheltered beneath the body of the female or the scale that she secretes (fig. 14). Each species of scale insect is restricted in its range of host plants and, according to species, may attack roots, bark, leaves, twigs or fruit. Some, like the mining scale (*Howardia biclavis*), develop below bark, others (*Asterolecanium pustulans*) induce the bark to swell up around them, and members of the Apiomorphinae give rise to galls of elaborate form. In most species female nymphs molt twice and the male three times before becoming adult. The sessile forms, having long feeding stylets, can inflict, on unthrifty plants, damage disproportionately large for their individual size. This, with their capacity for rapid reproduction, makes the group of major economic importance and the list of pest species is long. Some species of mealy bugs transmit plant viruses (such as swollen-shoot disease of cacao).



WALTER DAWN

FIG. 13.—LONGTAILED MEALYBUG (PSEUDOCOCCUS DONIDUM) ON A PALM LEAF

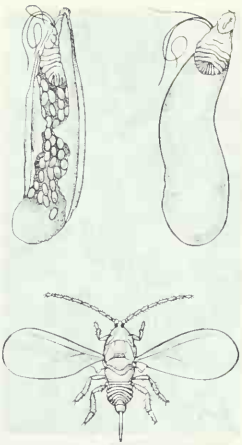


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FIG. 14.—THE OYSTERSHELL SCALE INSECT (LEPIDOSAPHES ULMI). (TOP LEFT AND RIGHT) FEMALE AND EGGS SEEN FROM BENEATH AND ABOVE; (BOTTOM) MALE OYSTERSHELL SCALE

Commercially useful species of the superfamily include lac insects, the Mexican cochineal insect and two oriental soft scales (which yield China wax). (*See* SCALE INSECT.)

See also ENTOMOLOGY; INSECT. (R. G. F.)

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HEMLOCK is the name commonly applied in North America to trees of the genus *Tsuga*, of the pine family (Pinaceae). The genus comprises ten species, six native to eastern Asia and four to temperate North America. They are tall, pyramidal, evergreen conifers, with cinnamon-red bark; slender horizontal or drooping

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EASTERN OR CANADIAN HEMLOCK (TSUGA CANADENSIS)

branches; flat, narrowly linear, two-ranked leaves; and small, pendulous, persistent-scaled cones bearing winged seeds.

The eastern hemlock (*T. canadensis*), called also Canadian hemlock and hemlock spruce, grows in upland forests from Nova Scotia to Minnesota and south to Maryland, Indiana, Wisconsin and the mountains of Georgia and Alabama. It is a handsome tree, usually 60 to 80 ft. tall (sometimes reaching 100 ft.) and up to 4 ft. in diameter. The dark green leaves, to three-quarters of an inch long, are grooved above and marked with two whitish bands beneath. The bark contains tannin used in tanning; the soft, coarse-grained, splintery wood, though inferior to pine or spruce, is used for building purposes. Young eastern hemlocks, introduced into England in 1736, are ornamental and several varieties are cultivated. The smaller Carolina hemlock (*T. caroliniana*), sometimes 70 ft. tall, a beautiful but local tree in the southern Alleghenies from Virginia to Georgia, is used also as an ornamental. The mountain hemlock (*T. mertensiana*), 20 to rarely 90 ft. tall, with leaves crowded densely around the branchlets, occurs on high mountains from southern Alaska to Montana and California.

The western hemlock (*T. heterophylla*), called also hemlock fir and Prince Albert's fir, is often 200 ft. tall, with a trunk 6 to 10 ft. in diameter. It grows from southeastern Alaska to California and Montana. The wood of the western hemlock is superior to that of all other hemlocks, comparing favourably with that of pine and spruce. More than 75% of the total cut of hemlock in the U.S. is this species with Oregon and Washington supplying 95% of the U.S. supply. Huge timbers, some 24 in. square and up to 20 ft. long, come from the better stands of western hemlock. Siebold's hemlock (*T. sieboldii*) attains 100 ft. in height, and the Japanese hemlock (*T. diversifolia*) grows to 80 ft. Both are natives of Japan and are used as ornamentals in North America and Europe.

Various plants of the parsley family (Umbelliferae) also are called hemlock; *e.g.*, poison hemlock (*q.v.*) and water hemlock (*q.v.*). The fool's-parsley (*Aethusa cynapium*) is known as small hemlock (*see* Umbelliferae). American yew (*Taxus canadensis*) is called ground hemlock because its foliage resembles that of the eastern hemlock (*see* Yew). The Douglas fir is sometimes called false hemlock (*see* Douglas Fir). *See* Conifers; Gymnosperms.

See W. Dallimore and A. B. Jackson, *A Handbook of Coniferae* (1948); W. M. Harlow and E. S. Harrar, *Textbook of Dendrology* (1958). (I. L. W.)

HEMOGLOBIN, the coloured substance within the red blood cells (erythrocytes) of all vertebrate animals, functions primarily in the transport of oxygen from the lungs to the tissues. Because of its oxygen-transport function, hemoglobin is essential for life in man and all other vertebrates. Hemoglobin is a member of a large group of hemoproteins that also includes the cytochromes, which are important transfer agents within many types of cells, and several important enzymes such as catalase and peroxidase. Hemoglobin is also related chemically to chlorophyll, the green pigment in plants that plays a vital role in photosynthesis, and to leghemoglobin, the red pigment in leguminous nodules. Hemoglobin also occurs in the coelomic corpuscles or the plasma of some annelid worms, where it acts as a supplemental oxygen carrier.

The hemoglobin molecule is composed of iron, a porphyrin-type ring and a protein portion known as globin. The iron and porphyrin ring, called porphin in hemoglobin, form a complex called heme. In hemoglobin, four hemes are attached to one globin. The porphin is made up of four pyrrole nuclei, each of which is a five-member ring containing four carbon and one nitrogen atoms; it is the porphin segment that gives hemoglobin its pigment characteristics. (*See* also Pigment, Animal: *Tetrapyrroles.*) The iron is held by the four nitrogen atoms of the four pyrrole rings and by certain amino acids of the globin.

The globin is a conjugated protein comprising four polypeptide chains of amino acids. The globin portion is by far the largest portion of the molecule, accounting for about 95% of the molecule's weight of approximately 66,800 (*see* Molecule). The sequence of amino acids in the chains varies with the species. Minor variations also occur within a species. This article deals chiefly with human hemoglobin.

Functions.—Hemoglobin in man carries about 98.6% of all the oxygen transported to the tissues; the remaining 1.4% is carried in solution in the blood. In the lungs, the oxygen present in the inspired air diffuses, because of differences in oxygen tension (concentration), through the lining of the alveoli (small air sacs of the lungs) and then through the walls of the pulmonary capillaries. On entering the blood stream the oxygen passes through the walls of the red blood corpuscles and is taken up by the hemoglobin within the erythrocyte. Hemoglobin that has taken up oxygen is called oxyhemoglobin. Because of the high affinity of hemoglobin for oxygen and the large amount of hemoglobin within the erythrocyte (the hemoglobin makes up 95% of the dry weight of the red blood cell), this system serves as an efficient means for transporting oxygen to the tissues. In an adult man, the hemoglobin carries about 600 litres of oxygen a day, or about 50 times as much as could be carried dissolved in the blood without hemoglobin.

After the blood passes from the lungs through the heart and to the tissues, the oxyhemoglobin dissociates (because of low oxygen tension in the tissues) to yield free oxygen, which passes out of the blood into the cells to be used for many oxidative reactions that yield energy. The dissociation of oxyhemoglobin regenerates the hemoglobin, part of which then combines at the tissue level with carbon dioxide, which it transports back to the lungs. In the lungs, all the hemoglobin again becomes available for combining with oxygen. A third function of hemoglobin is to assist in maintaining the important acid-base balance of the blood. (*See* also Respiration: *Carriage of Oxygen and Carbon Dioxide by the Blood.*)

When oxygen is taken up and carried by hemoglobin, the combination is not an oxidation since the iron in oxyhemoglobin remains in the reduced (ferrous, or 2^+) state of uncombined hemoglobin. Under certain conditions the hemoglobin may be oxidized (*i.e.*, the iron is raised to the ferric, or 3^+, state) to methemoglobin, which does not function as an oxygen carrier. The presence of methemoglobin in blood has been shown to occur as a result of certain intoxications, such as the ingestion of well water that contains nitrites, and in certain hereditary metabolic defects. The oxygen-carrying capacity of hemoglobin is also destroyed when it combines with such substances as carbon monoxide, hydrogen sulfide and hydrocyanic acid (hydrogen cyanide), which have greater affinity for hemoglobin than does oxygen. This accounts for their extremely lethal properties. (*See* also Carbon Monoxide Poisoning; Hydrocyanic Acid.)

Formation and Fate.—Hemoglobin is formed within the erythrocytes as they mature from more primitive cells within the bone marrow. Lack of certain essential nutrients interferes with the proper production of an adequate number of red blood cells and adequate amounts of hemoglobin. A deficiency of hemoglobin and erythrocytes is termed anemia (*q.v.*). Many types of anemia are known in man. The most common, which occurs frequently in children, is due to a lack of iron in the diet and is a hypochromic, microcytic anemia; *i.e.*, it is characterized by a low content of hemoglobin per cell and abnormally small erythrocytes. Anemias may also be caused by hereditary disturbances in the formation of hemoglobin. In all types of anemias, the deficiency of hemoglobin prevents the adequate transport of oxygen from the lungs to the tissues.

Abnormally large amounts of hemoglobin are formed (because

of a higher than normal production of red blood cells) as a result of chronic lack of oxygen, such as occurs at high altitudes. Inhabitants of high mountain ranges normally have more hemoglobin than individuals living at sea level. (*See* also HYPOXIA.)

In a normal individual, the erythrocyte has a life span of approximately 126 days. The old erythrocytes are taken up in the reticulo-endothelial cells of the body and the hemoglobin is destroyed. The iron is reused in the synthesis of new hemoglobin while the porphyrin ring is opened up and converted to a straight-chain yellow pigment, bilirubin, which is excreted chiefly in the feces by way of the liver and intestines and in trace amounts in the urine.

Importance of Chemical Structure.—The study of the chemical structure of hemoglobin has contributed important information to the understanding of human genetics and the interrelationship between genetic makeup and structure of body proteins. In 1910 it was discovered by J. B. Herrick that the blood of a severely anemic West Indian Negro student residing in Chicago contained elongated, sickle-shaped red corpuscles. It was soon learned that this defect was found commonly in other members of the Negro race who suffered from anemia, and the disease was named sickle-cell anemia. The shape of such cells is usually normal in the circulation but becomes abnormal when exposed to low oxygen tensions. The defect is inherited as a recessive characteristic by a simple Mendelian mechanism. Patients with sickle-cell disease have two sickle-cell genes, each inherited from one parent. Parents having only one sickle-cell gene do not have anemia but sickling can be demonstrated when their cells are exposed to low oxygen tensions. Such individuals are said to have a sickle-cell trait. Sickle-cell trait occurs in 1 in 12 U.S. Negroes, while sickle-cell anemia occurs in 1 in 600.

The chemical basis of sickle-cell anemia was discovered in 1949 by L. Pauling, H. A. Itano, S. J. Singer and I. C. Wells when they found that the hemoglobin of a patient with sickle-cell anemia migrated more slowly in an electrical field than did normal hemoglobin. It was further shown that blood from individuals with the sickle-cell trait contains a mixture of sickle-cell hemoglobin and normal hemoglobin. This fundamental discovery quickly led to the recognition of a large number of different human hemoglobins, about 20 of which have been identified. By 1961 it was recognized that chemical differences in different hemoglobins were due to variations in the structure of the protein (globin) portion of the molecule. The four polypeptide chains of the globin consist of two identical pairs, the α chains and β chains. As in all proteins, the polypeptide chains are made up of a series of different amino acids is arranged in a specific sequence. The α chain starts with a valyl-leucyl-sequence, while the β chain begins with valyl-histidyl-. The exact sequence of amino acids is apparently determined by the genetic makeup of the individual. A genetic variation or mutation results in a change of protein composition. In the case of sickle-cell anemia, the abnormality of sickle hemoglobin, or hemoglobin S, is due to the substitution of a single amino acid (valine for glutamic acid) in the two β chains of the molecule. This important discovery by V. M. Ingram led to the elucidation of abnormalities of a number of other hemoglobins. The exact structure of the α and β chains is determined by two separate genes. Genetically determined variations may occur in both chains. Other specific diseases have been traced to other abnormal hemoglobins. (*See* also GENETICS, HUMAN: *Inborn Errors of Metabolism: Sickle-Cell Anemia;* BLOOD, DISORDERS OF: *Disorders Affecting Red Cells;* ANEMIA: *Defective Red Cells: Sickle-Cell Anemia.*)

The hemoglobin of newborn infants differs from adult hemoglobin and contains completely different polypeptides, called γ chains, that substitute for the β chains of the adult hemoglobin. The infant, or fetal, hemoglobin is gradually replaced by the adult type during the first four months following birth.

The study of the distribution of human hemoglobins has been important not only in explaining human disease but also in increasing the understanding of racial interrelationships and population movements. It has been suggested, for example, that the evolutionary persistence of sickle-cell disease in African populations is due to a greater resistance of sickle cells to the malaria parasite.

See BLOOD: *Cells of the Blood: Red Blood Cells; see* also references under "Hemoglobin" in the Index volume.

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HÉMON, LOUIS (1880–1913), French author of the best-known novel of French-Canadian pioneer life, *Maria Chapdelaine,* was born in Brest, France, on Oct. 12, 1880. Educated in Paris, Hémon moved in 1903 to England, where he wrote numerous short stories and articles for French sporting and automotive magazines; he also composed three novels, which were published posthumously. Seeking new surroundings, Hémon sailed for Canada in Oct. 1911. After spending the winter in Montreal, he went north to Lac Saint-Jean, becoming a hired man on the farm of Samuel Bédard near Péribonka. There he found the materials for *Maria Chapdelaine.* First published as a serial in *Le Temps* (Paris) in 1914, the novel had hundreds of editions and was translated into all the major languages. Hémon did not live to see its success: he was killed by a train near Chapleau, Ont., on July 8, 1913.

Despite some resentment over Hémon's failure to idealize French-Canadian life, *Maria Chapdelaine* soon became a model for Canadian regionalistic writers, and Hémon's influence was apparent for more than a generation. It reached its peak in Abbé F. A. Savard's novel *Menaud, maitre-draveur* (*Boss of the River*) in 1937 and later declined as French-Canadian novelists turned to urban settings in the 1940s.

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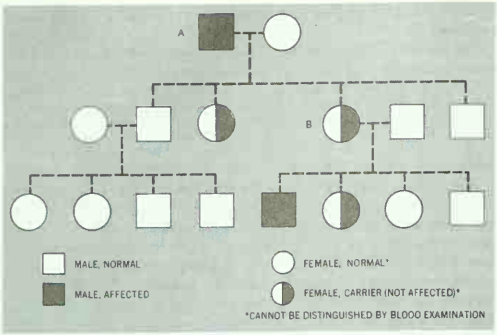
HEMOPHILIA. The word hemophilia means literally an affinity or liking for blood. Actually the term is used to designate a specific form of bleeding disease occurring in males and usually in certain male members of affected families, transmission taking place through female members of the same families. The disease has been known since biblical times and was noted in the Talmud by Hebraic writers, particularly in the unusual degree of bleeding that occasionally complicated ritual circumcision. Credit for the first delineation of the disease must be given to a U.S. physician, John C. Otto of Philadelphia, Pa., who described in 1803 . . . "an hemorrbagic disposition existing in certain families." He wrote as follows: "It is a surprising circumstance that the males only are subject to this strange affection . . . Although the females are exempt, they are still capable of transmitting it to their male children. . . ." It became popularly known as the "bleeder's" disease, or the "disease of kings," because of its common occurrence in the inbred royal families of Europe.

Only about half the cases give a well-defined history of "bleeders" in the family; there can be no doubt that there occur typical cases in which a history of familial disease is completely lacking. In the hereditary cases, the bleeders are always present in the mother's family; *i.e.,* in her brothers, her father or her uncles. Women transmit the disease through a recessive X-chromosome but are themselves free from it; careful studies have failed to demonstrate a specific abnormality. Sons of hemophiliacs are free from the disease and cannot transmit it.

The actual hereditary defect that is transmitted is not completely clear. In any event the plasma either lacks a normal material (antihemophilic plasma globulin factor VIII) in its globulin fraction or there is an excess of a circulating anticlotting material. The weight of the evidence is in favour of the former concept.

The fundamental abnormality of hemophilia is recognized by a great increase in the coagulation (clotting) time of the blood. Normally, if blood taken from a vein is placed in a glass test tube, it clots in from 5 to 15 min. In a hemophiliac, the clotting time is greatly increased, usually from 30 min. to several hours or even longer.

In some cases of hemophilia, the clotting time in glass tubes may



TRANSMISSION OF HEMOPHILIA: (A) MATING OF AFFECTED (HEMOPHILIC) MAN AND NORMAL WOMAN—ALL SONS NORMAL AND ALL DAUGHTERS CARRIERS. (B) MATING OF CARRIER WOMAN AND NORMAL MAN—HALF OF SONS NORMAL AND HALF AFFECTED; HALF OF DAUGHTERS CARRIERS, HALF NORMAL

be quite normal, but if the test is done in siliconized tubes (*i.e.*, tubes whose interiors have been coated with silicone), the defective clotting mechanism is usually exposed. Other more accurate tests include the prothrombin consumption and the thromboplastin generation tests. The latter accurately distinguishes between different clotting factors in the first stage of coagulation. Thus various forms of hemophilia have been described, depending upon the pinpointing of deficiencies in clotting factors. As a result, in addition to classical hemophilia, which is due to a deficiency in AHG (antihemophilic globulin, or factor VIII), other forms including PTC hemophilia (plasma thromboplastin component deficiency, or Christmas disease) and PTA hemophilia (plasma thromboplastin antecedent deficiency) have been recognized. These are milder forms of hemophilia. PTC deficiency has the same hereditary features as the classical form of hemophilia, but PTA deficiency may be transmitted either by males or females and is found in both sexes.

The diminished tendency of the blood to clot places the affected individual at a great disadvantage, since slight injuries such as occur during normal exertion (shoveling snow, striking a golf ball) may result in uncontrollable bleeding. A relatively insignificant cut may lead to bleeding for days. Operations, even such simple ones as dental extractions, may be followed by uncontrollable bleeding, which in some cases is fatal. A child romping about and falling on its knees or elbows develops bleeding into the joints; this may eventually lead to chronic swelling and finally to crippling deformities. Gross bleeding in the urine is common. The hemophiliac may be said to be constantly vulnerable, since at any moment his life may be endangered by what is to most persons a relatively insignificant occurrence.

The increased tendency to bleed becomes noticeable very early in life. Large bruises of the skin and soft tissue are almost always present. The teeth become carious because dentists are naturally loath to carry out even ordinary procedures. Few hemophiliacs, except in the milder forms of the disease, escape crippling joint disease. The diagnosis of the disease is usually readily made, especially if a history of bleeding disease in the family is obtained. The chief abnormality found in the blood is a well-defined increase in the coagulation time with simultaneously normal tests for platelets and other blood constituents. The clotting defect is characterized, as noted above, by a deficiency in one of the factors concerned in the first stage of coagulation: AHG (factor VIII), PTC (factor IX) and PTA. In the great majority of cases, factor VIII deficiency is present; this is classical hemophilia.

The treatment of hemophilia depends upon reduction of the coagulation time, which is usually achieved by transfusing the patient with fresh, normal blood. A patient with active bleeding may require several transfusions within a period of several days. Fresh normal liquid plasma or dried (lyophilized) plasma derived from fresh blood has the same effects as whole blood. Also of some value is the material known as fraction I of Cohn, which is rich in fibrinogen but contains a high concentration of factor VIII. This is derived from the fractionation of normal plasma and contains factor VIII in a far higher concentration than does normal plasma. Thus it may well prove useful in the management of certain cases of hemophilia. Attempts are continually being made to obtain a material that can be injected by the affected individual himself to reduce the clotting time, much as insulin is injected by the diabetic patient to reduce the blood sugar. Bleeding into joints represents a special problem requiring bed rest, immobilization of the joint in a favourable position and application of cold packs. Major surgical operations may become essential in some cases, and, even though extremely risky, may be done with use of fresh blood or fresh plasma just prior to, during and after operation. Several transfusions may be required in the convalescent period. Repeated transfusions may lead, in some cases of hemophilia, to the development of an anticoagulant—an antibody against AHG. This naturally poses another and very serious complication. (W. Dk.)

HEMORRHAGE, a general term for the escape of blood from a blood vessel. It may result from obvious damage to blood vessels by cutting or tearing or there may be spontaneous loss where no trauma is apparent but some disturbance of blood coagulation or blood vessel walls is at fault. Hemorrhage may be from an artery (where bright red blood is rapidly lost in a pulsating stream), from a vein (where darker blood is lost less rapidly as a steady stream) or from capillaries (where generalized oozing of blood from a raw surface takes place). Internal hemorrhage is loss of blood from vessels into a body cavity or organ and external hemorrhage is direct loss outside the body. Internal hemorrhage may be spontaneous (*e.g.*, ectopic pregnancy, bleeding peptic ulcer) or secondary to abdominal injuries (*e.g.*, ruptured spleen). Hemorrhage may occur into one of the body passageways and then later the blood may escape from a natural orifice. Thus, blood may be passed in vomitus (hematemesis), with the feces (melena), in the urine (hematuria), with sputum from the lungs (hemoptysis) or from the nose (epistaxis). In hematemesis and melena the colour may be dark brown or black as a result of the action of gastric and intestinal secretions. Hemorrhage may also take place into or under the skin producing a bruise, or ecchymosis, or a petechial hemorrhage, where red pinhead-size spots are seen (*see* also Purpura). A hematoma is a pocket of blood lying in the tissues. In severe fractures (*e.g.*, that of the femur) extensive blood loss may occur in the tissues without external bleeding.

The consequences of hemorrhage are varied and depend on the amount and rapidity of the blood loss. A very slow and prolonged loss may lead to a deficiency of red blood cells (anemia) but a larger and more sudden loss may lead to profound circulatory disturbances (*see* Shock) resulting in death unless the bleeding can be stopped and proper treatment administered. In healthy adults the loss of a pint of blood, the amount usually taken from blood donors, causes no harmful effects, but the sudden loss of a quart usually causes symptoms of mild shock. If a sizable temporary hemorrhage occurs, the body compensates for the loss by constricting vessels in some parts of the body, thus making the remaining blood available for circulation to vital organs such as the brain and heart wall. The body then makes up the deficient blood volume, first, by the addition of fluid from the tissues and later by addition of newly produced blood proteins and, finally, newly produced blood cells.

Hemorrhage may cease without treatment as a result of coagulation of blood over the open vessels, retraction and constriction of the severed blood vessels, or lowered blood pressure caused by the blood loss. Hemorrhage can usually be controlled temporarily by direct pressure on the bleeding point and elevation of the bleeding part. Hemorrhage from a large artery may necessitate use of a tourniquet, which should be released momentarily every 15 min. In surgical operations bleeding is controlled by clamping and ligating blood vessels or by the application of agents to enhance blood coagulation; *e.g.*, oxidized cellulose gauze, gelatin sponges and purified thrombin. Heat will also produce coagulation.

Cold is sometimes applied to an intact part to minimize ecchymosis by constricting vessels.

There are a number of diseases in which a defect in blood coagulation may convert a trivial injury into a serious situation. The bleeding tendency in jaundice and in prothrombin deficiency resulting from other causes may be overcome by the administration of vitamin K. In hemophilia, the intravenous injection of fresh whole blood or of a specially prepared globulin fraction of human plasma will temporarily correct the defect. In thrombocytopenic purpura, removal of the spleen is of great benefit.

The essential features in the treatment of hemorrhage are control of bleeding and prompt replacement of blood loss by blood transfusions. If blood is not available immediately, the intravenous administration of plasma, albumin, gelatin or saline is helpful temporarily in restoring the circulating blood volume. In addition, a supine posture is always preferable to a sitting or erect one since the compensatory mechanisms that maintain blood volume and blood pressure are more effective in the supine position. Indeed, a partially head-down posture may be indicated to improve blood flow to the brain.

See also references under "Hemorrhage" in the Index volume.

(I. S. R.)

HEMORRHOIDS, commonly called piles, are swellings formed by the dilatation of veins of the lowest part of the bowel, or of those just outside the margin of its aperture. The former, internal piles, are covered by mucous membrane; the latter, external piles, are just beneath the skin.

As the veins of the lining of the bowel become dilated they form definite bulgings within the bowel, and, at last increasing in size, escape through the anus during defecation. Growing still larger, they may come down spontaneously when the individual is standing or walking, and they are apt to be a grave source of pain or annoyance. Eventually they may remain constantly protruded; nevertheless, they are still internal piles because they arise from the interior of the bowel. Though a pile is sometimes solitary, there are usually several of them. They are apt to become inflamed, and the inflammation is associated with heat, pain, discharge and general uneasiness; ulceration and bleeding are also common symptoms, hence the term bleeding piles. The condition may be complicated by mucus leakage from the anus and itching.

The palliative treatment of hemorrhoids consists in obtaining a daily and easy movement of the bowels, augmented by rest, cold bathing, astringent injections, lotions and ointments. The radical treatment consists in their removal by operation.

HEMP, a common name for *Cannabis sativa*, a herbaceous plant of the family Cannabinaceae, which yields fibre, oil and a crude narcotic drug. Although there is but one species of the true hemp, there is much confusion about its common name because many other fibre-producing plants, and the commercial fibres obtained from them, have been incorrectly termed "hemp"; among these are manila hemp, sisal hemp, New Zealand hemp, Mauritius hemp, bowstring hemp, sunn hemp and ambari hemp, none of which is true hemp or has any botanical relationship to true hemp.

Description of the Hemp Plant.—The *Cannabis sativa* plant is an annual propagated by seed, is cross-pollinated, has a deep taproot system and is adapted to many countries throughout the temperate zones. The seed-producing flowers are borne on separate plants from those that produce pollen. The plants that produce seed are termed pistillate or "female" plants and those that produce pollen are termed staminate or "male" plants. There are rare variants that produce both kinds of flowers on the same plant. When the crop is produced under natural conditions the proportion of female to male plants is about equal. The male plants die soon after the pollen is shed, but the female plants continue to live until the seed is mature or until killed by frost.

When seeded broadcast or in close drills for the production of fibre, the fibre varieties produce relatively tall, slender, whiplike plants that are free from branches except at the tops. When spaced in rows or hills for seed production, the plants produce long, coarse branches from nearly every node, and the main stem (stalk) becomes very thick. The tallest-growing varieties, when spaced for seed production and when grown under favourable soil and climatic conditions, may reach a height of 16 ft. When seeded thickly for commercial fibre production the usual height is from five to ten feet. The varieties used primarily for producing oilseed in northeastern U.S.S.R. and northern China are relatively short and much branched; likewise the so-called drug-producing strains in India, Arabia and northern Africa are short-stemmed and extremely branched.

The stem of the hemp plant is hollow except at the base and tip. The thickness of the tissues that surround the hollow varies greatly among the different types, varieties and strains. The cells that produce the fibre of commerce are formed in the stems between the cambium and the epidermis, and specifically occur in the phloem and pericycle. In other words, the fibre is in that part of the stem that is commonly called bark. The staminate flowers are readily seen, but the pistillate flowers are so small that they are very difficult to observe. The male plants cannot be distinguished from the female plants, either in the seed or in the seedling plants, until the flower buds are considerably developed. The seeds are about the size of wheat grains, but more nearly round, and are produced in clusters at the top of the main stem or at the tips of branches or at the nodes along the branches. Some strains produce seed much more abundantly than others, and there is a wide variation as to the time required to mature seed; some kinds will mature as much as 60 days earlier than others.

JOHN H. GERARD

HEMP (CANNABIS SATIVA), FROM WHICH MARIJUANA IS DERIVED

Origin and Distribution.—It is thought that hemp originated in the general region just north of the Himalayas, and ancient writings indicate that in 2800 B.C. the plant was used for fibre in China. Evidently hemp is one of the first fibre plants used by man, and it is probable that both hemp and flax fibre were used long before man learned to write. It is supposed that hemp spread from Asia to eastern and southern Europe and that it reached western Europe in about A.D. 500. It is known that it was introduced into Chile about 1545 and into New England and Virginia about 100 years later. By the 20th century it was known as either a wild or cultivated plant in practically every country in the north temperate zone and also in several countries of the south temperate zone. As a cultivated fibre crop it is grown in the U.S.S.R., Italy, China, Yugoslavia, Rumania, Korea, Poland, Turkey, Hungary, Japan, Germany, Czechoslovakia, France, Bulgaria, Chile and the U.S.

Cultivation for Fibre Production.—There is wide variation in the methods used in growing and handling hemp in the many producing countries, but there are some general procedures that are common to nearly all. Thus it is common practice to seed the crop early in the growing season; to use a well-prepared and firm seed bed; to select the most fertile soil available; and to seed thickly by broadcasting or drilling. The rate of seeding varies perhaps as much within any one country as it does from one country to another and usually ranges from 33 lb. (three pecks) to fully 66 lb. (six pecks) per acre. The use of as much as 88 lb. (eight pecks) has been reported in Belgium and northern France. In all producing countries shallow seeding is practised (½ to 1 in. deep); no subsequent cultivation (intertillage) is given, and except for a few areas in Europe no weeding by hand or machines is practised. In nearly every producing country it is thought that, when grown for fibre, hemp is ready for harvesting as soon as the male plants are in full blossom and are freely shedding pollen. It is generally believed that the softest and finest (though weakest) fibre is obtained from plants harvested immediately after the shedding of pollen begins and that the greatest yield of strongest fibre (though more coarse and harsh) is obtained from the more completely matured plants. In some areas in Europe hemp is pulled (uprooted) by hand, but in nearly all producing countries the

crops are harvested by cutting a few inches above the ground—either with a hand sickle, a self-rake reaper or a special hemp-harvesting machine.

Retting Hemp Straw.—After the hemp stalks are harvested they must be retted; *i.e.*, subjected to a partial decomposition or rotting in order to make possible the separation of the fibre. Methods of retting vary greatly among the producing countries; in some areas water retting is practised, whereas in others the dew retting method is used.

Much of the Soviet crop and all of that grown in the United States is dew retted. In most other countries water retting is common. In dew retting, the harvested hemp straw is spread in thin layers on the stubble of the fields where it grew. The straw remains there until the moisture from rain and dew (and sometimes snow) has made it possible for microorganisms (bacteria and fungi) partially to decompose those plant tissues that surround the fibres. Such partial decomposition permits the mechanical separation of the fibre from the other tissues. The time required for dew retting is determined by weather conditions; it may vary from a week to many weeks and in some instances several months. When retting is completed, the straw is lifted and set up in open shocks to dry.

In water retting, the freshly harvested straw is allowed to become thoroughly dry and is then immersed in water, where it is left until the combined action of bacteria and the water have partially decomposed and dissolved the tissues and substances that surround the fibre. The time necessary for water retting is determined by the temperature of the water; it usually varies from 10 to 20 days, but in temperature-controlled tank retting the process may be completed in 3 to 5 days (using temperatures of around 32° C. [90° F.]). Both natural and artificially constructed pools and ponds are used, as well as small streams and rivers and tanks of various kinds.

In some countries the dew-retted straw is not bundled, but in the northern United States it is picked up and tied into bundles with a specially designed machine termed a gather binder. The shocks are so built that the air circulates freely through them. No drying other than that which occurs during shocking in the fields is practised, except in the United States, where drying is accomplished by artificial methods.

Separating and Cleaning the Fibre.—When the retted hemp straw is sufficiently dried, it is subjected to one of many mechanical methods for separating the fibre from other parts of the straw. The mechanical devices are termed brakes (because they break or crush the woody part of the straw) and the process itself is called breaking. After breaking, the crushed mass must be so handled as to separate the fibre from the broken woody core (termed hurds). This shaking, brushing and combing process is called scutching.

Hand brakes are used in some European countries. However, power-driven mechanical breaking machines are in common use in most countries where hemp is grown as a commercial crop. Nearly all the various kinds of mechanical brakes consist essentially of pairs of fluted rolls through which the retted straw is fed (usually lengthwise) and by means of which the woody portion (core) of the stalks is broken in short pieces (hurds).

The broken material (fibre and hurds) is either shaken by hand or subjected to a mechanical scutching machine, of which many kinds have been developed. Such machines separate the hurds from the fibre and in doing so also remove a considerable proportion of short, tangled and broken fibre, which is termed tow. The long, reasonably straight fibre from which the hurds and tow have been removed is termed line.

Yields.—Acre yields of total fibre (line and tow) vary greatly among the producing countries but may be approximated as ranging from about 500 lb. to as much as 1,800 lb. Lowest average yields are obtained in the U.S.S.R. and highest yields in northern Italy. In the United States acre yields of fully 1,600 lb. frequently have been reported, but the average over a ten-year period is probably not more than 850 lb.

Uses as a Fibre Plant.—In Asia and Europe hemp fibre at one time or another has been used for making a wide range of textile products, from fine fabrics to coarse ropes. Such general uses of hemp are still made in those countries where people do their own spinning and weaving. In North America the only hemp products of commercial importance manufactured in the period between World Wars I and II were hemp twines, but during the actual war periods hemp fibre was used extensively for making a variety of threads, twines and ropes; after 1950 considerable hemp fibre was used in the United States for making artificial sponges.

Hemp as an Oil and Feed Crop.—Hemp oil (of which the seed contains about 30%) is usable for making paints, varnishes and soaps; but the commercial use of hempseed oil has never been of any considerable importance. Hempseed was formerly much used in ready-mixed feed for caged birds and to some extent is still used for that purpose.

Hemp as a Drug Plant.—The leaves and other tissues of *Cannabis sativa* produce a resin from which the cannabis drug is obtainable. This drug is not recognized as a medicine in either the British or the United States pharmacopoeia, yet, if stable preparations of the drug could be obtained, it might be worthy of attention in medicine. As a narcotic, it is either smoked or eaten and is known as bhang, charas or ghanga in India, as hashish in Egypt and Asia Minor, as kef in northern Africa and as marijuana in the western hemisphere. After 1938 outstanding research was done on the chemistry of hemp drugs and their biological activity. Although such research clarified the subject, much still remained unknown in the early 1960s. It appears that the primary action of the drug is on the central nervous system; that it produces such symptoms as a "feeling of well-being" and various hallucinations; that it is not physically habit forming; that it is not an alkaloid; and that it is not a single substance but a complex mixture. There are no proved chemical tests for measuring the potency of the drug, and biological assays by the use of animals, though used, are not considered entirely reliable. Probably the potency varies in different regions; perhaps the most potent preparations are from plants grown in hot, relatively dry climates.

See FIBRE; MARIJUANA; DRUG ADDICTION; *see* also references under "Hemp" in the Index volume.

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HEMPSTEAD, a village in Nassau county, Long Island, N.Y., U.S., 5 mi. E. of New York city limits and a terminal of a branch of the Long Island railroad. The area, known as the Hempstead plains, was first settled in the 1640s and experienced slow but steady rural growth until the mid-19th century. The village was incorporated in 1853 and is now primarily residential. Hempstead is the hub of a large retail trade area of populous Nassau county. It is the home of Hofstra university, founded in 1935 and named for William S. Hofstra, a lumber merchant, whose widow bequeathed the Hofstra estate for such a general use. Once an affiliate of New York university but independent since 1939, it has an enrollment of more than 8,000. A reservoir known as Hempstead Lake State park (903 ac.) is located nearby.

For comparative population figures *see* table in NEW YORK: *Population.* (M. H. LE.)

HEMSTERHUIS, FRANS (1721–1790), Dutch scholar of philosophy and aesthetics, whose theories were founded on his classical studies and were influenced by John Locke and Anthony Ashley Cooper, 3rd earl of Shaftesbury, was born at Franeker on Dec. 27, 1721. His works, which had a considerable bearing on the thinking of Johann von Herder, Friedrich Jacobi, J. C. F. Hölderlin and the German romantics, reveal, with pleasing clarity and grace, his leaning toward an aesthetic, pantheistic Neoplatonism. He sought to co-ordinate rationalism and sensualism in his belief that all things in the perceptible universe provide evidence of a unifying force or spirit.

His works include *Lettre sur la sculpture* (1769), which contains the well-known definition of the Beautiful as "that which imparts the greatest number of ideas in the shortest space of time"; *Lettre sur l'homme et ses rapports* (1772); *Sophyle*

(1778); *Aristée* (1779); *Lettre de Dioclès à Diotime sur l'athéisme* (1787); *Simon* (1790); and *Oeuvres Philosophiques* (1792 and 1846–50). Hemsterhuis died at The Hague on July 7, 1790.

See J. E. Poritzky, *Franz Hemsterhuis: Seine Philosophie und ihr Einfluss auf die deutschen Romantiker* (1926); J. Romein in *Erflaters van onze beschaving, 3* (1939). (P. K. K.)

HÉNAULT, CHARLES JEAN FRANÇOIS (1685–1770), French man of letters, was born in Paris on Feb. 8, 1685. He became a councilor of the *parlement* of Paris (1705), president of the chamber of *enquêtes* (1710) and superintendent of the household of the queen (1753). But he became most famous as a man of varied literary talents and attended the salon of Mme du Deffand over a period of 40 years. He wrote tragedies, comedies, ballets, poetry and *Mémoires* (published 1855). His highly original *Abrégé chronologique de l'histoire de France* (1744) ran through eight editions during his lifetime and was translated into several languages, including Chinese. He died on Nov. 24, 1770.

HENBANE, the common name of the poisonous plant *Hyoscyamus niger,* a member of the family Solanaceae (*q.v.*), indigenous to Great Britain. It is found growing wild in waste places and on rubbish heaps. It occurs also in central and southern Europe and in western Asia extending to India and Siberia, and has long been naturalized in the United States. There are two forms of the plant, an annual and a biennial. The annual grows during the summer to a height of one to two feet, then flowers and sets seed. The biennial produces during the first season only a tuft of basal leaves, which disappear in winter, leaving underground a thick fleshy root, from the crown of which arises in spring a branched flowering stem, usually much taller and more vigorous than the flowering stems of the annual plants.

JOHN MARKHAM

HENBANE (HYOSCYAMUS NIGER), SOURCE OF SEVERAL USEFUL ALKALOIDS

The biennial form is of pharmaceutical interest. The basal leaves of biennial henbane spread out flat on all sides from the crown of the root; they are ovate-oblong, acute, stalked and more or less incisely toothed, of a grayish-green colour, and covered with sticky hairs; these leaves die at the approach of winter. The flowering stem pushes up from the root crown in spring, ultimately reaching from three to four feet in height. As it grows it branches and produces alternate sessile leaves, which are stem-clasping, oblong, unequally lobed, clothed with glandular sticky hairs and of a dull gray-green. The whole plant has a powerful nauseous odour. The flowers are short-stalked, the lower ones growing in the fork of the branches; the upper ones sessile in one-sided leafy spikes, which are rolled back at the top before flowering, the leaves becoming smaller upward and taking the place of bracts. The flowers have an urn-shaped calyx, which persists around the fruit and is strongly veined, with five stiff, broad, almost prickly lobes. The corollas are obliquely funnel-shaped, of a dirty yellow or buff, marked with a close network of purple veins. The capsule opens transversely by a convex lid and contains numerous seeds.

Commercial henbane, which consists of the dried leaves of *Hyoscyamus niger,* and sometimes of *H. muticus,* of Egypt, yields three dangerous narcotics, atropine, hyoscyamine and scopolamine (*qq.v.*). The major sources of supply of these leaves are Hungary, the U.S.S.R., Egypt and the United States, in all of which it is grown commercially. In France another species of henbane, *H. albus,* is used for the same purpose.

The leaves of *H. niger* are used in illicit preparations of smoking mixtures and, in India, as a beverage. Also in India the seeds (which contain more alkaloid than the foliage) have been employed as a somewhat dangerous remedy for toothache.

Medical use of henbane, as an extract, fluid extract and tincture, is complicated by the fact that the leaves contain varying amounts of the narcotics listed above. The isolated and purified drugs derived from henbane are valuable remedies for spasmodic muscular contractions, nervous irritation and hysteria. *See* also ALKALOIDS. (N. TR.; X.)

HENCH, PHILIP SHOWALTER (1896–1965), U.S. physician and Nobel laureate, one of the developers of cortisone, was born in Pittsburgh, Pa., Feb. 28, 1896. He studied at Lafayette college, Easton, Pa., and at the University of Pittsburgh (M.D., 1920). In 1921 he became a fellow in medicine at the Mayo foundation, Rochester, Minn., and in 1923 first assistant and member of the staff of the Mayo clinic. In 1926 he became a consultant in the division of medicine and head of the section on rheumatic diseases. Hench noticed that during pregnancy and in the presence of jaundice, the severe pain of arthritis has a tendency to abate and in some cases to disappear. This fact was well known to other workers, but Hench, in association with Edward C. Kendall (*q.v.*), pursued studies of endocrinologic factors in rheumatic diseases. They evolved and applied cortisone to the treatment of rheumatoid arthritis late in 1948 and early in 1949. For this work, in company with Tadeus Reichstein of Switzerland, they were awarded the 1950 Nobel prize in physiology and medicine. Hench died on March 31, 1965, in Ocho Rios, Jamaica. (J. R. EN.)

HENDERSON, ALEXANDER (1583–1646), leader in the Church of Scotland, was born at Creich, Fife, and was educated at St. Andrews, where, after graduation in 1603, he continued for several years, teaching philosophy and rhetoric. In 1612 he was presented by Archbishop George Gledstanes to Leuchars, where the strongly Presbyterian parishioners did their utmost to prevent his admission. In less than three years, however, Henderson became a convinced Presbyterian in doctrine and church policy. He suffered for his resistance to James I's cautious attempt in 1618 to bring Scottish worship more into line with that of England (the so-called Five Articles of Perth). For 25 years he was a quiet, efficient country minister, known to few, but with the growing esteem of his people. It was the emergency of 1637 that dragged him out of his seclusion.

The new book of canons (1636) imposed by Charles I was followed by the service book which fanned the slowly mounting discontent into a flame. Henderson was summoned to Edinburgh for disobedience to the order to procure copies for his parish. His bold and successful defense caused him to be hailed as a leader. From Edinburgh he organized the resistance that found expression in the National Covenant of 1638, the operative part of which was largely, if not altogether, his work. The general assembly—the first for 20 years—which Charles was driven to permit met in Glasgow at the end of 1638. Henderson was the moderator and his flawless conduct of its business brought him fame. Shortly after its close, he was translated from Leuchars to Edinburgh.

Throughout the two Bishops' Wars and the negotiations that followed Henderson was Scotland's supreme religious and political adviser. At the beginning of the first war in 1638 he wrote the pamphlet *Instructions for Defensive Arms,* justifying the people's right to defend itself. He upheld the idea of a covenant between sovereign and people but always disclaimed any attack on the throne itself. By 1641 the Presbyterian system was restored, and Henderson was occupied until 1643 with reorganizing the Church of Scotland.

The outbreak of the Civil War in England brought a crucial problem. King and parliament competed for the aid of the Scots. Led by Henderson, the great majority deemed it safer to put their trust in the English parliament. So in 1643 there was drawn up the document known as the Solemn League and Covenant (*see* COVENANTERS), which secured official military support for the parliamentary side, and the representation of Scotland in the Westminster assembly, which, though already in being as an advisory body to parliament, was now commissioned to draw up a new constitution and standards for the church in all three kingdoms. Henderson, Samuel Rutherford, Robert Baillie and George Gillespie were nominated as clerical commissioners; and for three years that assembly together with propaganda work in England by pamphlets,

sermons and interviews absorbed all Henderson's activities. Though his voice was not so prominent in the actual debates as that of several of his compatriots, his influence on the resultant documents was even more profound than theirs. When Charles I surrendered to the Scots' army (1646), Henderson had prolonged friendly discussions with him, in which neither made any deep impression on the other. Henderson's health was failing, and on Aug. 19, 1646, eight days after his return to Scotland, he died in Edinburgh. What purported to be Henderson's death-bed recantation indicating that the king had converted him to episcopacy deluded Clarendon and others. But the general assembly of 1648, after investigation, denounced it as nothing but "gross lies and impudent calumnies."

Next to John Knox, Alexander Henderson was the most important of the leaders of the reformed Church of Scotland. He has, not inaptly, been hailed by many as the leader of its second reformation. His works were, one and all, tracts for the times, the most effective being *The Government and Order of the Church of Scotland*, written in 1641 for the members of the Westminster assembly and other readers south of the border.

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(H. WA.)

HENDERSON, ARTHUR (1863–1935), British statesman, principal architect of the modern Labour party and foreign secretary in the second Labour government, was born in Glasgow, on Sept. 13, 1863, and educated at elementary schools there. His family then moved to Newcastle upon Tyne, where he became an iron-molder, an active trade unionist and a Liberal member of the city council. In 1895 he was selected as a Liberal parliamentary candidate but he did not go to the polls. His first, and successful, contest was at Barnard Castle in Durham in 1903, after he had joined the Labour party.

Although never an outstanding orator, Henderson rapidly achieved parliamentary prominence. He was chairman of the parliamentary Labour party in 1906 and joint whip for several subsequent sessions. He became secretary of the Labour party in 1911 and continued to hold that post until he resigned in 1934. When World War I broke out Henderson, with the majority of the Labour members of parliament, took up a position of general support for the British war effort and took over the parliamentary leadership from J. Ramsay MacDonald, who led the pacifist minority. When H. H. Asquith formed the first coalition government in 1915, Henderson became president of the board of education and a member of the cabinet. Later he was paymaster general and adviser on labour matters to the government. He took no active part in the fall of Asquith, but when Lloyd George achieved the premiership in Dec. 1916, Henderson rallied the Labour party to the support of the new government and became a member of the war cabinet of five. He went on a government mission to Russia in 1917 and accepted the view of the Russian provisional government that a European socialist conference at Stockholm was desirable. On Henderson's return Lloyd George seemed willing to accept such an idea but later changed his mind; thereupon Henderson resigned from the war cabinet.

During 1918 Henderson turned his main attention to his job as secretary of the Labour party and was largely responsible, with Sidney Webb, for drawing up the party constitution, which made it for the first time an avowed socialist party with constituency organizations based upon individual membership. These changes were an essential basis for the foundation of a national party which proved able, within six years, to form a government. At the general election of Dec. 1918 Henderson lost his seat at East Ham, but he returned to the house in 1919 on a by-election at Widnes. Electoral misfortune was a constant feature of his political life. At the general election of 1922 he was defeated at Widnes and moved to Newcastle. At the general election of 1923, which led to the formation of the first Labour government, he lost that seat in turn, but was soon back in the house as the member of Burnley. He held this seat until the Labour debacle of 1931.

When MacDonald was forming his first administration (1924) he made the extraordinary suggestion to Henderson that he should be chairman of the committee of ways and means and deputy speaker of the house of commons, but he later appointed him home secretary. In the second Labour government (1929–31) Henderson became foreign secretary and secured notable successes at the Geneva assemblies of the League of Nations. He played a prominent part in setting up the disarmament conference at Geneva in 1932–33 and became president of it after he had left office. At home Henderson, though he had always been a man of the centre, if not of the right wing in Labour party politics, took the lead in resisting the economy proposals which the May committee had urged upon the government and which were supported by both MacDonald and Philip Snowden (*see* ENGLISH HISTORY).

When this difference led to the breakup of the Labour government and MacDonald formed his national government in 1931, Henderson went into opposition and took over the leadership of the Labour party. After the general election of Oct. 1931 he was without a seat in parliament and devoted most of his time to disarmament work in Geneva. He was awarded the Nobel peace prize for 1934.

He returned to the house of commons for the last time as the member for Clay Cross through a by-election in 1933, but he did not resume the leadership of the Labour party. He died in London on Oct. 20, 1935. Henderson was never a dramatic or imaginative character, but he had considerable administrative ability, firm judgment and complete integrity of purpose. He epitomized the central tradition of loyalty to the Labour party of those days and commanded the highest respect throughout the movement.

See M. A. Hamilton, *Arthur Henderson* (1938). (R. J.)

HENDERSON, LAWRENCE JOSEPH (1878–1942), U.S. physiologist, biochemist and sociologist whose initial investigations of acid-base equilibria in blood plasma led him to recognize physical properties of matter uniquely related to the existence of life. He was born at Lynn, Mass., June 3, 1878, attended Harvard college and medical school, then studied in Strasbourg. Returning to Harvard university as instructor in biological chemistry in 1904, he remained on the medical faculty until 1911 when he transferred to the arts and sciences faculty. There he pioneered a famous course in the history of science and one in biochemistry. In 1920 he founded the laboratory of physical chemistry in the medical school. In 1927 he organized the fatigue laboratory in the business school as another means of interdisciplinary study.

His first book was *The Fitness of the Environment* (1913). In *The Order of Nature* (1917) he stressed the uniqueness of organisms. In 1919 he began to synthesize the reciprocal interrelations of oxygen, carbon dioxide and other components in blood. His Silliman lectures at Yale university summarized these researches in *Blood* (1928). In 1927 he first read the work of V. Pareto on social equilibriums. In it he found general concepts concerning multivariate systems. He thereupon extended his thinking to social phenomena. He lectured on Pareto at the University of California, Berkeley, in 1931, and in subsequent years conducted the Pareto seminar at Harvard, which resulted in his *Pareto's General Sociology* (1935).

Henderson admired French culture and British science, and he frequently visited Europe. In 1932 he organized the Society of Fellows at Harvard, by which 24 junior fellows are freed for independent studies. Henderson died at Cambridge on Feb. 10, 1942.

See *Biographical Memoirs*, National Academy of Sciences, 23:31–58 (1945). (E. F. AH.)

HENDERSON, SIR NEVILE MEYRICK (1882–1942), British diplomat, who, as British ambassador in Berlin from 1937 to 1939, was closely associated with Neville Chamberlain's policy of appeasement toward Hitler's Germany, was born on June 10, 1882. He was educated at Eton college and joined the diplomatic service in 1905.

After serving in various subordinate posts, Henderson became British minister in Egypt (1924–28), France (1928–29) and Yugoslavia (1929–35). At this point he was recommended to the then foreign secretary, Sir Samuel Hoare (afterward Lord Templewood), as "the coming young diplomat in the foreign service."

Promoted ambassador to Argentina in 1935, he was transferred in 1937 to Germany, where he stayed until the start of World War II in 1939. In Berlin he worked under severe nervous strain and was seriously ill in the winter of 1938. Some observers considered that he supported the appeasement policy even more vehemently than Chamberlain himself. Afterward he published his own account of the final phase of Nazi aggression in *Failure of a Mission* (1940). He was knighted in 1932 and made a privy councilor in 1937. He died in London on Dec. 30, 1942. His autobiography, *Water Under the Bridges,* was published posthumously in 1945. (J. F. B.)

HENDON, a municipal borough (1932) of Middlesex, Eng., which under the London Government Act 1963 was to be amalgamated on April 1, 1965, with Finchley, Barnet, East Barnet, and Friern Barnet to form the new London borough of Barnet (*see* LONDON). The municipal borough of Hendon lies on the Brent 8 mi. N.W. of St. Paul's cathedral. Pop. (1961) 151,500. Area 16.2 sq.mi. Hendon returns two members to parliament. It is a residential area with some industry (automobile bodies, aircraft accessories, etc.), and includes Mill Hill, where is a Roman Catholic missionary college and a boys' school founded by Nonconformists in 1660 and refounded in 1807. Edgware, Temple Fortune, Burnt Oak, Colindale (with the British Museum's newspaper library), Golders Green (with its Hippodrome and part of Hampstead Garden suburb founded in 1906), part of Hampstead heath, Golders Hill park (with deer), and greenbelt land (more than 1,600 ac. of open spaces in all) are located in the borough. Claude Grahame-White bought Hendon airfield in 1910 and founded the London Flying club; in 1911 the first United Kingdom airmail service was flown from there; in 1923 the air ministry took it over and it was used for military purposes in World Wars I and II; in 1957 it was closed to flying. The Metropolitan Police college was established at Hendon in 1934; it is now a training and driving school for the police. The University of London observatory was opened in 1929. There is a technical college (1939) and a local history museum at Chalk Farm house.

For nearly six centuries Hendon belonged to the abbot and monks of Westminster and they acquired for it two charters of liberty from Edward the Confessor and William the Conqueror. David Garrick lived at Hendon hall when he was lord of the manor.

HENDRICKS, THOMAS ANDREWS (1819–1885), U.S. political leader, vice-president of the United States in 1885, was born near Zanesville, O., on Sept. 7, 1819. He graduated from Hanover college, Hanover, Ind., in 1841, and began in 1843 a successful career at the bar. Identifying himself with the Democratic party, he served in the state house of representatives in 1848, and was a prominent member of the convention for the revision of the state constitution in 1850–51, a representative in congress (1851–55), commissioner of the U.S. general land office (1855–59), a U.S. senator (1863–69) and governor of Indiana (1873–77). From 1868 until his death he was put forward for nomination for the presidency at every national Democratic convention except that of 1872. Both in 1876 and 1884, after his failure to receive the nomination for the presidency, he was nominated by the Democratic convention for vice-president. In 1876, with S. J. Tilden, he lost the disputed election by the decision of the electoral commission, but he was elected with Grover Cleveland in 1884. He died at Indianapolis on Nov. 25, 1885.

HENGELO, a town in the province of Overijssel, Neth., lies on the Twente canal 8 km. (5 mi.) N.W. of Enschede. Pop. (1962 est.) 63,167. Hengelo is a railway junction and lies on the motorway from Amsterdam to Bremen and beyond. It is the centre of the flourishing industry of the Twente district, producing textiles (mostly cotton), machinery, electrical apparatus, chemicals and salt. There are many schools, a large stadium and a modern town hall, while 5 mi. away is the superb medieval castle of Twickel, seat of the baronial family van Heeckeren van Wassenaer. (R. J. J. L.)

HENGIST (HENGEST) **AND HORSA** (fl. *c.* A.D. 450), two brothers, legendary leaders of the first Anglo-Saxon settlers in Britain, went there, according to Bede, to fight against the Picts at the invitation of the British king Vortigern between A.D. 446 and 454. The *Anglo-Saxon Chronicle* says that they landed at Ebbsfleet, Kent, and that Horsa was killed at a place called Aegelsthrep in 455. Bede mentions a monument to him in east Kent. The chronicle says Hengist and his son Aesc (Oisc) began to reign in 455 and fought against the Britons in 456, 465 and 473, and it implies that Hengist died in 488, in which year it dates the succession of Aesc to the throne of Kent. These dates, however, cannot be firmly relied on. As Bede says the settlers in Kent were Jutes, Hengist may perhaps be identified with the hero of this name mentioned in the poem *Beowulf* in connection with a tribe called Eotan (probably Jutes). In any case *Beowulf* shows that Hengist (which means "stallion") is a possible personal name, though the combination with Horsa has been held to throw suspicion on the historicity of these persons. The *Historia Brittonum* of Nennius has a tale of Vortigern's marriage with Hengist's daughter and of a treacherous massacre of the Britons at a banquet. The historic kings of Kent traced their direct descent to Hengist.

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HENGSTENBERG, ERNST WILHELM (1802–1869), German Lutheran theologian and editor whose career was important for two enterprises, both of them in defense of Lutheran orthodoxy and in resistance to what he regarded as the rationalism rampant in the churches and especially in the theological faculties of Protestant Germany. He was born at Fröndenberg on Oct. 20, 1802, and studied at Bonn. After completing his studies at Berlin he became professor of theology there, remaining until his death on May 28, 1869.

Hengstenberg was the founder (1827) and for over 40 years the editor of the *Evangelische Kirchen-Zeitung,* a journal that campaigned against the "unbelief" and indifference of the state churches, pointed to the old ways of the Reformation confessions and served as a rallying point for conservatism, both theological and political. As his second weapon in the defense of orthodoxy he wrote his many biblical commentaries, chiefly on the Old Testament, and his three-volume *Christology of the Old Testament.* These works opposed the growing reliance upon historical-critical interpretation and followed the traditional method of reading the Old Testament as a Christian book, filled with prophecies of the Messiah that were literally fulfilled in the coming of Jesus Christ. Through his books, most of which were translated into English during the author's lifetime, Hengstenberg's influence reached into Great Britain and America as well. (J. J. PN.)

HENG-YANG (HENG-CHOW, HENG-HSIEN), an important city in central southern Hunan province, China, is on the Siang (Hsiang) river, near the junction of several tributaries, and is the head of navigation for steam-tug and motor-launch traffic. Pop. (1953) 235,000. Heng-yang is a transport centre for all of south and southwest China, for there highways, railways and local water transport lines branch out into the south and west. South of Heng-yang lie lead and zinc mining areas. After 1954 the Communists began to develop the city into an administrative and industrial centre. (J. E. SR.)

HENKE, HEINRICH PHILIPP KONRAD (1752–1809), German theologian and church historian, was born near Brunswick, on July 3, 1752. He studied at the then famous University of Helmstedt, where he was professor of philosophy from 1778 and of theology from 1780 until his death on May 2, 1809.

Henke stood for an *unverbildetes Christentum* (undistorted Christianity), unbiased by romanticism or bibliolatry. Influenced by Kant and in church history by J. L. von Mosheim, he belonged to the so-called rationalist school of historians, advocating the science of factual writing from primary sources. He wrote the *Allgemeine Geschichte der christlichen Kirche* (1788–1804) and *Lineamenta institutionum fidei Christianae historico-criticarum* (1793). (C. L. A. R. H.)

HENLE, FRIEDRICH GUSTAV JAKOB (1809–1885), German physician, one of the greatest anatomists of all time and the greatest histologist of his own time, was born July 17,

1809, at Fürth. After studying medicine at Heidelberg and at Bonn, where he took his doctor's degree in 1832, he became prosector in anatomy to Johannes Müller at Berlin. He published three monographs on new species of animals and papers on the structure of the lacteal system, the distribution of epithelium in the human body, the structure and development of the hair, and the formation of mucus and pus. In 1840 he became professor of anatomy at Zürich. In 1844 he was called to Heidelberg and in 1852 he joined the faculty at Göttingen. About this period he was working on his system of general anatomy, which formed the sixth volume of a treatise by S. T. von Sömmerring. He published a zoological monograph on the sharks and rays, in conjunction with Müller. His famous *Manual of Rational Pathology* (1846–53) marked the beginning of a new era in pathological study. The facts of disease were systematically considered with reference to their physiological relations. *The Handbook of Systematic Human Anatomy* (1866–71) was of great scientific merit and of epoch-making importance. During the latter half of his life Henle's researches were mainly histological in character, his investigations embracing the minute anatomy of the blood vessels, serous membranes, kidney, eye, nails, central nervous system, etc. He died at Göttingen on May 13, 1885.

See F. H. Garrison, *Introduction to the History of Medicine*, 4th ed. (1929); N. Robinson, *The Life of Jacob Henle* (1921). (F. L. A.)

HENLEY, JOHN (1692–1756), English eccentric, commonly called "Orator Henley," was born the son of a curate, at Melton Mowbray on Aug. 3, 1692. Educated at St. John's college, Oxford, and ordained in 1716, he held several cures before opening his own "oratory chapel" in London (1726). Sir Robert Walpole paid him £100 a year (1730–41) to edit the weekly *Hyp-doctor* in answer to attacks by the *Craftsman*. He died at Lincoln's Inn Fields on Oct. 14, 1756. Alexander Pope satirized Henley in the *Dunciad* and William Hogarth portrayed him in prints.

See I. Disraeli, *Calamities of Authors* (1881).

HENLEY, WILLIAM ERNEST (1849–1903), English poet whose best-known poem, *Invictus* (1875), concludes with the lines

> I am the master of my fate:
> I am the captain of my soul.

He was also a critic and editor, but is remembered today less for his own work than as the friend of Robert Louis Stevenson and as the leader of a group of writers, Tory and imperialist, including Rudyard Kipling and Charles Whibley, who in the 1890s acted as a kind of countermovement to the so-called *fin de siècle* "decadents." He was born at Gloucester on Aug. 23, 1849, and as a child contracted a tubercular disease that affected his bone structure and necessitated the amputation of one foot. It was while he was in Edinburgh infirmary in 1874 that he met Stevenson (who based part of the character of Long John Silver, in *Treasure Island*, on his crippled but violent and hearty friend) and wrote the impressionist poems, in free verse, owing something to French models, about hospital life, which established his poetic reputation. These poems were included in his volume *A Book of Verses* (1888). The rest of his best-known work is contained in *London Voluntaries* (1892–93) and *In Hospital* (1903).

Henley earned a living mainly as an editor, the most brilliant of his journals being the *Scots Observer* of which he became editor in 1889. This journal transferred to London in 1891 and became the *National Observer*. He projected the series of "Tudor Translations" on which his assistant Charles Whibley did useful work, and with T. F. Henderson edited the centenary edition of the poems of Robert Burns, still a very valuable edition, though Henley's biographical essay in its reaction against whitewash and hagiography exaggerates the wild side of Burns's character. His later years were saddened by a gradual estrangement from Stevenson, after Stevenson's marriage, and by grief for his beloved daughter, who died as a child. He earned much opprobrium for a "debunking" article on Stevenson written after Stevenson's death. Passionately affectionate, one-sided and quarrelsome, Henley was too impatient a writer ever to achieve formal perfection in verse or urbane balance in his critical prose. He was also rather tiresomely mannered in both prose and verse. But he was a good editor and a dominating personality and has a place in the history of literature, if not quite in literature itself. He died at Woking on July 11, 1903.

See John Connell, *W. E. Henley* (1949); J. H. Buckley, *William Ernest Henley* (1945). (G. S. F.)

HENLEY-ON-THAMES, a market town and municipal borough in the Henley parliamentary division of Oxfordshire, Eng., on the left bank of the Thames, 35 mi. W. of London by road and 57½ mi. by river. Pop. (1961) 9,131. It lies at the foot of the Chiltern hills where the river is crossed by a stone bridge of five arches built in 1786. Henley is celebrated for the annual Henley Royal regatta, the principal gathering in England of amateur oarsmen from all over the world, first held in 1839 and usually taking place in the first week of July (*see* ROWING). The parish church (Decorated and Perpendicular) has a tower of intermingled flint and stone, attributed to Cardinal Wolsey but more probably erected by Bishop John Longland; next to it is the 14th-century Chantry house.

Henley-on-Thames was a manor of the crown in Domesday Book and was granted (1337) to John de Molyns, whose family held it for about 250 years. It was incorporated in 1526. Henley suffered from both parties in the Civil War; later, in 1688, William III in his march on London received there a deputation from the lords. The prosperity of the 17th and 18th centuries was attributable to glass, lace and malt and to the corn and wool trade. Modern Henley is mainly a riverside resort, with market gardening, brewing and engineering industries. There is considerable river fishing.

The Thursday market was granted by King John and the Corpus Christi fair by Henry VI. At Shiplake-on-Thames, 3½ mi. upstream, is the Andrew Duncan convalescent home for boys, opened in 1950.

HENNA is the Persian name for a small shrub (*Lawsonia inermis*) found in Asia, Australia and along the African coasts of the Mediterranean, where it is frequently cultivated. It forms a slender plant, from 8 ft. to 10 ft. high, whose branchlets harden into spines with age; it bears opposite lance-shaped smooth leaves, which are entire at the margins, and small white four-petaled sweet-scented flowers disposed in panicles. It is grown as an ornamental in the subtropical region of the U.S., where it is called mignonette tree, and in greenhouses elsewhere. In England it is called Egyptian privet, and in the West Indies, where it is naturalized, Jamaica mignonette.

A paste made of powdered henna leaves is of ancient repute as a cosmetic. It has been used by Egyptian and Indian women to dye their fingernails and other parts of their hands and feet an orange-red colour, which is considered to add to their beauty. The colour lasts for three or four weeks. It is moreover used for dyeing the hair and beard, and even the manes of horses; and the same material is employed for dyeing skins and morocco leather a reddish yellow. The practice of dyeing the nails was common among the Egyptians, and not to conform to it would have been considered indecent. It has descended from very remote ages, as is proved by the evidence afforded by Egyptian mummies, the nails of which are most commonly stained a reddish hue. Henna is also said to have been held in repute among the Hebrews, considered to be the plant referred to as camphire in the Bible (Song of Solomon i, 14; iv, 13). Mohammed, it is said, used henna as a dye for his beard, and the fashion was adopted by the caliphs.

The preparation of henna powder consists in reducing the leaves and young twigs to fine particles, catechu or lucerne leaves in a pulverized state being sometimes mixed with them. When required for use, the powder is made into a pasty mass with hot water, and is then spread upon the part to be dyed, where it is generally allowed to remain for one night. The distilled water from the flowers is used as a perfume.

HENNEPIN, LOUIS (*c.* 1640–after 1701), Franciscan missionary and explorer, was born at Ath, in Hainaut, and joined the Franciscan order at an early age. In 1675 he went to Canada in company with a Recollect mission, crossing in the same ship with René Robert Cavelier, sieur de la Salle, whose chaplain he became in 1678. In 1679 Hennepin accompanied La Salle on his expedition through the Great Lakes to the region of Illinois. They reached

the site of Peoria in Jan. 1680 and built Fort Crèvecoeur there. La Salle was compelled to return to Fort Frontenac for supplies, and Hennepin and the remainder of the party were dispatched to explore the upper Mississippi. In April they were captured by Sioux Indians, whom they accompanied on several hunting expeditions, during the course of which they reached the falls of St. Anthony, where Minneapolis stands. Hennepin was rescued by Daniel Greysolon, sieur du Lhut (Duluth), in July 1680 and went to Quebec. Returning to France in 1682, he published his *Description de la Louisiane* (1683; new Eng. trans., 1938), a full account of his exploits and an immediate popular success. After La Salle's death (1687), however, he brought out a revised account, *Nouvelle découverte d'un très grand pays situé dans l'Amérique* (1697; Eng. trans., 1698, ed. by R. G. Thwaites, 1903), in which he claimed to have explored the Mississippi to its mouth. This bold assumption was soon discredited, and Hennepin's otherwise valuable contributions to the history of New France and to American ethnology are looked upon with suspicion. For reasons unknown he incurred his order's displeasure and spent his last years in obscurity, being last heard of in Rome in March 1701.

See Justin Winsor, *Narrative and Critical History of America* (1889); Hugolin (*i.e.*, Stanislas le May), *Bibliographie du Père Louis Hennepin* (1937).

HENNER, JEAN JACQUES (1829–1905), French painter, best known for his rather sensuous pictures of nymphs and naiads in vague landscape settings, and of idealized, almost symbolist, heads of young women and girls. He also painted a number of portraits in a straightforward naturalistic manner. Henner was born on March 5, 1829, at Bernweiler, Alsace, and studied at Strasbourg and at the École des Beaux-Arts in Paris under Michel Drolling. In 1858 he won the Prix de Rome, and he spent the years 1859–65 in Italy where the chiaroscuro, colour and sentiment of the paintings of Correggio and Giorgione made a lasting impression on him.

Henner exhibited regularly at the Paris salon and was one of the most successful artists of his day, but his reputation was already in decline at the time of his death in Paris on July 23, 1905.

See L. Bénédite, articles in *Gazette des Beaux Arts*, i and ii (1906), ii (1907) and i and ii (1908). (A. Bs.)

HENOGAMY, a term used to denote the custom by which one, and only one, member of a family is permitted to marry. The classic case is that of the patrilineal Nambudiri Brahmans of Malabar, in Madras state, India, where only eldest sons were permitted to marry Nambudiri women and have legitimate children. Younger sons entered into *sambandham* unions with the matrilineal Nayar (*q.v.*) women of a lower caste, but the children here belonged to the Nayar *taravad* or lineage household.

The custom is concerned with the need to keep property intact and to limit the number of legitimate heirs, but is also buttressed by the teachings of Manu and belief in reincarnation. In the Malabar region it likewise represents an accommodation between the Nambudiri Brahmans and the Nayar caste, where the men traditionally spent several years in the military service of the ruler.

The term henogamy is sometimes extended to situations where one member of the family is required to marry according to rules which are not binding on other members of the family. Among the matrilineal Garos and some other groups in Assam the youngest daughter has a special position with regard to inheritance and succession and formerly had to marry a particular relative, whereas elder daughters were free to make their own arrangements.

Such customs represent adjustments to specialized situations rather than survivals of earlier stages, as once thought.

(F. R. E.)

HENRI, ROBERT (1865–1929), U.S. painter, the leader of the Ash Can school and one of the most influential teachers in the history of American art, was born in Cincinnati, O., June 25, 1865. He studied at the Pennsylvania Academy of Fine Arts, Philadelphia, and in Paris, and on returning to the United States became in 1891 an instructor at the Women's School of Design in Philadelphia. His vigorous ideas attracted a group of young illustrators for the Philadelphia press: J. Sloan, E. Shinn, G. Luks and W. Glackens. From 1896 to 1900 he was again in Paris and exhibited at the salon. He settled in New York city, where in 1908 he was among the painters who exhibited together and came to be known as The Eight. During an extremely active life as an artist, Henri exercised considerable influence as a portrait painter. From 1915 to 1923 he taught at the Art Students' league, New York city.

Henri's book, *The Art Spirit*, embodying his conception of art as an expression of love for life, was first published in 1923 and maintained a continuing popularity among artists and art students. He died in New York city, July 12, 1929.

HENRIETTA MARIA (1609–1669), queen consort of Charles I of Great Britain, was born on Nov. 25 (new style; Nov. 15, old style), 1609, the youngest daughter of Henry IV of France and Marie de Médicis. From the beginning Henrietta Maria's life was spent in an atmosphere of political turmoil. Her father was assassinated a few months after her birth, and when she was seven her mother was banished from Paris. Her marriage with Charles was arranged after the negotiations for his proposed match with the Spanish infanta had broken down; a ceremony by proxy took place on May 11, 1625 (N.S.), followed by another, with Charles, at Canterbury on June 13 (O.S.). The child queen (she was then 15) was small, inexperienced and had no knowledge of English. She was treated with insolence by Charles's favourite, the duke of Buckingham, and a year after her arrival the king ordered the entourage which had accompanied her from France to return home. But after the assassination of Buckingham (Aug. 1628), who had been one of the principal causes of misunderstanding between the king and queen, Charles fell in love with his wife. Their first child, Charles (b. 1629), died shortly after birth, but there followed Charles (afterward Charles II) in 1630, Mary in 1631, James (afterward James II) in 1633, Elizabeth in 1635, Anne in 1637, Katharine in 1639 and Henry in 1640. These years were happy ones for the queen, only slightly marred by the visit to London in 1638 of her formidable mother.

As the Civil War approached, everything changed. Henrietta Maria, who was devoted to her husband, showed the courage and determination natural to a daughter of two strong-minded parents; but she did not understand English politics and thought that a military coup would overthrow the parliamentarians. She left for the Netherlands early in 1642 to sell jewels and raise funds for the king and returned with munitions in Feb. 1643. She then landed at Bridlington, Yorkshire, having been protected on the voyage by a Dutch naval escort, and reinvigorated the royalist cause in Yorkshire. After some adventures she joined her husband at Kineton in Worcestershire in July 1643 and accompanied him to his wartime capital of Oxford. The parliamentarians nicknamed her the "Generalissima" as she always pressed bold measures on the king. Her youngest child, Princess Henrietta Anne, was born at Exeter in June 1644. Since the royalist cause was then desperate, Henrietta Maria returned to France, accompanied by her loyal servant, Lord Jermyn. She never saw her husband again. She settled for a time in the Louvre and later in the Palais Royal, but after the execution of Charles I, played little further part in politics. An attempt to convert her youngest son, Henry, duke of Gloucester, to Roman Catholicism alienated her from her eldest son, Prince Charles. She founded a convent at Chaillot where she spent much time. After the Restoration she visited England (Oct. 1660) and was granted a pension of £60,000 a year. She paid two further visits to England but was not comfortable there and finally returned to France in 1665 and died at the chateau of Colombes near Paris on Sept. 10 (N.S.; Aug. 31, O.S.), 1669.

See Carola Oman, *Henrietta Maria* (1951). (M. P. A.)

HENRY (Holy Roman emperors): *see* HENRY, German kings.

HENRY (*c.* 1174–1216), Latin emperor of Constantinople from 1206 to 1216, was a younger son of Baldwin, count of Flanders and Hainaut (d. 1195). Having joined the fourth crusade about 1201, he distinguished himself at the siege of Constantinople in 1204 and elsewhere, and soon became prominent among the princes of the new Latin empire of Constantinople. When his brother the emperor Baldwin I was captured by the Bulgars at the battle of Adrianople in April 1205, Henry was chosen regent of the empire, succeeding to the throne when the fact of Baldwin's death

seemed to be confirmed. He was crowned on Aug. 20, 1206. Henry was by far the most capable and energetic of the Latin emperors. His reign was largely spent in defending and enlarging the conquests of the Franks, Lombards and Venetians against the Bulgars in the north and against the successors of the Byzantine empire in the east and west, Theodore I Lascaris in Nicaea and Michael I Angelus in Epirus. By bold strategy and clever diplomacy he held all his enemies at bay and bound them by agreements to recognize the existence and the rights of a Latin empire in the Greek and Slav world. He also crushed a dangerous rebellion of the Lombard knights in Greece. Under his firm but intelligently tolerant administration many Greeks became almost resigned to the shame of occupation by the Latins. He died, poisoned, it is said, by his Bulgarian wife, in Thessalonica on June 11, 1216.

See J. Longnon, *L'Empire latin de Constantinople* (1949).

(D. M. N.)

HENRY, the name of four kings of Castile.

HENRY I (1203–17), king of Castile from 1214 to 1217, was the youngest son of Alfonso VIII and Eleanor of Aquitaine. He was killed in an accident (June 6, 1217) while still a minor.

HENRY II (1333–79), king of Castile from 1369 to 1379, was born at Seville in 1333, the illegitimate son of Alfonso XI. After the accession (1350) of his half brother Pedro I, Henry devoted himself unremittingly to the task of seizing a throne denied him by his illegitimacy. Finding little support for his ambitions at home, he spent ten years abroad, in France and Aragon, awaiting the moment when he could have himself installed in Castile by foreign troops and conducting a violent propaganda campaign against Pedro. The latter, however, was as determined and ruthless as Henry and did not lose control until 1366, when Henry invaded Castile with the veteran mercenaries of the *compagnies,* financed by Charles V of France, the francophile pope Urban V and the king of Aragon. Henry was crowned at Burgos (March 29, 1366) under the protection of Bertrand du Guesclin (*q.v.*), but Pedro invoked the Anglo-Castilian alliance and the usurper fled the country after being routed by the army of Edward, the Black Prince, at Nàjera (April 3, 1367). He soon returned, defeating and murdering Pedro with his own hand at Montiel (March 23, 1369). His consequent usurpation of the Castilian throne founded the dynasty of Trastámara.

Henry, who had not hesitated to wage war on his fellow countrymen to force them to accept him, now alienated crown lands wholesale to satisfy his Castilian and foreign supporters. He was also obliged to repay his debt to Charles V by actively entering the Hundred Years' War as an ally of France against England. Spanish historians are inclined to interpret favourably Henry's brief reign since, during it, Castile re-established its peninsular hegemony and played a significant part in European affairs, the Castilian fleet winning notable victories against the English. But it is difficult to see how Henry's career in any way served Castilian interests, and his successors were left to face the grave political, financial and social consequences of the usurpation. He died at Santo Domingo de la Calzada in 1379.

HENRY III (1379–1406), king of Castile from 1390 to 1406, was born at Burgos in 1379, the son of John I. As prince of Asturias, Henry married in 1388 Catherine, daughter of John of Gaunt, duke of Lancaster, as part of the dynastic settlement between his father and Lancaster. After the usual troubled minority, marked by violent anti-Jewish pogroms, Henry ruled personally from 1393 and effectively re-established the crown's authority. During his reign the Castilian fleet won fresh successes against England and in the Mediterranean, while Castile emerged without disaster from a renewal of the war with Portugal (1396–98). More constructively, the Canary Islands were colonized, under Henry's sponsorship, by Jean de Béthencourt and Gadifer de la Salle.

HENRY IV the Impotent (1425–74), king of Castile from 1454 to 1474, was born at Valladolid in 1425, the son of John II. Henry possessed a vacillating and incompetent personality and his reign was marked by continual civil war, court scandals and rumours—never entirely substantiated—of the king's own sexual abnormalities. His heiress, Joan (Juana "la Beltraneja"), was rejected by the nobles as they believed Henry not to be her father. The contemporary satirical poem, the *Coplas de Mingo Revulgo,* gives a vivid picture of the deplorable state of Castile under the last Trastámaran king. Henry died in Madrid in Dec. 1474, and was succeeded by his sister Isabella I (*q.v.*). (P. E. R.)

HENRY I (1068–1135), king of England, fourth but third surviving and youngest son of William the Conqueror and Queen Matilda, was born in England in 1068. In 1086 he was knighted by his father at Westminster. At the Conqueror's death in the following year Henry received no land but a legacy of 5,000 pounds of silver. His eldest brother Robert Curthose succeeded to the Norman duchy and the second brother, William Rufus, took the English crown. Henry bought the Côtentin from Duke Robert, founding the close connection with western Normandy that was to stand him in good stead all his life. In 1090 he supported the duke against Rufus, but in the next year the two elder brothers joined forces to drive Henry from the duchy, and for two years he lived precariously, till the townspeople of Domfront, rebelling against Robert of Belesme, took him as their lord. Henry then allied with Rufus, and from 1096, when Duke Robert pawned Normandy to Rufus so that he could be a leader of the first crusade, until 1100, he remained in the English king's service. He was a member of the hunting party in the New Forest on Aug. 2, 1100, when Rufus was killed by an arrow, shot, as is usually believed, by Walter Tirel, lord of Poix. It cannot be proved that Rufus' death was not accidental, or that, if it was deliberate, Henry was privy to the deed. But Tirel was brother-in-law of Gilbert and Roger de Clare who were also with the hunting party, and Henry afterward showed favour to the related families of Clare and Giffard into which Tirel had married. Duke Robert was still on his way home from the east and Henry acted swiftly. To make good his claim to the throne he needed money, baronial support and the blessing of the church. He rode to Winchester and seized the royal treasure despite opposition from William of Breteuil, son of William Fitz-Osbern, earl of Hereford and ally of Robert of Belesme, who supported Duke Robert's claims.

Accession.—On Aug. 5, 1100, Henry was crowned at Westminster by Maurice, bishop of London, and Gerard, bishop of Hereford: Anselm (*see* ANSELM, SAINT), archbishop of Canterbury, was still in exile, and the new king could not even wait for the arrival of the aged Thomas, archbishop of York. Henry, however, in a conciliatory letter, invited Anselm to return, and until early in 1103 his relations with the church were harmonious. The barons he placated partly by putting William II's unpopular minister Ranulf Flambard into the Tower, partly by publishing throughout the kingdom a masterly "charter of liberties," which frankly admitted the enormities perpetrated by Rufus and promised freedom to the church, adherence to the accepted rules of feudal society, and—for the mass of the people—remission of the *murdrum* fines (penalties for unexplained killings), firm peace and the "laws of King Edward the Confessor." Powerful baronial support was forthcoming from the Clares and the Beaumonts (Henry, earl of Warwick, and his brother Robert, count of Meulan), and an appeal was even made to native English sentiment when Henry married (Nov. 11, 1100) Edith of Scotland (who took the name Matilda). She was the daughter of King Malcolm III and through her mother Margaret, the great niece of Edward the Confessor, represented the old West Saxon dynasty. On March 10, 1101, Henry made a military alliance with Count Robert II of Flanders against Duke Robert. The speed and skill of Henry's coup had made the duke's cause virtually hopeless. On invading England (July 1101) he was easily forced to withdraw his claims (treaty of Alton, 1101), and his more dangerous supporter Robert of Belesme was defeated in 1102. It was now Henry's turn to carry the offensive south of the channel. Flambard, who had escaped from the Tower (Feb. 1101) to help Curthose, was reconciled at Alton and thereafter intrigued in Normandy against the duke. The culmination of Henry's attack on Normandy came on Sept. 28, 1106—exactly 40 years after the Norman landing at Pevensey—with the battle of Tinchebrai. Henry, relying on his west Norman and Breton allies, put to flight Robert of Belesme and captured Duke Robert, who remained in prison till his death in 1134. Henry allowed the duke's son William Clito to go free but appropriated the duchy,

thus giving England the first of those large territorial commitments south of the channel which it was to have until the 15th century. Although William Clito (d. 1128) was the focus of several baronial plots and rebellions, Henry's control of England and Normandy was never in doubt, but he was troubled by the enmity of the kings of France and anxieties about the succession. Queen Matilda died in 1118, and the king's only son William was drowned in the White Ship in 1120. There remained an only daughter, Matilda (Maud), who had been married first (1114) to the emperor Henry V, after whose death (1125) she was married (1128) to Geoffrey Plantagenet, count of Anjou. This attempt to end the traditional animosity of Normans and Angevins eventually proved highly successful, in that the eldest son of the marriage, Henry II, became king of England as well as duke of Normandy and count of Anjou. It was proof of Henry's fears for the future and of his strength of character that in Jan. 1127 he compelled the English baronage to take an oath of fealty to Matilda as his heir.

Relations With the Church.—In church-state relations Henry I's reign was in some respects the most important period between the Norman Conquest and the time of Henry VIII. Henry I inherited and strove to preserve a large measure of control over the church, especially in appointments to bishoprics and abbacies. In practice the king chose new bishops, received their homage and fealty as vassals, and invested them with their sees by bestowing the symbolic ring and staff. This custom was strongly opposed by the reforming party within the church, which sought to exalt the priestly order above lay society and make bishops independent of secular authority. Unlike his predecessor, Henry was not irreligious, but for him bishoprics and abbeys were not only spiritual offices but also great fiefs, disposing of much wealth and often owing the crown military services. The churchmen who held them must therefore be acceptable to the king and tied to him by feudal bonds. The opposing views came into conflict in 1102, when Archbishop Anselm refused to consecrate bishops elect who had taken ring and staff from the king. From 1103 to 1106 Anselm and Pope Paschal II strove in vain to persuade Henry to relinquish investiture and the claim to homage. At Laigle (Normandy) in July 1105 a compromise was put forward, perhaps devised by Henry himself, which eventually formed the basis of what proved a permanent agreement (London, 1107). By this, consecration would not be withheld from bishops elect; the king would in future abandon investiture, but new bishops would do him homage and receive their temporalities before being invested and consecrated by the appropriate ecclesiastical authority. Thus effective royal control was preserved and until the 16th century episcopal appointments followed this pattern.

Administration and Character.—Henry I had the avarice and relentless energy typical of his race. His highly efficient government followed the lines laid down by the Conqueror and Rufus, but was more systematic and for the feudatories more oppressive. He employed outstandingly able administrators, such as Robert, count of Meulan, Ralph Basset and his son Richard, and, most notably, Roger, bishop of Salisbury (d. 1139), who as justiciar developed the exchequer, assisted in his later years by his nephew Nigel, bishop of Ely, the treasurer. The use of royal writs to convey the king's will to all parts of the realm was greatly extended, and both directly and through the medium of the "popular" courts of shire and hundred royal justice began to be made available to the ordinary freeman, instead of being virtually confined to the feudal tenants in chief. In property disputes, Henry's government is noteworthy for its insistence that actions between tenants of different lords must be heard in the shire court, often acting by direct royal precept, and for the beginnings of the rule that no one could be challenged in his freehold without a royal "writ of right" being first obtained. Criminal law under Henry I was harsh; many thieves were hanged and dishonest coiners of money were mutilated. Local communities were expected to cooperate with the king's itinerant justices, whose circuits became more frequent and regular, in presenting suspected criminals for trial. "In his days," wrote an admiring contemporary, "no man dared to wrong another. He made peace for man and beast." The king's peace was expensive, and fiscal administration, through the exchequer and sheriffs, was so efficient that it seemed like oppression.

Henry, whose second marriage (1121) to Adelaide of Louvain proved childless, begot more bastards than any other English king, 9 sons and 11 daughters. Among them were Robert, earl of Gloucester, who played a leading role during Stephen's reign, and Sibyl, queen of Scots (1107–22). Though not nicknamed "Beauclerk" until the 14th century, Henry was an exceptionally well-educated layman, the first literate English king since Alfred. Conventionally pious, Henry protected churchmen and their property and founded Reading abbey in whose church he was buried. He died at Lyons-la Forêt in eastern Normandy on Dec. 1, 1135.

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(G. W. S. B.)

HENRY II (1133–1189), king of England from 1154 to 1189 and one of the most powerful and respected rulers of western Europe in the second half of the 12th century. The son of Geoffrey Plantagenet, count of Anjou, by Matilda, daughter and heir of King Henry I of England, he was born at Le Mans on March 5, 1133. While his mother's supporters were making war on Stephen, Henry was brought to England (1142) and placed under a tutor, Master Matthew, at Bristol. His early teachers also included Adelard of Bath, the famous scientist, and William of Conches. His schooling was thorough, and he came to the throne fully literate, fluent in French and English, and with a good knowledge of Latin. In 1144 he returned to Normandy, which his father had won from Stephen on his behalf, but in 1147 he undertook a campaign in England which ended in ignominious failure. His next visit (1149) began more auspiciously: he was knighted at Carlisle by his great-uncle King David I of Scotland, whose military help he sought, but their ensuing attack on Stephen failed, and Henry was forced to escape to Bristol by hidden ways. Stephen remained secure on the throne, but lost heart when his elder son Eustace died in Aug. 1153. Before this, Henry had been recognized as duke of Normandy (1150), and on his father's death in 1151 had succeeded as count of Anjou. In May 1152, Henry married Eleanor, in her own right duchess of Aquitaine, whose marriage to King Louis VII of France had been annulled two months previously. The marriage made Henry ruler of much of the greater part of France, and he was a power to be reckoned with when he came to England in Jan. 1153. Landing probably at Bristol, he took Malmesbury and won over Robert, earl of Leicester, and other magnates. He then occupied important midland strong points, and came in July to Wallingford, which with amazing steadfastness had held out for the Angevins throughout the civil war. There he made a truce with Stephen, and by a formal treaty at Westminster late in 1153 Stephen accepted Henry as his heir, to the exclusion of his younger son William. Stephen died in Oct. 1154, and Henry was crowned on Dec. 19, 1154.

Accession and Policy.—The new king, only 21 years old, was helped by the universal desire for strong government after the horrors of the anarchy. From the start Henry's aim was to restore royal authority, power and possessions to what they had been under Henry I, but his achievement surpassed his intention and he made the crown appreciably more powerful than it had been in his grandfather's day. Unlicensed baronial castles were demolished, recalcitrant barons punished and full support was given to the county justiciars and sheriffs in keeping peace and dispensing justice. A plan to conquer Ireland (allegedly "given" to Henry by Pope Adrian IV in 1155) was temporarily dropped, but in 1157 King Malcolm IV of Scotland was forced to give up Cumberland, Westmorland and Northumberland (continued possession of which had been promised to the Scots by Henry himself in 1149), while an invasion of north Wales fixed Owain Gwynedd's frontier at the river Clwyd. In 1159 Henry led an army to Toulouse to enforce his wife's claim to that county, but when the king of France hurriedly occupied Toulouse Henry called off his attack, lest defiance of his feudal superior should set a bad example among his own vassals.

The Quarrel With Thomas Becket.—Henry appointed out-

standing officers to key positions: Richard de Lucy and Earl Robert of Leicester, joint chief justiciars; Nigel, bishop of Ely, treasurer; and, as chancellor, Thomas (a) Becket, an able clerk and protégé of Archbishop Theobald of Canterbury. Becket and Henry became firm friends, and the king, making his chancellor archbishop on Theobald's death in 1162, planned with his help to restore the old boundaries of royal jurisdiction vis-à-vis the church, widely encroached on during Stephen's reign. To Henry's astonishment and fury, Becket took his stand upon the most extreme claims of clerical privilege, especially on the treatment of men in clerical orders accused or convicted of crime. Henry wished such men, if convicted in the church courts, to be handed over for punishment to the secular arm. In 1164 he drew up the Constitutions of Clarendon (*q.v.*), which provided for "criminous clerks" on these lines and also surveyed the whole field of relations between crown and church, including episcopal appointments, and aimed at a return to the "ancient customs" of Henry I's time. After first rejecting and then accepting the "ancient customs," Becket again refused to agree to them and was supported by papal condemnation of most of the constitutions. In a council at Northampton (Oct. 1164), a charge of contempt of the king's court was trumped up against Becket, and the king asked him to account for money which had passed through his hands when chancellor. Fearing physical violence, Becket fled to France, and for the next six years Henry kept him in exile, engaging in halfhearted negotiations for his return or deposition with the pope, the king of France and the emperor. In 1170, Henry proceeded with his plans to have his eldest surviving son Henry crowned in his own lifetime to ensure the succession. In defiance of papal prohibition and Becket's strident protests, the "Young King" was crowned in June by Roger, archbishop of York. After a show of reconciliation (July), which allowed Becket to return to Canterbury, the primate suspended or excommunicated his suffragans who had assisted at the coronation. In his rage, Henry uttered words which formed the pretext for four household knights to hasten to Canterbury and murder the archbishop in his cathedral (Dec. 29, 1170). At first the effect of the murder was a setback for Henry's ecclesiastical policy, but ultimately the crown lost very little by it: "benefit of clergy," the immunity of clerks to prosecution for felony in the secular courts, remained, but its operation was restricted by the vigilance of the royal judges.

Wars in Ireland and on the Continent.—An unexpected outcome of the struggle was Henry II's "conquest" of Ireland, where he found a refuge from the storm which broke after the murder. Some of Henry's vassals from south Wales, hard pressed by the Welsh, found an outlet for their energies and the prospect of land in eastern Ireland, to which they gained entry by exploiting local squabbles. Alarmed lest they become too independent, Henry came in person (1171) and annexed Ireland as a lordship of the English crown, making his youngest son John lord of Ireland (1177) and administering the country on his behalf. Despite a setback in Wales in 1165, Henry II found it easier to exert a dominant influence north of the channel than on the continent. His sons, Henry, Richard, Geoffrey and John, to whom he denied real power, cared little for England and fought for a share of Henry's continental fiefs, aided by their mother who was too proud to tolerate her husband's persistent infidelity. In 1173, the Young King and his brothers, backed by Eleanor, King Louis VII of France, Count Philip of Flanders and King William of Scotland, rebelled against their father and were joined by powerful barons on both sides of the channel. Leaving England in charge of Richard de Lucy and Ranulf de Glanville, Henry fought off the rebel attacks on Normandy and Anjou. In 1174 he crossed to England, now the scene of greatest danger, especially from the Scots' invasion of Northumberland. But on July 13 the king of Scots was captured at Alnwick, and thereafter the rebellion, the gravest challenge Henry ever had to face, collapsed. William the Lion acknowledged Henry's overlordship of Scotland (Falaise, 1174), and the French threat receded until the king's closing years. The Young King died in 1183, and Henry, though recognizing Richard's right to succeed to the throne, took the part of Geoffrey and of John, his favourite, against their brother. It was during a campaign which Richard, in alliance with the French king Philip II, conducted against him that Henry, shocked by the treachery of John and overcome by illness and shame, died, at Chinon, on July 6, 1189. In addition to five sons, Henry and Eleanor had three daughters who made marriages of great political importance: Matilda to Henry the Lion, duke of Saxony and Bavaria (1168), Eleanor to Alfonso VIII of Castile (1170), and Joan to William II of Sicily (1177). Henry's bastards included Geoffrey, archbishop of York (1191–1212), and William Longsword, earl of Salisbury (d. 1226).

Administration.—Henry II's government shows many points of continuity with that of his Anglo-Norman predecessors, especially Henry I. He maintained the shire and hundred courts, and the sheriff remained the pivot of local administration, although after the drastic inquiry into the sheriffs' conduct in 1170 many were changed and the sheriffs' position became more subordinate. In keeping with Henry's position as ruler of what was virtually an empire, stretching from the river Tweed and even the Pentland firth to the Pyrenees, conscious emphasis was laid on the overriding superiority of royal authority and by the end of the reign there were few effective checks to the king's will. His autocratic centralized government was generally popular not only because it kept the peace but also because it offered positive advantages which the older systems of territorial and feudal jurisdiction lacked. In criminal law Henry was conservative in methods but revolutionary in effectiveness of execution. County justiciars were replaced by itinerant justices almost constantly on circuit, and under the Assizes of Clarendon (1166) and Northampton (1176), which temporarily suspended the immunity of private franchises, local communities were ordered to co-operate fully with these justices in eyre and with the sheriffs in the arrest and trial of suspected criminals. The way was opened for the replacement of the primitive proof by ordeal by jury verdicts. The most fruitful part of Henry II's legislation lay in the field of property law. Adapting to feudal society the Roman distinction between *possessio* and *proprietas*, possession and ownership, Henry and his advisers made available in the royal courts "petty assizes" to deal with possession or "seisin" and the "grand assize" to deal with ownership or *jus*. Instead of using the primitive and mistrusted trial of battle, litigants could have disputes settled by the declarations of bodies of sworn recognitors. Those willing to settle their disputes amicably could have their agreements ratified by royal justices in a "final concord" which remained an effective title deed. Finally, under Henry II, the chancery began to make available writs by which any free man could get a remedy in the local or feudal court and, if that failed, take his case to the king's court. The number of itinerant judges increased and from about 1180 a royal court began to sit permanently at Westminster. It is no coincidence that the first systematic treatises on English law, the *Tractatus de legibus et consuetudinibus regni Angliae* ("Treatise on the Laws and Customs of England"), known by the name of Ranulf de Glanville, and on the exchequer, Richard FitzNeale's *Dialogus de scaccario*, date from Henry II's reign. *See* ENGLISH HISTORY; ENGLISH LAW; *see* also references under "Henry II" in the Index volume.

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HENRY III (1207–1272), king of England from 1216 to 1272, was born at Winchester on Oct. 1, 1207, the elder son of King John and Isabella of Angoulême. When John died (Oct. 19, 1216) he held only western and southwestern England, and a barrier of midland castles from Oxford and Windsor to Scarborough: the rebel barons and Louis, son of Philip II of France, held London, the southeast, East Anglia and the north. As a papal vassal,

John had commended Henry to papal protection; and at Gloucester Henry did homage to the papal legate Guala, and was crowned (Oct. 28, 1216) with Isabella's circlet by Peter des Roches, bishop of Winchester, the archbishop of Canterbury, Stephen Langton, being absent in Rome. A council of regency was formed, with John's loyal servant, the aged William Marshal, earl of Pembroke, as secular regent and Peter des Roches as Henry's tutor; the civil servants, led by the justiciar Hubert de Burgh, and John's mercenaries under their Norman captain Falkes de Bréauté shared the work, supported by the prelates and royalist barons. The marshal's conciliating wisdom, Hubert's dogged energy, the powerful moral influence of Langton and the bishops, helped by the judicious use of papal authority by the legates Guala and his successor (1218) Pandulph, slowly restored royal authority; the rebels were defeated, Louis forced to withdraw, peace restored, and the excessive claims of the magnates curbed. The lawless mercenaries were tamed and Falkes de Bréauté expelled (1224); and after the marshal's death (May 1219), Hubert de Burgh forced Peter des Roches to withdraw (1227), leaving Hubert master of England despite Henry's second coronation (May 1220), a declaration by Pope Honorius III that Henry had assumed control of his seal (April 1223), and a proclamation of his own majority by Henry himself (Jan. 1227). Hubert, while antagonizing many nobles by his firm assertion of royal rights and embittering Henry by his cautious and conservative policy, greatly enriched and ennobled himself, making himself earl of Kent (1227) and marrying Margaret, sister of king Alexander II of Scotland. Resenting Hubert's tutelage and blaming him for the failure of the French campaign of 1230 (undertaken against Hubert's advice), Henry, athirst for a militant foreign policy, plotted secretly with Peter des Roches, now back in England, and suddenly (July 1232) stripped Hubert of all offices and possessions, and would have killed or imprisoned him on monstrous charges of treason had not the barons, scandalized by Henry's arbitrary vindictiveness, intervened to save Hubert's life.

The brilliant and ambitious Peter des Roches and his "nephew" (possibly his son), Peter of Rivaux, appointed treasurer of the household, now launched a palace revolution aimed at making England the most efficiently centralized kingdom and Henry the richest king in Europe, overriding the restraints of English custom and law in administrative interests. Rivaux, assuming an unprecedented concentration of central and local offices, controlled the entire administration personally, ruthlessly dismissing all opponents, and rigorously overhauling royal finance and government. He used the royal wardrobe as nerve centre of the new system and worked through both English and Poitevin civil servants. His cynical disregard of individual rights and of law and custom provoked Richard Marshal, earl of Pembroke, to rebellion (1233). Richard's death in Ireland (April 1234), in circumstances suggesting treachery by Henry's advisers, united the entire baronage behind Edmund Rich, archbishop of Canterbury, who forced Henry to expel the Poitevins, abandon their projects, and promise in the future to observe law and custom and the counsel of his native magnates.

Henry's Personal Rule.—Henry governed England personally from 1234 to 1258. His administration has been unfairly maligned; he had many able and devoted servants like the clerk John Mansel, and great judges like Henry de Bracton; important administrative developments took place during his reign and rapid judicial progress was made. Henry was a devoted husband, an indulgent father, a clever, literate, pious and charitable king: his sensitive, cultured taste, shown in his rebuilding of Westminster abbey, his patronage of a refined, elegant style of painting, and his collection of elaborate jewelry, greatly fostered contemporary English art. But he utterly lacked the gifts of ruling. He never matched his extravagant ends to his limited means: detesting every restraint, he became furious when thwarted, disregarding the effect of his venomous tongue. When his policy provoked dangerous opposition, he turned in panic against his own agents. When his or his friends' interests prompted, he ignored justice, and did nothing to curb overzealous officials. Eager for fame and glory, he sought to dominate European politics, and especially to recover his lost French inheritance: yet he was a cowardly incompetent leader, and a credulous unpractical diplomat. He feared and distrusted his English barons, despised their truculent uncultured insularity, and consulted them unwillingly, preferring more polished and pliant foreigners and obedient civil servants, most of them English, though some were Savoyards or Poitevins. Although his barons desired no responsibility for government, they expected to be consulted on important matters, and due regard to be paid to their advice: but at first they inclined to tolerance toward their young king, provided he observed accepted feudal ways. But Henry soon offended them by his choice of advisers and officials, by his indifference to harsh administration, his extravagance, his diplomatic follies and his military ineptitude, and the rift between king and barons widened yearly. Repeated clashes taught Henry nothing: his barons, formulating their varying demands for improvement, realized slowly that Henry's failures brought them inescapable responsibility. Important fiscal, constitutional and political developments, changes in the principles of taxation, demands for elected privy counselors and for responsible ministers, and the growth of parliament and of the idea of limited monarchy, resulted from this conflict.

Henry's marriage (Jan. 14, 1236) to Eleanor of Provence, whose numerous Savoyard uncles received valuable grants and offices, and entangled Henry expensively in their Italian ambitions, provoked a sharp crisis in 1237. The magnates insisted upon electing three counselors for Henry and on controlling the collection and expenditure of an "extraordinary" aid of one-thirtieth, granted to assist Henry's finances. In Jan. 1238, the secret marriage arranged by Henry between his sister Eleanor and Simon de Montfort, earl of Leicester, a brilliant young French favourite of Henry's, caused a dangerous protest, led by Henry's brother Richard, earl of Cornwall, and ending in Henry angrily driving Simon and Eleanor overseas (Aug. 1239). Henry's mother, Isabella of Angoulême, had married (1220) as her second husband Hugh of Lusignan, count of la Marche; in 1242 Henry joined the conspiracy organized by his Lusignan kinsmen to drive Louis IX from Poitou, but was shamefully defeated at Saintes, where Richard's diplomacy and Montfort's courage saved Henry from capture. Heavily indebted to Gascon merchants and Italian bankers, Henry begged his disgruntled barons for help, provoking some remarkable demands (probably in 1244, although the date has been contested) for severe limitations on Henry's government, closely foreshadowing the provisions of 1258: Henry survived the crisis by shifty exactions. The lawless greed of his Lusignan half brothers, refugees from Poitou, increased Henry's unpopularity, and subsequent crises produced repeated demands for baronially elected privy counselors and responsible ministers, which Henry always found dubious means of evading. Henry felt a deep obligation to the papacy for saving his crown during his minority, and he was often blamed, sometimes unfairly, for excessive compliance with papal demands for money from England, and for allowing papal provisions of alien clerks to English livings. Simon de Montfort, who in 1248 had unwillingly accepted the governorship of Gascony, finally broke (1252) with Henry, who deserted him when the Gascon nobles complained of his ruthless suppression of their rebellious habits.

Having taken the cross (1250), Henry made a disastrous bargain (1254) with Pope Innocent IV, accepting the kingdom of Naples and Sicily for his younger son Edmund, promising to finance and conduct the conquest of Sicily from the Hohenstaufen family, and receiving Innocent's permission to tithe all church revenues in his lands: Henry's Savoyard advisers are usually blamed for this foolish scheme, which Richard of Cornwall had earlier (1252–53) rejected contemptuously. The news precipitated another crisis, the clergy accepting Innocent's orders resentfully, and demanding Henry's solemn (but empty) confirmation of the charters (1253). Innocent's invasion of Naples collapsed (1254), and Henry, with a debt of five times his normal revenue, faced bitter wrangles with his clergy and increasing pressure from Rome. Earl Richard's superficially successful candidature for the "kingship of the Romans" (1257) widened the crazy plan for English predominance in Europe, but the English barons held contemptuously aloof.

The Provisions of Oxford and The Baron's War.—In March 1258 Pope Alexander IV finally threatened Henry with immediate excommunication unless he promptly fulfilled his promises. Henry appealed abjectly to his magnates, who promised help in return for a far-reaching plan of reform, the Provisions of Oxford (*see* OXFORD, PROVISIONS OF) whereby Henry would govern on the sole advice of a privy council of 15, chosen (indirectly) by the magnates, and controlling the entire administration, central and local, including all royal officials, the chief royal castles being transferred, as a guarantee for 12 years, to baronial castellans. Henry agreed at the parliament of Oxford (June 1258): his Lusignan half brothers were expelled; a justiciar, chancellor and treasurer were appointed and sworn to obey king and council jointly; all sheriffs were changed; a national inquiry into administrative misconduct by royal officials was begun; and a program of administrative and legal reforms was undertaken, leading to a stringent ordinance (Oct. 1258) regulating the conduct of all local royal officials. An undertaking was made (Feb. 1259) that all reforms enjoined upon royal officials should apply equally to baronial officers; and an important code of legal and administrative reforms, the Provisions of Westminster (Nov. 1259), was drawn up. The council also negotiated a definitive peace with France, the treaty of Paris (Dec. 1259).

These reforms split the baronage into a conservative group behind Richard de Clare, earl of Gloucester, resisting the application of the ordinances to their own officials and opposing the Provisions of Westminster (which drastically curbed their powers over their tenants), and the radicals, led by Montfort. Skilfully advised by John Mansel, Henry fomented these differences, assisted by Montfort's mistakes and violence. In April 1260, employing large mercenary forces and supported by Gloucester, Henry overawed the radicals, put Simon on trial for treason, and although he was acquitted, Simon was driven into retirement. In June 1261 Henry published a papal bull, secretly obtained by Mansel, absolving him from his oath of 1258: he abrogated all the reforms and dismissed the officials appointed under the provisions. The baronage reunited briefly, but quickly broke apart again: Gloucester made peace (Oct. 1261) and Simon, completely deserted, left England. But Henry, despite a second bull of absolution from the new pope Urban IV, published in England in May 1262, could not keep control: baronial discontent rekindled, Simon returned to lead the revolt (April 1263), and without bloodshed, forced Henry to restore the Provisions, subject to arbitration on all differences. Simon's support crumbled equally fast, and in Dec. 1263 both sides accepted Louis IX's arbitration. By the Mise of Amiens (Jan. 1264) Louis utterly invalidated the Provisions and all subsequent undertakings and enactments. Simon rejected this award as *ultra vires*, and after unsuccessfully attempting negotiation, was forced to fight. Henry won the opening moves, destroying a large rebel army at Northampton, overrunning the midlands, and relieving Rochester castle. But by brilliant leadership Simon destroyed Henry's greatly superior army at Lewes (May 14, 1264), capturing Henry, his eldest son the Lord Edward (afterward Edward I), and his brother King Richard. By the Mise of Lewes Henry again accepted the Provisions in full, subject to arbitration within specified limits. Simon now ruled England by military dictatorship: Henry, nominally free, was effectively Simon's prisoner, with the Lord Edward and King Richard's son Henry of Almain as hostages. Although Simon strove hard to bring the remaining royalists to terms, to restore order, and to transform his dictatorship into legalized rule based on consent, summoning knights from the shires and burgesses from the towns to parliament (June 1264 and Jan. 1265) for this purpose, his unavoidable monopoly of power alienated young Gilbert de Clare, earl of Gloucester, who joined the royalist Marcher lords and planned Edward's escape (May 1265). By superb generalship Edward penned Simon behind the river Severn, destroyed the large relieving army at Kenilworth (Aug. 1) and trapped and slew Simon and his allies at Evesham (Aug. 4), rescuing Henry, whom they had taken into battle with them.

Enfeebled and senescent, Henry allowed Edward to take control: Edward's savage and revengeful policy prolonged the successful resistance of the rebels at Kenilworth, Axholme, Ely and elsewhere until the legate Ottobuono, King Richard and Henry of Almain persuaded Henry to accept the more moderate settlement of the *Dictum de Kenilworth* (Oct. 1266), which ended the rebellion by July 1267. The moderates also persuaded Henry to reenact, slightly altered, the valuable reforms of the Provisions of Westminster as the Statute of Marlborough (Nov. 18, 1267). The remaining years of the reign passed quietly, and Henry died on Nov. 16, 1272. *See* ENGLISH HISTORY; *see* also references under "Henry III" in the Index volume.

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HENRY IV (1366–1413), king of England from 1399 to 1413, son of John of Gaunt, duke of Lancaster, and of Blanche of Lancaster, was born at Bolingbroke castle, Lincolnshire, probably in April 1366. Created earl of Derby possibly in 1377 when he became a knight of the Garter, and duke of Hereford 20 years later, he was already during his father's lifetime well provided for both out of the Lancastrian inheritance and by his marriage (1380 or 1381) with Mary, daughter and coheiress of Humphrey de Bohun, earl of Hereford. Mary died in 1394; in 1403 he married Joan of Navarre. But while his father lived, Henry's place in politics was necessarily subordinate to his. Only in 1387–88, when Gaunt was abroad in Spain and when part at least of the Lancastrian power was in Henry's hands, did he make a precocious entry into politics as one of the younger "appellants" who accused of treason the friends of his cousin Richard II. However "salutary to the constitution" this may or may not have been, it did not in the end endear him to Richard. Nor did his participation in a possible proposal to depose the king, made between Christmas 1387 and new year 1388, from which Richard was saved by Henry's insistence on the claims as substitute of his father over those of his uncle Thomas of Woodstock, duke of Gloucester. But Gaunt's loyalty preserved the king until his own death in Feb. 1399. Henry was banished in Sept. 1398 and left England in October, following his mysterious quarrel with Thomas Mowbray (d. 1399), duke of Norfolk, of which Richard took advantage to revenge himself on his remaining enemies of 1388. But when the king seized his inheritance and began to attach to himself Gaunt's "affinity" (influence and connections), the basis of Lancastrian power, his return was precipitate. He set out in June, landed at Ravenspur on the Humber (July 1399) and the king surrendered to him at Conway in August. If Henry ever claimed only his own inheritance, he soon claimed that of his cousin also. Richard was forced to abdicate (September), was declared deposed by parliament and Henry's reign as king was held to have begun on Sept. 30, 1399.

Although Henry had based his claim on a Lancastrian descent from Henry III, exploiting the legend that Edmund, earl of Lancaster, called "Crouchback," was an older and not a younger brother of Edward I, his hold on the throne was precarious. Magnate coalitions beset him; parliament bullied him and made the fictitious "constitutionalism" of his accession a fact; Scots and Welshmen harried his borders; sickness and assassins made onslaughts on his person and his conscience gave him trouble. (Tudor historians saw in the unquietness of his time a reward for his perfidy in the murder of Richard: a reward visited on his whole house.) Though he was handsome, brave and energetic, had acquired a European reputation for chivalry in Germany in the 1390s, was liberal, affable, devout, well-read and an accomplished musician, this was not enough. Discontent with government continued as it had under Richard, for Henry was determined that the royal power should continue as it had been under Richard. Open revolt was endemic in the early years. Although Henry attempted to protect them, Richard's friends feared Henry's too much; a revolt in Jan. 1400 eliminated them and

led incidentally to the death of Richard himself. Then plots thickened around Richard's declared heir, Edmund Mortimer, earl of March, the great-grandson of Gaunt's elder brother Lionel, duke of Clarence. Between 1403 and 1408 a series of revolts, inspired by Henry's erstwhile but now discontented friends the Percy family, were suppressed with more or less trouble: at the battle of Shrewsbury (July 1403) Sir Henry Percy, called "Hotspur," son of the earl of Northumberland, was killed and his uncle Thomas Percy, earl of Worcester, was executed two days later. Richard Scrope, archbishop of York, and Thomas Mowbray, earl of Norfolk, were executed in 1405 after the failure of another rebellion; in the same year, also, Gaunt's nephew Edward, duke of York, had been imprisoned for plotting; in Feb. 1408 Northumberland himself and Thomas Lord Bardolf were killed in an encounter with royalist forces led by the sheriff of Yorkshire at Bramham moor.

A more peaceable but not less lively opposition to the administration had been evident in parliament since the beginning of the reign. From 1401 to 1406 there was again an endemic battle with the commons over government expenditure and as a corollary to this over the composition of the king's council. Warfare, internal or external, was costly to the crown; "mismanagement" of finance was as marked under Henry as it had been under Richard and a major cause of both magnate and parliamentary discontent under both of them. Henry did not emerge unscathed through such crises as that of the parliament of 1406, which forced the king to nominate a council and pressed for an audit of his accounts; parliamentary pressure, though it was never as great as in that year, continued throughout his reign. But danger from Scotland ended in 1406 with the capture of the heir to the kingdom, afterward James I, on his way to France; and resistance in Wales with French assistance was effectively broken by 1405, though the revolt of Owen Glendower dragged on until 1409. The French peril itself diminished from 1407; and about the same time disputes active since 1400 with Brittany, Flanders and the Hanseatic league were settled. But though murder plots ceased after 1404, Henry's health began to decline; as early as 1408 he felt a well-merited death and probable damnation were upon him for his sins. Conscience may partly explain his considerable reliance on Thomas Arundel, archbishop of Canterbury, which continued for the rest of his life.

By 1405 an opposition party was developing inside the administration itself. Centred on the Beaufort sons of John of Gaunt, this developed with and in rivalry to the power of Arundel, which was apparent from that year. In 1407 Arundel became chancellor and, as the king's health degenerated, little less than vicegerent. A leader for the opposition was found in Prince Henry, who possibly as early as 1406 was not averse to thoughts of deposing his father. The king's partial recovery in 1409 encouraged unfilial aspiration; and after a most obscure crisis Arundel was displaced as chancellor (Dec. 1409) by Thomas Beaufort. A new council was strongly reinforced with the prince's friends early in 1410 and during the following year some attempt was made at financial reform, if only to provide the means for the prince's active intervention in the French civil war. But by the end of 1411 a crisis equally as obscure as that of 1409 brought down Prince Henry and the Beauforts; though rumours of deposition were in the air the king could now safely weather them and even claim formally that he intended "to stand as free in his prerogative as any of his predecessors." An alliance with the French faction of the Armagnacs (May 1412), instead of with the prince's friends the Burgundians, marked the change of administration and seems to have precipitated the final crisis of the reign. Prince Henry gathered forces and protested energetically that he did not intend to use them against his father; and in any case he had not long to wait. From the end of 1412 the king was practically moribund; he died in the Jerusalem chamber at Westminster abbey on March 20, 1413.

A usurper's government is necessarily unstable; and it is to Henry IV's credit that some political stability was achieved in that unquiet time. Fair game for magnates unscrupulous as he and for members of parliament anxious not to pay taxes to a government they knew to be corrupt, for external enemies and for rebelling Welsh nationalists, racked with disease contemporaries called leprosy but which was certainly not this and which was possibly congenital syphilis, stricken as a result by conscience at this act of God and deserted by the son through whom the curse of Lancaster was to be transmitted, he had not done too badly as king. Indeed, to the chronicler Thomas Walsingham at least, Henry IV had during his span of "thirteen and a half years less five days, reigned gloriously." *See* ENGLISH HISTORY; *see* also references under "Henry IV" in the Index volume.

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HENRY V (1387–1422), king of England, eldest son of Henry, earl of Derby (afterward Henry IV), by Mary de Bohun, was born at Monmouth in 1387, probably on Sept. 16. On his father's exile in 1398 Richard II took the boy into his own charge, treated him kindly and knighted him during the expedition to Ireland in 1399. Henry's uncle, Henry Beaufort, bishop of Winchester, seems to have been responsible for his training, and despite his early entry into public life, he was well educated by the standards of his time. He grew up fond of music and reading, and became the first English king who could both read and write with ease in the vernacular tongue. On Oct. 15, 1399, after his father had become king, Henry was created earl of Chester, duke of Cornwall and prince of Wales, and soon afterward, duke of Aquitaine and Lancaster. From Oct. 1400 the administration of Wales was conducted in his name, and in 1402 he took over actual command of the war against the Welsh rebels, a struggle which absorbed much of his restless energy until 1408. Thereafter he began to demand a voice in government and a place on the council, in opposition to his ailing father and Thomas Arundel, archbishop of Canterbury. The stories of Prince Henry's reckless and dissolute youth, immortalized by Shakespeare, and of the sudden change which overtook him when he became king, have been traced back to within 20 years of his death, and cannot be dismissed as pure fabrication. This does not involve accepting them in the exaggerated versions of the Elizabethan playwrights, to which the known facts of his conduct in war and council provide a general contradiction. Probably they represent no more than the natural ebullience of a young man whose energies found insufficient constructive outlet. The most famous incident, his quarrel with the chief justice, Sir William Gascoigne, was a Tudor invention, first related in 1531.

Henry succeeded his father on March 21, 1413. In his early years his position was threatened by an abortive Lollard rising (Jan. 1414) and by a conspiracy of Richard of York, earl of Cambridge, and Henry Lord Scrope of Masham in favour of Edmund Mortimer, earl of March (July 1415). On each occasion Henry was forewarned and the opposition was suppressed without mercy. Neither incident long distracted him from his chief concern, his ambitious policy toward France. Not content with a demand for possession of Aquitaine and other lands ceded by the French at the treaty of Calais (1360) he also laid claim to Normandy, Touraine and Maine (the former Angevin empire) and to part of France never in English hands. Although such exorbitant demands were unlikely to be conceded even by the then distracted government of France, Henry seems to have convinced himself that his claims were just, and they cannot be regarded as a merely cynical cover for calculated aggression. Yet, from the outset, if "the way of justice" failed, he was ready to turn to "the way of force," and warlike preparations were well advanced long before the negotiations about his claims were finally broken off in June 1415.

The French Wars.—Henry V's true genius is revealed in the planning and execution of his subsequent campaigns for the conquest of France. Before hostilities began, his diplomatic skill was exerted in an effort to secure the support or at least the neutrality of John the Fearless, duke of Burgundy. His attempts to deprive France of maritime assistance show an awareness of

the importance of sea power unusual in medieval kings, and after the battle of the Seine (Aug. 1416), England's naval mastery of the channel was not seriously disputed. At home, Henry turned to the systematic financing of his projected invasion, partly through large-scale borrowing, partly through parliamentary taxation, the generosity of which reflects his success in arousing national enthusiasm for the war. Henry began the struggle with the wholehearted support of the magnates and the backing of a united nation. His military strategy was conceived with equal ability. It stands in marked contrast with the haphazard and spasmodic operations of the English in France in the previous century. His main objective, to which the winning of battles was largely irrelevant, was the systematic reduction of the great towns and fortresses of northern France. These, maintained as the headquarters of permanent English garrisons, would then become the focal points for the subjection of the surrounding countryside; and behind the soldiers were to come the administrators and tax collectors, who would make the war pay for itself. Despite the forethought and grasp which this plan displayed, its execution took longer than Henry had anticipated. It absorbed all his energies for seven years and finally brought him to an early grave.

His first campaign brought the capture of Harfleur (Sept. 1415) and the great victory of Agincourt (Oct. 25, 1415). This resounding triumph made Henry the diplomatic arbiter of Europe: it won him a visit (1416) from the emperor Sigismund with whom he made a treaty of alliance at Canterbury (1416) and whose influence was used to detach Genoa from its naval alliance with France. The co-operation of the two rulers led directly to the ending of the papal schism through the election of Martin V (1417), an objective which Henry had much at heart. Thereafter he returned to the long, grim war of sieges and the gradual conquest of Normandy. Rouen, the capital of northern France, surrendered in Jan. 1419, and the murder of Duke John of Burgundy by the dauphin's partisans in Sept. 1419 brought him the Burgundian alliance. These successes forced the French to agree to the treaty of Troyes on May 21, 1420. Henry was recognized as heir to the French throne and regent of France, and Catherine, the king's daughter, was married to him on June 2. He was now at the height of his power; but his triumph was short-lived. His health grew worse during the sieges of Melun and Meaux, and he died of camp fever at Bois de Vincennes on Aug. 31, 1422.

Character and Ability.—Henry's character is by no means wholly admirable. Hard and domineering, he was intolerant of opposition and could be ruthless and cruel in pursuit of his policy. His lack of chivalrous qualities deprives him of any claim to be regarded as "the typical medieval hero." Yet contemporaries united in praising his love of justice, and even French writers of his own day admired him as a brave, loyal and upright man, an honourable fighter, and a commanding personality in whom there was little of the mean and the paltry. Although personally lacking in warmth, he had the capacity to inspire devotion in others, and he possessed high qualities of leadership. His piety was genuine, and on his deathbed he expressed a last wish that he might live to rebuild the walls of Jerusalem in a new crusade. In respect of ability, he must rank high among English kings. A modern biographer judged him to be "indisputably the greatest Englishman of his day," who also towered above contemporary foreign rulers. His achievement was remarkable; it has been rightly observed that "he found a nation weak and drifting and after nine years left it dominant in Europe." The tragedy of his reign was that he used his great gifts not for constructive reform at home but to commit his country to a dubious foreign war. His own premature death made success abroad unlikely and condemned England to a long difficult minority.

See ENGLISH HISTORY; *see* also references under "Henry V" in the Index volume.

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HENRY VI (1421–1471), king of England from 1422 to 1461 and from 1470 to 1471, son of Henry V and Catherine of Valois, was born at Windsor on Dec. 6, 1421. After he succeeded his father as king on Sept. 1, 1422, the council took control of government in England and in Nov. 1422, Humphrey, duke of Gloucester, was given the office of lord protector with limited powers. In accordance with the terms of the treaty of Troyes (1420), Henry was proclaimed king of France following the death (Oct. 21, 1422) of his maternal grandfather, Charles VI, and until 1429 his uncle, John, duke of Bedford, who acted as regent in France, successfully defended Henry V's conquests. During the king's minority English politics were dominated by the rivalry between Duke Humphrey and the king's great-uncle, Henry Beaufort, bishop of Winchester, who became a cardinal in 1426. Henry's coronation as king of England, which terminated Gloucester's lord protectorship, took place on Nov. 6, 1429. French victories, which culminated in the coronation of Charles VII at Reims on July 17, 1429, made it necessary for Henry VI to visit (April 1430–Jan. 1431) Normandy and Paris. He was crowned in Paris on Dec. 16, 1431. English rule in northern France depended largely on Burgundian support and in 1435 Philip the Good, duke of Burgundy, made a separate peace with Charles VII by the treaty of Arras; the regent Bedford died immediately afterward, on Sept. 14.

The king's minority was never officially ended, but the reappointment of the council in Nov. 1437 indicated that Henry was now considered old enough to rule for himself; henceforth his personality was all-important. There is evidence that, as a boy, he was headstrong and unruly, and Richard Beauchamp, earl of Warwick, who was the king's tutor from 1428 to 1436, seems to have found him a difficult pupil; in 1434 Henry was already taking an interest in affairs of state. Despite his early precocity, he grew up to be a pious and studious recluse and was never the real ruler of England. Although his mental breakdown did not occur until 1453, his intellect was not strong and he had none of the qualities requisite in a king. Henry was no judge of character and his profuse generosity, exploited by his courtiers, further impoverished the crown. Religious observances and the planning of his educational foundations were his chief concern; the founding of Eton college in 1440, and King's college, Cambridge, in 1441 were the only royal acts for which Henry was genuinely responsible. Since the king did not attend to governmental business, his ministers ruled in his place. Before 1440 Cardinal Beaufort had finally established his ascendancy at court and Duke Humphrey of Gloucester was powerless.

Henry's horror of bloodshed made him favour a peace settlement with his uncle, Charles VII of France; probably Beaufort and later William de la Pole, earl (afterward duke) of Suffolk, won his confidence by engaging in negotiations to end the French war. In May 1444, Suffolk obtained at Tours a truce for two years and also arranged Henry's marriage (April 23, 1445) with Margaret of Anjou, a niece of the French queen. For these transactions a price had to be paid; in Dec. 1445, Henry was made to authorize the surrender of the county of Maine to the French. Cardinal Beaufort and Duke Humphrey of Gloucester both died early in 1447 and Suffolk's control of the government was unchallenged until the French reconquest of Normandy, which followed the renewal of the war in July 1449, brought about his fall (March 1450). Jack Cade's rebellion, almost immediately after Suffolk's murder (May 2, 1450), exposed Henry's inability to provide political leadership. Suffolk's place at court was filled from Sept. 1450 by Edmund Beaufort, duke of Somerset, whose incompetence had hastened the loss of Normandy. He faced a rival in Richard, duke of York, who had taken advantage of the Kentish rebellion to return (Aug. or Sept. 1450) from Ireland, where he had virtually been banished as lord lieutenant in 1449.

The struggle between York and Somerset ushered in the last phase of Lancastrian rule. Duke Richard's first bid to seize power by force in Feb. 1452 failed, but the king's insanity, which began in July 1453, led to his appointment as lord protector in March 1454. Meanwhile the birth of Edward, prince of Wales, on Oct. 13, 1453, had destroyed York's hopes of ultimately succeeding

to the crown. The king's recovery, soon after Christmas 1454, made civil war inevitable, as Somerset, who had been imprisoned, was now restored to power (Feb. 1455); in the first battle of St. Albans on May 22, 1455, the king's army was defeated and Somerset was killed. York's second term of office as lord protector (Nov. 1455–Feb. 1456) was necessitated by serious disorders in the west country, but the queen's hostility prevented him from continuing thereafter as Henry's chief counselor. The formal reconciliation between York's supporters and the queen's party (March 1458) may have been inspired by Henry himself. Fighting was renewed in Sept. 1459 and at the battle of Northampton (July 10, 1460) the king was made prisoner by the Yorkists. In parliament in October, York claimed the crown, but there was little desire for a change of dynasty; by a compromise it was agreed that Henry should remain king, but he was compelled to recognize York as lawful heir to the throne, to the exclusion of his own son. Although York was defeated and killed at Wakefield (Dec. 30, 1460) and Henry was recaptured by the Lancastrians at the second battle of St. Albans (Feb. 17, 1461), the Yorkists won the civil war. Henry's reign officially ended when Edward of York, Richard's heir, was proclaimed king in London on March 4. After the decisive battle of Towton on March 29, Henry fled, with his wife and son, to Scotland, which was his refuge for most of the next three years.

Henry returned to England in 1464 to support a Lancastrian rising which was crushed at the battles of Hedgley Moor (April) and Hexham (May 1464). After remaining in hiding for over a year, he was captured near Clitheroe, in Lancashire, in July 1465, and imprisoned in the Tower of London. The quarrel between Richard Neville, earl of Warwick, and Edward IV led Warwick to restore Henry to the throne in Oct. 1470, but his few months of nominal kingship ended when Edward IV entered London on April 11, 1471. Prince Edward was killed in the battle of Tewkesbury on May 4, and the Yorkist victory sealed Henry's fate; he was murdered in the Tower on the night of May 21, 1471. Because of his many virtues, Henry was popularly venerated as a saint after his death and in Henry VII's reign a process for his canonization was begun. His incapacity for government was the chief cause of the Wars of the Roses and the downfall of the house of Lancaster. *See* ENGLISH HISTORY; *see* also references under "Henry VI" in the Index volume.

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HENRY VII (1457–1509), king of England from 1485 to 1509, son of Edmund Tudor, earl of Richmond, and Margaret Beaufort, was born at Pembroke castle on Jan. 28, 1457, two months after his father's death. His father was half brother of Henry VI, being the son of Owen Tudor, who had married Catherine, daughter of Charles VI of France and widow of Henry V of England. His mother was the great-granddaughter of John of Gaunt, duke of Lancaster, and Catherine Swynford. Richard II's legitimation of the children of this union (*see* BEAUFORT) was confirmed by a patent of Henry IV which, however, professed to exclude the Beauforts from the succession to the throne. Henry of Richmond's fortunes were thus bound up from birth with the fortunes of the Lancastrian party in the Wars of the Roses. Until he was 11 he lived in Wales under the protection of his uncle, Jasper Tudor, earl of Pembroke. Then with the surrender of Harlech castle, the last Lancastrian stronghold, in 1468, he fell into the hands of the Yorkist William, Lord Herbert, until the brief restoration of Henry VI in 1470 restored him to Jasper's care. Next year the murders of Henry VI and Prince Edward, after the Yorkist triumph at Tewkesbury, left him head of the house of Lancaster. He was still a mere boy, and his claim was weakened by the fact that few—apparently not even he himself—knew that the clause in Henry IV's patent barring the Beauforts from the throne was an interpolation not found in the original act legitimating them. Nevertheless, the final victory of Edward IV (May 4, 1471) made England, and even Wales, unsafe for him, and his uncle took him to Brittany. Duke Francis II readily gave him asylum, and there he remained until the usurpation of Richard III split the Yorkist party and at length opened the way for new attempts to assert the Lancastrian claim.

The first attempt, in 1483, was planned in concert with the duke of Buckingham's rebellion (*see* BUCKINGHAM, HENRY STAFFORD, 2nd duke of), but failed, largely because of bad weather. But the conspiracy continued. The coalition between Lancastrians and malcontent Yorkists was confirmed by Henry's sworn undertaking to marry Elizabeth of York, eldest daughter and (since the death of her two young brothers) heiress of Edward IV. On the basis of this coalition and with French support, Henry in 1485 tried again and, thanks largely to the Stanleys' desertion to him, succeeded in defeating and slaying Richard III at Bosworth on Aug. 22 (*see* BOSWORTH FIELD, BATTLE OF). After his coronation (Oct. 30), followed by formal recognition from parliament, had manifested his claim to be king in his own right, he fulfilled his bargain with his Yorkist allies by marrying Elizabeth on Jan. 18, 1486.

Yorkist Plots.—Opposition from Yorkists who had adhered to Richard was, however, by no means at an end. They were hampered by lack of a suitable claimant, for Henry, besides marrying Elizabeth, had imprisoned the boy Edward, earl of Warwick, the duke of Clarence's son. Nevertheless, they could always rely upon support from the dowager duchess of Burgundy, Edward IV's sister Margaret; they could hope for ready help from Yorkist Ireland; and they knew that France and Scotland were not eager to see Henry VII, or any English king, too firmly settled upon his throne. With the forces that such sympathizers might provide, the malcontents could still hope to succeed in an England grown weary of wars and inclined to stand by until the issue of the first battle clearly indicated the probable victor. So, for about 12 years after Bosworth, Henry was troubled and sometimes endangered by Yorkish conspiracies. The ill-concerted and aimless rising of Lord Lovell and the young Staffords in 1486 was dangerous only because it took Henry by surprise. But more threatening plots were then organized around the impostors Lambert Simnel, who impersonated Warwick, in 1487, and Perkin Warbeck, who impersonated Richard of York, the younger of the princes in the Tower, between 1492 and 1497. Simnel was partly financed by Margaret of Burgundy; John de la Pole, earl of Lincoln, whom Richard III had named as his heir, deserted Henry to join him; Ireland welcomed him as king; the queen dowager was apparently suspected of a hand in the plot; and Simnel's invasion of England was defeated only after three hours' hard fighting at Stoke on June 16, 1487.

Warbeck found still wider support abroad, at first probably from France, then in the Netherlands from the regent Maximilian, as well as from Margaret, and finally from James IV of Scotland. Thanks to Sir Edward Poynings' work as lord deputy, Ireland would not declare for him as it had for Simnel, and the execution of Sir William Stanley cooled any English ardour for his cause. Yet for five years he gravely complicated Henry's foreign policy even if he never seriously menaced his throne. Warbeck's execution, along with the unfortunate Warwick, in 1499 seems to have been part of the price paid by Henry for cementing his alliance with Spain by the marriage of his eldest son, Arthur, to Catherine of Aragon. For hitherto he had been surprisingly lenient toward pretenders and had made their supporters pay for their rebellions more often with their property than with their lives. At all events, after 1497 there were no more Yorkist insurrections, though the activities of the younger De la Poles occasionally troubled Henry's mind and even deflected his policy.

Restoration of Government.—Henry, however, was not content merely to detect conspiracies and suppress rebellions. He sought also to remedy the weaknesses in government that made such things possible; to give strength to royal justice, authority

and efficiency to royal administration, and above all riches to the royal coffers. He was not afraid to choose able men to serve him; and generally they served him well, for powerful as his councilors became, they drew their power from him and he remained always their master. Among them were noblemen such as the earls of Derby, Surrey and Oxford; but he trusted most ecclesiastics such as Archbishop John Morton, his lord chancellor, and Bishop Richard Fox, his lord privy seal, or officials of middling fortune such as Reginald Bray, Thomas Lovell and later Richard Empson and Edmund Dudley. The power of the council to deal promptly and efficiently with riot and unlawful practices such as maintenance were reasserted by the so-called Star Chamber act of 1487. By that act and in other ways special responsibility was placed upon particular councilors for particular aspects of the council's work; groups of councilors were again, as in Yorkist times, sent to York and Ludlow to invigorate royal authority in the north and in the Welsh marches; and a series of measures placed new responsibilities upon the local justices of the peace, while at the same time bringing them more closely under the council's control. It is not possible to say how far these improvements in justice and administration were Henry's own idea and how far they originated with his councilors. However, it may be said at least that their effectiveness was attributable not to any intrinsic novelty but to the persistence with which they were applied, and for that the credit must go chiefly to the king himself.

In the work of enriching the royal coffers, on the other hand, it is clear that Henry took a detailed and constant interest. That enrichment came quite as much from careful administration as from spectacular measures such as the Act of Resumption of 1485. And Henry's hand is constantly apparent in the development of speedier, less formal methods of receiving and issuing money and of auditing accounts that grew up outside the old exchequer around the treasurer of the chamber and the general surveyors. He himself audited the treasurer's books almost daily and exercised a direct control in matters of finance which none of his predecessors had equaled and none of his successors was to imitate. Yet here again there was no great novelty in the methods used. Success was chiefly attributable to the king's own persistent application to business. The success was remarkable. Henry had become a lender rather than a borrower by 1490; by 1497 he had no need of grants from parliament; and he died one of the richest kings in Christendom. Many of his and his ministers' devices for raising money were not popular, and Empson and Dudley in his later years aroused much resentment. Yet he knew how to appear magnificent, even if he was seldom generous; and his court, though modest by comparison with his son's, maintained the state expected of a king. He knew when to spend as well as how to save, but he never forgot that his power depended upon his saving and could easily be undermined by lavish spending.

Foreign Affairs.—For this reason he avoided foreign wars. He did go to war with France early in his reign to preserve the independence of Brittany, and when his allies, Spain and Maximilian, failed him, he made a show of invading France. But in Nov. 1492 he readily came to terms, wisely preferring to leave the French in Brittany rather than overstrain his resources by renewing the Hundred Years' War. The preoccupation of the French with the Italian wars made friendly relations possible thereafter, but the activities of Perkin Warbeck and fear lest French ambition might turn back toward Flanders prevented Henry from relapsing into an isolationist policy. The support which first Maximilian and then James IV gave to Warbeck led to sharp quarrels with the Netherlands and Scotland. By economic measures Henry was able to induce Maximilian and the Netherlands government to abandon the pretender and make a treaty of peace and friendship in 1496. This, and the alliance with Spain which he had made in 1489, gave him an insurance not only against continental support of Yorkist conspiracies but also against any revival of French designs upon Flanders. He was thus able to concentrate upon Scotland and by threats of war combined with generous offers to obtain in 1499 a peace which was consolidated in 1503 by the marriage of his eldest daughter, Margaret, to James IV. The marriage of his eldest son, Arthur, to Catherine of Aragon in 1501 seemed to set the seal of success on his foreign policy. The death of Arthur (1502) and of Catherine's mother, Isabella of Castile (1504), with the resultant rivalry for control of Castile between her father, Ferdinand II of Aragon, and her brother-in-law the archduke Philip of Burgundy, jeopardized Henry's system of alliances and involved him in new and sometimes strange combinations. Yet, as the rivalry of the powers of Europe remained centred upon Italy, he could still avoid any deep commitments. Indeed, the skill with which he had all along taken advantage of this situation to give England a breathing space from foreign wars was in no small measure responsible for his success in rebuilding the strength of the monarchy at home. The success was all the greater because, when dynastic interests did not overrule it, he used his diplomacy vigorously to further the prosperity of English overseas trade. For, as Francis Bacon wrote of him, "he could not endure to see trade sick."

Henry VII died at Richmond on April 22, 1509. He was, indeed, to quote Bacon again, "a wonder for wise men." The judicious moderation of his policies at home and abroad, his grasp of essentials and his persistence in concentrating upon them made him perhaps the greatest, if also the least heroic, of the Tudor sovereigns. He had the presence and personality to command respect; he chose his servants wisely and was notably well served. He had a pleasantly sardonic humour and though cool-headed was not cold-blooded. He lacked the popular appeal of a bluff king Henry VIII or an artful Elizabeth I, but he possessed in full measure the solid virtues that his times required. *See* ENGLISH HISTORY; *see* also references under "Henry VII" in the Index volume.

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HENRY VIII (1491–1547), king of England from 1509 to 1547, the third child and second son of Henry VII and Elizabeth of York, was born at Greenwich on June 28, 1491. He was the first English monarch to be educated under the influence of the Renaissance, and his tutors included the poet John Skelton. He became an accomplished scholar, linguist, musician and athlete. The death of his elder brother, Arthur, in 1502 made him heir apparent, and in 1503 he was betrothed to Arthur's widow, Catherine of Aragon. His father, however, delayed the marriage and even made him enter a protest against it, while some doubts were expressed about its validity in canon law. Nevertheless one of Henry VIII's earliest acts after his accession (April 22, 1509) was to marry Catherine.

The Ascendancy of Wolsey.—The young king at first displayed little of his father's application to business, and for two years and more affairs were managed by the pacific Richard Fox and Archbishop William Warham. Yet, although preoccupied with sport and other amusements, he showed a keen interest in learning and in the navy, while his inborn pride and thirst for fame soon made him listen to the warlike counsels of his father-in-law, Ferdinand II of Aragon, and of his almoner Thomas Wolsey. In Nov. 1511 he committed himself to a policy of war with France and in 1513 crossed the channel with an army and took part in the successful sieges of Thérouanne and Tournai and in the battle of Guinegate. Then, deserted by Ferdinand, he made peace with Louis XII, who married his sister Mary (1514). It was even reported from Paris that he would divorce Catherine, whose issue had so far been attended with fatal misfortune, and take a French wife. It seems unlikely that he had in fact yet thought of such a course, and, in any case, the renewed antagonism between England and France upon the accession of Francis I (1515) led to a *rapprochement* with Ferdinand, while the birth of Princess Mary to Catherine (1516) held out hopes of the male issue which Henry so much desired. Moreover, Ferdinand died in 1516 and the emperor Maximilian in 1519. Their grandson Charles V succeeded them both in all their realms and dignities, in spite of Henry's hardly serious candidature for the empire; and a lifelong rivalry broke out between Charles and Francis. Both monarchs courted England's favour in 1520, Francis at the Field of Cloth of Gold

and Charles more quietly in Kent. At the conference of Calais in 1521 English influence reached its zenith, but the resulting alliance with Charles destroyed the balance on which that influence depended. Charles, sure of English help, concentrated his efforts on Italy, while English campaigns in northern France, lacking adequate imperial support, bore little fruit. Parliament's refusal of Wolsey's demands for money (1523) put an end to these campaigns and drove Henry into underhand negotiations with France (1524). Nevertheless Francis was overweighted by the Anglo-imperial alliance, and his defeat at Pavia (1525) left the emperor supreme. Henry at once urged Charles to join him in partitioning France. However, violent popular resistance to the "amicable grant" of 1525, which Henry demanded from his subjects in order to prosecute the war against France, again prevented any English invasion of France, and Charles, satisfied with his victory, not only rejected the English proposals but also asked to be released from his promise, made in 1521, to marry Princess Mary.

The Succession Problem.—This brought the question of the succession to the fore and gave Henry an urgent personal interest in politics. He had shown, at least as early as 1519, his anxiety about his lack of a son, and each succeeding year made it more certain that he could not hope for more children by Catherine. There was, of course, Mary; but no queen regnant had yet ruled in England; Margaret Beaufort had been passed over in favour of her son in 1485 and there was a popular impression that women were excluded from the throne. Mary's marriage to the emperor might have solved the problem, but now that Charles had broken his engagement, her accession (or that of any other living candidate) seemed likely to mean a recurrence of civil war. Henry's first reaction (1525) was to bring out of obscurity his only illegitimate son, create him duke of Richmond and Somerset and give him precedence over Mary. Soon, however, he adopted a more drastic policy. The unexampled fatality which had attended his issue revived the theological scruples about his marriage to Catherine; the quarrel with Charles sharpened them; and all these considerations were magnified by Henry's passion for Anne Boleyn, though she was not the sole or the main cause of the divorce. That the succession was the main point is proved by the fact that Henry's efforts were all directed to securing a wife and not a mistress. Wolsey persuaded him that the necessary divorce could be obtained from Rome, as it had been in the cases of Louis XII of France and Margaret of Scotland. A French alliance was made, to increase the pressure on the pope; for a time Clement VII seemed inclined to concede the demand, and in 1528 Lorenzo Cardinal Campeggio was given ample powers to try the case in England. But the prospect of French success in Italy, which had encouraged the pope, proved delusive, and in 1529 he had to submit to the emperor's yoke. This made it difficult for him to grant the divorce, for Charles would not readily allow the casting aside of his aunt, the disinheriting of his cousin and perhaps the eventual succession of the son of a French princess to the English throne. Campeggio was therefore recalled in July 1529.

Wolsey fell when Campeggio was recalled, and his fall meant the triumph of the antiecclesiastical party in England. Laymen who had resented their exclusion from power were now promoted to offices such as those of lord chancellor and lord privy seal which they had rarely held before, and parliament was encouraged to propound lay grievances against the church. Henry relied on the support of the laity to abolish papal jurisdiction and reduce clerical privilege and property in England, and by a close entente with Francis I he insured himself against the enmity of Charles V. But it was only gradually that the breach with Rome was completed. Henry had defended the papacy against Luther in 1521 and had received in return the title "defender of the faith." He never liked Protestantism, and he was prepared for peace with Rome on his own terms. Those terms were impossible of acceptance by a pope in Clement VII's position, but before Clement had made up his mind to reject them, Henry had discovered that the papacy was hardly worth conciliating. His eyes were opened to the extent of his own power as the exponent of national antipathy to papal jurisdiction and ecclesiastical privilege, and his appetite for power grew. With Thomas Cromwell's help he secured parliamentary support, and its usefulness led him to extend parliamentary representation to Wales and Calais, to defend the privileges of parliament and to yield rather than forfeit its confidence (*see* CROMWELL, THOMAS). He had little difficulty in securing the Acts of Annates, Appeals and Supremacy which completed the separation from Rome, or the dissolution of the monasteries, which, by transferring enormous wealth from the church to the crown, really, in Cecil's opinion, ensured the reformation.

The abolition of the papal jurisdiction removed all obstacles to the divorce from Catherine and to the legalization of Henry's marriage with Anne Boleyn (1533). But the recognition of the royal supremacy could only be enforced at the cost of the heads of Sir Thomas More, Bishop Fisher and a number of monks and others among whom the Carthusians signalized themselves by their devotion (1535). Anne Boleyn fared no better than the Catholic martyrs; she failed to produce a male heir to the throne, and her conduct afforded a jury of peers, over which her uncle, the duke of Norfolk, presided, sufficient excuse for condemning her to death on a charge of adultery (1536). Henry then married Jane Seymour, who was obnoxious to no one, gave birth to the future Edward VI, and then died (1537). The dissolution of the monasteries had meanwhile evoked a popular protest in the north, and it was only by skilful and unscrupulous diplomacy that Henry was enabled to suppress the Pilgrimage of Grace (Feb. 1537). Foreign intervention was avoided through the renewal of war between Francis and Charles, and the insurgents were hampered by having no rival candidate for the throne and no means of securing the execution of their program.

Nevertheless their rising warned Henry against further doctrinal changes. He had authorized the English Bible and some approach toward Protestant doctrine in the Ten Articles. He had also considered the possibility of a political and theological alliance with the Lutheran princes of Germany. But in 1538 he definitely rejected their theological terms, while in 1539–40 they rejected his political proposals. By the Act of Six Articles (1539) he took his stand on Catholic doctrine; and when the Lutherans had rejected his alliance, and Cromwell's nominee, Anne of Cleves, had proved both distasteful on personal grounds and unnecessary because Charles and Francis were not really projecting a Catholic crusade against England, Anne was divorced and Cromwell beheaded (1540). The new queen, Catherine Howard, represented the triumph of the reactionary party under Bishop Stephen Gardiner and Norfolk; but there was no idea of returning to the papal obedience, and even Catholic orthodoxy as represented by the Six Articles was enforced only by spasmodic outbursts of persecution.

The secular importance of Henry's activity has been somewhat obscured by his achievements in the sphere of ecclesiastical politics; but no small part of his energies was devoted to the task of expanding the royal authority at the expense of temporal competitors. Feudalism was not yet dead, and in the north and west there were medieval franchises in which the royal writ and common law hardly ran at all. Wales and its marches were brought into legal union with the rest of England by the statutes of Wales (1534–36), and after the Pilgrimage of Grace the council of the north was reorganized to bring into subjection the extensive jurisdictions of the northern earls. Neither they nor the lesser chiefs who flourished on the lack of common law and order could be reduced by ordinary methods, and the councils of Wales and of the north were given summary powers derived from the Roman civil law similar to those exercised by the Star Chamber at Westminster and the court of Castle Chamber at Dublin. Ireland had been left by Wolsey to wallow in its own disorder; but disorder was anathema to Henry's mind, and in 1534 Sir William Skeffington was sent to apply English methods and artillery to the government of Ireland. Sir Anthony St. Leger continued his policy from 1540; Henry, instead of being merely lord of Ireland dependent on the pope, was made by an Irish act of parliament king and supreme head of the Irish church. Conciliation was also tried with some success; plantation schemes were rejected in

favour of an attempt to Anglicize the Irish; their chieftains were created earls and endowed with monastic lands, and so peaceful was Ireland in 1542 that the lord deputy could send Irish foot soldiers to fight against the Scots.

Henry, however, seems to have believed as much in the coercion of Scotland as in the conciliation of Ireland. Margaret Tudor's marriage had not reconciled the realms; and as soon as James V became a possible pawn in the hands of Charles V, Henry reconsidered his old claims to suzerainty over Scotland. At first he was willing to subordinate them to an attempt to win over Scotland to his antipapal policy, and he made various efforts to bring about an interview with his nephew. But James V was held aloof by David Cardinal Beaton and by his two French marriages; and France was alarmed by Henry's growing friendliness with Charles V, who was mollified by his cousin Mary's restoration to her place in the succession to the throne. James madly sent a Scottish army to ruin at Solway Moss in 1542; his death a few weeks later left the Scottish throne to his infant daughter Mary Stuart, and Henry set to work to secure her hand for his son Edward and the recognition of his own suzerainty. A treaty was signed with the Scottish estates, but it was torn up a few months later under the influence of Beaton and the queen dowager Mary of Guise, and the earl of Hertford was sent in 1544 to punish this breach of promise by sacking Edinburgh.

Perhaps to prevent French intervention in Scotland Henry joined Charles V in invading France, and captured Boulogne (Sept. 1544). But Charles left his ally in the lurch and concluded the peace of Crêpy that same month, and in 1545 Henry had to face alone a French invasion of the Isle of Wight. This attack proved abortive, and peace between England and France was made in 1546. Charles V's desertion inclined Henry to listen to the proposals of the threatened Lutheran princes, and the last two years of his reign were marked by a renewed tendency to advance in a Protestant direction. Catherine Howard had been brought to the block (1542) on charges in which there was probably a good deal of truth, and her successor, Catherine Parr, was a patroness of the new learning. An act of 1545 dissolved chantries, colleges and other religious foundations, and in the autumn of 1546 the Spanish ambassador was expecting further antiecclesiastical measures. Gardiner had almost been sent to the Tower, and Norfolk and Surrey were condemned to death, while Thomas Cranmer asserted that it was Henry's intention to convert the mass into a communion service. An opportunist to the last, Henry would readily have sacrificed any theological convictions he may have had in the interests of national uniformity. He died in London on Jan. 28, 1547, and was buried in St. George's chapel, Windsor.

The Achievements of Henry VIII.—The atrocity of many of Henry's acts, the novelty and success of his religious policy, the apparent despotism of his methods, or all combined, have made it difficult to estimate calmly the importance of Henry's work or the conditions which made it possible. Henry's egotism was profound, and personal motives underlay his public action. While political and ecclesiastical conditions made the breach with Rome possible—and in the view of most Englishmen desirable—Henry VIII was led to adopt the policy by private considerations. He worked for the good of the state because he thought his interests were bound up with those of the nation; and it was the real coincidence of this private and public point of view that made it possible for so selfish a man to achieve so much for his country. The royal supremacy over the church and the means by which it was enforced were harsh and violent expedients, but it was of the highest importance that England should be saved from religious civil war, and it could be saved only by a strong government. It was necessary for the future development of England that its governmental system should be centralized and unified, that the authority of the monarchy should be more firmly extended over Wales and the western and northern borders, and that the still existing feudal franchises should be crushed; and these objects were worth the price paid in the methods of the Star Chamber and of the councils of the north and of Wales. Henry's work on the navy requires no apology; without it Elizabeth's victory over the Spanish Armada, the liberation of the Netherlands and the development of English colonies would have been impossible; and "of all others the year 1545 best marks the birth of the English naval power" (Sir J. S. Corbett, *Drake and the Tudor Navy*, vol. i, p. 59).

His judgment was more at fault when he sought by violence to bring Scotland into union with England. But at least Henry appreciated the necessity of union within the British Isles, and his work in Ireland relaid the foundations of English rule. No less important was his development of the parliamentary system. Representation was extended to Wales, Cheshire, Berwick and Calais; and parliamentary authority was enhanced, largely that it might deal with the church, until men began to complain of this new parliamentary infallibility. The privileges of the two houses were encouraged and expanded, and parliament was led to exercise ever wider powers. This policy was not attributable to any belief on Henry's part in parliamentary government but to opportunism, to the circumstance that parliament was willing to do most of the things which Henry desired, while competing authorities, the church and the old nobility, were not. Nevertheless, to the encouragement given by Henry VIII parliament owed not a little of its future growth, and to the aid rendered by parliament Henry owed his success.

He has been described as a "despot under the forms of law"; and it is apparently true that he committed no illegal act. His despotism consists not in any attempt to rule unconstitutionally but in the extraordinary degree to which he was able to use constitutional means in the furtherance of his own personal ends. His activity, his remarkable political insight, his lack of scruple and his combined strength of will and subtlety of intellect enabled him to utilize all the forces which tended at that time toward strong government throughout western Europe. The monarchy alone seemed capable of guiding the state through the social and political anarchy which threatened all nations in their transition from medieval to modern organization. The king was the emblem, the focus and the bond of national unity; and to preserve unity men were ready to put up with vagaries which to other ages seem intolerable. Henry could thus behead ministers and divorce wives with comparative impunity, because the individual appeared to be of little importance compared with the state. The elevation and the isolation of his position fostered a detachment from ordinary virtues and compassion, and he was a remorseless incarnation of Machiavelli's *Prince*. He had an elastic conscience which was always at the beck and call of his desire, and he cared little for principle. But he had a passion for efficiency and for the greatness of England and himself. His mind, in spite of its clinging to the outward forms of the old faith, was intensely secular, and he was as devoid of a moral sense as he was of a genuine religious temperament. His greatness consists in his practical aptitude, in his political perception and in the self-restraint which enabled him to confine within limits tolerable to his people an insatiable appetite for power. *See* ENGLISH HISTORY: *The Tudors; see* also references under "Henry VIII" in the Index volume.

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(A. F. PO.; R. B. WM.)

HENRY I (*c.* 1008–1060), king of France, was the second son of Robert II and the grandson of Hugh Capet. After the death of his elder brother Hugh, in his father's lifetime, he was anointed king at Reims (1026), but on Robert II's death (1031) Henry's mother, Constance of Aquitaine, supported a rebellion in favour of her youngest son, Robert. Henry took refuge in Normandy (1031–32), and the duke of Normandy, Robert the Devil, helped him in a long struggle against feudatories such as the counts of Blois and Champagne. Henry helped Robert's successor, William II the Bastard (the future William I of England), to quell his rebellious vassals at the battle of Val-aux-Dunes (1047), but was thereafter usually at war with him. He supported the revolt of Godfrey of Lower Lorraine (1044) and at a meeting with the

emperor Henry III at Ivois (1056) revived the western claim to Lorraine. Henry I tried to resist papal interference but could not prevent Pope Leo IX from holding a council at Reims (1049). By his second wife, Anne, daughter of Yaroslav I, grand duke of Kiev, Henry had two sons: Philip I, his successor, crowned at Reims (May 1059); and Hugh, afterward count of Vermandois. Henry died at Vitry-aux-Loges, near Orléans, on Aug. 4, 1060.

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(M. PAC.)

HENRY II (1519–1559), king of France from 1547, was born at St. Germain-en-Laye on March 19, 1519, the second son of Francis I and Claude de France. During the lifetime of his elder brother the dauphin Francis he had the title duc d'Orléans. Sent with the dauphin as a hostage to Spain in 1526, he returned to France in 1530 after the conclusion of the peace of Cambrai (*see* FRANCIS I). On Oct. 27, 1533, he was married to Catherine (*q.v.*) de Médicis. On his elder brother's death (1536), he became dauphin. Differences between the king and dauphin were accentuated by the rivalry between Henry's mistress, Diane de Poitiers (*q.v.*), and the king's, Anne de Pisseleu, duchesse d'Étampes, as well as by Henry's continuing support of the constable, Anne de Montmorency, when the latter lost the king's favour. When Henry became king on March 31, 1547, he dismissed many of his father's ministers and raised Montmorency and the house of Guise (*q.v.*) to favour. Henry's reputation has suffered by contrast with his father's brilliance, and his melancholy made him unsympathetic; yet he successfully continued his father's policy. Like Francis I, he undertook administrative reforms: the functions of the different sections of the king's council became more specialized; the commissaries sent into the provinces "to execute the king's orders" were the forerunners of the intendants; and an edict of Jan. 1552 created the *présidiaux*, intermediary tribunals between the justices in the *bailliages* and the *parlements*.

In foreign affairs likewise Henry continued his father's warfare against the Holy Roman emperor Charles V (Charles I of Spain) in Italy and in northeastern France. French troops besieged Parma in the spring of 1551 and defended Siena between July 1554 and April 1555. In Jan. 1552, moreover, Henry signed the treaty of Chambord with the German Protestant princes, promising them troops and subsidies; in return they agreed to France's taking the bishoprics of Metz, Toul and Verdun, which Charles V was not able to recapture, despite his siege of Metz (Oct. 1552–Jan. 1553). Though Henry made the truce of Vaucelles with Charles V in Feb. 1556, war was resumed after the emperor's abdication, when a French expedition was sent to Italy under François, duc de Guise (1557). The Spaniards from the Netherlands, however, besieged St. Quentin in Picardy, and Montmorency was defeated in an attempt to relieve the town (Aug. 10, 1557). After Guise had somewhat retrieved the situation by taking Calais, Guines and Thionville (1558), the financial difficulties of both France and Spain, combined with Henry's desire for a free hand to fight heresy in France, led to the peace of Cateau-Cambrésis (April 1559).

A bigoted Catholic, Henry was rigorous in the repression of heresy. In Oct. 1547 the *chambre ardente*, for trying heretics, was created in the Paris *parlement;* during a temporary suppression of the *chambre ardente* (1549–53) the edict of Châteaubriand (June 1551) transferred the trial of notorious cases to the secular courts; and the edict of Écouen (June 1559) laid the ground for systematic persecution of the Protestants, since the Franco-Spanish peace relieved Henry of the need to consider the feelings of his German allies.

The peace of Cateau-Cambrésis was to be cemented by the marriages of Henry's daughter Elizabeth and of his sister Margaret to Philip II of Spain and to Emmanuel Philibert of Savoy respectively. In a tournament during the festivities, on June 30, 1559, Henry was stricken on the temple by the lance of Gabriel de Montgommery, captain of the Scottish guard. He died in Paris on July 10. By Catherine de Médicis he had four sons, the future kings Francis II, Charles IX and Henry III and François, duc d'Alençon; and three daughters, Elizabeth (1545–68), queen consort of Spain, Claude (1547–76), married in 1559 to Charles III the Great, duke of Lorraine, and Margaret, married in 1572 to Henry of Navarre. One of his natural children was Diane de France.

HENRY III (1551–1589), king of France from 1574, was born at Fontainebleau on Sept. 19, 1551, the third son of Henry II and Catherine de Médicis. Before his accession to the crown he was duc d'Anjou. During the reign of his brother, Charles IX, Henry was given command of the royal army against the Huguenots in the third of the wars of religion and defeated the prince de Condé (Louis I de Bourbon) at Jarnac in March 1569 and Gaspard de Coligny at Moncontour in October. His mother, meanwhile, whose favourite son he was, used her influence to advance his fortunes. In 1572 she presented him as a candidate for the vacant throne of Poland. He helped her to prepare the massacre of St. Bartholomew's day (*q.v.*) and may have taken part in the murder of Coligny (Aug. 1572). These activities alarmed Protestant members of the Polish diet, but largely through the efforts of the French envoy, Jean de Monluc, Henry was elected king of Poland in May 1573. He raised the siege of La Rochelle, which he had been directing, to assume his crown. In May 1574, however, he succeeded to the French crown on the death of Charles IX. Abandoning Poland in unseemly haste, he traveled home by way of Vienna and Venice, where he was magnificently entertained. Crowned at Reims on Feb. 13, 1575, he was married on Feb. 15 to Louise de Vaudémont, a princess of the house of Lorraine.

The French wars of religion continued during Henry III's reign. In May 1576 he agreed to the peace of Monsieur, named after the style of his brother François, duc d'Alençon, who then acceded to Henry's former title of duc d'Anjou; but his concessions to the Huguenots in the Edict of Beaulieu angered the Catholics, who formed the Holy League to protect their own interests. Henry had to resume the war against the Huguenots, but the estates-general (Dec. 1576) denied him adequate subsidies. The peace of Bergerac (Sept. 1577) ended hostilities temporarily; the Huguenots lost some of their liberties by the edict of Poitiers, and the League was dissolved. In 1584 the Catholics were alarmed when the Huguenot leader, Henry of Navarre, became heir to the throne on the death of the duc d'Anjou; the League was therefore revived under the leadership of Henry, 3rd duc de Guise (*see* GUISE, HOUSE OF).

Henry III, acting on his mother's advice, tried to placate the League by revoking past edicts of toleration for the Huguenots, but its members regarded him as a lukewarm defender of the faith and argued in favour of his deposition. A rising of the people of Paris on May 12, 1588 (the Day of the Barricades), caused the king to flee to Chartres. In Dec. 1588 he took advantage of a meeting of the estates-general at Blois to have the duc de Guise and his brother Louis, the cardinal de Lorraine, assassinated. This merely exacerbated the League's hostility, and Henry III was compelled to ally himself with Henry of Navarre. Together they laid siege to Paris, but on Aug. 1, 1589, Jacques Clément, a fanatical Jacobin friar, gained admission to the king's presence and stabbed him in the abdomen. He died in the early hours of Aug. 2, after acknowledging Henry of Navarre as his heir, for he had no children of his own to succeed him.

Henry III had a good intellect, an ingratiating manner, cultivated tastes and a gift for oratory, but his faults were large. He issued many ordinances but was too indolent to see them applied. He was more attentive to the trappings of power than to its substance; by his aloofness at court and by the favours he conferred upon his *mignons*, a small group of young courtiers as effeminate as himself, he alienated many nobles. His extravagance and the excesses that marked his pleasures and religious devotions shocked his subjects generally.

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Catherine de Médicis, 2 vol. (1922); L. Gérin-Ricard, *Henri III le Méconnu* (1935). (R. J. K.)

HENRY IV (1553–1610), king of France from 1589, also king of Navarre, as Henry III, from 1572, was born at Pau in Béarn on Dec. 14, 1553, the son of Antoine de Bourbon, duc de Vendôme (*see* BOURBON), and of Jeanne d'Albret (queen of Navarre from 1555). The prince de Béarn, as he was styled until his mother's death, was taken to the French court at Amiens in 1557 and entered the Collège de Navarre in Paris in 1561, but was allowed to rejoin his mother in 1564. She educated him as a Protestant and, during the third war of religion (1568–70; *see* FRANCE: *History*), took him to Gaspard de Coligny, who became leader of the Protestant forces on the death of Henry's uncle, Louis I de Condé, in 1569. Henry then distinguished himself at the battle of Arnay-le-Duc in Burgundy (1570). He became king of Navarre on his mother's death in June 1572. On Aug. 18, 1572, he was married, in Paris, to Charles IX's sister Margaret (Marguerite de Valois), but within a week of the marriage, on Aug. 24, there followed the massacre of St. Bartholomew's day (*q.v.*). He was then constrained to abjure his Protestantism. In Feb. 1576, however, he at last succeeded in escaping from the French court, whereupon he renounced his enforced Catholicism and joined the combined forces of Protestants and Catholic rebels against Henry III of France; the peace of Monsieur or treaty of Beaulieu, in May, accorded him the government of Guienne. He secured the treaty of Bergerac to end the sixth civil war in 1577, but began the so-called Lovers' War (partly because of quarrels with his wife and the French king's unwelcome interventions) by seizing Cahors in June 1580; this was terminated by the treaty of Fleix in November.

The death of the French king's brother François, duc d'Anjou, in 1584 made Henry of Navarre heir presumptive to the French crown. Excluded from the succession by the treaty of Nemours (July 1585) between Henry III of France and the Holy League headed by Henry, duc de Guise, he fought the War of the Three Henrys mainly in the southwest: at Coutras (Oct. 20, 1587) he defeated Henry III's army under Anne, duc de Joyeuse. Henry III, however, after his *coup d'état* at Blois in Dec. 1588, when he had the duc de Guise murdered, became reconciled with Henry of Navarre (April 1589), whose help he needed in order to recover Paris from the League. Assassinated, the dying Henry III recognized the king of Navarre as his successor to the French crown (Aug. 1–2, 1589).

The Conquest of the Kingdom (1589–98).—Henry IV had to struggle for nearly nine years against the League before securing his kingdom. The main events of the first four years were Henry's victories at Arques (Sept. 21, 1589) and at Ivry (March 14, 1590) over Charles, duc de Mayenne; the unsuccessful sieges of Paris (May–Aug. 1590) and of Rouen (Nov. 1591–April 1592) by the king's armies; the meeting of the estates-general convened in Paris by the League (Jan. 1593), which the *Satire Ménippée* turned to ridicule; and Henry's final conversion to Catholicism and provisional absolution by the archbishop of Bourges, Renaud de Beaune (July 1593). The famous comment *Paris vaut bien une messe* ("Paris is well worth a Mass") may not in fact have been made by Henry at the time, but his conversion did remove all legitimate pretext for resistance, and on March 22, 1594, Paris gave in to him. Yet Spain, against whom Henry declared war in 1595, continued to support the remaining resistance. Mayenne, however, was defeated at Fontaine-Française in Burgundy on June 5, 1595; Henry was absolved by Pope Clement VIII on Sept. 17, 1595; Amiens, which the Spaniards had seized, fell to Henry in Sept. 1597; the duc de Mercoeur (Philippe Emmanuel de Lorraine), who had been holding out in Brittany, came to terms in March 1598; and the peace of Vervins between France and Spain was signed on May 2, 1598. Already in April 1598 Henry had signed the great Edict of Nantes (*q.v.*), establishing the rights of the Protestants in France.

The Achievement of the Reign.—Henry now proceeded to bring order and prosperity back to France. Even if the situation was not as desperate as is sometimes described, disorder was general and the rapidity with which order was restored surprised contemporaries. The effect of the king's personal policy in that achievement cannot be ignored. This policy, indeed, stemmed from the wide experience that he had acquired during the conquest of the kingdom: acquainted with all the social classes in France, he knew what each one needed (he is traditionally credited with having desired for every labourer *la poule au pot*, a chicken to eat, every Sunday); and he used his geniality and his persuasive manner to win obedience.

It was, however, the rich merchants and the crown officials who had contributed most to Henry's success, and he looked to them for economic progress and for the rehabilitation of the kingdom. Though he succeeded in suppressing certain useless offices, he consolidated many others by according the "annual right" or *paulette* (1604; named after the financier Charles Paulet), whereby the holder of an office could make it hereditary through yearly payments of one-sixtieth of the price originally paid for it. He began by controlling the *parlements* through the moderate approach of the chancellor Pomponne de Bellièvre, but gradually asserted his personal authority more and more, relying on his devoted Maximilien de Béthune, baron de Rosny and duc de Sully (*q.v.*).

Henry reformed the finances, repressed abuses, extinguished the formidable debt and realized a reserve of 18,000,000 livres. To alleviate the distress of the people he undertook to develop both agriculture and industry, planting colonies of Dutch and Flemish settlers to drain the marshes of Saintonge, introducing the silk industry, encouraging the manufacture of cloth, of glassware and of tapestries and, under the direction of Sully—named *grand voyer de France*—improving and increasing the routes for commerce. A complete system of canals was planned, that of Briare partly dug. New capitulations were concluded with the sultan Ahmed I (1604) and treaties of commerce with England (1606), with Spain and with Holland. Attempts were made in 1604 and 1608 to colonize Canada. The army was reorganized, its pay raised and assured, a school of cadets formed, artillery constituted and strongholds on the frontier fortified. While lacking the artistic tastes of the Valois, Henry beautified Paris, finishing the Tuileries and building the great gallery of the Louvre, the Pont Neuf, the Hôtel-de-Ville and the Place Royale.

Himself a convert, Henry managed to reassure the Protestants and to grant them privileges in the state but at the same time to promote the Catholic Counter-Reformation (notably through the Jesuit college at La Flèche), to protect the monastic orders and to improve the recruitment of the Catholic clergy.

Henry IV's foreign policy, without being aggressive toward Spain, was designed to diminish the Spanish influence in Europe. He won Tuscany, Mantua, Venice and the papacy to France's side and forced Savoy, which had not acceded to the treaty of Vervins, to sign the treaty of Lyons (1601), whereby France acquired Bresse, Bugey, Valromey and Gex in exchange for the marquisate of Saluzzo. He also concluded alliances with the German Protestant princes, with Lorraine and with the Swiss (treaty of Soleure, Jan. 1602).

A great French success was the mediation between Spain and the United Provinces of the Netherlands, which led to the conclusion of the Twelve Years' truce in 1609. In the same year difficulties arose with the Holy Roman emperor on the subject of the Cleves-Jülich succession (*see* JÜLICH). Henry, after hesitating, finally decided on a military expedition to expel the imperial troops from Jülich, but whether he would have gone on to risk a new general war against the Habsburgs can never be known. On May 14, 1610, he was assassinated in Paris by François Ravaillac.

Sully in his *Économies royales* attributes to Henry IV the "great design" of constituting, after having defeated Austria, a vast European confederation of 15 states—a "Christian republic"—directed by a general council of 60 deputies reappointed every three years. But this "design" has been attributed rather to Sully's imagination than to the king's more practical mind.

Character and Personal Life.—Henry IV was better at soldiering than at strategy. Authoritative by disposition, he was nevertheless ready to profit from the advice and co-operation of well-chosen counselors: Sully; Nicolas Brulart de Sillery; Nicolas

de Neufville, seigneur de Villeroy; and Pierre Jeannin.

Henry had no children by his first wife, Margaret, whom he divorced in 1599. By Marie de Médicis, whom he married in 1600, he had six children (*see* BOURBON: *Table II*). His love affairs were numerous. The most celebrated were those with Gabrielle d'Estrées, whom he made duchesse de Beaufort and by whom he was the father of César, duc de Vendôme, Alexandre de Vendôme and Catherine Henriette, later married to Charles, duc d'Elbeuf; with Henriette de Balsac d'Entragues, whom he made marquise de Verneuil and three of whose children he legitimated; and with Charlotte des Essarts, married long after to François de L'Hospital.

Often remembered as Henry the Great for his political achievement and as *le vert galant* for his amours, Henry IV is one of the most popular figures of French history, if not the most popular. The *Recueil des lettres missives de Henri IV,* edited by J. B. de Xivrey, six volumes (1843–53), contains numerous letters written personally by Henry and revealing much of his characteristic charm.

See also references under "Henry IV" in the Index volume.

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HENRY, the name of nine German kings, six of whom were also Holy Roman emperors.

HENRY I (*c.* 876–936) the Fowler, king from 919, was a member of the Liudolfing family, the son of Otto the Illustrious, duke of Saxony, and his wife Hathui. He was married first to Hatheburg, daughter of Count Erwin of Merseburg, but divorced her because of ecclesiastical protests, though he kept her rich dowry. Second, in 909, he married Mathilda, daughter of a Count Dietrich, and as Dietrich had possessions in Westphalia, Henry was able to establish himself there. Having succeeded his father as duke of Saxony in 912, he was constantly at war with Conrad I (*see* CONRAD, German kings), especially over lands in Thuringia, until the settlement of Grona, near Göttingen, in 915. On his deathbed (Dec. 918) Conrad I designated Henry as his successor; and at a meeting of Saxon and Frankish nobles in Fritzlar in May 919, Henry was elected king. The legend that he was surprised by the princes while out hawking (hence his nickname) does not accord with fact. He refused the anointing and coronation offered him by Heriger, archbishop of Mainz.

Swabia and Bavaria did not recognize Henry as king; but since he was determined to continue the traditions of East Frankish kingship he led an army against Burchard of Swabia in 919 and forced him to an agreement—by which, however, Burchard maintained a large measure of independence. In the meantime, however, Arnulf of Bavaria had been elected king by the East Franconians and Bavarians; apparently he regarded the East Frankish empire as defunct and wanted to revive the Carolingian kingdom of Bavaria. Henry's first campaign against him failed, and only in 921 was a compromise reached, at Regensburg, whereby Arnulf renounced the royal title but was granted what amounted to complete independence. Meanwhile in Lotharingia, which had separated itself from the East Frankish state in 911, Giselbert, son of Rainier I of Hainaut, had had himself elected king in 920. Henry in fact renounced Lotharingia to the West Frankish king Charles III the Simple under the treaty of Bonn, but subsequently proceeded to recover the territory in two campaigns (923 and 925). He reconciled Giselbert by marrying him to his daughter Gerberga and recognizing him as duke. By these means Henry I restored the fortunes of the East Frankish state, which had been seriously threatened at Conrad's death, and prepared the foundations on which the German kingdom grew up.

In 926 Henry bought off the frequent plundering raids of the Magyars for nine years, by releasing a captured Magyar chieftain and agreeing to pay a yearly tribute. He used the time to build fortifications and develop a cavalry force, which he trained in wars against the Slavs. Thus in 928 he conquered Brennabor (Brandenburg), the capital of the Hevellians, and then the territory of the Daleminzians, on which he founded Meissen. In 929 he campaigned in Bohemia and had a dangerous Slav rising suppressed by his marcher counts. When he withheld tribute from the Magyars in 932, they resumed their raids but were defeated in 933 at Riade on the Thuringian-Saxon border. In 934 Henry was also successful against the Danish king Knuba. He received the "holy lance," with nails from the cross of Christ, from King Rudolf II of Burgundy in exchange for the cession of Basel. Perhaps this was intended to provide a justification for his planned intervention in Italy. Having designated Otto, the eldest son of his second marriage, as his successor, Henry died on July 2, 936, in his palace of Memleben. He was buried at Quedlinburg. His charters and statutes are printed in the *Monumenta Germaniae Historica,* series *Diplomata,* vol. i (1879), and *Constitutiones,* vol. i (1893).

HENRY II (973–1024) the Saint, German king from 1002 and emperor from 1014, was born at Abbach in Bavaria, the son of the Liudolfing Henry the Quarrelsome, duke of Bavaria, and his consort Gisela of Burgundy. Originally destined for the church, he received a careful education, but became duke of Bavaria on his father's death in 995. He subsequently married Kunigunde of Luxembourg. When his cousin, the emperor Otto III, died childless on Jan. 23, 1002, Henry succeeded—chiefly as a result of the support of Archbishop Willigis of Mainz—in being elected German king by the spiritual and temporal magnates of Bavaria, Franconia and Upper Lorraine; and on June 7 he was crowned at Mainz. Within a few months he was also recognized by the other German princes; but again and again, particularly at the start of his reign, he had to struggle with rebellious noblemen, among them his own brother.

The conflict with Boleslaw I the Brave of Poland was protracted almost throughout Henry's entire reign. In three wars (1004–05, 1007–13 and 1015–18), which ended respectively with the treaties of Poznan, Merseburg and Bautzen, Boleslaw succeeded in obtaining as fiefs from the German king the eastern parts of the mark of Meissen (the Milzen district) and the eastern half of the Saxon Ostmark (Lusatia), which he had conquered. On the other hand, Henry was able to recover Bohemia, which Boleslaw had also conquered.

A further dispute lay in store for Henry in Italy, where in 1002 the margrave Arduin of Ivrea had been crowned king. Henry achieved his own coronation on May 14, 1004, in Pavia, without any resistance on Arduin's part, though Henry failed to subjugate him completely. In the west there also were struggles which tied the king down for years. He subdued the Frisians in 1005, then fought the count of Flanders up to 1007. From 1008 to 1012 he had to contend with Kuno and Dietrich of Luxembourg, his wife's brothers, who against his wishes had contrived to be elected archbishop of Trier and bishop of Metz respectively. In 1006 Henry induced the childless king of Burgundy, Rudolf III, to make him his heir; Rudolf confirmed this arrangement at Strasbourg in 1016 and at Mainz in 1018 and in return for it obtained Henry's military support against the rebellious Burgundian nobles. In 1013 Henry went to Rome. There he recognized as pope the Tusculan Benedict VIII, who crowned him emperor on Feb. 14, 1014, and whom Henry supported against his rival, the Crescentian Gregory VI. On the request of Benedict, who visited him at Bamberg in 1020, Henry undertook a third campaign to Italy in 1021. He defeated the Greeks in southern Italy and subdued the princes of Capua and Salerno, but epidemics in the army soon compelled him to return to Germany.

On July 13, 1024, Henry died at his castle of Grona near Göttingen. He was buried in the cathedral of Bamberg. His ecclesiastic inclination had been shown in numerous pious foundations, in the establishment of the bishopric of Bamberg (1007) and in his endeavours to bring about a moral reform of the church; in these efforts he was supported by his friend Odilo, abbot of Cluny. However, the idealization of the "holy king," which began as early as the 11th century and culminated in his canonization in 1146, does not correspond with the facts. Henry was a sober and realistic statesman who ruled the church with a hard hand and did not scruple to conclude an alliance with the heathen Liutitsy against

the Christian Poles. With toughness, untiring energy and much political astuteness he contrived to conserve the empire which had been threatened on Otto III's early death by external enemies and internal feuds; and he passed it on, undiminished, to the Salian rulers. His festival is celebrated on July 15. His legislative acts and charters are printed in *Monumenta Germaniae Historica*, series *Constitutiones*, vol. i (1893), and *Diplomata*, vol. iii (1900–03). (K. RE.)

HENRY III (1017–56), German king from 1028, sole ruler from 1039 and emperor from 1046, of the Salian dynasty, was born on Oct. 28, 1017, the only son of the future emperor Conrad II and Gisela, widow of Ernest I, duke of Swabia. He was designated as his father's successor in 1026 and crowned king on April 14, 1028, but did not become sole ruler till his father's death in June 1039. He married first, in 1036, Gunhilda (Kunigunde), daughter of Canute of Denmark and England; and second, in 1043, Agnes of Poitou, daughter of William V of Aquitaine. Agnes eventually bore him a son, the future Henry IV, in 1050.

In the early part of his reign Henry was preoccupied with his eastern frontier, since Bratislav, prince of the Bohemians, was reviving the idea of an independent Slav state and had conquered various Polish towns. After suffering two defeats in 1040, Henry was more successful in 1041 and forced Bratislav to sue for peace and do homage for Bohemia. He then turned his attention to Hungary, where King Peter had been expelled by a certain Obo, who attacked Bavaria. Henry restored Peter, instituted Bavarian law in Hungary and received the fealty of both king and nobles.

In the west Henry was less successful, for though he received the submission of Burgundy (1041), he never came to terms with the problem of Lotharingia, where feudal tendencies were more strongly developed than in the rest of Germany. The main point at issue was whether the emperor could divide the duchy between the two surviving sons of Duke Gozelo (Gothelon), or whether he was obliged to let the elder son, Godfrey the Bearded, inherit it all. Henry attempted to divide it, but Godfrey revolted in 1044 and, after a temporary reconciliation, again in 1046.

Henry is most famous for his reform of the papacy in 1046. When he reached Italy he found three rival popes claiming the papacy, but at synods held at Sutri and in Rome (Dec. 20 and 23) he had all three deposed, and a German, Suidger, bishop of Bamberg, set up in their place as Pope Clement II. On Christmas day Henry was crowned emperor by the new pope, and the Romans recognized him as "patrician" with authority, in effect, to appoint popes. Henry exercised this authority in due course by appointing three more Germans in succession to Clement II. The men whom he appointed were ecclesiastical reformers like Leo IX (1049–54) and undoubtedly raised the standing of the papacy in Europe, though they met with opposition from the nobles of the city of Rome itself.

After his coronation, Henry made a victorious progress in southern Italy, restoring Pandulf IV to the principality of Capua and asserting his authority over the Normans in Apulia and Aversa (1047). But after this his power began to decline. Even while he was in Italy a revolution in Hungary caused the overthrow of King Peter in favour of Andrew I, who made frequent attacks on Bavaria and was still undefeated at the end of Henry's reign. Godfrey the Bearded of Lotharingia stirred up further revolts in Lotharingia (1047–49) before transferring his attention to Italy (1051), where he married Beatrice of Tuscany, whose lands lay across the main route from Germany to Rome. When Henry made an expedition to Italy (1055) Godfrey fled to Flanders, leaving his wife to be taken prisoner by the emperor for daring to marry a "public enemy." But because of Henry's death, at Bodfeld in the Harz mountains on Oct. 5, 1056, the marriage survived. Its disastrous effects for the empire were seen in 1057 when Godfrey's brother was elected pope as Stephen X (IX), uniting in his person the anti-imperial forces of Lotharingia, Tuscany and the papal court.

Henry III was a great emperor and his reform of the papacy was of the utmost importance, even if it was not to the advantage of the empire. His highhanded dealings with the nobles alienated them as a class, however, and it is doubtful if he, any more than his son, would have been able to save the empire from the combined attack of nobles and papacy. Henry's charters are printed in the *Monumenta Germaniae Historica*, series *Diplomata*, vol. v (1926–31).

HENRY IV (1050–1106), German king from 1054, sole king from 1056 to 1077 and emperor from 1084 of the Salian dynasty, was born at Goslar on Nov. 11, 1050, the son of the emperor Henry III and Agnes of Poitou. He succeeded his father on Oct. 5, 1056, having been elected and crowned king in 1054. His mother ruled for him till 1062, when he was kidnaped by a group of nobles led by Anno, archbishop of Cologne. During the next three years there was a perpetual struggle for power between Anno and Adalbert, archbishop of Bremen. The latter was influential in turning Henry against the Saxon nobility. Consequently when Henry began his personal rule in 1066 (in which year he also married Bertha of Turin), he immediately tried to re-establish the royal power by recovering those portions of his demesne which had been usurped by the nobles of Saxony and Thuringia during his minority. The foremost of these nobles was Otto of Nordheim, who in 1061 had been made duke of Bavaria by the empress Agnes. In 1070 he was accused of plotting to murder the king and was deprived of his duchy. He promptly rebelled, and though he was forced to make a temporary submission in 1071, he remained Henry's implacable enemy and played a leading part in the Saxon wars which, with slight intermissions, lasted from 1073 to 1088. His first wife having died in 1087, Henry married a Kievan princess, Praxedis or Eupraxia (in German called Adelheid), in 1088 or 1089.

Henry's attempt to restore the royal power was the cause not only of his Saxon wars but also of his struggle with the papacy. Pope Gregory VII (*see* GREGORY) was not prepared to see him use the church as a mere instrument of empire and consequently forced a quarrel on the key issue of the investiture of bishops (*see* also INVESTITURE CONTROVERSY; PAPACY; *The Medieval Papacy [590–1304]: Gregory VII*). Henry challenged his authority dramatically and was excommunicated and deposed (Feb. 21, 1076). This action gave the Saxons and the other opponents of the king an unparalleled opportunity. At the diet of Trebur (Tribur) on Oct. 16 they decreed that Henry would lose his kingdom if he did not receive papal absolution within a year and a day of his excommunication. They intended to keep Henry in Germany until the pope reached Augsburg for a council in Feb. 1077, but Henry escaped to Italy (where most of Lombardy was faithful to him) and obtained the pope's absolution at Canossa (Jan. 1077). He claimed that the pope had also restored him to his kingdom. Gregory disputed this, but it is certain that the news of the absolution came as a great blow to the German rebels.

Eventually the rebels elected Rudolf, duke of Swabia, as antiking on March 13, 1077, but Henry was supported by most of the German bishops and in most of Lombardy, Burgundy, Bavaria and Franconia. He gained a foothold in Swabia, where he appointed his son-in-law, Frederick, count of Staufen, as duke in 1079 (*see* HOHENSTAUFEN). In 1080 he invaded Saxony and, though defeated at Flarchheim (Jan. 27), succeeded in winning over the duke, Magnus Billung. He then began to threaten the pope, who since 1077 had remained neutral in the civil war. The result was that Gregory excommunicated and deposed Henry a second time (March 1080). Henry IV for his part summoned a council at Brixen (Bressanone) to depose Gregory and set up Archbishop Guibert of Ravenna in his place as the antipope Clement III. For a while fortune favoured Henry. The antiking Rudolf was killed in Oct. 1080, and Henry, now free to leave Germany, invaded Italy, besieged Rome (1082) and was crowned emperor by his antipope (March 31, 1084). But then Gregory VII's ally, Robert Guiscard, duke of Apulia, forced him to retire to Germany.

There the rebels had chosen a new antiking, Hermann, count of Salm (of the first house of Luxembourg), but he lacked the prestige of his predecessor and retired from the conflict before his death (1088). The only resolute opposition came from the papal party, which was led by the legate Odo of Châtillon; but he was supported by very few German bishops, and his attempts at ecclesiastical reform alienated the Saxon nobles who had misappro-

priated church lands. Odo had to rely for the most part on Welf V (later Welf II of Bavaria), whose father Welf IV (I) had been deposed from the dukedom of Bavaria and whose mother was a daughter of Otto of Nordheim. Himself the husband of Matilda (*q.v.*) of Tuscany, Welf had a certain amount of success in Italy; and when Odo of Châtillon was elected pope as Urban II in 1088, Henry had to mount an expedition to retake Mantua and Milan and to reinstate his antipope in Rome. Had Henry abandoned his antipope and recognized Urban II, he might have had a most advantageous peace; but as it was he remained obstinate, and opposition to him mounted. First his eldest son, Conrad, whom he had had crowned as German king in 1087, rebelled against him (1093–1101); then, after Conrad's death (1101), his second son, Henry (*see* below), whom he had had crowned in Conrad's stead in 1098, rebelled in 1104. In 1105 he was captured by the young Henry and compelled to abdicate, but in violation of the conditions was detained at Ingelheim and denied his freedom. Escaping to Cologne, he entered into negotiations with England, France and Denmark and was engaged in building up an army against his son when he died at Liège on Aug. 7, 1106.

Henry was undoubtedly an astute ruler, but he always showed greater ingenuity in adversity than common sense in victory. He has come to be regarded both as a tragic figure and as a national hero in Germany, if not for his opposition to the papacy at least for the efforts he made to maintain a united German kingdom in face of the particularist tendencies of the nobility. His charters are printed in the *Monumenta Germaniae Historica,* series *Diplomata* (1941–); his letters are edited by C. Erdmann (1937); and there is a collection of the correspondence of the period edited by C. Erdmann and N. Fickermann (1950). (R. H. C. D.)

Henry V (1081–1125), German king from 1098, sole ruler from 1106 and emperor from 1111, of the Salian dynasty, was born in Goslar on Jan. 8, 1081, the second son of the future emperor Henry IV and his first wife, Bertha of Turin. Crowned German king in 1098, he rebelled against his father in 1104, with the support of the church and the higher nobility (*see* above); but though he was able through perfidy to imprison his father for a while, there was no decisive battle between them. After his father's death, Henry V was recognized as king by all. He first turned eastward: campaigns against Hungary (1108) and Poland (1109) failed, but he reasserted German overlordship over Bohemia in 1110. Betrothed to Matilda, daughter of Henry I of England, in 1110, Henry married her in 1114.

An understanding with the pope in the controversy over investiture was essential to Henry. Having entered Italy at the head of a great army in 1110, he met Pope Paschal II at Sutri and there renounced the right to investiture, whereupon the pope agreed to direct the church in Germany to give back all lands and rights received from the crown. When these conditions were promulgated at St. Peter's in Rome on Feb. 12, 1111, they caused a tumult among the German bishops, who saw themselves at one stroke deprived of their powers. Their protests killed the agreement.

Henry had to leave Rome temporarily in the face of a popular rising, but took the pope with him as a prisoner and won his assurance that the king should invest the bishops with ring and staff after their canonical election. On April 13, 1111, Henry was crowned emperor in St. Peter's. Strong opposition, however, arose in the curia against the privilege granted by Paschal II; a council declared the privilege invalid, and Archbishop Guido of Vienne, against the pope's will, excommunicated the emperor.

In Germany, Henry followed his father's policy of favouring the *ministeriales* and the towns and provoked, in his turn, the antagonism of the princes. Rebellion soon broke out; Archbishop Adalbert of Mainz fomented unrest in the upper Rhineland and the revolt of Lothair of Supplinburg (later king as Lothair III and emperor as Lothair II) in Saxony ended in 1115 in a severe defeat for Henry. Nevertheless in 1116 Henry undertook his second Italian expedition, intending to take possession of the inheritance of Matilda of Tuscany, who had died in 1115. Further negotiations with the curia over the investiture question were without success. When in 1118 Pope Gelasius II was elected successor to Paschal II, Henry set up an antipope, Gregory VIII, who however could not maintain himself. Gelasius II's successor in 1119 was Calixtus II, with whom in 1122 Henry concluded the concordat of Worms. By this the king guaranteed the freedom of episcopal elections and renounced the investiture with staff and ring; but he was to be present at the elections with a casting vote, and he was to enfeoff the elected bishop with the temporalities of his see. This agreement, however, applied only to Germany, whereas in Italy and in Burgundy the enfeoffment was to follow consecration and would therefore be a pure formality.

New possibilities of altering the balance of power in the emperor's favour were envisaged in 1120, when William, the only son of Henry I of England, was drowned and Matilda, Henry's wife, became heiress to the English throne. Henry V therefore supported his father-in-law against France, but he could achieve nothing militarily. He died at Utrecht in the Netherlands on May 23, 1125, and was buried in Speyer cathedral. His legislative acts are printed in the *Monumenta Germaniae Historica*, series *Constitutiones,* vol. i (1893). (K. Re.)

Henry VI (1165–97), German king from 1169, sole ruler from 1190 and emperor from 1191, of the Hohenstaufen dynasty, was born in the last quarter of 1165 at Nijmegen in the Netherlands, the second son of the emperor Frederick I Barbarossa and Beatrix of Burgundy (Franche-Comté). He was educated under Conrad of Querfurt, afterward bishop of Hildesheim and Würzburg. Chosen German king at Bamberg in June 1169, he was crowned at Aachen on Aug. 15. He was invested with lands in Germany in 1179. In 1184 his father sought to procure his coronation from Pope Lucius III, but the pope refused because of the marriage arranged between Henry and Constance, daughter of the late Roger II of Sicily, a step which threatened to unite Sicily with Germany. This marriage took place at Milan in Jan. 1186, and soon afterward Henry was crowned king of Italy. Having been recognized by the pope as Roman emperor elect, Henry took over the government of the empire when his father went on crusade (Easter 1189). He suppressed a revolt of the Welf Henry (*q.v.*) the Lion in 1190 and then, after his father's death on the crusade, proceeded to Italy for his coronation by Pope Clement III.

Henry purchased the support of the cities of northern Italy, but on reaching Rome found Clement's successor, Celestine III, disinclined to carry out the coronation. However, the strength of the German army and a treaty made between the king and the Romans induced the pope to crown Henry on April 15, 1191. Meanwhile a party in Sicily had chosen Tancred, an illegitimate son of Constance's brother Roger, as king. Henry marched to Naples, but was compelled to raise the siege and return to Germany.

There the Welfs and their earlier opponents were united against the emperor, vacancies in various bishoprics added to the confusion, and Henry was suspected of being implicated in the murder of Albert, bishop of Liège. His salvation came from the captivity of Richard I, king of England, and the skill with which he used this event to make peace with his foes. When Henry the Lion came to terms in March 1194, order was restored to Germany. In the following May, Henry VI went again to Italy, where Pope Celestine had espoused the cause of Tancred. When he reached Sicily he found Tancred dead, and, meeting with little resistance, entered Palermo, where he was crowned king on Dec. 25, 1194. On the following day his wife gave birth to the future emperor Frederick II at Jesi. In June 1195 Henry left her as regent and returned to Germany.

Henry soon began to cherish ideas of universal empire. Richard of England had already acknowledged his supremacy. Declaring that he would compel the king of France to do the same, Henry sought to stir up strife between France and England. Nor did the Spanish kingdoms escape his notice. Tunis and Tripoli were also claimed. When the Byzantine Isaac II Angelus asked his help, he demanded the recognition of Isaac's daughter Irene, wife of Henry's brother Philip, as heiress to the eastern empire. The kings of Little Armenia and Cyprus asked for investiture at his hands.

To complete Henry's scheme two steps were necessary: a recon-

ciliation with the pope and the recognition of his young son, Frederick, as his successor in the empire as well as in Sicily. The reconciliation was accomplished through the emperor's undertaking to organize a new crusade; the matter of the succession was more difficult because Henry conceived the ambitious plan of having the German kingdom transformed from an elective to a hereditary monarchy. In the winter of 1195–96 he induced about 50 princes to agree to this plan, and at the diet of Würzburg (April 1196) a majority voted for it; but the minority, led by Adolf of Altena, archbishop of Köln, continued to oppose it. To circumvent the opposition, Henry in June went to Rome to persuade the pope to crown Frederick, but the pope would not immediately comply, and in Oct. 1196, at the diet of Erfurt, the German opposition was increased by the adherence of a strong faction led by the landgrave of Thuringia, Hermann. Finally Henry had to be content with the election of Frederick as German king, in the customary way, at Frankfurt in December. Then, when Henry was in southern Italy preparing his crusade, the oppressive rule of his officials there provoked an insurrection. This was put down with savage cruelty; but on Sept. 28, 1197, Henry died of malaria at Messina. He left some poems, published by F. H. von der Hagen in his *Minnesinger* (1838). (X.; R. H. C. D.)

HENRY (VII) (1211–42), German king from 1220 to 1235, of the Hohenstaufen dynasty, was born in Sicily, the son of the future emperor Frederick II and Constance, daughter of Alfonso II of Aragon. He was crowned Sicilian king in 1212. In 1216 Frederick promised Pope Innocent III to hand the kingdom over to Henry on being crowned emperor, but in April 1220 the diet of Frankfurt elected Henry, whom Frederick had made duke of Swabia in 1216 or 1217, as German king, so depriving Frederick's promise to the pope of all practical value, since Germany and Sicily would remain united under him. Henry was crowned at Aachen on May 8, 1222, by Archbishop Engelbert I of Köln, whom Frederick had appointed regent and guardian. On Nov. 29, 1225, he married Margaret, daughter of the Babenberg Leopold VI of Austria. After the assassination of the powerful archbishop on Nov. 7, 1225, Louis I, duke of Bavaria, was appointed to be Henry's guardian, but Henry broke with him at the end of 1228, took over the government and defeated the duke in the summer of 1229.

With *ministeriales* instead of princes as his chief counselors, and often taking the side of the towns against their bishops, Henry had soon to face the resistance of the princes, and in 1231 he was forced to yield to them. After having forbidden urban communes, he issued in May the *Constitutio* or *Statutum in favorem principum* which recognized and extended princely liberties in opposition to the expanding towns. In May 1232, at Cividale, Frederick confirmed the greater part of the *Constitutio* and made Henry swear him unconditional obedience.

During the following two years Henry vacillated between observance of and resistance to the emperor's wishes. In Feb. 1234 he intervened against the savage persecution of heretics, in contradiction to Frederick's antiheretical legislation; and in September, at Boppard, he openly rebelled against his father. The rebellion collapsed when Frederick came to Germany in spring 1235. Having submitted to his father in July, Henry was imprisoned and deposed. Taken to the Sicilian kingdom in 1236, he died in Feb. 1242 in captivity near Nicastro, possibly by suicide. (N. R.)

HENRY RASPE (1202–47), landgrave of Thuringia from 1227 and German antiking from 1246, was the second surviving son of Hermann I of Thuringia and Sophia, daughter of Otto I of Bavaria. On the death of his elder brother, the landgrave Louis IV (husband of St. Elizabeth), in 1227, Henry seized power and excluded his nephew, Hermann II, from the succession. The usurpation was tolerated by the emperor Frederick II, and Henry in return assisted the emperor in 1236 to crush the rebellion of the Babenberg Frederick II of Austria and was one of the 11 princes who elected the emperor's son Conrad IV as German king at Vienna in 1237. In 1238 Henry weakened his relations with the emperor by his marriage to Gertrude, sister of the childless Frederick of Austria. The emperor reacted by affiancing his daughter Margaret to Hermann II, but this engagement was broken, and Henry remained faithful to the imperial cause; he was excommunicated by the papal agent Albert Behaim in 1240. The emperor appointed him vicegerent in Germany in 1242, but Henry made no attempt to discharge his duties. On April 21, 1246, Pope Innocent IV urged the German princes to elect Henry as king in place of Conrad IV, recently deposed by papal decree. Henry was elected by an assembly of ecclesiastical princes at Veitshöchheim on May 22, 1246. He defeated Conrad near Frankfurt on Aug. 5, 1246, but failed to take Ulm, the key to Conrad's duchy of Swabia. Exhausted by his exertions, he died at the Wartburg on Feb. 16, 1247. (C. C. BA.)

HENRY VII (*c.* 1275–1313), German king from 1308 and emperor from 1312, was the son of Henry III, count of Luxembourg, whom he succeeded in 1288. He married Margaret, daughter of John I, duke of Brabant, in 1292. Closely attached to the court of Philip IV of France, Henry was regarded as a supporter of French policy in German affairs. On the death of the German king Albert I, of the house of Habsburg, Henry was elected as his successor on Nov. 27, 1308, at Frankfurt—thanks largely to the exertions of his brother Baldwin, archbishop of Trier—with the support of Pope Clement V, who was anxious to maintain good relations between Germany and France while limiting any expansion of French power. Crowned at Aachen on Jan. 6, 1309, Henry made a settlement with the rival Habsburgs and acquired a strong base for the Luxembourg dynasty by marrying the heiress of King Wenceslas II of Bohemia to his son John (*q.v.*), who was crowned king of Bohemia in 1310.

Meanwhile Henry had announced his coming to Italy, to be crowned emperor in Rome; and the pope, to whom the Italian Guelphs appealed for advice, urged them to obey the king. Henry entered Italy in Oct. 1310 with a small German army and assumed the Lombard crown in Milan on Jan. 6, 1311. The cities of Piedmont and Lombardy submitted to him and, in accordance with his proclaimed program of peace and impartial justice, he reconciled the warring factions and restored the exiles to their homes; but as most of these were Ghibellines, his policy aroused suspicion and discontent, fomented by the Florentines and their Guelph allies in Tuscany and Romagna. Disorders broke out in February, culminating in the revolt of Brescia, which Henry did not subdue until September, after a four months' siege. These events forced Henry into greater dependence on the Ghibellines; his measures grew harsher, his tone more authoritarian. After wintering in Genoa and Pisa, he marched to Rome. There he found part of the city, including St. Peter's, held against him by the troops of Robert, the Angevin king of Naples, whose attitude had hitherto been ambiguous. Henry was crowned emperor in St. John Lateran on June 29, 1312, by cardinals nominated by the pope for the purpose. But his quarrel with Robert, against whom he now allied himself with the Aragonese Frederick III of Sicily, involved him in difficulties with Clement V and Philip IV of France. Henry returned to Tuscany where, after ineffective attacks on Florence, he withdrew to Pisa, summoning a large German force to join him in May 1313. Before this had materialized and while he was mainly dependent on Pisan finance, he moved south again in the summer to attack Naples, against the specific command of the pope, but was taken ill with fever and died at Buonconvento, near Siena, on Aug. 24, 1313. He was buried in Pisa cathedral.

Henry's mission of peace with justice in Italy was acclaimed by Dante, and even among his enemies there was widespread recognition of his qualities and of his sincerity; but he lacked the material force to impose himself on local interests aggravated by interference from other princes. The documents of the reign are printed in the *Monumenta Germaniae Historica*, series *Constitutiones*, vol. iv (1906–11). (D. M. B. DE M.)

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HENRY I (*c.* 1210–1274), king of Navarre and count, as Henry III, of Champagne, was the youngest son of Theobald I of Navarre (Thibaut IV of Champagne) by Margaret of Foix. He succeeded his eldest brother, Theobald II (Thibaut V), in both kingdom and countship in Dec. 1270. His proclamation at Pamplona, however, did not take place till March 1271, and his coronation was delayed until May 1273. By his marriage (1269) to Blanche, daughter of Robert I of Artois and niece of Louis IX of France, he had one daughter, Joan, whom, by the convention of Bonlieu (Nov. 30, 1273), he promised to one of the two sons of Edward I of England, Henry and Alfonso. This would have led to a union of his dominions with English Gascony, but it came to nothing. King Henry died on July 22, 1274; both the English princes died in the next decade, and Joan was married in 1284 to the future Philip IV of France.

HENRY II (1503–1555), king of Navarre from 1517, was born at Sangüesa in April 1503, the son of Catherine de Foix-Grailly, queen of Navarre, by her consort Jean d'Albret. His parents lost most of their kingdom to Ferdinand II of Aragon in 1512 and had to retire north of the Pyrenees. His father died in 1516, his mother in Feb. 1517, whereupon Henry succeeded to her rights. In 1521, when war broke out between Francis I of France and the Holy Roman emperor Charles V (Ferdinand's successor in Spain), French troops invaded Spanish Navarre to recover it for Henry, but were expelled in June. In 1525, in Italy with Francis, Henry was captured with him at Pavia but contrived to escape. He was married in Jan. 1527 to Francis' sister, Margaret (*q.v.*) of Angoulême. The peace of Cambrai (1529) gave him no satisfaction for Navarre, but he had the government of Guienne from Francis. He later tried in vain to treat with Charles V about his claims. Henry died at Hagetmau in Gascony on May 29, 1555, and was succeeded by his daughter Jeanne (1528–72), mother of the future Henry IV of France.

HENRY (1512–1580), king of Portugal from 1578 to 1580, son of Manoel I, was born at Almeirim in 1512 and embarked upon an ecclesiastical career. He became successively archbishop of Braga (1534), Evora (1540) and Lisbon (1564), and was made a cardinal in 1545. Henry's brother King John III died in 1557 and was succeeded by his grandson Sebastian, for whom Henry was regent during his minority. When Sebastian was killed in the battle of the Three Kings (1578), Henry, aged and ailing, came to the throne. His short reign was dominated by the problem of the succession, for Henry's celibacy made it certain that the direct male line of the house of Avis would end with his death. Henry had indicated no preference for any of the principal contenders for the throne—Philip II of Spain, the duchess of Braganza or Antonio (*q.v.*), prior of Crato—when he died (Jan. 31, 1580), leaving this decision to the council which thereafter governed Portugal for a short period. *See* also Portugal: *History.* (Da. A. P.)

HENRY II Jasomirgott (after 1106–1177), the first duke of Austria, was a member of the house of Babenberg (*q.v.*), being the son of the margrave Leopold III of Austria and Agnes, daughter of the emperor Henry IV; it is not known why he was given the appellation Jasomirgott.

Henry received the rank of count palatine from the German king Conrad III, his half brother, in 1140 and was granted the margraviate of Austria in fief, after the death of his brother Leopold IV, in 1141. To this, in 1143, was added the duchy of Bavaria, after Conrad had in 1142 negotiated Henry's marriage with Gertrude, daughter of the emperor Lothair II and widow of Henry the Proud, the Welf duke of Bavaria and Saxony. After Gertrude's death in 1143, however, the Welfs resumed their claim to Bavaria. At first Henry was able to maintain himself against them, but armed opposition by the bishop of Regensburg and by the archbishop of Salzburg, together with Henry's defeat by the Hungarians in 1146, made him leave Bavaria and transfer his seat to Vienna (where in 1155 he founded a monastery for Irish monks).

On his return from the second crusade Henry, in the summer of 1148, married Theodora, a niece of the Byzantine emperor Manuel I Comnenus and probably a daughter of the *sebastokrator* Andronicus. Though the German king Frederick I Barbarossa had favoured the claim of the Welf Henry the Lion (*q.v.*) to Bavaria from 1152 and awarded the duchy to him in 1154, Henry Jasomirgott refused to cede it. For the sake of his Italian and Byzantine policy, Barbarossa in 1156 agreed to a compromise, which led to the *privilegium minus* (*see* Austria, Empire of): to compensate for the loss of Bavaria, Henry Jasomirgott and Theodora together received Austria as a duchy, with special assurances regarding the order of succession. These, however, did not come into force, as a son, Leopold V, was born to Henry in 1157. After Henry Jasomirgott's death (Jan. 13, 1177), this son succeeded him as duke of Austria. (He. Fl.)

HENRY II the Younger (1489–1568), duke of Brunswick-Wolfenbüttel from 1514, was born on Nov. 10, 1489, the son of Henry I the Elder, whom he succeeded. He fought for the coalition against the bishop of Hildesheim, John IV, in 1519–23, with eventual success; and during the peasants' revolt, together with his north and middle German peers, he defended the interests of the territorial princes (1525). Soon afterward he went to join Emperor Charles V in Spain. A campaign for Charles in northern Italy (1528) failed because his allies did not give him adequate support, and he had to retire to his duchy. There he found that the Reformation had taken strong root during his absence. His attempt to restore Catholicism by force deepened the antagonism between him and the estates, against whom the hot-tempered prince struggled obstinately for an extension of his prerogatives. To avoid having to partition the duchy with William, one of his younger brothers, Henry held him prisoner from 1524 until he consented to the so-called *Pactum Henrico-Wilhelminum* (1535), which established the rule of succession by primogeniture. When Henry, alarmed at the progress of the League of Schmalkalden, began to take threatening measures not only against the ducal city of Brunswick but also against the imperial city of Goslar (whose riches his predecessors had long coveted), John Frederick I of Saxony and Philip of Hesse drove him out of his duchy (1542) and took over the administration of his territories, where they began systematically to introduce the Reformation. There followed a flood of pamphlets from both sides. Then, in 1545 Henry and his eldest son, Charles Victor, trying to reconquer the duchy,

were captured in battle near Höckelheim (Oct. 1545) and taken to Hesse. Liberated after Charles V's victory over the Schmalkaldic league at Mühlberg (1547), Henry again attempted to enforce Catholicism in his duchy. On July 9, 1553, he won the battle of Sievershausen against Albert Alcibiades of Brandenburg-Kulmbach and Maurice of Saxony, but Charles Victor and Henry's second son, Philip Magnus, were killed. After this followed years of bitter conflict between Henry and his son Julius, mainly over the latter's apostasy of Lutheranism. Finally, however, Henry was reconciled to his son and in his last years even showed tolerance to adherents of the new doctrines. The duke died on June 11, 1568.

See F. Koldewey, *Heinz von Wolfenbüttel* (1883); E. Brandenburg, *Die Gefangennahme Herzog Heinrichs von Braunschweig durch den Schmalkaldischen Bund* (1894). (WA. HE.)

HENRY OF ALMAIN (1235–1271), nephew of the English king Henry III, the eldest son of Richard (*q.v.*), earl of Cornwall and "king of the Romans," was born at Hailes, Gloucestershire, on Nov. 1, 1235. He was so named from his father's German kingship. ("Almain" in Anglo-French). Attracted at first to the baronial reform party in 1263, he rejoined the royalists a few months later, was captured at the battle of Lewes (May 14, 1264) and became a hostage in the hands of Simon de Montfort for the fulfillment of the mise of Lewes, the terms of surrender. Twice released on parole to bear requests for peace negotiations to Louis IX, he was probably in France when the battle of Evesham was fought (Aug. 1265), and he helped in restoring royal authority, defeating and capturing the rebel Robert de Ferrers, earl of Derby, at Chesterfield (May 1266). He helped to secure better terms for the disinherited rebels in the settlement reached by the *Dictum de Kenilworth* (Oct. 1266), and he mediated (1267) between Henry III and Gilbert de Clare, earl of Gloucester. Taking the cross (1268) he left England (1270) with the Lord Edward (afterward Edward I), who sent him back from Sicily to negotiate peace with the Montfort brothers. But he was foully and senselessly murdered by Guy de Montfort in the parish church of St. Silvestro at Viterbo (March 13, 1271).

See F. M. Powicke, *King Henry III and the Lord Edward* (1947). (R. F. T.)

HENRY OF BLOIS (*c.* 1099–1171), bishop of Winchester from 1129 to 1171, who as papal legate played the part of a kingmaker during the civil war between Stephen and Matilda, was the fourth son of Stephen, count of Blois and Chartres, and, through his mother Adela, was the grandson of William the Conqueror. His career exemplified the manner in which great ecclesiastical offices were virtually turned into feudal lordships for the benefit of the younger sons of royal families. Abbot of Glastonbury (1126), bishop of Winchester, the richest see in England (1129), as much a knight as a churchman, Henry was largely instrumental in having his brother Stephen recognized as king (1135) and hoped in return for the archbishopric of Canterbury (1136). Foiled in this by the hostility of St. Bernard of Clairvaux, he was made papal legate (1139) in England with powers superior to those of the archbishop as primate, but his legation expired in 1143. Generally an adherent of Stephen in the civil war, Henry's change of front (1141) nearly brought Matilda to the throne; but they soon quarreled and she besieged him in his castle of Wolvesey at Winchester (Aug.–Sept. 1141). Henry played a leading role in English politics until 1154, but thereafter retired to Cluny, France, and reorganized the abbey finances. Returning to England in 1162, he abandoned luxury and political ambition and died, a "beloved elder statesman," on Aug. 8, 1171, at Winchester, where he had founded St. Cross hospital.

See K. R. Potter (ed.), *The Historia Novella of William of Malmesbury* (1955); D. Knowles, *The Episcopal Colleagues of Archbishop Thomas Becket* (1951). (G. W. S. B.)

HENRY OF GHENT (d. 1293), scholastic philosopher called *doctor solemnis* (the "solemn teacher"), was born either at Tournai in Hainaut or at Ghent in Flanders. He was a canon of Tournai in 1267 and became archdeacon of Bruges in 1276. In 1279 he was principal archdeacon of Tournai, but his duties do not seem to have been too onerous, for he was teaching at Paris in the faculty of arts and, after 1276, in the faculty of theology. He was also a member of the commission which, under the direction of Étienne Tempier, bishop of Paris, drew up the famous condemnation of Averroism in 1277. The genuine works of Henry are the *Summa theologica* (printed at Paris, 1520, and at Ferrara, 1646) and the *Quodlibeta* (Paris, 1518, and Venice, 1608). The *Quaestiones super Metaphysicam Aristotelis*, the *Syncathegorematum liber*, the *Commentum in Librum de causis* and the commentary on the *Physics* of Aristotle formerly attributed to him were probably not his work.

Henry was an eclectic who cannot be classed either as Aristotelian or as Augustinian. In some ways he anticipated Duns Scotus. Thus he taught that matter could be created by God to exist independent of form, denied a real distinction between essence and existence and between the soul and its faculties, and also attacked the Thomist theory about the possibility of creation from eternity. Like Duns Scotus he was a voluntarist who regarded reason as being related to will as servant to master, but a servant carrying the torch to illuminate the master's path. On the other hand, Duns Scotus criticized Henry's theory of individuation through negation, his unsatisfactory treatment of the intelligible species and his doctrine of a special illumination. At first Henry supported the Thomist doctrine of the unity of forms, but he soon changed his opinion by restricting it to the material world and by positing two substantial forms in man, a spiritual soul and a *forma corporeitatis* or "form of corporeity" (the latter term being taken from Avicenna).

See E. Hocedez, "Gilles de Rome et Henri de Gand," *Gregorianum* (1927); J. Paulus, *Henri de Gand: essai sur les tendances de sa métaphysique* (1938). (S. J. C.)

HENRY OF HUNTINGDON (*c.* 1080/90–*c.* 1155), English chronicler whose *Historia Anglorum*, from 55 B.C. to A.D. 1154, is interesting historically for the light it throws on the Anglo-Saxon Chronicle, on which the earlier part is based. Born sometime between 1080 and 1090, probably in Lincolnshire, Henry entered the household of Robert Bloet, bishop of Lincoln, at an early age, and in 1110 was appointed by him archdeacon of Hertford and Huntingdon. He was on familiar terms with his patron and also, apparently, with Bloet's successor, Alexander of Blois, who encouraged him to undertake the writing of his history. The first text, dealing with the period of 1129, appeared in 1130; four subsequent recensions brought it down to the accession of Henry II in 1154 which was made the occasion of a verse panegyric showing all the writer's loftiness of style. Henry must have died soon after, for a new archdeacon was appointed in 1155. The only recorded event of his later life is that in 1139 he accompanied Theobald, archbishop of Canterbury, to Rome.

The *Historia Anglorum*, formerly much esteemed, is now regarded as being of little independent value for the period before 1126, being largely a compilation or translation of such sources as Bede and the Chronicle, interspersed with passages of rhetoric. The later part, disappointingly, does little to illuminate contemporary events. More interesting for its sidelights on famous personalities of the day is the minor moralizing tract *Epistola ad Walterum de contemptu mundi*, written probably about 1135. Henry also wrote *De Miraculis*, a book of extracts from Bede, and two other Latin epistles, appended to later recensions of the *Historia*. He is known to have composed eight books of Latin epigrams, of which two books survive in a manuscript copy of the *Historia* (Lambeth manuscript, no. 118).

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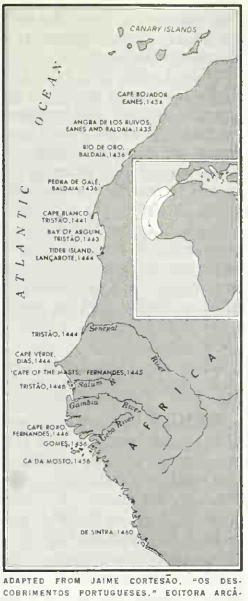
HENRY THE NAVIGATOR (1394–1460), so called because of his interest in maritime affairs and his encouragement of the Portuguese voyages of discovery, was born at Oporto on March 4, 1394, the third surviving son of John I of Portugal and Philippa, daughter of John of Gaunt, duke of Lancaster. Little is known of Henry's life before 1412 when, with his bastard half brother

Afonso, conde de Barcelos, he was placed in charge of recruiting part of the army for the projected attack upon Ceuta. He accompanied his father and brothers on the expedition and distinguished himself in the assault upon Ceuta (Aug. 21, 1415), when his standard was the first to enter the city. Knighted four days later, Henry was made duke of Viseu and lord of Covilhã on his return to Portugal. By 1420 he was also invested with the functions of governor and administrator of the Order of Christ.

The infante's interest in overseas exploration seems to date from the Ceuta expedition. He returned there with help for the besieged Portuguese garrison in 1418 and did not return home until 1419, but by this time his sailors had already reconnoitred the islands of Porto Santo and Madeira. Henry then made several unsuccessful attempts to master the Canary Islands and to explore the African coast beyond Cape Bojador. Although it proved impossible to dislodge the Castilians from possession of the Canaries, the 15th attempt to round Cape Bojador, by Gil Eanes in 1434, was successful. Excited by this news and by the samples of earth and flowers from the coast beyond the cape which Eanes had brought back with him, Henry sent Eanes and Afonso Gonçalves Baldaia to continue the exploration; and in 1436 Baldaia, alone, went beyond the Rio de Oro as far as Pedra da Galé.



ADAPTED FROM JAIME CORTESÃO, "OS DESCOBRIMENTOS PORTUGUESES," EDITORA ARCÁDIA, LISBON

AREA OF AFRICA REACHED DURING THE EXPLORATIONS SPONSORED BY HENRY THE NAVIGATOR

Meanwhile John I had been succeeded (1433) by Henry's eldest brother, Edward (Duarte). Both monarchs encouraged the infante's ventures and Edward made him a life grant of all the revenues of the islands of Madeira, Porto Santo and Desertas (Sept. 26, 1433). From 1436 Henry was occupied with planning an expedition, of which he was appointed commander in July 1437, against Tangier; it was a disastrous failure. A year later (Sept. 1438) Edward died and Henry was involved in the internal crisis resulting from the minority of Edward's son Afonso V. Having helped establish his elder brother Pedro as regent, Henry retired to Algarve, where thenceforward he chiefly resided. At Vila do Infante (built to Henry's orders), near Sagres, he assembled a team of navigators and geographers.

Exploration began again in earnest when Nuno Tristão reached Cape Blanco (1441) and discovered (1443) the bay of Arguin and some of its islands. By royal charter of Oct. 22, 1443, Henry was given a monopoly of navigation, trade and conquest on the African coast beyond Cape Bojador. In 1444, three successive expeditions reached the Naar and Tider islands, Senegal and Cape Verde. Alvaro Fernandes discovered the "Cape of the Masts" in 1445 and a new voyage by Nuno Tristão, in 1446, took him to the mouth of the Salum river, where he was killed by natives in a landing affray. Also in 1446 another expedition led by Fernandes reached the northern part of what became Portuguese Guinea. In the following decade, various expeditions, notably those of the Italians Antoniotto Usodimare and Alvise Ca Da Mosto and of the Portuguese Diogo Gomes discovered the coast as far as the Geba river. Finally, still in Henry's lifetime, Pedro de Sintra explored (1460) the stretch of coast from the Geba river to Sierra Leone—the southern limit of Henry's discoveries in Africa. In the west, Diogo de Teive, in the course of returning (1452) from a wider voyage in the northern Atlantic, ran into the western islands of the Azores, Corvo and Flores.

Henry died at Vila do Infante on Nov. 13, 1460. His name has become famous less for the achievements, significant though they were, of his own lifetime than for the fact that it was the impetus he gave to maritime exploration that led to the great expansion of Europe during the 16th century. *See* also PORTUGAL: *History*.

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Biographies in English include R. H. Major, *The Life of Henry of Portugal* (1868), and C. R. Beazley, *Prince Henry the Navigator* (1895), both of which are out of date, and Elaine Sanceau, *Henry the Navigator* (1946). *See* also E. Prestage, *The Portuguese Pioneers* (1933); Damião Peres, *Historia dos descobrimentos portugueses* (1943); Jaime Cortesão, *Os Descobrimentos portugueses* (1959–61). (V. R. R.)

HENRY THE LION (1129–1195), duke of Saxony from 1142 and of Bavaria from 1156 to 1180, one of the most controversial figures in medieval German history, took over as grandson of the emperor Lothair II the leadership of the Welf party against the Hohenstaufen after the death of his father Henry (*q.v.*) the Proud. Even after investiture as duke of Saxony (1142), his first object remained the recovery of Bavaria, which Conrad III, the first Hohenstaufen German king, had granted to the Babenberg margrave of Austria, Henry (*q.v.*) Jasomirgott. In 1147 Henry the Lion married Clementia, daughter of Conrad, duke of Zähringen, main opponent of the Hohenstaufen in Swabia, and in the same year he laid claim to Bavaria, but an attempt to take possession in 1151 was unsuccessful. The death of Conrad III and the accession of Frederick I Barbarossa, whose mother was a Welf, to the German kingship changed the situation. Frederick recognized Henry the Lion as duke of Bavaria in 1154 and secured his possession of the territory in 1156, the Babenbergs being compensated by the elevation of Austria into a duchy.

For the next 20 years Frederick and Henry worked together without serious friction. Henry supported Frederick on his Italian expeditions (1154–55, 1159–60, 1161) and against the Poles (1157). But his main effort was directed toward building up his own territorial power in northern Germany. Participation in the Wendish crusade (1147) had shown him the potentialities of expansion beyond the Elbe at Slav expense. In 1163 and 1164 the resistance of the Obodrites was broken and Saxon garrisons were established in the conquered lands, where the bishoprics of Mecklenburg, Oldenburg and Ratzeburg were reconstituted. Henry's claim to invest these bishoprics, disputed by the archbishop of Bremen, was confirmed by Frederick, now Holy Roman emperor. His ambitions also brought him into conflict with other neighbouring German princes, particularly Adolf II of Holstein (who had been compelled to hand over Lübeck in 1158); Albert the Bear, margrave of Brandenburg; and Archbishop Wichmann of Magdeburg. A first attempt by the other North German princes to check Henry's ambitions was settled by Frederick's intervention in 1168.

Subsequently, however, Henry's quarrelsome nature and excessive ambitions placed the emperor in an impossible position. In 1168, six years after divorcing his first wife, Henry married Matilda, daughter of Henry II of England, whereas Frederick, after 1173, was to draw closer to France. In 1171, after long-drawn-out hostilities with Valdemar I of Denmark over the island of Rügen, Henry's daughter Gertrude married the Danish prince Canute. In 1172, during his pilgrimage to Jerusalem, Henry was received in Constantinople by the Byzantine emperor Manuel I Comnenus, and this gave rise (probably unjustly) to rumours of disloyalty. In any case, Henry's independent policies in Saxony (where he raised Brunswick almost to the rank of a capital city) and, most of all, his arrogant self-interest and indifference to imperial policy were bound to cause difficulties. He himself was displeased when his uncle, Welf VI, disposed of his Italian and Swabian lands to Frederick. When Frederick needed support in Italy in 1176 Henry's price, which was refused, was the imperial

city of Goslar. After his defeat by the Lombard league at Legnano, Frederick came to terms with the church, but Henry refused to give up church lands he had seized. The result was a war with the bishop of Halberstadt, in which many of the Saxon nobles, oppressed by Henry, joined. Frederick now refused Henry his support. Summoned to answer the charges against him, Henry failed to appear, and in 1180 a judgment of the imperial court deprived him of his two duchies. Defeated in 1181, he submitted at Erfurt, was allowed to retain his hereditary lands of Brunswick and Lüneburg but was banished for three years.

From his exile at the Plantagenet Henry II's court in Normandy and in England Henry the Lion returned to Germany in 1185. Again banished in 1189, he returned after Frederick's death (1190) and stirred up trouble against the German king Henry VI. Though the Lion's efforts to restore his fortunes were unsuccessful, the hostility of the Welf and Hohenstaufen dynasties persisted after his death (in Brunswick on Aug. 6, 1195), coming to a head when his son, later the emperor Otto IV, took the lead in the civil wars following Henry VI's death.

Much was made by older historians of Henry the Lion's furtherance of German interests against the Italian entanglements of the Hohenstaufen. Such idealization is historically false. Nor should the constructive character of Henry's policy in Saxony be exaggerated. Certainly he fostered the Saxon cities, notably Lübeck, but only where his interests were directly engaged; there was no over-all plan. In Bavaria, he attempted and achieved little. The lasting significance of Henry's career lies rather in the ruin, through his egoism, of the prospect of German recovery from the civil wars at the beginning of the 12th century. The deposition of Henry in 1180 marked, in fact, a milestone in the disintegration of Germany. Bavaria, from which Austria had been separated in 1156, now lost Styria as well. Saxony was also dismembered: the lands west of the Weser river were conferred, as the duchy of Westphalia, on the archbishop of Cologne and thus associated with the Rhineland; those east of the Weser (*see* ANHALT) passed to the son of Albert the Bear. Later, in 1235, Henry the Lion's patrimony was made into the duchy of Brunswick-Lüneburg for Henry's grandson Otto. The result was a weakening of ducal power, which rendered impossible the assertion of authority over the small counts, barons and urban communities and contributed greatly to the later splintering of Germany. More than anything else it was Henry's personality which brought to nothing the 12th-century attempt to reorganize German political life on the basis of co-operation between the duchies and the monarchy.

BIBLIOGRAPHY.—Henry's charters are edited by K. Jordan, *Die Urkunden Heinrichs des Löwen* (1941–49). Otherwise the original authorities are those on the reigns of Frederick I and Henry VI. *See* further A. L. Poole, *Henry the Lion* (1912); K. Hampe and F. Baethgen, *Deutsche Kaisergeschichte in der Zeit der Salier und Staufer* (1949); T. Mayer, *Friedrich I und Heinrich der Löwe* (1957). For Henry's activities in Saxony *see* R. Hildebrand, *Der sächsische "Staat" Heinrichs des Löwen* (1937), though this exaggerates his initiative, particularly in regard to the towns; K. Jordan, *Die Städtepolitik Heinrichs des Löwen* (1960). (G. BR.)

HENRY THE PROUD (*c.* 1100–1139), duke of Bavaria and Saxony, second son of Henry the Black, duke of Bavaria, and Wulfhild, daughter of Magnus Billung, duke of Saxony, was a member of the house of Welf (*q.v.*). His father and mother both died in 1126, and as his elder brother Conrad had entered the church Henry became duke of Bavaria and shared the family possessions in Saxony, Bavaria and Swabia with his younger brother, Welf. In 1127 he married Gertrude, the only child of the German king Lothair, and at once took part in the warfare between the king and the Hohenstaufen brothers Frederick II, duke of Swabia, and Conrad, afterward the German king Conrad III. Simultaneously he suppressed a rising in Bavaria, led by Frederick, count of Bogen, during which both duke and count sought to establish their own candidates in the bishopric of Regensburg. Frederick submitted in 1133, and two years later the Hohenstaufen brothers made their peace with Lothair. In 1136 Henry accompanied Lothair to Italy and, taking command of one division of the German army, marched into the south, devastating the land as he went. It was probably about this time that he was invested with the margraviate of Tuscany and the lands of the countess Matilda (*q.v.*). After the Italian campaign Henry was appointed by Lothair (now emperor as Lothair II) to succeed him in the dukedom of Saxony.

When Lothair died in 1137 Henry's wealth and position made him a formidable candidate for the German throne; but his very strength aroused the jealousy of the princes and prevented his election. The new king, Conrad III, demanded the imperial insignia which were in Henry's possession, and Henry in return asked for his investiture with the Saxon duchy. Conrad refused on the pretext that it was unlawful for two duchies to be in one hand. Attempts at a settlement failed, and in July 1138 the duke was placed under the ban of the empire, and Saxony was given to Albert the Bear, afterward margrave of Brandenburg. War broke out in Saxony and Bavaria, but was cut short by Henry's sudden death at Quedlinburg on Oct. 20, 1139. Henry was a man of great ability, and his early death alone prevented him from playing as important a part in German history as did his son, Henry the Lion.

BIBLIOGRAPHY.—S. Riezler, *Geschichte Bayerns*, vol. i, 2nd ed. (1927); W. Bernhardi, *Lothar von Supplinburg* (1879); A. L. Poole, "Germany, 1125–1152," *Cambridge Medieval History*, vol. v, reprinted (1948).

HENRY (HENRY FITZHENRY, called the Young King) (1155–1183), second son of Henry II of England by Eleanor of Aquitaine, was born in London on Feb. 28, 1155. He was fond of boasting that unlike his father and elder brother William (b. 1153) he was "born in the purple," *i.e.*, born the son of a reigning king; and from 1156, when his elder brother died, he was regarded as his father's successor for England, Normandy and Anjou. In 1158 he was betrothed to Margaret, daughter of Louis VII of France, on condition that her dowry would be the Vexin, the vitally important border region between Normandy and France. Henry II, impatient to gain this district, took advantage of Pope Alexander III's difficulties at the start of his pontificate to win papal permission for the children to be married in 1160. In 1170 Henry was crowned at Westminster by Archbishop Roger of York, a defiance of Thomas Becket which led directly, through his protests, to Becket's murder at the end of the year. Crowned again in 1172 the young king was given no real power, and in 1173, with his mother and two brothers, he led the rebellion which nearly overthrew Henry II. Forgiven for his part in the revolt, he continued to intrigue with the French king against his father and in 1182–83 waged war against his brother Richard from whom he wished to wrest Poitou. Just as a fresh rebellion was threatening, he died of dysentery at Martel (Lot) on June 11, 1183. Henry, who left no children, was handsome, gay and likeable, but quite feckless and irresponsible.

See C. E. Hodgson, *Jung Heinrich, König von England* (1906); A. L. Poole, *From Domesday Book to Magna Carta*, 2nd ed. (1955).
(G. W. S. B.)

HENRY, JOSEPH (1797–1878), U.S. physicist and scientific administrator, was born in Albany, N.Y., on Dec. 17, 1797, of Scottish ancestry. He showed little early interest in study and at age 13 was apprenticed to a watchmaker.

When Henry was 16 a popular book on natural science stimulated him to enter Albany academy; teaching in country schools and tutoring paid his way. He continued his studies in chemistry, anatomy and physiology with a view to practising medicine. An unexpected appointment in 1825 to survey a route for a New York state road changed his goal to engineering, but in 1826 he reluctantly accepted an appointment to teach mathematics and natural philosophy in the Albany academy.

Working with electromagnets, Henry was the first to insulate wire for the magnetic coil, and he invented the spool winding. He discovered the law of proportion between electromotive force and coil resistance, and his powerful short-coil magnet (1829) is essentially the one used in modern generators and electric motors. The principles of efficient long-distance transmission of current with his long-coil intensity magnet serve as the basis of every electromagnetic telegraph since invented. Henry's working version of the telegraph (*q.v.*) preceded the invention of modern commercial instruments, and in 1829 he devised and constructed an early version of the electromagnetic motor.

After his transfer (1832) to the College of New Jersey (later Princeton university), he improved the design of relays by using a relatively feeble electromagnet, which in turn controlled the local circuit of a more powerful magnet. It was in this period that Henry first used the earth as a return conductor. Chiefly in recognition of his discovery (1832) of self-induction, the International Congress of Electricians in Chicago in 1893 gave his name to the standard unit of inductive resistance. His discovery of electromagnetic induction was made independently and at the same period by Michael Faraday, who published first.

At Princeton Henry taught physics and mathematics and lectured in chemistry, mineralogy and geology, later adding astronomy and architecture. Continuing his researches he discovered that a current of low potential could induce a current of high potential by a suitable arrangement of coils, and elucidated the laws upon which the transformer (*q.v.*) is constructed. He found, also, that currents could be induced at a distance, and in one case he magnetized a needle by the transmission from a lightning flash 8 mi. away. This appears to be the earliest record of the action of waves of the type employed in radio (*q.v.*). The discovery of the oscillatory character of the electrical discharge came in 1842. He showed, by means of a thermogalvanometer, that sun spots radiate less heat than the general solar surface, and invented a new method for determining the velocity of projectiles. In 1844 he presented a theoretical paper foreshadowing the principle of the conservation of energy.

In Dec. 1846 Henry became the first secretary of the Smithsonian institution and contributed to the development of many branches of science in the United States. He aided in enlisting and giving direction to the government's support of scientific activity. One of his first acts at the Smithsonian was to organize a corps of volunteer weather observers and for 30 years he helped support the corps' activities. The success of the Smithsonian meteorological work led to the creation of the U.S. weather bureau. While at the Smithsonian Henry inaugurated a service for the free publication and distribution of scientific studies.

In 1852 Henry became a member of the federal lighthouse board, serving as chairman from 1871 until his death. This prompted him to study sound, and led to a serviceable system of fog signals. His researches also greatly increased the efficiency of light beacons. He directed the mobilization of scientific effort during the American Civil War, was a prime mover in the organization of the National Academy of Sciences of which he was the second president, and took a leading part in the organization of the American Association for the Advancement of Science and of the Philosophical Society of Washington. He died in Washington, D.C., on May 13, 1878. (C. G. A.; X.)

HENRY, MATTHEW (1662–1714), English Nonconformist biblical scholar and author of many devotional works and sermons, was born on the confines of Flintshire and Shropshire on Oct. 8, 1662. He was the son of the clergyman Philip Henry, who had, two months earlier, been ejected from his living by the Act of Uniformity. From 1687 to 1712 Matthew Henry was minister to a Presbyterian congregation at Chester. He died suddenly on June 22, 1714, at Nantwich. Henry's well-known *Exposition of the Old and New Testaments* (1708–10), for which he is chiefly remembered, is a commentary of a practical and devotional rather than of a critical kind on the Old Testament and on the Gospels and Acts.

HENRY, O. (William Sidney Porter) (1862–1910), U.S. short-story writer, romanticized the commonplace and expressed the effect of coincidence on character through humour, grim or ironic; despite contrived plots and occasional clowning, his stories are significant social documents, artistically told. Born in Greensboro, N.C., Sept. 11, 1862, he was christened William Sidney Porter. (In 1898 he dropped the first name and changed his middle name to Sydney.) He attended a school taught by his aunt, then clerked in his uncle's drugstore. In 1882 he went from a gloomy home to Texas with friends. On a ranch managed by Lee Hall, famous Texas ranger, Porter absorbed the robust life of La Salle county, but served only as a sheepherder or mail carrier. Within two years he was in Austin, working in the general land office and later as teller in the First National bank. He began writing free-lance sketches at about the time of his marriage to Athol Estes in 1887, and in 1894 he started a humorous weekly, *The Rolling Stone*. When this venture failed, Porter joined the *Houston Post* as reporter, columnist and occasional cartoonist.

On Feb. 10, 1896, he was indicted for embezzlement of bank funds. Friends aided his flight to New Orleans, where he worked as a reporter and felt the spell of the old French quarter before reaching safety in Honduras. Soon news of his wife's fatal illness brought him back to Austin, but lenient authorities did not press the case until after her death. When convicted, Porter received the lightest sentence possible and was allowed to appeal his case. In April 1898 he entered the penitentiary at Columbus, O.; his sentence was shortened to three years and three months for good behaviour. As night druggist in the prison hospital he could write to earn money for support of his daughter Margaret. His stories of adventure in the southwest and Central America were immediately popular with magazine readers, and when he emerged from prison W. S. Porter had become O. Henry.

In 1902 O. Henry arrived in New York—his "Bagdad on the Subway"—to begin a career as brief as it was brilliant. From Dec. 1903 to Jan. 1906 he produced a story a week for the *New York World*, writing also for syndicated magazines. His first book, *Cabbages and Kings* (1904), depicted fantastic characters against exotic Honduran backgrounds. *The Four Million* (1906) revealed the lives of the multitude of New York in their daily routines and searchings for romance and adventure. *The Trimmed Lamp* (1907) also explored metropolitan life, and *Heart of the West* (1907) presented accurate and fascinating tales of the Texas range. Then in rapid succession came *The Voice of the City* (1908), *The Gentle Grafter* (1908), *Roads of Destiny* (1909), *Options* (1909), *Strictly Business* (1910) and *Whirligigs* (1910).

Despite his popularity, O. Henry's final years were marred by ill-health, a desperate financial struggle and addiction to alcohol. A second marriage in 1907 was unhappy. After his death on June 5, 1910, three more collected volumes appeared: *Sixes and Sevens* (1911), *Rolling Stones* (1912) and *Waifs and Strays* (1917). Later seven fugitive stories and poems, *O. Henryana* (1920), *Letters to Lithopolis* (1922) and two collections of his early work on the *Houston Post*, *Postscripts* (1923) and *O. Henry Encore* (1939), were published. Foreign translations and adaptations for other art forms attest his universal application and appeal. (E. H. Lg.)

O. Henry's varied life is reflected in his stories. The genial magic of his fine imagination, humour and brilliant narrative skill triumph over the occasional journalism of his method, and he remains endlessly and enchantingly rereadable. His New York stories are the most famous, but it is probable that some of the southern and western tales, in which there is less strain for glittering effect, are of more lasting value. The tragedy of his own life taught him a chivalrous tenderness for the unlucky. Some of the greatest native endowments a writer can have were undeniably his; of him, as much as of any modern writer, it can be said that he had "no talent, only genius." (C. M.)

Bibliography.—*The Complete Works of O. Henry*, 2 vol., introduction by Harry Hansen (1953). *See* C. Alphonso Smith, *O. Henry Biography* (1916); R. H. Davis and A. B. Maurice, *The Caliph of Bagdad* (1931); E. Hudson Long, *O. Henry* (1949); and Gerald Langford, *Alias O. Henry* (1957). (E. H. Lg.)

HENRY, PATRICK (1736–1799), American orator and statesman, was born at Studley, Hanover county, Va., on May 29, 1736. He was the son of John Henry, a well-educated Scotsman who served in Virginia as a surveyor, colonel and justice of the Hanover county court. His mother was a sturdy and devout woman of the Winston family, presumably from the English West Country. From the Winstons young Patrick derived some of his oratorical talent, and he found further inspiration in two eloquent preachers who came to Hanover county, Samuel Davies and George Whitefield.

Before he was ten, Patrick received some rudimentary education in a local school, later reinforced by tutoring from his classically trained father. As a youth, he failed twice in seven years as a storekeeper and once as a farmer, meantime increasing his re-

sponsibilities by marriage in 1754 to Sarah Shelton. The demands of a growing family spurred him to try law and in this profession he soon displayed remarkable ability. Within a few years after his admission to the bar in 1760 he had a large and profitable clientele; within about a decade he was confining his practice chiefly to the general court of the colony. He was especially successful in criminal cases where he made good use of his quick wit, his knowledge of human nature and his forensic gifts.

Meantime, his oratorical genius had been revealed in the trial known as the Parson's Cause (1763). This suit grew out of the Virginia law, disallowed by the king, that permitted payment of the Anglican clergy in money instead of tobacco when the tobacco crop was poor. Henry astonished the audience with his eloquence in invoking the doctrine of natural rights. Two years later, at the old capitol in Williamsburg, where he had just been seated as a member of the house of burgesses, he delivered a speech in opposition to the British Stamp act. Henry offered a series of resolutions asserting the right of the colonies to legislate independently of parliament and he supported these resolutions with "torrents of sublime eloquence." "Caesar had his Brutus, Charles the First his Cromwell, and George III . . ." Here he was interrupted by cries of "Treason, treason" but concluded, according to a likely version, ". . . may profit by their example. If *this* be treason, make the most of it."

During the next decade Henry was an influential leader in the radical opposition to the British government. He was a member of the first Virginia committee of correspondence and a delegate to the continental congresses of 1774 and 1775. At the Virginia revolutionary convention on March 23, 1775, in St. John's church, Richmond, he delivered the speech which assured his position as one of the world's great orators and advocates of human liberty. Convinced that war was inevitable, he presented strong resolutions for arming the Virginia militia, and defended them in a fiery speech with the dramatic peroration, "I know not what course others may take, but as for me, give me liberty or give me death."

The resolutions passed and Henry was appointed commander of the Virginia forces, but he was so curbed by the committee of public safety that he resigned on Feb. 28, 1776. He served on the committee in the Virginia convention of 1776 that drafted the first constitution for the state, was elected governor the same year and was re-elected in 1777 and 1778 for one-year terms, thus serving continuously as long as the new constitution permitted. As wartime governor, he gave Gen. George Washington able support and authorized the expedition under George Rogers Clark (*q.v.*) into the Illinois country.

After the death of his first wife, Henry married Dorothea Dandridge and returned to plantation life. But he was recalled to public service as a leading member of the state legislature from 1780 to 1784 and again from 1787 to 1790. From 1784 to 1786 he served as governor. He declined to attend the Philadelphia constitutional convention of 1787, and in 1788 was the leading opponent of ratification at the Virginia convention. This action, which has aroused much controversy, resulted from his suspicion that the north would abandon to Spain the right of navigation of the Mississippi and, above all, from his fear for state and individual rights. He was reconciled, however, to the new federal government, especially after the passage of the Bill of Rights, for which he had been largely responsible. Because of family responsibilities and ill-health, he declined a series of high government posts. In 1799, however, he consented to run again for the state legislature, where he wished to oppose the Virginia and Kentucky resolutions that asserted a form of states' rights doctrine. During his successful electoral campaign he made his last speech, a moving plea for American unity. He did not take his seat, for he died on June 6 at Red Hill, his last plantation home, near Brookneal, Va.

BIBLIOGRAPHY.—R. D. Meade, *Patrick Henry: Patriot in the Making* (1957), comprising Henry's life to 1775; George Morgan, *The True Patrick Henry* (1907); William Wirt Henry, *Patrick Henry: Life, Correspondence and Speeches* (1891). Some of Henry's letters, not published by W. W. Henry, are found in *Official Letters of the Governors of the State of Virginia* (1926). (R. D. ME.)

HENRY, VICTOR (1850–1907), French philologist probably best known for his comparative Greek-Latin and English-German grammar books, was born at Colmar in Alsace on Aug. 17, 1850. Having held appointments at Douai and Lille, he was appointed professor of Sanskrit and comparative grammar in the University of Paris. Important works by him on India and Indian languages are: *Manuel pour étudier le Sanscrit védique* (with A. Bergaigne, 1890); *Eléments de Sanscrit classique* (1902); *Précis de grammaire Pâlie* (1904); *Les Littératures de l'Inde: Sanscrit, Pâli, Prâcrit* (1904); *La Magie dans l'Inde antique* (1904); *Le Parsisme* (1905); *L'Agnistoma* (1906). Obscure languages (such as Innok, Quichua, Greenland) and local dialects (*Lexique étymologique du Bréton moderne; Le Dialecte Alaman de Colmar*) also claimed his attention. *Le Langage Martien* is a curious book. It contains a discussion of some 40 phrases (amounting to about 300 words), which a certain Mademoiselle Hélène Smith (a well-known spiritualist medium of Geneva), while on a hypnotic visit to the planet Mars, learned and repeated and even wrote down during her trance as specimens of a language spoken there, explained to her by a disembodied interpreter.

HENRY, WILLIAM (1775–1836), English physician and chemist, author of "Henry's law" that the amount of gas absorbed by a liquid is proportional to the pressure of the gas upon the liquid, was the son of Thomas Henry (1734–1816), apothecary, translator of Lavoisier's *Opuscules* and writer on chemistry. William Henry was born at Manchester on Dec. 12, 1775, and was educated at Edinburgh (M.D., 1807). He devoted himself to industry and scientific studies. One of his best known papers (*Philosophical Transactions of the Royal Society*, 1803) describes experiments on the quantity of gases absorbed by water under different pressures, the conclusion he reached being that "water takes up of gas condensed by one, two or more additional atmospheres, a quantity which, ordinarily compressed, would be equal to twice, thrice, etc., the volume absorbed under the common pressure of the atmosphere." His *Elements of Experimental Chemistry* went through 11 editions. In a fit of melancholia, he committed suicide at Pendlebury, Sept. 2, 1836. (R. E. O.)

HENRYSON, ROBERT (fl. 1475), one of the foremost of the Scottish Chaucerians. He is described on some early title pages as schoolmaster of Dunfermline—probably at the Benedictine abbey school—and he appears among the *morts* in William Dunbar's *Timor mortis conturbat me*, which was printed about 1508. Otherwise, the only detail known of his life is a circumstantial account of his deathbed wit in Sir Francis Kynaston's manuscript translation of Chaucer's *Troilus* into Latin (1635).

Henryson's longest work is *The Morall Fabillis of Esope the Phrygian, Compylit in Eloquent & Ornate Scottis*, a version of 13 fables based mainly on John Lydgate and William Caxton and running to over 400 seven-lined stanzas. The collection, made "be requeist and precept of ane Lord," has a prologue; and each tale is adorned with a *moralitas*. Some of the tales may have been written with some oblique political intention but their virtue lies in the freshness of the narrative, the sly humour and sympathy of Henryson's animal characterization and in his miniatures of the Scottish countryside. Not all the fables are written, as he modestly says, in "hamelie language and in termes rude," for he rises easily into an aureate style for comic effect or instruction; but his fundamental style is excellently colloquial.

In *The Testament of Cresseid*, a narrative and "complaint" in 86 stanzas, Henryson completes the story of Chaucer's Criseyde. He describes how he settled down on a winter night with *Troilus and Criseyde* and, questioning "gif all that Chauceir wrait was trew," turned to another version of the tale. From this he describes Criseyde's rejection by Diomede, her decline into prostitution, her rebuke to the gods, her punishment in leprosy and her death. The "uthir quair" is usually explained as a conventional fiction; but it may have been *The Spectakle of Luf*, a Latin work containing a hint of Criseyde's fate among a series of *exempla*, which was translated at St. Andrews in 1492 (*see* J. Kinsley in the *Times Literary Supplement*, Nov. 14, 1952). The *Testament* is more than a splendid piece of rhetorical craftsmanship; blended with Henryson's unwavering concern for justice are an aesthetic attraction to the repulsive and grotesque, and a refined sense of the "variance" of human love.

Among the shorter poems ascribed to Henryson are the lovely *Orpheus and Eurydice*, based on Boethius and akin to the *Testament* in mood and style; the "pastourelle" *Robene and Makyne*, in which a traditional French *genre* assimilates the speech and humour of the Scottish peasantry; and a number of fine moral narratives and meditations. Henryson is a slighter and less volatile figure than Dunbar; but in a narrower range he is as exquisite an artist.

BIBLIOGRAPHY.—*Manuscripts: The Morall Fabillis* is contained in four manuscripts: (1) the Asloan ms. (early 16th century), now in the possession of the Talbot de Malahide family in Dublin (ed. by W. A. Craigie for the Scottish Text society, 2 vol., 1923–5); (2) the Bannatyne ms. (1568), in the National Library of Scotland (ed. by W. T. Ritchie for the Scottish Text society, 4 vol., 1928–34); (3) British museum Harleian ms. 3865 (1571; the most complete ms. version); and (4) the Makculloch ms., in the Edinburgh university library (one fable only). Early printed editions are dated 1570 (published by H. Charteris, Edinburgh, and surviving in a unique copy), 1571 (published by Bassandyne, Edinburgh, and surviving in a unique copy) and 1577 (London). There are no early manuscripts of *The Testament of Cresseid*. The earliest printed text is included in W. Thynne's *Chaucer* (1532). Later surviving editions are dated 1593 and 1663; at least two other 17th-century editions are lost. *Orpheus and Eurydice* was printed at Edinburgh by W. Chepman and A. Myllar *c.* 1508, and survives in a unique but incomplete copy. It is also included in the Asloan and Bannatyne mss. The shorter poems are preserved in the Bannatyne and other early mss.

Editions: The standard collected edition is by G. Gregory Smith, for the Scottish Text society, 3 vol. (1906–14). There is a useful students' edition by H. Harvey Wood, 2nd ed. (1958).

See also M. W. Stearns, *Robert Henryson* (1949), a full but uneven discussion of the poems and their background; E. M. W. Tillyard, in *Five Poems, 1470–1870* (1948); A. K. Moore, "Robene and Makyne," in *Modern Language Review*, vol. xliii (1948); E. Muir in *Essays on Literature and Society* (1949); J. Kinsley in *Scottish Poetry: a Critical Survey* (1955); C. Elliott, on the *Testament*, in *The Journal of English and Germanic Philology*, vol. liv (1955). (J. KY.)

HENSCHEL, SIR (ISIDOR) GEORGE (1850–1934), English singer, conductor and composer of Polish origin, was born at Breslau on Feb. 18, 1850. He made his first public appearance as a pianist in Berlin in 1862. Subsequently he took up singing, having developed a fine baritone voice. He studied in Leipzig and Berlin and later became friendly with Brahms. He went to England in 1877. In 1881 he married the U.S. soprano Lillian Bailey (1860–1901), with whom he gave many recitals in Britain and the U.S. From 1881 to 1884 he was the first conductor of the Boston Symphony orchestra. Returning to England he organized and conducted choral and orchestral concerts in London.

Henschel was naturalized in 1890 and from 1893 to 1895 he conducted the Scottish orchestra in Glasgow. In 1907 he married Amy Louis, also a singer. He was knighted in 1914 and continued singing and teaching until he was over 80. Among his compositions are two operas; choral works including a *Stabat Mater* and a Requiem Mass; and songs. He died at Aviemore, Inverness, on Sept. 10, 1934.

See George Henschel, *Musings and Memories of a Musician* (1918); Helen Henschel, *When Soft Voices Die*, 2nd ed. (1949). (H. RU.)

HENSELT, ADOLF VON (1814–1889), German pianist, a follower of Liszt, was born at Schwabach, Bavaria, May 12, 1814. He studied the piano under J. N. Hummel at Weimar and composition under Simon Sechter in Vienna. He toured Germany as a pianist in 1836, and in 1838 settled in St. Petersburg, where he acquired a great position as teacher and performer and received a title. His manner of playing was similar to that of Liszt, except that, whereas Liszt relied on the pedals for maintaining sonority, Henselt developed an exceptionally large stretch of the hand, which enabled him to hold down widely spaced notes. His method is illustrated in his *Études*, his *Exercices préparatoires* and his edition of the studies of J. B. Cramer for which he provided a second piano part. He also edited the piano works of Weber and made piano transcriptions of his overtures. His compositions include a piano concerto (op. 16), some smaller piano pieces, a duo for piano and horn, a piano trio and two sets of choral pieces, *Maienzeit* and *Morgenständchen*. He died at Warmbrunn, Silesia, Oct. 10, 1889.

See W. von Lenz, *Die grossen Pianoforte-Virtuosen unserer Zeit* (1872).

HENSLOW, JOHN STEVENS (1796–1861), English clergyman, botanist and geologist who popularized botany at the University of Cambridge and largely inspired Charles Darwin's taste for natural history, was born at Rochester, Kent, on Feb. 6, 1796. He graduated in mathematics at St. John's college, Cambridge, in 1818 and then turned to natural history, making geological expeditions to the Isle of Wight and the Isle of Man with Adam Sedgwick. Henslow and Sedgwick founded the Cambridge Philosophical society in 1821. In 1822 Henslow became professor of mineralogy at Cambridge, and was ordained in 1824. In 1827 he was made professor of botany, and enlivened its teaching, especially through excursions. He obtained for Darwin, his pupil and friend, the position of naturalist to H.M.S. "Beagle" (1831–36), and, in Darwin's own words, "took charge of the collections I sent home, and by his correspondence directed my endeavours." In 1837 Henslow was made rector of Hitcham, Suffolk, living there from 1839. Despite opposition, he fostered among his parishioners an interest in the economic and practical aspects of botany, greatly to the improvement of local farming practice. He formed many collections, and helped Sir W. J. Hooker with the botanical museums at Kew. His publications include *A Catalogue of British Plants* (1829; 2nd ed., 1835); *Principles of Descriptive and Physiological Botany* (1835). He contributed to E. Skepper's *Flora of Suffolk* (1860).

Henslow died at Hitcham on May 16, 1861.

HENSLOWE, PHILIP (d. 1616), English theatre proprietor and manager, the most important of the Elizabethan age, was born in Lindfield, Sussex, and apparently settled in Southwark, London, before 1577. He married the widow of Viscount Montague's bailiff, in whose service he had been, and with her money became an owner of much Southwark property, including inns and lodging houses. At various times he had interests in dyeing, starch-making and wood selling, as well as pawnbroking, moneylending and theatrical enterprises. He was a churchwarden and held some minor court offices, becoming a Groom of the Chamber. In 1587 Henslowe and a partner built the Rose playhouse on the Bankside near Southwark bridge, and under Henslowe's financial management various companies acted there from 1592 to 1603. He had an interest in the suburban Newington Butts theatre in 1594 and later in the Swan playhouse in Paris garden, at the western end of the Bankside. With the actor Edward Alleyn, who had married Henslowe's stepdaughter, he presented bearbaiting and bullbaiting in an old arena near the Swan. In 1610 Henslowe built a new theatre, the Hope, designed for plays as well as bearbaiting, on this site. The most sumptuous of Henslowe's theatres was the Fortune, built just north of London for the Admiral's Men in 1600.

Henslowe's theatres saw the first production of many important Elizabethan dramas; he was associated in one way or another with most of the famous playwrights for a quarter of a century, and his Admiral's Men were the chief rivals of Shakespeare's company. Henslowe was a shrewd, crotchety man of business who kept a tight hand on his theatrical companies, his players and his playwrights. "Should these fellowes come out of my debt I should have no rule over them." In the year before his death his players brought an indictment of "oppression" against him. The famous "Henslowe's diary" is really a manuscript book of miscellaneous accounts and memoranda, playhouse receipts, payments to playwrights, loans or advances to players, payments for materials, costumes, etc. It is one of the most important sources for the theatrical history of the time. For example, fully two-thirds of the plays mentioned in the diary are now otherwise lost. This book and other important theatrical papers were left by Edward Alleyn as part of his benefaction to Dulwich college. J. P. Collier edited the diary for the Shakespeare society in 1845, but unfortunately inserted a number of forged interpolations.

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HENSON, HERBERT HENSLEY (1863–1947), English bishop who won general acclaim after being initially suspected as a theological modernist, was born in London on Nov. 8, 1863.

Elected a fellow of All Souls college, Oxford, at the age of 21, he became dean of Durham in 1912. When he was nominated bishop of Hereford in 1918 some bishops refused to take part in his consecration. This caused the iron to enter into his soul, for he was personally very sensitive, though apparently often indifferent to the sensitiveness of others. After two years at Hereford he became bishop of Durham (1920–39). His opinions, expressed in flowery yet incisive and devastating English, assured him wide attention. His works include *Retrospect of an Unimportant Life* (3 vol., 1942–50), which reveals both his self-concern and his excellence in the discharge of his duties. He died at Hintlesham, Suffolk, on Sept. 27, 1947. (J. S. Be.)

HENTY, GEORGE ALFRED (1832–1902), English writer of adventure stories for boys, was born at Trumpington, near Cambridge, on Dec. 8, 1832. Educated at Westminster school, he went up to Gonville and Caius college, Cambridge, but left without a degree to volunteer for service in the hospital commissariat in the Crimea. While there he became correspondent to the *Morning Advertiser*, and in 1865 was appointed special correspondent to the *Standard*, for which he reported the Austro-Italian War (1866), accompanying Garibaldi in the Tirolese campaign; Lord Napier's expedition to Magdala (1867–68); the Franco-German War; the Khiva expedition (1873); and the one to Ashanti (1873–74); the Carlist insurrection (1874); and the Turko-Serbian War (1876). Meanwhile he had begun to write books of adventure for boys, often using his own experiences as a background, or basing them on historical events. *Out on the Pampas* (1868) began a series of about 80 stories, the most famous being *Under Drake's Flag* (1883), *With Clive in India* (1884), *The Cat of Bubastes* (1889), *Redskin and Cowboy* (1892), *On the Irrawaddy* (1897) and *With Roberts to Pretoria* (1902). The last, *With the Allies to Pekin* (1904), was published posthumously. Henty was a great exponent of "manliness" in boys' books, but he overworked a not very bountiful imagination, and soon developed a formula, repeated wearily in most of his stories. He died on his yacht in Weymouth harbour, on Nov. 16, 1902.

See George Manville Fenn, *George Alfred Henty, the Story of an Active Life* (1907); L. Coffin, "George Alfred Henty, a Bibliographical Study," *Bulletin of Bibliography*, xix (1949). (R. L. Gr.)

HENZADA, a town and district of the Union of Burma, in the Irrawaddy division. Area 2,807 sq.mi. Pop. (1962 est.) 896,836. The district lies to the west of the Irrawaddy river and stretches to the crest of the Arakan Yomas, which form the boundary between Henzada and the Sandoway district of Arakan. The district thus comprises a tract of hilly, forested country on the west and a portion of the plain of the Irrawaddy on the east. The town of Henzada itself is usually regarded as lying at the southern end of the Irrawaddy valley proper and at the head of the delta. The low-lying eastern portions of the district are protected from inundation by immense embankments, so that the greater part is suitable for rice cultivation though there are some extensive freshwater swamps. Tobacco is also an important crop. The chief town of the district is Henzada, which had in 1953 a population of 61,972. Smaller towns in the district are Myan-aung and Kyangin. The river towns are served by the steamers of the Inland Water Transport commission and a branch of the Burma railways runs from Kyangin to Henzada and from Henzada to Bassein. On the opposite side of the river a branch line connects with the Prome-Rangoon line. (L. D. S.)

HEPATICA, the generic and common name for anemonelike plants, of the buttercup family (Ranunculaceae), called also liverleaf and noble liverwort. They are found in open woodlands of the north temperate zone. The common hepatica of North America, *H. americana*, is native from Nova Scotia to Manitoba and south to Florida and Missouri. It is a low, almost stemless perennial, about 3 in. high, often growing in tufts, with thick, evergreen, three-lobed basal leaves on very hairy stalks, and delicate blue, purple or white flowers, about ⅞ in. broad, composed of 6 to 12 sepals, and borne singly on hairy stalks. Immediately beneath the flower are three leaflets (involucre) simulating a calyx. The very similar sharp-lobed hepatica (*H. acutiloba*), with pointed instead of rounded leaf lobes, found from Quebec to Minnesota and south in the Alleghenies to Georgia and in the interior to Missouri, is rare or absent near the Atlantic coast. The hepaticas are among the earliest and best-known woodland wild flowers of eastern North America, the two species occurring together in many localities. The leaves that last over winter are deep olive green or bronzy above and reddish-purple or liver-coloured beneath. *H. nobilis*, widely distributed in Asia and Europe, and often cultivated, is not found native in the British Isles.

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A EUROPEAN HEPATICA (H. NOBILIS)

HEPATITIS: *see* Gall Bladder, Biliary Tract and Liver, Diseases of: *Liver*.

HEPATITIS, CANINE VIRAL, is an acute viral infection common in young dogs, affecting the liver and inner lining of blood vessels. It is usually characterized by fever, lack of appetite, vomiting, intense thirst, abdominal tenderness and hemorrhages. This disease has long been confused with canine distemper, next to which it is the most important disease of dogs in the United States. It also infects foxes, timber wolves, coyotes and bears.

In 1930 Richard Green of the United States published information indicating that the cause of infectious canine hepatitis in foxes was a virus. The disease as produced experimentally in dogs was first described by Green in 1934. In 1947 Sven Rubarth of Sweden published a comprehensive paper on the disease as it occurred both naturally and experimentally. Rubarth suggested that the virus producing infectious canine hepatitis was the same as Green's virus, and his theory was tested further by William Carlson and Harold Siedentopf, who confirmed it.

Symptoms and Treatment.—This disease is usually seen in young dogs, but occurs in older dogs also. Puppies seem most susceptible, and in this group the mortality rate is highest. The infection may occur at any time during the year. The severity of the illness varies from an unnoticeable disease to a fatal infection. Usually, a susceptible dog becomes ill six to nine days after exposure to a dog discharging the virus. The first sign of infectious hepatitis is an elevation of the dog's temperature, the fever lasting from one to six days. A fever of short duration is sometimes the only sign of canine infectious hepatitis, but if the fever persists for more than two days, other symptoms become apparent.

In addition to the general signs of distress, the primary indication of infectious hepatitis is an attitude of apathy, followed by a partial or complete loss of appetite, combined with intense thirst. A watery exudate is occasionally discharged from the eyes. Fiery redness of the mouth lining is considered an important sign. Complications, such as tonsillitis, are sometimes noticed, but the degree of severity varies. Abdominal tenderness is frequently observed, and pain is evidenced by pressure on the abdomen in the region of the liver and gall bladder. Vomiting is occasionally seen. Swellings, causing disfigurement, are sometimes found in the region around the neck, head and trunk. Skin hemorrhages may result from a bodily injury, and these bleed profusely from the site of the wound; control of hemorrhage is difficult because of the prolonged blood clotting time. Sometimes jaundice is reported. Nervous disorders in dogs have been observed in a few natural cases but never in experimentally infected dogs.

Approximately 25% of the dogs that recover from infectious hepatitis develop temporary bluish-white discolorations of one or both corneas. These may develop between seven and ten days after disappearance of acute illness.

Treatment of symptoms by a veterinarian is desirable to prevent the complications that may occur as a result of secondary bacterial infection. Careful nursing also is needed. Unfortunately there is no therapeutic substance that affects the disease course resulting from direct virus action, once symptoms are observed.

Lesions.—In fatal cases the primary destruction occurs in the

blood vessels and in the liver cells. Multiple hemorrhages and excessive fluid in tissues and body cavities occur as a result of blood vessel damage. The liver is slightly enlarged and is usually tan-coloured with darker mottled streaks. A characteristic change is the thickened gall bladder wall. A definite diagnostic aid is the presence of intranuclear inclusion bodies in liver cells and the cells of the inner lining of blood vessels.

Transmission and Immunization.—In 1951 George Poppensiek and James Baker reported a finding that explains the transmission and survival of the canine infectious hepatitis virus. It persists for months in the urine of most dogs that recover from the infection and serves therefore as a constant source of infection to susceptible dogs. Thus prevention becomes the most important aspect in protecting the dog population from this highly contagious infection, and vaccination is the practical solution.

Various vaccines are available to immunize dogs against canine hepatitis. One, an inactivated virus vaccine, is extremely safe since the virus is treated chemically to inhibit its disease-producing properties. However, protection by this method is of limited duration. By contrast, a live virus vaccine produces a dependable immunity of longer duration. The live virus vaccine is desirable since it elicits no unfavourable reaction in the dog, having been modified through transfer in tissue-cultured dog kidney cells and then in tissue-cultured pig kidney cells.

In 1952 James Gillespie, James Robinson and Baker found that dogs could be infected simultaneously with canine infectious hepatitis and another important disease of dogs, canine distemper. After recovery the dogs were immune to both diseases. Later in the same year Poppensiek and Baker proved that immunity against both diseases can be produced in dogs by the administration of distemper virus modified by culture in hen's eggs in combination with canine hepatitis virus derived from infected dogs. When given simultaneously with antiserum, no clinical signs of illness resulted from the vaccination procedure. By use of canine hepatitis virus modified by tissue culture transfer, serum is no longer necessary to immunize dogs against canine distemper and infectious canine hepatitis. The dual vaccine has proved to be a safe and effective method for immunization of dogs.

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HEPHAESTION, a Macedonian general, celebrated as the friend of Alexander the Great. In the later campaigns in Bactria and India he superintended the founding of cities and built the fleet intended to sail down the Indus. He became virtually Alexander's second-in-command and married Drypetis, the sister of Alexander's wife Barsine (324 B.C.). In the same year he died suddenly at Ecbatana and was buried with great pomp at Babylon. Mourning was ordered throughout Asia and he was honoured as a hero. *See* ALEXANDER III the Great.

HEPHAESTION (? 2nd century A.D.), Greek metrist of Alexandria, author of a work on metre in 48 books which was reduced to form a manual (Gr. *enchiridion*) by successive abridgments. The manual became a popular schoolbook and it alone survives. It is the only complete ancient work on metrics extant (*see* PROSODY, CLASSICAL). Appendixes dealing with poetic structure and with metrical notations may not be by Hephaestion. Important scholia have independent value.

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HEPHAESTUS (Greek HEPHAISTOS), the god of fire. He was originally a deity of Asia Minor and the adjoining islands, as his un-Hellenic name and the distribution of his cult testify. One home of his worship seems to have been the Lycian Olympus, where natural gas (still escaping from the soil) provided both his image and his sanctuary. Another important site was at Moschylos on the island of Lemnos, where the similar escapes of burning gas have ceased. As god of fire, Hephaestus became the divine smith and patron of craftsmen; and the natural volcanic or gaseous fires already connected with him were often considered to be his workshops. His cult reached Athens not later than about 600 B.C. and, at an early date, the volcanic Lipari islands off Sicily, whence it spread to Sicily and to Campania. Crete it never reached, and it scarcely touched Greece proper, except Attica.

In classical times Hephaestus was said to be the son of Zeus and Hera, who at first cast him out from heaven and later readmitted him. According to one account, Zeus threw him down to earth for taking his mother's part during one of the many quarrels between his parents, so that he fell on the island of Lemnos and was lamed. Another version says that he was born lame, thrown into the ocean by Hera in disgust, and rescued by the seagoddesses Eurynome and Thetis, with whom he dwelt for nine years. During this time he fashioned many wondrous things, including a golden chair with invisible chains, which he sent to Hera in revenge. When she sat in it she was held fast, and Dionysus the wine-god had to go and make Hephaestus drunk in order that he might be brought back to Olympus to free her. His return to Olympus is a favourite theme in early art. He was married, according to the *Iliad,* to Charis (Grace); when the Graces were held to be three in number, he was husband of Aglaia (brightness). In the *Odyssey* and in later literature his wife was Aphrodite. These relationships were largely allegorical.

The skill of Hephaestus in metallurgy is often mentioned in Homer; it has been suggested that at an early stage of society the trade of a smith would be suitable for lame persons. His forge was on Mt. Olympus, where he was served by golden images of handmaidens that he had animated. In epic poetry he is rather a comic figure, and his halting gait provokes "Homeric laughter" among the gods.

Hephaestus was important at Athens, with its large industrial population, and found a place in the local myths. His temple there has been identified beyond doubt with the previously so-called Theseum. It contained statues of him and of Athena together; the two deities are often associated, in both literature and cult, as the joint givers of civilization to the Athenians. Artisans were under their special protection, and the festival they shared, the Chalkeia, commemorated the invention of bronzeworking by Hephaestus. The Hephaisteia, his own especial festival, included a torch race. In origin this was probably connected both with him and with the Titan Prometheus (*q.v.*), usually represented as his opponent; for Prometheus, among other exploits, stole fire for the use of man—according to some accounts from Hephaestus' very workshop. The race may have been intended either to purify and quicken the land or to renew polluted fire. But it did not imply equality between Hephaestus and Prometheus—despite the latter's origination of civilization by the gift of fire, Hephaestus' cult was much the more important.

In archaic art Hephaestus is generally represented as a middle-aged, bearded man, although occasionally a younger, beardless type is found, as on a vase (in the British museum) that depicts him as a young man assisting Athena in the creation of Prometheus' troublemaking sister-in-law Pandora. Subsequently the bearded type prevails. The god usually wears a short, sleeveless tunic and a round, close-fitting cap on his unkempt hair. He is, in fact, represented as an idealized Greek craftsman, with hammer and sometimes pincers. No attempt was made, as a rule, to indicate his lameness; but Alcamenes is said to have suggested it without spoiling his statue. His Roman counterpart was Vulcan (*q.v.*).

See L. R. Farnell, *The Cults of the Greek States,* vol. v (1909).

HEPHTHALITES (EPHTHALITES). This many-named and enigmatic tribe was of considerable importance in the history of India and Persia in the 5th and 6th centuries and was known to the Byzantine writers, who call them Ephthalitoi, Euthalitoi, Nephthalitoi or Abdeloi. The last of these resembles the name Haital used by Arab chroniclers. They were also called Leukoi, Hounnoi or Chounoi, White (that is, fair-skinned) Huns. The earliest information about the Hephthalites comes from the Chinese chronicles, in which it is stated that they were originally a tribe of the great Yue-Chi (*q.v.*), living to the north of the Great

Wall and in subjection to the Jwen-Jwen, as were also the Turks at one time. Their original name was Hoa or Hoa-tun.

Before the 5th century A.D. they began to move westward, for about 420 they were in Transoxiana and for the next 130 years they were a menace to Persia, which they continually and successfully invaded, though they never held it as a conquest. The Sassanid king Bahram V fought several campaigns with them and succeeded in keeping them at bay, but they defeated and killed Firuz, A.D. 484. The Persians were not quit of the Hephthalites until 557, when Khosrau I Anushirvan destroyed their power with the assistance of the Turks.

The Huns who invaded India appear to have belonged to the same stock as those who molested Persia. The headquarters of the horde were at Bamian and at Balkh, and from these points they raided to the southeast and southwest. Skandagupta repelled an invasion in 455, but the defeat of the Persians in 484 probably stimulated their activity, and at the end of the 5th century their chief Toramana penetrated to Malwa in central India and succeeded in holding it for some time. His son Mihiragula (*c.* 510–540) made Sakala in the Punjab his Indian capital, but the cruelty of his rule provoked the Indian princes to form a confederation and revolt against him *c.* 528. He took refuge in Kashmir, where he seized the throne. Soon after his death (*c.* 540), the Hephthalites collapsed under the attacks of the Turks. They were probably absorbed in the surrounding populations.

Another theory concerning the racial origin of the Hephthalites is that they were one branch of the Chionites (also known as Hunas or White Huns). This branch is said to have settled in Bactria (*q.v.*) whence they invaded Persia, while a second branch, the Zavula, moved south and settled round Kabul and Ghazni. It was the Zavula, according to this theory, who invaded India.

The accounts of the Hephthalites, especially those of the Indian Hunas, dwell on their ferocity and cruelty. Their invasions shook Indian society and institutions to the foundations but, unlike the earlier Kushans, the Hephthalites do not seem to have introduced new ideas into India nor to have acted as other than a destructive force. Many of Mihiragula's coins bear the Nandi bull (Shiva's emblem); and the king's name is preceded by the title *sahi* (shah), which had previously been used by the Kushan dynasty. Toramana's coins are found plentifully in Kashmir, which probably formed part of the Huna dominions before Mihiragula's time.

Greek writers give a more flattering account of the Hephthalites; Procopius says they were far more civilized than the Huns of Attila. The Chinese writers say their customs were like those of the Turks: that they had no cities, lived in felt tents, were ignorant of writing and practised polyandry. Nothing whatever is known of their language.

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HEPPLEWHITE, GEORGE (d. 1786), English cabinet-maker and furniture designer whose name is famous for a graceful style rather than for the work of his own hand. Little is known of his life except that he was apprenticed to Robert Gillow of Lancaster, went to London and opened a shop in Redcross street, St. Giles, Cripplegate. He died in 1786, and administration of his estate was granted to his widow, Alice, who carried on the business. The *Cabinet-Maker and Upholsterer's Guide* was published in 1788, with nearly 300 designs "from drawings by A. Hepplewhite and Co. Cabinet-makers." A second edition, almost unchanged, appeared in 1789, and a third edition was published in 1794, the section on chairs being brought up to date, notably by the inclusion of chairs with square backs. The plates in the *Guide* are unsigned, but ten designs signed "Hepplewhite" or "Heppelwhite" are included in the *Cabinet-Makers' London Book of Prices* (1788).

Pieces of furniture based on designs in the *Guide* are rare, and no piece can be definitely attributed to Hepplewhite's firm. Nor can Hepplewhite's personal responsibility for the designs in the *Guide* be established. In a note on a chair design incorporating the three feathers, it is claimed that it "has been executed with good effect for the prince of Wales," but the firm is not mentioned in the royal accounts, nor is there any other evidence to show that Hepplewhite's was a fashionable firm. The achievement of the *Guide* was to translate into simple yet elegant terms the more extravagant furniture of the neoclassical style as seen in the designs of Robert Adam. This purpose is expressed in the preface, "to unite elegance and utility, and blend the useful with the agreeable." That the designs are not an original creation but rather the expression of the best in current taste is again confirmed in the preface, "we designedly followed the latest or most prevailing fashion only, purposely omitting such articles, whose recommendation was mere novelty, and perhaps a violation of all established rule."

Simplicity, elegance and utility are characteristic of all the designs in the *Guide*. Many of them were intended to be made in inlaid satinwood, others in mahogany or with japanned decoration. Chairs, with straight tapered legs, have shield-, heart- and oval-shaped backs, incorporating urns, festoons, cornhusk chains and other typical motifs of the neoclassical style. Upholstered settees of serpentine form, window seats with scrolled arms, small square- and circular-topped inlaid tables and bookcases with delicate tracery in the glazed doors are all characteristic of the graceful style to which Hepplewhite has given his name.

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HEPTARCHY, a word used by historians to designate the period between the setting up of Anglo-Saxon kingdoms in England toward the end of the 5th century and the destruction of most of them by the Danes in the second half of the 9th century. It is derived from the Greek words for "seven" and "rule" and appears first to have been used by William Lambarde in 1576. The seven kingdoms were Northumbria, Mercia, East Anglia, Essex, Kent, Sussex and Wessex. The term is inaccurate, however, for in some periods Northumbria consisted of the two kingdoms of Deira and Bernicia, and Lindsey also had a royal line, while Sussex ceased to be a separate kingdom in the late 8th century. (D. WK.)

HERA, in Greek mythology a daughter of the Titans Cronus and Rhea, sister-wife of Zeus and queen of the Olympian gods. The Romans identified her with their Juno (*q.v.*). The derivation of Hera's name is obscure, but it probably means simply "lady"; it is likely that she was a pre-Hellenic deity. Hera plays an important part in literature from the time of Homer and Hesiod, appearing most frequently as the jealous and rancorous wife of Zeus and pursuing with vindictive hatred the heroines, such as Alcmene, Leto and Semele, who were beloved by Zeus, as also their children. In cult, however, her dignity and power are naturally more emphasized.

Hera was worshiped throughout the Greek world, and especially in the ancient centres of Argos, Mycenae and Sparta, which she claims in the *Iliad* as her three dearest cities—although her Spartan cult subsequently somewhat declined. She was particularly honoured on the island of Samos, off the coast of Asia Minor, and worshiped also extensively in Magna Graecia, as witness her temple at Crotona on the south Italian coast.

FOTO MARBURG

HEAD OF HERA FROM THE VOTIVE GROUP IN THE HERAION AT OLYMPIA

Hera was held to be the sole lawful wife of Zeus from an early time; she soon supersedes Dione, who shares with him his ancient oracle shrine at Dodona in Epirus. He and Hera therefore often share altars and sacrifices, and also a dramatic representation of their sacred marriage.

There existed a story to the effect that Hera had left Zeus in

anger; that Zeus, to win her back through jealousy, announced that he was about to marry and dressed up a puppet to imitate a bride; and that Hera, meeting the wedding procession and tearing off the "bride's" veil, discovered the ruse and was reconciled to her husband. Every sixth year this mime was performed with numerous images, which were then burned on the top of Mt. Cithaeron together with animals and the sacrificial altar. The rite thus appears to be a charm designed to quicken the growth of vegetation; the marriage of Zeus and Hera would, in this case, represent the union of the king and queen of May. Legends also often mention how the pair had anticipated marriage.

But Hera and Zeus need not for all that have had anything originally to do with the earth or with vegetation. The ceremony of the solemn concealment and discovery of Hera's image on the seashore at Samos suggests a marriage neither of heaven and earth nor of two vegetation spirits but rather a reflection of certain local marriage customs. It is to be noted that Hera had little to do with agriculture except at Argos, and that she was not closely associated with earth and vegetation deities.

In general Hera was worshiped in two main capacities: as consort of Zeus and queen of heaven; and as goddess of marriage and of the life of women. This latter sphere naturally made her the protectress of women in childbed, and she bore the title of Eileithyia (*q.v.*), the birth-goddess, at Argos and Athens. In Homer and Hesiod she is the mother of Eileithyia. Her cult titles of "maiden," "wife," "widow" or "divorced" express her worshipers' different conditions of life.

At Argos and Samos, however, Hera was more even than queen of heaven and marriage-goddess. She was patron of those cities, which gave her a position corresponding to that of Athena at Athens. Her Argive ritual was markedly agricultural; the first plow oxen were hers as "lady of the yoke," and the sprouting ears of corn were "the flowers of Hera." Girls called "flower-bearers" served in her temple, and a spring flower festival was celebrated by Peloponnesian women. She also had a celebration called the Shield, and there was an armed procession in her honour at Samos. All this resulted from the breadth of functions attributed to the patron deity of a Greek state; a city-goddess must be chief in peace and war alike, and her interests reflect those of her people.

The animal especially sacred to Hera was the cow. The Homeric epithet *boopis* may have meant "cow-faced" to her earliest worshipers—the heifer-goddess Io (*q.v.*) was her first Argive priestess—although it was later understood as "large-eyed" (like a cow). Oxen drew her car in processions, and cows were sacrificed to her. Her sacred bird was first the cuckoo, later the peacock.

Hera's first primitive cult images consisted of a log, a plank or a pillar. Later came statues, of which the most celebrated was the work of gold and ivory made by the elder Polyclitus for the Heraeum at Argos soon after 423 B.C. He seems to have fixed her type as the majestic, rather severe but youthful matron. *See* also references under "Hera" in the Index volume.

See M. P. Nilsson, *Geschichte der griechischen Religion,* 2nd ed., vol. i, pp. 427–433 (1955).

HERACLEA (HERACLEIA), the name of a large number of ancient cities founded by the Greeks and named after the Greek hero Heracles (Hercules). The more important are listed below.

HERACLEA, an ancient city of Lucania, near the modern Policoro, Italy, 3 mi. from the coast of the Gulf of Tarentum, between the Aciris (Agri) and Siris (Sinni) rivers. It was a Greek colony founded by the Tarentines after a conflict with the Thurians in 433 B.C. There Pyrrhus, king of Epirus, defeated the consul P. Valerius Laevinus in 280 B.C., after he had crossed the Siris river. In 278 B.C. the Romans made a special treaty with Heraclea, on such favourable terms that in 89 B.C. the Roman citizenship given to the inhabitants by the *Lex Plautia Papiria* was accepted only after considerable hesitation. Having accepted Roman citizenship, the city became a municipium; part of a copy on bronze of the *Lex Julia Municipalis* of Julius Caesar (a collection of regulations, possibly carried en bloc by Mark Antony after Caesar's death), found between Heraclea and Metapontum (Metaponto), is of the highest importance for knowledge of that law. Heraclea was still of importance under the empire.

HERACLEA MINOA, an ancient town on the south coast of Sicily, at the mouth of the Halycus (modern Platani) river, on the modern Cape Bianco in the province of Agrigento. It was founded from Selinus (Selinunte) and was always a border town between Carthaginian and Greek territory. It was taken by Spartan colonists under Euryleon shortly before 500 B.C. but must have fallen into Carthaginian hands before Acragas (Agrigento) did in 406. The Carthaginians lost it temporarily to Agathocles and Pyrrhus, but used it as a base in the First Punic War.

Euryleon's colonists were the survivors of the expedition of Dorieus, brother of Cleomenes I of Sparta, to found another Heraclea near Mt. Eryx in northwestern Sicily. This Heraclea was soon destroyed by Carthaginians and Segestans.

HERACLEA PONTICA (modern Eregli in the *il* of Zonguldak, Turkey), an ancient city on the Black sea coast of Asia Minor. It was founded *c.* 560 B.C. by Megarians, who soon subjugated the native Mariandynians and extended their power over a considerable area. The prosperity of the city was utterly destroyed in the Third Mithradatic War. The modern town is known for its coal mines.

HERACLEA, an ancient town in western Asia Minor about 10 mi. E. of Miletus, at the foot of Mt. Latmus (modern Besparmak, Turkey). There are traces of a temple of Athena and a theatre, also of extensive and elaborate fortifications, probably dating from *c.* 300 B.C. In its neighbourhood was the supposed burial cave of Endymion.

HERACLEA-CYBISTRA (modern Eregli in the *il* of Konya, Turkey). Cybistra was a town of Cappadocia near the foot of the Taurus range, on the road to the Cilician Gates; Heraclea was a fort nearby. It lay in the way of armies and was sacked by the Arab invaders of Asia Minor in A.D. 805 and 832. It was conquered by the Seljuk Turks in the 11th century. Eregli grew from a large village to a town after the railway reached it in 1904.

HERACLEA PERINTHUS (modern Marmaraereglisi in the *il* of Tekirdag, Turkey), on the European coast of the Propontis (Sea of Marmara), was founded by Samian colonists *c.* 600 B.C.; the name Heraclea appears to date from the late 3rd–early 4th century A.D. It withstood an energetic siege by Philip II of Macedonia in 340 B.C. and only lost its supremacy in the area with the foundation of Constantinople (A.D. 322).

HERACLEA TRACHINIA, an ancient city about 5 mi. W. of the pass of Thermopylae, Greece. Its fine strategic position commanding the pass led the Spartans to found it as a colony in 426 B.C., but it suffered from internal discord and the hostility of the Thessalians. In 371 it was given to the local Oetaeans by Jason of Pherae. It continued to be the chief town of the Oetaeans under the Romans, despite having been sacked by them in 191 B.C.

HERACLEA LYNCESTIS (modern Bitola in Yugoslavia) was a town in Macedonia, on the Via Egnatia.

HERACLEA was also the name of one of the Cyclades Islands, between Naxos and Ios, which is still called Iraklia and bears traces of a Greek town with temples to Tyche and Zeus Lophites.

HERACLEIDES PONTICUS (d. after 322 B.C.), Greek philosopher, an eminent member of the Greek Academy (*see* ACADEMY, GREEK), was born at Heraclea in Pontus. Some authorities count him among the Peripatetics; but he was certainly a pupil of Plato, who left the Academy temporarily in his charge; and he was nearly elected to succeed Speusippus as the head of the Academy. His writings are lost except for a few fragments. We know that he taught the axial rotation of the earth, that he anticipated either the geoheliocentric or the geocentric hypothesis (Copernicus expressed his indebtedness to him, but the interpretation of the details of Heracleides' astronomic theories is controversial) and that he taught some kind of (teleological) atomism. Several works of his were devoted to literary criticism, musicology, etc. Besides these (more scientific) interests, he dealt with occult phenomena (trances, cosmological visions, prophecies, portents) and cataclysms, proving or illustrating by them the existence of gods, divine retribution, reincarnation, etc., thus exemplifying the supranaturalistic tendencies of Platonism and foreshadowing some aspects of Neoplatonism.

See F. Wehrli (ed.), *Herakleides Pontikos* (1953); P. Duhem, *Le*

Système du monde, i, iii (1913, 1915). (Pp. M.)

HERACLEON (fl. 2nd century A.D.), a Gnostic teacher, a follower of Valentinus. Origen, who treats Heracleon as a notable exegete, has preserved fragments of his commentary on the Gospel of St. John, while Clement of Alexandria quotes what appears to be a passage from a commentary on Luke. These writings are intensely mystical and allegorical.

See A. E. Brooke, "The Fragments of Heracleon," *Texts and Studies*, vol. i, no. 4 (1891).

HERACLEONAS (Heraclonas) (615–641), Byzantine emperor from Feb. to Sept. 641, was the son of Heraclius (*q.v.*) and Martina. In 638 he obtained through his mother's influence the title of Augustus, and after Heraclius' death was proclaimed joint emperor with his half brother Constantine III. The premature death of Constantine in May 641 left him sole ruler. But suspicion that he and Martina had murdered Constantine led to a revolt and to the mutilation and banishment to Rhodes of the supposed offenders in Sept. 641. Nothing further is known of him.

See G. Ostrogorsky, *History of the Byzantine State* (1956). (J. M. Hy.)

HERACLIDAE, the general name for the numerous descendants of Heracles (Hercules); the name is especially used in antiquity for Hyllus and his descendants, the leaders of the Dorian invasion by the Peloponnese. *See* Dorians; Greece.

HERACLITUS (*c.* 540–*c.* 480 B.C.), Greek philosopher, of Ephesus, was descended from the earlier kings of the city but surrendered his family privileges to his brother. He was a violent critic of his fellow citizens, of other thinkers and of mankind in general. Most of the stories about his life and death (*e.g.*, that he buried himself in dung to cure dropsy) are malicious embroideries on some of his well-known sayings, by Hellenistic biographers writing in the 3rd century B.C. and later. More than 100 short fragments survive as quotations in later writers; his style, vivid, gnomic and often cryptic, rapidly earned Heraclitus the name "the obscure."

According to Heraclitus the most important thing for men was the understanding of the *logos*, the universal formula of things in accordance with which all natural events occur and which all men should be able to assimilate. The majority, he complained, ignored the *logos*, even when he himself explained it, and relied like dreamers on a private and therefore false view of the world. An important manifestation of the *logos* was the underlying connections between opposites. This was illustrated by Heraclitus with many concrete examples; *e.g.*, sea water is both harmful (for men) and beneficial (for fishes). The connection between opposites—apparently the most divergent of all things—meant that the world was not just an indeterminate agglomeration of essentially distinct components, but a coherent and discoverable system in which changes in one direction are ultimately balanced by corresponding ones in the other; there is a hidden attunement or connection between things which means that what is apparently "tending apart" is actually "being brought together." The apprehension of the formal unity of the world of experience, rather than the genetic unity sought in the theogonic and Milesian tradition, together with the conviction that man's first task is to understand the principles that control both himself and his environment, was perhaps Heraclitus' main philosophical contribution.

The world order is eternal, an "ever-living fire kindling in measures and being extinguished in measures." (It was a Stoic interpretation, perhaps following Theophrastus, that assigned to Heraclitus the idea of a periodic universal conflagration.) Fire is in one respect a concrete manifestation of the *logos*, since its own changes are proportionate and "measured" in terms of fuel, flame and smoke. Pure fire fills the sky, as ether or the shining upper air. Parts of it "turn to" sea (presumably as rain), while parts of sea turn to earth. Simultaneously equivalent masses of earth and sea throughout the world as a whole are reverting to sea and fire; thus a continuous world order is preserved. Heraclitus illustrated this kind of persistence of unity through change by the analogy of the river: "Upon those who step into the same rivers different and ever different waters flow down." Plato, who may have been thinking in terms of the exaggerated version of Heraclitus' doctrine propagated by Cratylus, took this to mean that all things absolutely are in constant flux, though this often escapes the senses. But Heraclitus, who said "The things of which there is seeing, hearing, understanding, are those that I prefer," is unlikely to have favoured an explanation of change which contradicted the senses unnecessarily. He was acutely aware of the "strife" of things, without which, indeed, the reaction between opposites, and thus their essential connection, would cease; but not all parts of the cosmic battlefield need be in strife at the same time: rocks and mountains, for example, can be temporarily stable, though they too will eventually change.

God was identified by Heraclitus with the opposites, persisting through their changes and thus able perfectly to comprehend their unity. Thus God knows "how all things are steered through all" and is completely wise. The rites of conventional religion were ridiculed by Heraclitus, unless by accident they symbolized the true relation of opposites.

The soul is made of fire and is bound up in the same cycle of changes as individual parts of the world as a whole. Death involves the total extinction of soul; sleep, drunkenness, or stupidity, its partial moistening. It seems that particularly fiery and virtuous souls (notably of those who died suddenly and bravely in battle, unmoistened by sickness) might survive for a time as beneficent daemons, before returning to ethereal fire.

Bibliography.—H. Diels and W. Kranz, *Fragmente der Vorsokratiker*, 7th ed. (1954); G. S. Kirk, *Heraclitus, the Cosmic Fragments*, with Eng. trans. and commentary (1954); G. S. Kirk and J. E. Raven, *The Presocratic Philosophers* (1957); and, for all the fragments in Eng. trans., J. Burnet, *Early Greek Philosophy*, 4th ed. (1930). *See* further O. Gigon, *Untersuchungen zu Heraklit* (1935); K. Reinhardt, "Heraklits Lehre vom Feuer" and "Heraclitea," *Hermes*, 77: 1–27, 225–248 (1942); G. Vlastos, "On Heraclitus," *American Journal of Philology*, 76: 337–368 (1955). (G. S. Kk.)

HERACLIUS (*c.* 575–641), Byzantine emperor from 610 to 641, was born in Cappadocia. His father held high military command under the emperor Maurice, and as governor in north Africa maintained his independence against the usurper Phocas (*q.v.*). When invited to head a rebellion against the latter, he sent his son Heraclius to Constantinople with a fleet. Phocas was deposed and Heraclius proclaimed emperor (610). He set about reorganizing the disordered administration and imperial defenses. At first he was helpless before the Persian armies of Khosrau II (*q.v.*), which were overrunning Syria, Egypt and Asia Minor and by 615 had reached the Bosporus. Matters were so desperate that in 618 Heraclius even proposed abandoning his capital city of Constantinople for Carthage, but was dissuaded by the patriarch Sergius. Throughout the struggle against the Persians he had the support of the church, which lent him funds. He appears to have made far-reaching reforms in both central and provincial administration. He is usually credited with inaugurating in Asia Minor the system of themes, developed and extended by his successors. This was the grouping of several of the old provinces into a single unit, called a theme, where organization had a strong military character; supreme control lay with the commander in chief of the army stationed there (the Greek *thema* meant a division of troops). Within these themes soldier-farmers received unalienable grants of land in return for hereditary military service, thus building up native recruitment.

In a series of arduous campaigns Heraclius and his generals met the double menace of the Slavs and Avars in the Balkans and the Persians in the east. In 621 he made a treaty with the Avars and in 622 took the field against Persia. During his first expedition he cleared Asia Minor and defeated the Persians in Armenia. In 623 he again entered Armenia and got help from the Caucasian tribes. During the years 624–625 he failed to push through to Persia, but in 626 during his absence with his army in Lazica at the eastern end of the Black sea a double attack of the Avars and Persians on the capital was defeated. In 627 Heraclius drove into Persian territory; after a brilliant march across the Armenian highlands into the Tigris plain he gained a hard-fought victory over Khosrau's general Shahrbaraz. In 628 Khosrau was dethroned and his successor, his son Kavadh II, made peace with Heraclius, whose troops were now advancing on the Persian capital,

Ctesiphon. Having secured his eastern frontier Heraclius victoriously returned to Constantinople. He was now able to negotiate for the true cross, which the Persians had taken from Jerusalem and he returned this in person probably in 630. Heraclius also helped to break Avar domination north of the Danube. During his reign the Serbs and Croats began to settle in considerable numbers in the Balkans, though Byzantine claims to overlordship over them were at this time very tenuous.

Toward the end of Heraclius' reign a new peril menaced the eastern provinces. In 629 the Arabs were raiding Transjordan (*see* CALIPHATE: *The First Four Caliphs*); in 636 they won a victory on the Yarmuk (Hieromax), and in the following years conquered Syria, Palestine and Egypt, and Byzantine Mesopotamia. Worn out and ill, Heraclius made no attempt to retrieve the misfortunes of his generals. As the Arabs flooded into Syria and Palestine he returned to Constantinople, where he died on Feb. 11, 641.

During the latter years of his life he had spent much time in theological speculation and ecclesiastical reforms. His religious enthusiasm led him to oppress his Jewish subjects. On the other hand he attempted to reconcile the Christians, who were in disagreement about the divine and human natures in Christ. To this effect he propounded in his *Ecthesis* (638), the compromise called Monothelitism (the doctrine of a single will in Christ), which however found favour neither with the orthodox nor with the Monophysites (*see* MONOTHELITES). Heraclius was twice married; his second union with his niece Martina was uncanonical and frequently made a matter of reproach to him. In spite of his partial failures, Heraclius was one of the greatest of Byzantine rulers, and his campaigns against the Persians and Avars and his invigorating reforms were the means of saving the empire. His reign marks a turning point in Byzantine history both in cultural and political developments. Greek had become the dominant language in administration as in everyday life; with the Arab advance troublesome eastern provinces were lost, and the Slav penetration south of the Danube, though introducing many problems, also brought fresh blood into the empire. It was under Heraclius and the dynasty he founded that the medieval Byzantine empire took shape. *See* also BYZANTINE EMPIRE.

See J. B. Bury, *History of the Later Roman Empire*, vol. 2 (1889); G. Ostrogorsky, *History of the Byzantine State* (1956). (J. M. HY.)

HERALD. For the medieval and modern functions of a herald, *see* HERALDRY. The word "herald" is also used to translate several Greek and Latin terms.

Greek Heralds.—The Greek word *keryx* or *karyx*, usually translated "herald," has various meanings. In Homer, a *keryx* is mostly a trusted attendant or retainer of a chieftain. But *kerykes* also have official and public functions; they proclaim and execute the king's will—in which capacity it seems that they are inviolable—and summon and keep order at the assembly of the people. These functions continued at later times, and heralds are found acting as inviolable messengers between states, even in time of war (though without the power to make terms vested in the *presbeis*, "ambassadors"), proclaiming meetings of the council, popular assembly or court of law, reciting there the formulas of prayer, etc., and summoning persons to attend. Hermes, himself the herald of the gods, is their patron and carries the herald's staff (caduceus; *q.v.*). Besides these paid functionaries of the state, there was a clan of Kerykes at Eleusis who had certain duties in connection with the mysteries. The word, however, often means no more than a crier, whether at the Olympic or other games or simply at a sale or the like.

Roman Heralds.—There is a counterpart of the Greek *keryx* in his capacity as an inviolable messenger in the Roman *fetialis*. A college of *fetiales* existed from very early times; such an institution was not peculiar to Rome; other Latin towns are known to have had *fetiales*. At Rome, if a breach of international law by a neighbouring state was alleged, two *fetiales* at least were appointed, the pater patratus, who was the senior member of the deputation, and the verbenarius, or carrier of the sacred herbs (*verbenae, sagmina*), which apparently represented the Roman territory. These went to the state in question and three times solemnly demanded redress (*clarigatio*). If this was not obtained within 33 days, they reported the matter at Rome. When war was voted they returned to the frontier and flung a javelin, made of cornel-wood and having either an iron point or one end sharpened and hardened by fire (this clearly is the older form), into the hostile territory, calling on the gods to witness the justice of their cause. In later times a plot of land in Rome near the temple of the war-goddess Bellona was by a legal fiction made to represent hostile territory, and the javelin was cast into it, thus avoiding the long journey overseas to perform the ceremony.

The *fetiales* also made treaties of peace, when the terms had been agreed upon and ratified. For this purpose the deputation carried a flint knife (or perhaps more than one) which was the embodiment of Jupiter and kept in one of his temples (*Iuppiter lapis*). They met the deputation of the other state; the terms of the treaty were read aloud; a pig was killed with the knife; and Jupiter was invoked to smite Rome in like manner if Rome were the first wantonly to violate the treaty. The college of 20 *fetiales*, though little is heard of it after 201 B.C., continued to exist throughout the empire.

See, for the Roman ceremonies, Livy, i, 24 and 32.

HERALDRY, more correctly termed ARMORY, is a hereditary system of personal recognition, employing symbols (called charges) upon a shield, which developed among the nobles of medieval Christendom. These symbols were at first personal but later took on a hereditary character, so that, in time, certain combinations of forms became associated with particular families. From this arose such definitions of heraldry as that of Johannes de Bado Aureo in his *Tractatus de Armis* (*c.* 1394), who said that it was for the purpose of distinguishing one person from another; and later that of Sir William Dugdale (*The Ancient Usage in Bearings of Arms*, 1681), who wrote that arms were "Ensignes of Honour . . . which of later times have been chiefly used for distinctions of families." A. R. Wagner added the definition that heraldry is "the systematic use of hereditary devices centred on the shield." This article will trace the development of this system from the earliest to modern times and is divided as follows:

I. Origins and Systematization of Heraldry
II. Accidence and Grammar of Heraldry
  1. Language and Colours
  2. Points of the Shield and Partitioning
  3. Patterns of Colours
  4. Charges of Objects and Animals
  5. Crest
  6. Motto and Slogan
  7. Wreaths and Banderoles
  8. Mantle or Lambrequin
  9. Supporters
  10. Compartment
  11. Badges and Devices
  12. Armorial Ensigns
  13. Canting Arms or Armes Parlantes
  14. Allusions to Offices in Arms
  15. Marshaling
  16. Arms of Women
  17. Arms of Divorced Persons
  18. Insignia of Rank
  19. Coronets and Caps of Estate
  20. Helmets
  21. Value of Heraldry in Historical Studies
  22. Nobiliary Aspects of Heraldry
III. General Development and Modern Status of Heraldry
  1. Noble Status Obtained Previously to Ennoblement by the Crown
  2. Administration of Arms; the Heraldic Authorities
  3. Heraldic Visitations
  4. Rise of the New Men
  5. Character of the Grants of Arms in Ancient Times
  6. Heraldic Courts; Courts-Martial or Courts of Chivalry
  7. Prescriptive Right to Arms in the 20th Century
  8. Continued Status of a Coat of Arms
  9. Proofs of Nobility
  10. Cadency and the Armorial Family
  11. Arms as Feudal Heritage
  12. Arms of Bastardy
  13. Corporate Heraldry
  14. Arms as Property
  15. Arms and the Surname
  16. Grants of Arms in the Second Half of the 20th Century
IV. Service Heraldry

1. Military Insignia
2. Heraldry and the Orders of Chivalry
V. Ecclesiastical Heraldry
VI. Royal and Dominion Arms
VII. Heraldic Art
1. Historical Conspectus
2. Rolls of Arms
3. Heraldic Memorials
4. Heraldic Bookplate
5. Heraldry and Inn Signs

1. ORIGINS AND SYSTEMATIZATION OF HERALDRY

Heraldry differs both from the use of symbols on shields in ancient Greece and from the display seen, for example, in the 11th-century Bayeux tapestry; for these cannot be shown to have been transmitted consistently, or indeed at all, as hereditary charges. Heraldry differs also from totemism, because it is personalized and transmitted in individual families instead of being extended to the whole of a widespread group or tribe. The Japanese *mon*, or badge, of a noble family differs from heraldry principally in that the charge which constitutes the *mon* is not represented upon a shield.

FIG. 1.—JAPANESE MON OR BADGE

FIG. 2.—ROYAL ARMS OF ENGLAND OF RICHARD I

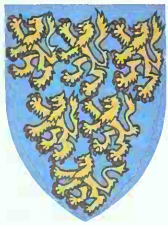


FIG. 3.—ARMS OF WILLIAM LONGESPÉE, EARL OF SALISBURY

FIG. 4.—ARMS OF GILBERT DE CLARE, EARL OF HERTFORD, 1138–46

Heraldry arose in feudal western Europe in the 12th century A.D. The shields of highly placed personages began at this time to carry charges, and the custom spread downward among their noble followers and outward to neighbouring principalities. The tournament, in active existence from the first half of this century, would tend to popularize the use of armory through the ostentation, mock warfare and duels which it involved and because it was presided over by great princes, so bringing together nobles from many provinces and lands. It is, however, probable that the second and third crusades were the greatest causes of the very rapid taking root of heraldry throughout western Christendom. The commencement of English royal heraldry is found on the seal of Richard I in 1189 and the beginning of the present English royal arms on his second seal in 1198.

By the end of the 12th century, seals bearing arms were becoming common, and these arms were, in the main, transmitted to the descendants of their first owners. Consequently it can be said that what is now called armory or heraldry had come into existence.

The earliest-known coat of arms is that of Geoffrey of Anjou, who, on being knighted by his father-in-law, Henry I of England, received from him a shield of golden lions. As William Longespée, earl of Salisbury, illegitimate son of Henry II, who was the son of Geoffrey of Anjou, bore "Azure six lions rampant or," it is evident that this coat became hereditary. The earl of Hertford, Gilbert de Clare, bore on his seal between 1138 and 1146 the three chevrons subsequently used by his descendants.

Another early coat is that which appears on the seal of Philip I of Flanders (1164). In Scotland the Stewart arms appear in 1170 on a seal. Louis VII of France (reigned 1137–80) used a fleur-de-lis (though not on a shield) upon his seal; and since the fleur-de-lis appears later (from the reign of Louis VIII, 1223–26) on the shields of the kings of France, it is hard to escape the conclusion that this was the beginning of French regal heraldry. Mention must not be omitted of the parallel case of a fleur-de-lis without a shield on the seal of John Montgomerie of Eaglesham, Scot., about 1170, to be followed later by that charge in the family's arms. The Holy Roman emperor Charlemagne is believed to have used an eagle as his badge. In 1080 his flag had an eagle upon it, although it may not have appeared on the imperial shield until later. J. H. Stevenson expressed the view that while heraldry may have originated in Germany, the reduction of mere devices on shields to an orderly and heritable arrangement is undoubtedly to the credit of the French. Such a sequence of events may account for the German word *blasen*, to blow a horn, being transformed into the heraldic term blazon, as well as for the widespread use of French terms.

FIG. 5.—ARMS OF PHILIP I OF FLANDERS, 1164

FIG. 6.—ARMS OF STEWART, 1170

It is the romantic writer who is responsible for the idea that heraldic charges invariably record some great event of former times. While this may be so in some cases, it does not necessarily follow, although in modern coats there are very often references to events in the life of their first bearer. For example, Robert Cecil Gale, a former professor at the Royal Military College of Science connected with the University of London, bears three grenades. The view of J. R. Planché (see *Bibliography*) that, where investigated, stories of arms having been assumed commemoratively were found to be late inventions, must be taken with some reserve. There must often have been some particular reason for the adoption of a certain charge as, for example, the fleur-de-lis to indicate devotion to the Trinity. As Stevenson observed, it could not have been by accident that the Holy Roman emperors assumed the cognizance of the king of birds and the kings of Scots and of England that of the king of beasts. The lion is used as a regal symbol in Norway,

FIG. 7.—ARMS OF ROBERT CECIL GALE

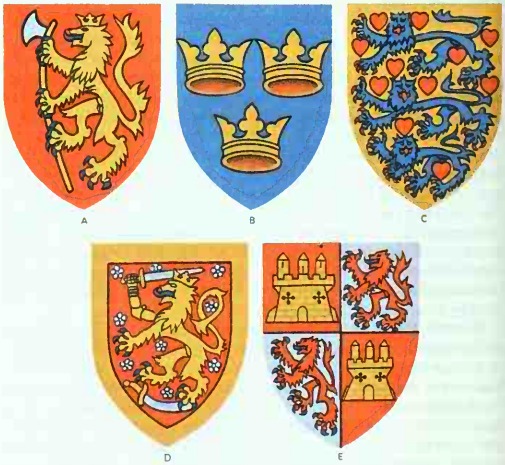


FIG. 8.—ARMS OF: (A) NORWAY; (B) SWEDEN; (C) DENMARK; (D) FINLAND; (E) SPAIN (CASTILE AND LEÓN). NOTE THE FREQUENT USE OF THE LION IN REGAL HERALDRY

Sweden, Denmark and Finland, as well as in Flanders and Spain (Castile and León). The regality which is supposed to reside in the Leo of astrology, prominent in all ancient lore, must have been a powerful inducement to monarchs to assume the lion as a device. Stevenson indicated, moreover, that the story found in Fordun, Boece and others, relating to the manner in which the Scrymgeours obtained their coat of a lion with a curved sword, their name of "Skyrmischur" and their office of royal standard-bearers, is probably founded upon fact. Thus, while many of the stories connected with the meaning of certain charges may be apocryphal, it must not be assumed that all are. Although arms were common by the end of the 12th century, it was not until the early 13th that, by reason of the now established inheritance of arms, their prescribed modes of use, the restriction of them to certain orders of society (the noblesse) and the systematization of their description (blazon), heraldry became a science.

FIG. 9.—ARMS OF SCRYMGEOUR

A device which could be personal to its user and at the same time hereditary, indicating his ancestors, his descendants and all his kin, had obvious advantages. It is commonly thought that the main use of heraldry was in war, to distinguish one horseman from another, especially when the vizor of the helmet was closed. While there is no doubt that this use accelerated the development and spread of heraldry, it was not the sole factor involved—armorial shields existed before the vizored helmet.

Heraldry, once the idea of it had been conceived, became so essential to feudal society that its employment was as necessary in civil affairs as in martial. In an age when only clerks could write, a personal armorial seal was as indispensable for the recognition of the party to a document as was his shield of arms for the warrior in battle. The same coat of arms was needed to fly from the nobleman's tower to mark his occupancy of his fief as was needed on his monument to indicate his tomb. When he moved from lodging to lodging, his arms hanging from the balcony told where he lay, while his banner marked his ship at sea.

II. ACCIDENCE AND GRAMMAR OF HERALDRY

The colours, devices, etc., which may appear on a shield, and the terms used to describe them, must now be discussed.

While in every realm there are local variations of the rules, and while those pertaining in one realm may not all be applicable in another, generally speaking most of them are of very wide application and many are wholly international.

1. Language and Colours.—It should be observed that while in many countries vernacular terms are used in the specially constructed language for the description of arms, French and Latin terms tend to be in the majority. In English, Irish and Scottish heraldry most of the technical terms are in fact old French words. Consequently the words for the heraldic colours in general use are in that language, thus: silver or white (argent); gold (or); blue (azure); red (gules); black (sable); green (vert); purple (purpure). In French heraldry itself all these terms are not employed, however; green, for example, is *sinople*. Likewise in Italian heraldry red is *rosso*, black *nero*, green *verde* and blue *azzurro*. The heraldic colours are all strong; no pastel shades are employed. The purpose of heraldic colouring was and is ready identification. Besides the above tinctures, divided into metals (argent and or) and colours (sable, azure, gules, vert and purpure), there are furs: ermine, ermines, erminois, pean, vair, countervair, potent and counterpotent.

In English, Irish and Scottish heraldry, which show a greater degree of primitive simplicity than the armorial systems of some other countries, strict observance attaches to the rule that colour may not be laid on colour, nor metal on metal, nor fur on fur; but that colour may only be laid on a metal or a fur, a metal only on a colour or fur, etc. This facilitates maximum contrast, thus making for clearer and so readier identification. In Italy, however, this rule is by no means scrupulously observed. For example, the house of Perriello-Zampelli bears: *Gules on a fesse azure three crescents 2 and 1 or* (*Libro d'oro della nobiltà italiana*, p. 1493, vol. xiii, 12th ed., 1958–61). It will be realized how much less contrasting the colours are in this arrangement than if they had been: *Gules on a fesse or three crescents 2 and 1 azure*. In German and Spanish heraldry the same laxity in observing the rules of tincture has developed.

FIG. 10.—ARMS OF PERRIELLO-ZAMPELLI

The majority of the symbols employed in heraldry have their own technical terms, as have all the parts of a shield. In addition, there is a scientific method of verbal description (called blazoning) which enables any armorist anywhere to emblazon (*i.e.*, to draw and colour) any arms. This is true even when an English herald receives a French, Italian or Portuguese blazon, for the rules are fundamentally the same and there is little difficulty in understanding the description. Thus the Anglo-French description employed in the British Isles for the above Perriello-Zampelli coat describes a red shield with a broad band across it of blue, and on this band three gold crescents set two above and one below. The Italian blazon of this coat is: *Di rosso fasciato d'azzurro a tre crescenti montanti d'oro 2 e 1.*

These tinctures are indicated in black and white drawings by a special system of dots for gold, vertical lines for red, horizontal lines for blue, cross-hatched for black, lines diagonally descending from left to right (from the point of view of one facing the shield) for green and the opposite, from right to left, for purple. The left-hand side of the shield in relation to one facing it is called the dexter (right), and the right-hand the sinister (left), because right and left are determined from the point of view of the wearer.

2. Points of the Shield and Partitioning.—The shield is divided into the following "points": the dexter chief; the chief; the sinister chief; the dexter flank (side); the fesse point (centre); the sinister flank (side); the dexter base; the base; the sinister base. Between the fesse point and the chief lies the honour point, and between the fesse point and the base is the nombril point. The lines which partition the various parts of the shield or which are employed in such charges as crosses, etc., are as shown in fig. 11.

The shield is divided (*i.e.*, "parted") by any of the foregoing lines (most commonly by simple straight lines) into divisions:

Per pale, divided in half vertically.
Per fesse, divided in half horizontally.
Quarterly or per cross, divided into four quarters.
Per bend, from the dexter corner of the top of the shield diagonally.
Per bend sinister, from the sinister corner of the top of the shield diagonally.
Per chevron, divided chevronwise across the middle.

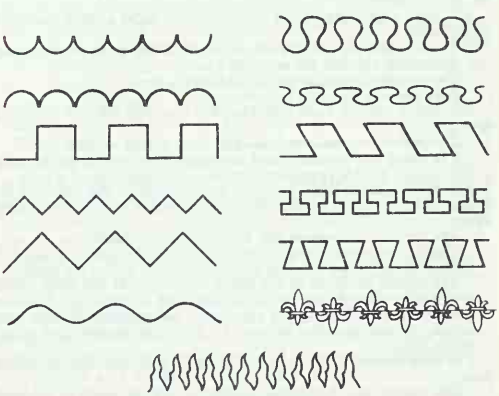


FIG. 11.—LINES USED IN HERALDRY: (LEFT, TOP TO BOTTOM) ENGRAILED, INVECTED, EMBATTLED, INDENTED, DANCETTÉ, WAVY; (RIGHT, TOP TO BOTTOM) NEBULÉ (DEEP), NEBULÉ (SHALLOW), RAGULY, POTENTÉ, DOVETAILED, FLORY COUNTER-FLORY; (CENTRE BOTTOM) RAYONNÉ

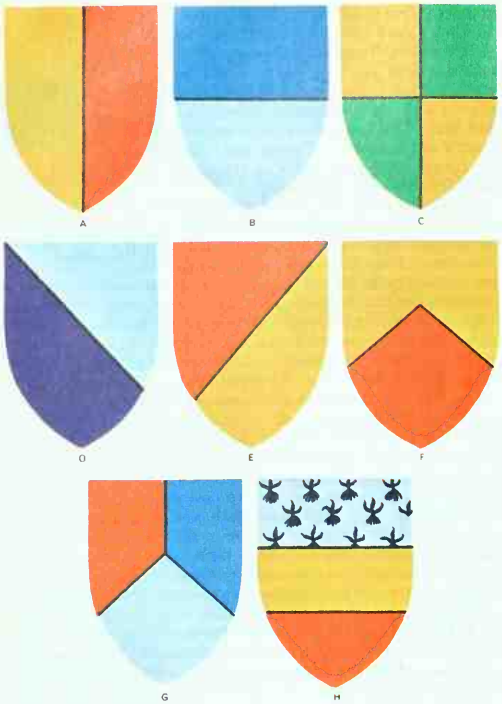


FIG. 12.—DIVISIONS OF THE SHIELD: (A) PER PALE; (B) PER FESSE; (C) QUARTERLY OR PER CROSS; (D) PER BEND; (E) PER BEND SINISTER; (F) PER CHEVRON; (G) TIERCED IN PAIRLE REVERSED; (H) TIERCED IN FESSE

Tierced in pairle reversed or per pale and chevron, divided per chevron (but lower down the shield) and the upper half then divided per pale.

Tierced in fesse, divided horizontally into three.

After the divisions of the field come the basic simple forms, called ordinaries, and their diminutives, as follows:

The chief, the upper part of the shield, just under one-third of the surface area.

The filet, about a quarter of the thickness of the chief and occupying its lowest quarter.

The fesse, a horizontal band occupying just under a third the depth of the shield.

The bar, like the fesse but about one-fifth the depth of the shield.

The closet, one-half the width of a bar.

The barrulet, one-quarter the width of a bar.

Bars gemelles, barrulets in pairs.

The pale, a vertical band somewhat less than one-third of the shield in width.

The pallet, a vertical band one-half the width of the pale.

The endorse, a vertical band one-quarter the width of the pale. This is used like bars gemelles, in pairs one on each side of a pale.

The bend, a band, again supposed to be one-third the width of the shield, which crosses it diagonally from the dexter chief to the sinister base.

The bendlet or garter is half the width of the bend.

The cost or cotise is a quarter the width of the bend. These, like the bars gemelles, are borne in pairs, one on each side of the bend.

The riband or baton is one-eighth the width of the bend. This is now very often shown as couped (*i.e.*, with its ends cut off so that it does not reach the edges of the shield) but anciently it went right across. It may be borne sinister; *i.e.*, from the sinister chief to the dexter base.

The bend sinister is the bend extending from sinister chief to dexter base.

The scarpe (*i.e.*, the bendlet sinister) is half the width of the bend sinister.

The baton is one-fourth the width of the bend sinister, and is nowadays shown as couped.

The chevron is an inverted V-shaped band across the shield, with its point in chief. (It can, however, be reverse—*i.e.*, V-shaped.) It occupies about one-fifth the depth of the shield.

The chevronel is one-half the chevron in width.

The couple-close is one-fourth the chevron in width. These are borne in couples, like the bars gemelles, and usually one on each side of a chevron. Nowadays, however, they are usually not described, the blazon simply stating that the chevron is cotised.

The cross has arms each approximately one-tenth the area of the field, but made wider when charges are placed upon it. It has no diminutive, but there are numerous varieties.

The saltire is a diagonal cross.

The pile is a wedge shape which is shown with its point toward the base of the shield, unless specified otherwise. There may be more than one pile on a shield, and the field may be divided pily.

The pall has the same general shape as the ecclesiastical pallium and issues from the dexter and sinister chiefs.

The shakefork is a pall with the extremities cut off so that it does not touch the edges of the shield.

The next most important divisions of the shield are the subordinaries and these consist of:

The quarter, which occupies one quarter of the shield. It is now rarely met with.

The canton, a smaller variant of the quarter, is difficult to distinguish

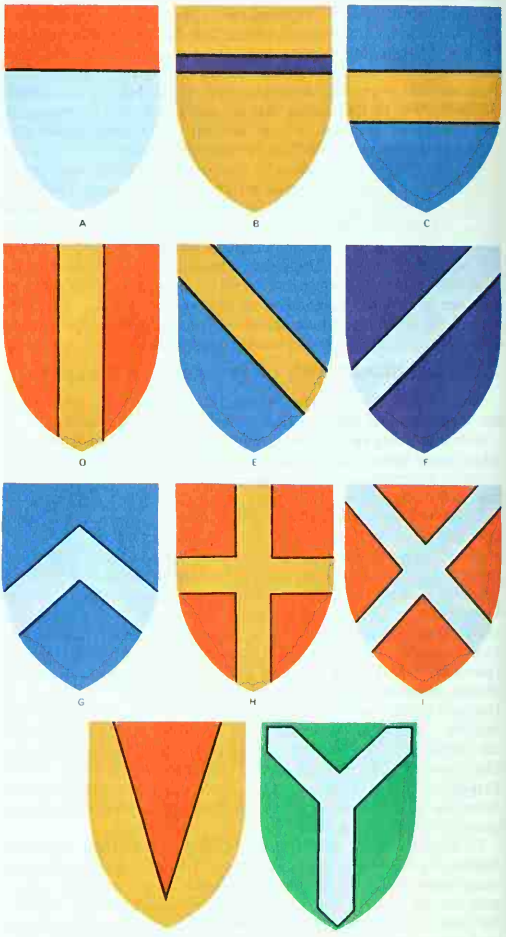


FIG. 13.—THE ORDINARIES AND THEIR DIMINUTIVES: (A) CHIEF; (B) FILET; (C) FESSE; (D) PALE; (E) BEND; (F) BEND SINISTER; (G) CHEVRON; (H) CROSS; (I) SALTIRE; (J) PILE; (K) PALL OR SHAKEFORK

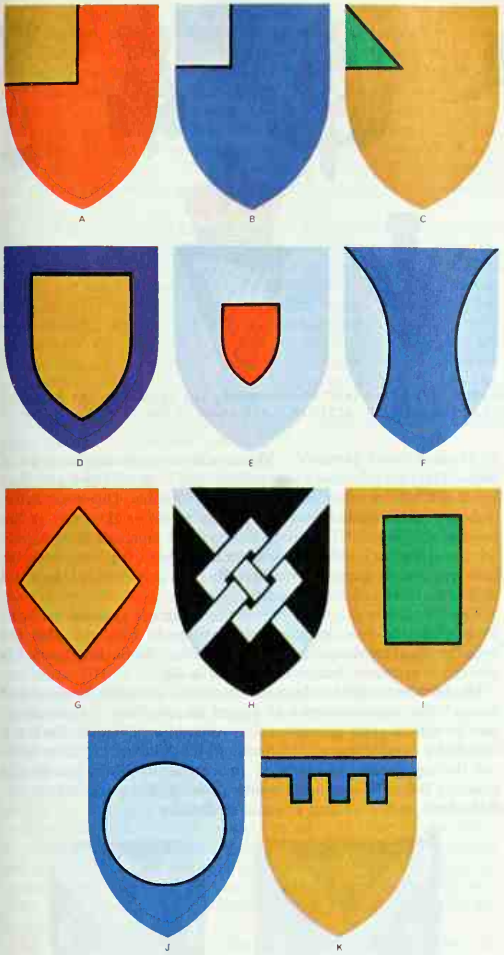


FIG. 14.—THE SUBORDINARIES: (A) QUARTER; (B) CANTON; (C) GYRON; (D) BORDURE; (E) INESCUTCHEON; (F) FLANCHES; (G) LOZENGE; (H) FRET; (I) BILLET; (J) ROUNDLE OR ROUNDEL; (K) LABEL

from it and has replaced it in general use. The quarter and the canton always surmount any bordure (*see* below) shown in the arms.

The gyron is the lower half of a diagonally divided quarter with its point toward the centre of the shield.

The bordure is a border round the outer edge of the shield. It is variously divided, as follows:

Compony or gobonny: made up of pieces of alternating metal and colour, metal and fur or colour and fur.

Counter-compony: made up of two tracks of such alternating tinctures.

Checky: containing three tracks of small checks of the alternating tinctures, not curving with the shape of the shield as in the two foregoing cases.

Gyronny: divided into six, eight or ten segments.

Quartered: divided into four segments.

Tierced in pairle: divided into three segments.

(In addition a bordure may be parted per pale, per fesse and per bend or may contain charges, and its outlines may be straight or made up of any of the above lines. It may also be charged with bends, bars, chevrons, etc.; *i.e.,* the extremities of these charges may appear upon it.)

The orle is half the width of the bordure and does not extend to the edge of the shield.

The tressure is an orle a quarter the width of the bordure. Tressures are usually borne in pairs and flory counter flory; *i.e.,* there are eight fleurs-de-lis issuing from them, first one side and then the other.

The inescutcheon (shield of pretense) is borne in the centre of the field and is about one-fifth of its area.

The flanches are always borne in pairs, and are formed by curved lines from the corner of the shield in the dexter and sinister chiefs to the edges of the shield at the dexter and sinister bases respectively.

Flasques or voiders are variants of the flanches which are formed from flatter curves and occupy less of the field.

The lozenge is of a diamond shape.

The fusil is an elongated lozenge.

The mascle is a voided lozenge; *i.e.,* it has a lozenge-shaped hole in the centre.

The rustre is a lozenge with a round hole in the centre.

The fret is a mascle interlaced with two bendlets in saltire.

Fretty is an interlacing of dexter and sinister bendlets to form a trellislike effect.

The Billet is an oblong figure, said by some to represent a letter.

Billetty is a field seme (*i.e.,* strewn) of billets.

The roundle is a small circular figure, its name varying with its tinctures, as follows: bezant (gold); plate (silver); torteau (red); hurt (blue); pellet or ogress (black); pomme (green); golpe (purple); orange (orange, tenné); guze (sanguine, deep red). When bearing six wavy bars of white and blue it is a fountain. A roundle may also be of any of the furs, and it sometimes bears other charges.

The annulet is a hollow roundle.

The label is a narrow bar across the chief from which may depend any number of pendents; three are understood unless the blazon states otherwise. They can bear other charges upon them.

3. Patterns of Colours.—The field of the shields and principal charges can be divided into patterns of colour based upon the principal ordinaries; *e.g.,* perpendicularly (paly) of so many stripes; or bendy, or barry, or paly-bendy, paly-bendy sinister, barry-bendy, lozengy, fusilly, and so on. Checky is a check pattern of two differing tinctures.

4. Charges of Objects and Animals.—Heraldic charges have increased in variety from the simpler objects, such as lions, dragons, unicorns or eagles, to railway engines, in the 19th century, and to cog-wheels (arms of David Kirkwood, Lord Bearsden) in the 20th. Objects such as railway engines, however, are normally not suitable for heraldic charges. They defeat the objective of ready identification of arms which is a prime purpose of heraldic art.

FIG. 15.—ARMS OF DAVID KIRKWOOD, LORD BEARSDEN

For animal charges (*e.g.,* lions) there are technical terms, such as rampant, statant, passant, guardant, etc., to indicate the stances and positions of the creatures. There are certain rules for their colouring also. On a red ground a lion would always have blue claws, tongue, etc.; and on a blue, green, or purple ground, red.

5. Crest.—Crests are charges borne either upon the helmet, encircled by a coronet or by a silken wreath (usually of two livery colours), or upon the chapeau or cap of estate worn on the helm. Fan-shaped plates set on helmets are known from the 12th century, and on them was often painted a device (*cf.* Richard Coeur de Lion's great seal, *c.* 1198, which has a lion passant on it).

There is little doubt that the crest tended to be restricted to the greater nobles and those around the court, for it came to be an important accessory to the pageantry of the tournament, which only the leading figures of the realm would normally attend. In Germany helm-shows, in which each participant's crest was put on view, were held at the opening of a tournament.

During the great social revolution of Tudor times in England, when new families were thrusting themselves forward, the crest came to be regarded as a necessary adjunct to all coats of arms and was allowed freely. However, some pre-Tudor families still in existence have no crests. In Italy and France crests are not essential, but in Germany they are still considered very important.

6. Motto and Slogan.—Although a motto is not necessarily a war cry there is little doubt that the former has been influenced by the existence of the latter. The well-known war cries of some very ancient houses are their mottoes; *e.g.,* the Fitzgerald *Crom a boo* and the Montmorency *Dieu aide au premier Chrétien.* The

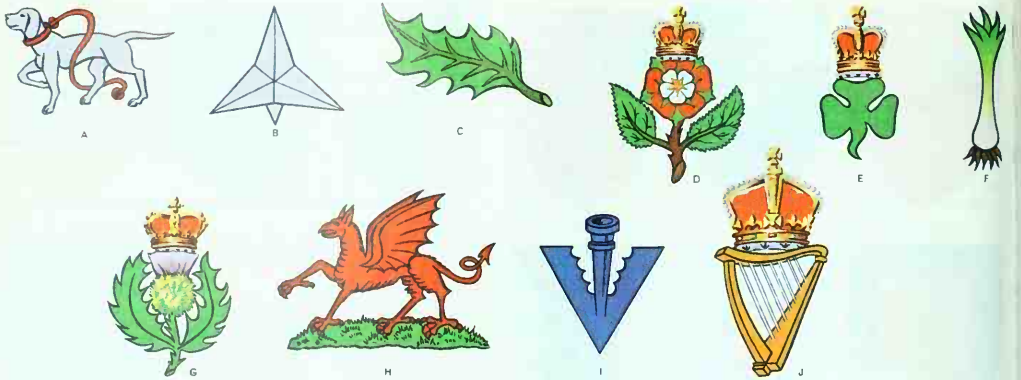


FIG. 16.—BADGES: (A) SLEUTH-HOUND OF DRUMMOND; (B) CALTRAP OF DRUMMOND; (C) HOLLY LEAF OF DRUMMOND; (D) ENGLISH PLANT BADGE OF THE ROSE; (E) IRISH PLANT BADGE OF THE SHAMROCK; (F) WELSH PLANT BADGE OF THE LEEK; (G) SCOTTISH PLANT BADGE OF THE THISTLE; (H) WELSH BEAST BADGE OF THE DRAGON; (I) PHEON OF SIDNEY; (J) IRISH HARP BADGE

war cry, or slogan, as it is termed in Scotland, has always been limited to magnates (peers and chiefs) and was forbidden to all below the rank of knight banneret. In the middle ages (and indeed up to the present) the slogan has distinguished the greater from the lesser nobles in the same way as do supporters (*see* below). That is why the generality of the noblesse were called *nobles d'armes* and the magnates *nobles de cri*.

The war cry, although today often carried on a motto scroll, is more properly displayed on the standard.

7. Wreaths and Banderoles.—Wreaths of twisted silk in the livery colours (which are usually the principal tinctures of the shield) are normally borne on the helm between it and the crest. In earlier times banderoles or helm *streamers* were used, and these are still occasionally granted.

8. Mantle or Lambrequin.—Draped from the helmet is a mantle, often cut into artistic shapes, which today is usually of the livery colours of the shield; *i.e.*, the principal metal and colour. However, in ancient times this rule was not invariably followed, and in modern times the English, Irish and Scottish heralds have allowed the mantling to be of the actual livery colours of the house (which in old families are not always the same as those of the arms) or of other distinctive tinctures. In these cases the wreath is often of the shield livery colours while the mantling is of other tinctures.

9. Supporters.—Supporters appear to have arisen either from ornament introduced into seals to fill the space on each side of the shield, or from pageantry figures supporting the shields of arms at tournaments, or from both sources. In earliest times their use was not in any way controlled, as is the case today in Hungary, where anyone can use supporters if he wishes.

However, in the British Isles restriction of their use gradually developed, and in England they are confined to peers, to knights grand cross of the orders of chivalry (for life) and to important corporations. Ireland follows much the same rules, excepting that supporters are also granted to chiefs of names. In Scotland they are allowed to certain ancient feudal barons, baronets, chiefs of names and important corporations.

Occasionally there is a single supporter and not a pair like the lion and dragon of the English royal arms in Tudor times or the two unicorns of the Scottish royal arms. Single supporters are common in French heraldry and are well known from the eagle supporters of the imperial arms of Germany, Austria-Hungary and Russia. There is a single supporter for the arms of the Scottish city of Perth. When the unicorn first appeared, as a Scottish royal supporter, in the reign of James I of Scotland (reigned 1406–37), it was a single supporter, a unicorn sejant. (James I also had two lions for royal supporters on his privy seal, as did subsequent monarchs until the union of the crowns.) The unicorn continued after his time as a single supporter and is so found with the arms of James IV and James V. Meanwhile, as early as the reign of James III, two unicorns as supporters had been adopted, and they are found on the privy seal of James V. Mary, Queen of Scots, displayed them on her great seal, while retaining the lions on her privy seal. James VI continued to use the unicorns until his accession as James I of England, when he adopted the lion (from the lion and dragon supporters of his English predecessor) as a co-supporter to one of his unicorns.

The unicorn is placed in the senior (dexter) position in Scotland, while the lion occupies this position in England; this has been the usual legal practice since the union. In Scotland, too, the unicorn is crowned, but in England it is not.

10. Compartment.—In most countries, including England and Ireland, the supporters may be placed on any form of ornamentation or upon a grass ground. This, when of a definable character, is called a compartment. In Scotland it is allowed, with or without the supporters, to heads of ancient territorial houses of the realm. Some houses have quite peculiar compartments; *e.g.*, Robertson of Struan and Dundas of Dundas.

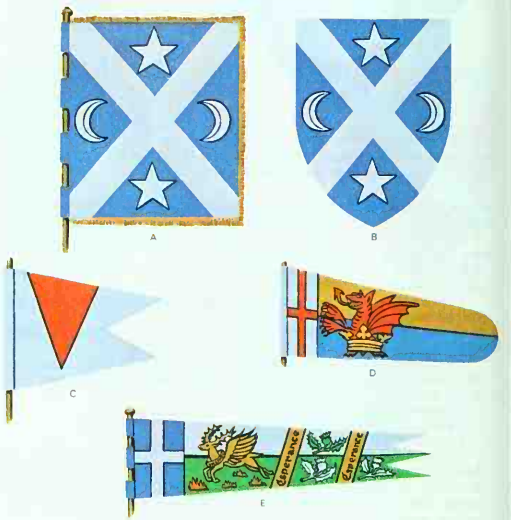


FIG. 17.—ARMORIAL ENSIGNS: (A) BANNER OF HAIG OF BEMERSYDE; (B) ARMS OF HAIG OF BEMERSYDE; (C) PENNON OF SIR JOHN CHANDOS; (D) GUIDON OF MAYSTER COMPTON; (E) STANDARD OF BOURBON OF FRANCE

A shield complete with its ornaments is called an achievement.

11. Badges and Devices.—The badge as an adjunct to arms arose for the purpose of marking property and was also worn by liveried dependents in the feudal forces and retinues. It is likely that more families had badges than had crests, but in the 16th century, when the use of the crest became common, many badges may well have been converted into crests. This probably accounts for the continued use of the badge, even after it became a crest, for its previous purposes. This is the origin of the official Scottish use of the crest within a strap and buckle, bearing the magnate's motto.

There are three main types of badge: first, the beast badge (for instance, the sleuth-hound of Drummond, earls of Perth); next, some simple charge (*e.g.*, for the Drummonds, the caltrap); and, finally, the plant badge (*e.g.*, the Drummond holly leaf). In the regal heraldry of Great Britain the plant badges are the English rose, the Irish shamrock, the Welsh leek and the Scottish thistle. The dragon as a badge for Wales is an example of a royal beast badge. The pheon, or broad arrow, and the Irish harp are examples of simple charges used as badges. Badges are transmitted to the bearer of undifferenced arms.

Monarchs also use cyphers as badges. These consist of crowned initials, with or without a numeral.

All royal houses (as well as many of those of lower rank) have associated with them certain badges, many of which have become well-known and, indeed, famous. Among these are the Knots of Savoy, the Crowned Thistle, the Crowned Rose and the Dolphin. The famous English royal badge that consists of the three ostrich feathers issuing from a coronet and is usually accompanied by the words *Ich dien* ("I serve") has come to be associated with the heir apparent to the English crown—the prince of Wales. The ostrich feather probably goes back to Philippa, queen of Edward III, and from that time onward it was used by more than one of the Plantagenet kings of England. The legend is that the badge was derived from the blind king of Bohemia by Edward the Black Prince at the battle of Crécy, but of this there is no evidence. By Tudor times, although the badge had been widely used among members of the royal house, it came to be associated with the heir to the throne, and by the time of Edward VI was portrayed substantially in its present form.

Such badges as the broad arrow and the crowned cypher are used widely on British government property, pillar boxes, post-office vans and the like. In this connection, also, the use of the crown as a badge should not be overlooked; it appears on the hat badges and uniforms of government employees. In Scotland, the Scottish crown is used as a badge for this purpose on pillar boxes and post-office vans because of the strong popular opposition to the EII cypher.

12. Armorial Ensigns.—These are principally the banner, the pennon, the guidon and the standard.

The banner, anciently, was restricted to magnates (peers, feudal barons, bannerets and chiefs of names). Today this, the most cherished ensign of medieval times, is generally used by all armigerous persons throughout Europe except in Scotland, where it is restricted to magnates.

The ensign used by simple knights was the pennon. On the field of battle, when promotion to the rank of knight-banneret was made, the points of the knight's pennon were cut off to make it into an improvised banner. The pennon is the type of armorial flag which all below banneret's rank can use with propriety.

The guidon, a long, tapering flag, was the cavalry standard. It usually had in the hoist the national cross (St. George, St. Andrew, etc.), and in the fly a principal (beast) badge which, with the field, was in the livery colours.

The standard, which was half as long again as the guidon, was the central rallying flag of the infantry and used in camp for the whole force. It was like the guidon, except that it usually bore more badges.

Other armorial flags are the badge-pennon, the gonfallon and the streamer. (For fuller discussion of these and other types of flag, *see* FLAG.)

13. Canting Arms or Armes Parlantes.—Frequently the coat of arms assumed by a family or public body is allusive to its name. Examples of this will be found in all systems of heraldry. A typical one from the commune of Ticinesi, Switz., is Ponte Capriasca ("Goat Bridge"). There are also Colla (derived from *colle* = hill); Castagnola (chestnut); Castro (tower or castle). (*See* fig. 18).

Occasionally the name is taken from the arms. This is a frequent practice in Sweden, where, for instance, the coat of Spalding

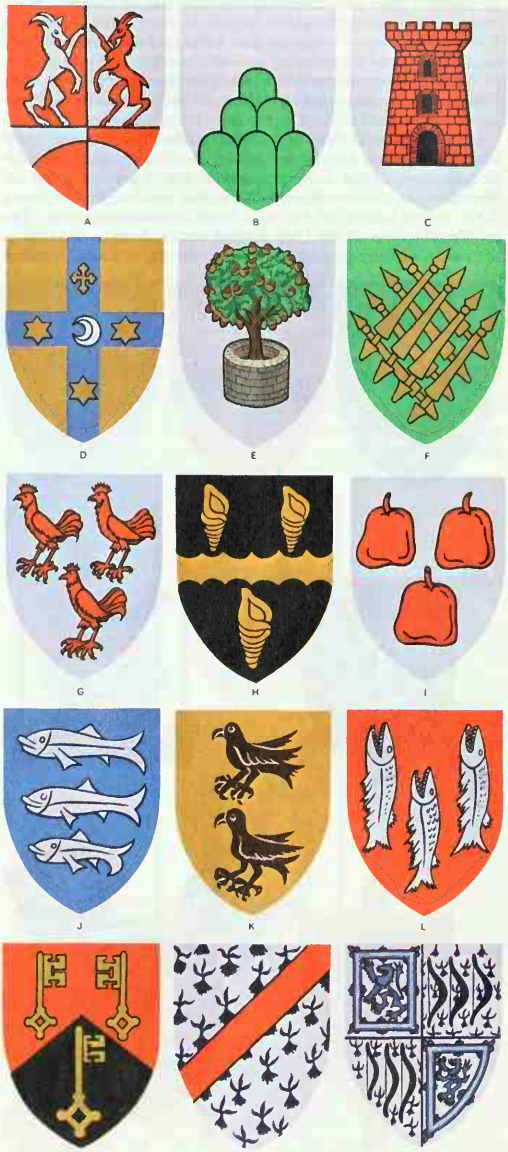


FIG. 18.—CANTING ARMS: (A) PONTE CAPRIASCA; (B) COLLA; (C) CASTRO; (D) SPALDENCREUTZ; (E) WELLWOOD; (F) BREAKSPEAR; (G) COCKBURN; (H) SHELLEY; (I) APPLEGARTH; (J) ROCHE; (K) CORBET; (L) LUCY; (M) KEYS; (N) BARRE; (O) BOWES-LYON

with a cross on it has given rise to the name Spaldencreutz ("Spalding cross").

In British heraldry the following are examples of canting arms: Wellwood, a tree growing out of a well; Breakspear, a brake of spears; Cockburn, three cocks. Others are: Shelley, *sable a fesse engrailed and three whelk shells or*; Applegarth, *argent three apples gules*; Roche, *azure three roaches argent*; Corbet, *or two corbies or*; Lucy, *gules three luces or* (luce = pike; *i.e.*, fish); Keys, *party per chevron gules and sable three keys or*. One of the best-known examples of canting heraldry is that of the British family of Bowes-Lyon: *Argent a lion rampant within a double tressure flory counter flory azure quartering ermine three bows in pale proper*. In French armory there is, for example, the Barre family, with *Ermine a bend sinister* (called a barre in French heraldry). Similar instances can be found in the heraldry of all countries.

14. Allusions to Offices in Arms.—Heraldry may also show allusions to offices held by a family. The English queen's champion quarters a coat *Sable a sword in pale argent pomelled or*. The marquess of Ormonde, hereditary chief butler of Ireland, bears in the second quarter of his arms *Gules 3 covered cups or*. The archchamberlains of the Holy Roman empire bore in pretense in the centre of their personal coats a shield *Azure charged with a gold staff*, which was the badge of office of chamberlain.

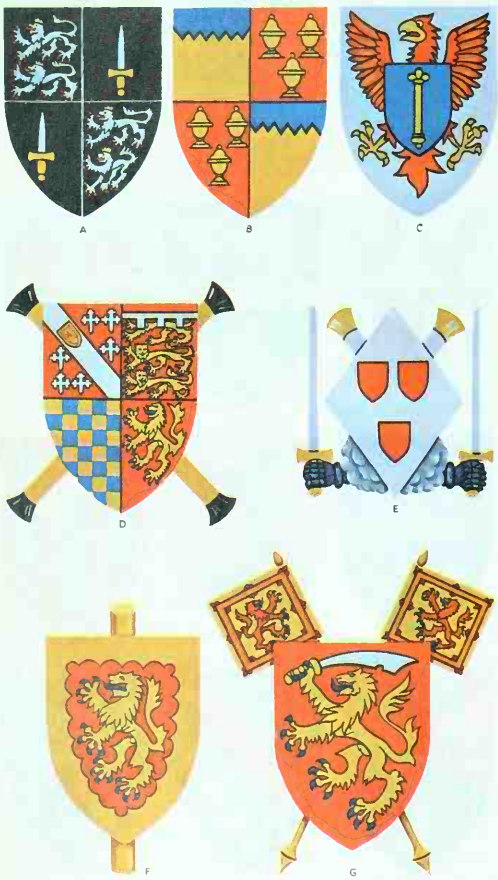


FIG. 19.—ALLUSIONS TO OFFICES IN ARMS: (A) QUEEN'S CHAMPION; (B) MARQUESS OF ORMONDE; (C) ARCHCHAMBERLAINS OF THE HOLY ROMAN EMPIRE; (D) EARL MARSHAL OF ENGLAND; (E) LORD HIGH CONSTABLE OF SCOTLAND; (F) LORD HIGH STEWARD OF IRELAND; (G) ROYAL BANNERMAN OF SCOTLAND

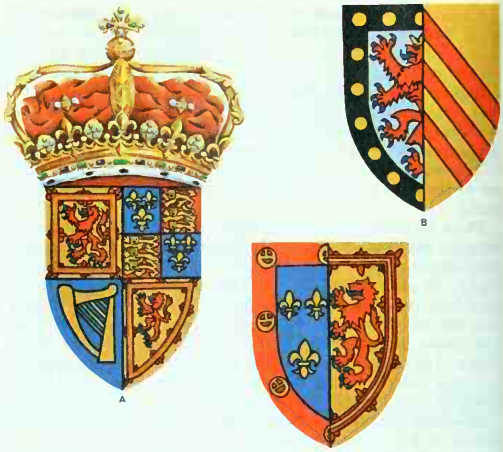


FIG. 20.—MARSHALING OF ARMS: (A) BY GRAND QUARTERS (ROYAL STUART); (B) BY DIMIDIATION (CORNWALL DIMIDIATING DE CLARE); (C) BY IMPALING (D'AUBIGNY IMPALING SCOTLAND)

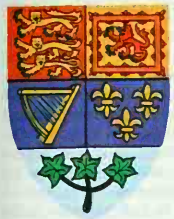
These allusions to office, while a species of canting heraldry, are more related to the quartering of the arms of fiefs. More often than not they take the form of additaments. Thus the earl marshal of England has two batons crossed behind his shield, while the lord high constable of Scotland has in addition a hand on each side (issuant from clouds behind the shield); both hold a sword. The lord high steward of Ireland has an upright baton behind the shield, and the royal bannerman of Scotland bears two crossed banners of Scotland. In France and elsewhere, great officers of state bore similar additaments.

15. Marshaling.—Although at first families only emblazoned a single coat of arms on a shield, the inheritance of fiefs through heiresses occurred, and it became necessary to display the arms of fiefs so inherited in association with paternal arms. This led to various ways of marshaling, or combining arms. At first a new coat composed from all those concerned would be created. This was not very satisfactory, and so there developed the system of quartering and of bearing the arms in inescutcheons. The outcome is that, especially in England and Ireland, the arms of an armorial heiress or co-heiress are borne by her husband, on his own arms, on an inescutcheon of pretense because he "pretends" to her arms. (An heiress, co-heiress or heir portioner is simply a woman who has no brothers to inherit her father's arms; she need have no other inheritance.) Children quarter their father's arms with those of their mother. In Scotland it is more usual for a husband to quarter his wife's arms at the outset and for this to be allowed only where the armorial heiress also brings in some important additional inheritance.

It follows from this system of marshaling more than one coat on a shield that in time many coats can be accumulated. In England the normal process is to divide the shield into as many parts as is necessary to contain all the arms involved. In Scotland marshaling is by grand quarters (*i.e.*, four quarters only); and each of these may be subdivided into four. The royal Stuart arms had this type of marshaling, France and England quarterly occupying one whole quarter between them. In Scottish heraldry it is not necessary to include the arms of all the families through which the inheritance of an important fief may come. In England they must normally be shown. The result is that Scottish-marshaled arms tend to be simpler than those of old English families.

It is the custom for a bishop or the head of any corporation to impale his personal arms with those of his office, to which he is "married," his personal arms being on the sinister side of the shield. This custom arises from the method of temporary marshal-

ing of the arms of husband and wife, even where the wife's arms are not inherited. Originally this was done by dimidiation; *i.e.*, by joining the dexter half of the husband's arms to the sinister half of the wife's. This arrangement was unsatisfactory, however, and was soon replaced by the present system of impaling the whole arms of the wife with those of the husband. (Where one has a bordure, dimidiation still takes place with regard to that subordinary.)



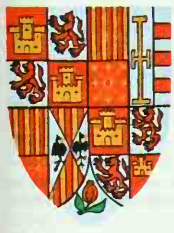


FIG. 21.—OTHER SYSTEMS OF MARSHALING: (A) BASE OF SHIELD AS AN ADDITIONAL QUARTER (CANADIAN ROYAL ARMS); (B) PER FESSE AND PER PALE; (C) TIERCED IN PAIRLE REVERSED (ARMS OF ANSTRUTHER AND KILRENNY); (D) ROYAL ARMS OF SPAIN, SHOWING "QUARTER" WITH POMEGRANATE FOR GRANADA

In England and Ireland marshaling is done very largely to represent heiresses or representation in blood, whereas in Scotland, as on the continent of Europe, the possession of fiefs (not necessarily acquired by marriage) is very frequently indicated by this means. Among English examples of this practice may be mentioned the arms of Thomas Stanley, earl of Derby (d. 1572), who bore quarterly Stanley and Latham in the first grand quarter, and Strange and Wydeville in the fourth, with the arms of Man in the second and third.

In European continental heraldry the methods of marshaling by quartering and impaling are very much supplemented by other systems. Thus in Spain and Sicily quartering per saltire is found. In Spain and Germany arms may be combined by imfessment (*i.e.*, joined by placing them one on top of the other instead of side by side) as distinct from impalement. This method was common in Scotland in the 17th century and emphasizes once more the fact that Scottish heraldry is the bridge between Anglo-Irish and continental heraldry. Such imfessments were not merely alternatives to impalements (*i.e.*, temporary combination of the arms of spouses) but were, as on the continent, intended more for permanent combinations of "quarterings."

In European heraldry the base of the shield (called the champagne) is cut off and becomes an additional quarter (*cf.* the Canadian royal arms, where the champagne is charged with the maple leaf as the quartering for the fief [dominion] of Canada).

Often, especially in Germany and also in Scotland, "quartering" takes the form of dividing the shield into three per fesse and the upper half per pale.

Another method of dividing the shield into three is found, especially in France (and again also in Scotland); this is tierced in pairle reversed (*cf.* the burgh of Anstruther and Kilrenny). Somewhat similar is the system in which the lower third quarter is smaller and the sides are curved (fig. 21 *cf.* the royal arms of Spain).

Spanish and Portuguese heraldry has also the system of surrounding one coat by the bordure of another. This is rarely found in England and Scotland; and, when it is, by way of cadency rather than marshaling.

The combination of English with Scottish coats raises problems in England but not in Scotland, where the English coats would take their place in the system of grand quartering. But when the reverse occurs, and a Scottish grand quartered coat has to be fitted into the English system, whose divisions may number more than four grand quarters, great difficulties can arise. For the quartered Scottish coat is complete, often surrounded by a bordure, and loses its status and meaning if broken up into its constituent arms with each given a separate quarter in the English coat.

In English, Welsh and Irish heraldry, the number of quarterings likely to accumulate in any family can be very considerable, thus defeating the purpose of heraldry, which is clarity of identification. To correct this, many families do not display all the quarterings they may inherit from female ancestors.

Because of the right of heraldic heiresses to inherit arms even when transmitting no estate or fief, it follows that the occasions on which a woman may be the heiress of her mother (although not of her father) are more frequent in the Anglo-Irish than in most other systems. A procedure has had to be devised for these cases, whereby a woman inheriting from her mother places a canton of her father's arms on her mother's and transmits these. Fig. 22 provides a remarkable example of a double instance of such heirship through the female lines.

While in Anglo-Irish and Scottish heraldry the arms of husband and wife (when the latter is not an heiress) are impaled, on the continent of Europe the arms are normally placed side by side leaning toward each other, with the husband's on the dexter.

The same practice, however, occurs in the heraldry of the English-speaking countries when knights and peeresses marry each other. Thus while a gentleman or a knight bachelor impales the arms of his wife, quarters them or puts them on an escutcheon of pretense, a knight of an order must not put his wife's arms within the ribbon, circle or collar of the order. On the dexter will appear the husband's arms with his order, and on the sinister his arms again, impaled with those of his wife. If the knight has supporters to his arms then these are put on the outside of both shields.

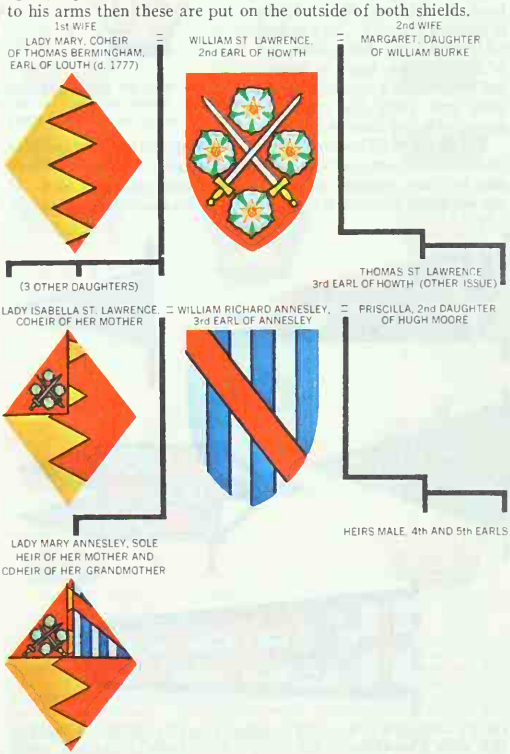


FIG. 22.—HEIRSHIP THROUGH THE FEMALE LINES

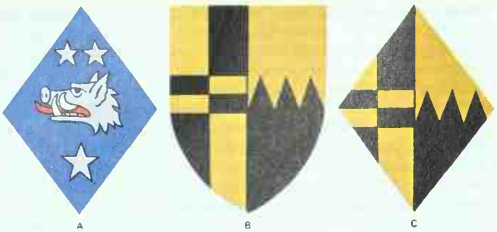


FIG. 23.—ARMS OF WOMEN: (A) LOZENGE OF AN UNMARRIED WOMAN; (B) MARRIED WOMAN (HUSBAND'S ARMS ON THE DEXTER AND WIFE'S ON THE SINISTER); (C) LOZENGE OF A WIDOW

A peer impales his wife's arms, under his helm and coronet and within his supporters. If his wife is a peeress in her own right then his arms, with hers on an escutcheon of pretense surmounted by her coronet, are borne by his supporters; and alongside, on the sinister, her arms, on a lozenge ensigned by her coronet, are borne by her supporters. If a husband is in *nobilitas minor* the same arrangement is followed, but his arms do not carry supporters.

16. Arms of Women.—All women except sovereigns observe the following rules: (1) unmarried women bear the arms of their fathers on a lozenge or oval cartouche, surmounted by a true lover's knot usually in the livery colours; (2) married women marshal their arms with those of their husbands; (3) widows bear the marshaled arms on a lozenge. In many countries of Europe and in Scotland widows place around their arms symbols of widowhood; in Scotland the cordeliere is allowed for this. In England no woman other than a sovereign is allowed crest, helm or motto; but in Scotland a woman who is a chief may carry the crest and motto with her lozenge.

17. Arms of Divorced Persons.—In England husband and wife revert to their arms as borne before marriage. A divorced woman may bear her paternal arms on a lozenge with a mascle added. If she remarries the mascle is removed. In Scotland the guilty party is *civiliter mortuus* and not entitled to the arms of the innocent spouse; the latter bears arms as though the other party were dead.

18. Insignia of Rank.—Rank is indicated heraldically in a variety of ways. Chiefship of a family is shown by the bearing of its undifferenced arms. If it is an important family this is usually shown by additional attributes, such as one or all of the following, according to the laws of the realm involved: guidon, standard, pennon, pinsel, a form of armorial weather vane, compartment, supporters or slogan. Baronial rank is shown by the relevant coronet or chapeau. Higher titles and peerage ranks are shown by the coronets of the country concerned. In each heraldic jurisdiction, too, the helmet indicates the rank of the bearer. Special official positions, such as those of high constable, marshal, etc., are indicated by symbols carried behind their bearers' shields. On the continent of Europe (and sometimes in Britain) a peer, prince or sovereign also displays his arms on a mantle of his peerage or princely rank, and this is surmounted by his coronet or crown.

19. Coronets and Caps of Estate.—In British heraldry there is a series of coronets, divided into two categories: those which do not carry any peerage rank (*i.e.*, which in themselves indicate only *nobilitas minor*, although they may form part of the achievements of arms of peers as well); and those which are of peerage significance and so relate to *nobilitas major*.

Ducal or crest coronet, consisting of three visible strawberry leaves on a gold circlet. This is no longer granted in Anglo-Irish heraldry. In Scottish heraldry it is restricted to clan chiefs.

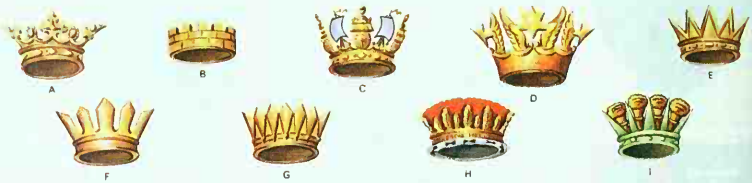


FIG. 25.—BRITISH INCLUDING NOBILITAS MINOR CORONETS: (A) DUCAL OR CREST CORONET; (B) MURAL CORONET; (C) NAVAL CROWN; (D) ASTRAL CROWN; (E) EASTERN CROWN; (F) CROWN VALLERY; (G) PALISADO CROWN; (H) KING OF ARMS CROWN; (I) COUNTY COUNCIL CORONET

Mural coronet, composed of masonry, variously tinctured; in Anglo-Irish heraldry it is restricted to high-ranking officers (it is also, in England, allowed to certain counties and municipal corporations); in Scotland it is allowed to burghs.

Naval crown, formed of three visible ships' sterns alternating with two square-rigged sails; granted to eminent seamen and, in England, to certain cities and towns with naval associations; *e.g.*, Plymouth and Chatham.

Astral or Air Force crown, of modern creation, consisting of three visible stars each between a pair of wings; for distinguished airmen and certain corporations (*e.g.*, British European Airways).

Eastern or antique crown, once restricted to those who had done great services in Asia, is now in more general use.

Crowns vallery and palisado, more freely granted in England and Ireland than in Scotland, where they are allowed only for a special nobiliary reason.

King of arms crown, to which each king of arms is entitled; it consists of nine visible oak leaves alternately long and short, with on the circlet the words *Miserere mei Deus secundum magnam misericordiam tuam* (Ps. li, 1). Lyon king is also entitled to a nonjeweled replica of the Scottish crown.

County council coronet, of four visible golden wheatsheaves between five spikes on a circlet green, is peculiar to Scotland. An English county council uses a mural coronet.

In the British Isles the ranks and accompanying coronets which indicate *nobilitas major* (peerage) are as follows: (1) lords of parliament (lord barons) have resting on a circlet four visible pearls; (2) viscounts, the same with nine pearls; (3) earls, five pearls on tall stems with four strawberry leaves between; (4) marquesses, three strawberry leaves with two pearls on short stems between them; and (5) dukes, five strawberry leaves.

Usually the British peers have a cap of estate (chapeau) inside the circlet with its ermine protruding below.

On the continent of Europe, coronets indicate rank except those used as charges. The mural coronet (*Mauerkrone*) is a burghal crown. Less important towns have three towers, more important ones four, and capital or royal cities five.

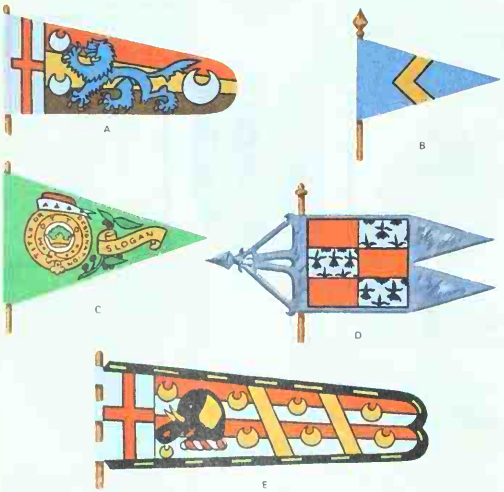


FIG. 24.—INSIGNIA OF RANK: (A) GUIDON (HOUSE OF PERCY); (B) PENNON (SIR JOHN D'ABERNOUN); (C) PINSEL; (D) ARMORIAL WEATHER VANE; (E) STANDARD (MAYSTER FROGMORTON, TUDOR PERIOD)

FIG. 26.—BRITISH NOBILITAS MAJOR CORONETS: (A) LORD BARON; (B) VISCOUNT; (C) EARL; (D) MARQUESS; (E) DUKE

In the Netherlands a type of naval coronet was formerly sometimes allowed to admirals.

The coronets of rank on the continent of Europe differ considerably in many cases from those of Britain. Some of the principal forms are as follows:

In Italy, a patrician bears a plain circlet or a coronet of three visible flowers between two pearls; a *nobile* (gentleman) has a coronet similar to that of a lord. The same rank in Germany and Austria has no coronet unless it is conceded in the patent of nobility; but, in fact, the insignia of a British earl or the crest coronet are used. In Belgium, the Netherlands, Scandinavia, France and Russia, the latter is used by all nobles.

The coronet of a knight in Belgium and the Netherlands is similar to that of an earl, without the strawberry leaves, but has a rope of pearls wrapped round it. In Spain and Portugal this coronet consists of three strawberry leaves, between which are a pair of pearls each on a short stem and between them in each case a cluster of three pearls on a long stem. In France, a knight maintains the ancient insignia of the *wreath*, *torse* or *tortillon*, of two colours, with its ends loose and fluttering.

Hereditary knights in Italy have a circlet surmounted by three pearls; knights banneret in France have a plain circlet.

Barons have: in Scandinavia a circlet bearing three clusters of three pearls each between which are single pearls; in Italy and France a plain circlet enwrapped by a rope of pearls three times; in Spain and Portugal the same with the addition of four pearls; in Austria, Belgium, Germany, the Netherlands and Russia seven pearls on tall stems, with, in Belgium, the alternative of a circlet and cap, and over this four arches. (This is parallel to the use of the cap of estate by Scottish feudal barons.)

Counts' coronets generally consist of nine pearls on long stems (as in Belgium, Austria, Germany, France and Spain) and indicate the origin of the British earl's coronet. In Italy the pearls are set on low points, in Russia on alternately high and low points. In Belgium and France in earlier times this basic form had clusters of three pearls on the middle and outside points.

Marquises in Belgium and the Netherlands have five strawberry leaves on the circlet; whereas in Denmark, Italy, France and Spain there are three, with two clusters of three pearls each between them.

Dukes in France, Italy, Spain and Portugal have four points between the five strawberry leaves; in the Netherlands and Belgium three strawberry leaves with two pearls between them.

20. Helmets.—When helmets were used in war, their various forms were evolved for practical reasons and no particular significance was attached to them. But with the gradual disappearance of armoured warfare and the confinement of armour chiefly to the tournament, which was ceremonious and governed by exact rules of protocol, there developed the signification of rank by various outward forms of display. By the time heraldry came to be codified in the 16th and 17th centuries, particular positions and forms of helmet had come to be allotted to each rank of society. In France it was the rule that the newly ennobled could not use a helm at all, and only those who had become *gentilshommes*, after three generations of nobility, were allowed them. In Scotland this same rule was followed.

By the 17th century the rules as to the forms of helmets in France had come to be as follows: (1) gentlemen, a closed, or almost closed, vizored helmet in profile; (2) knights, barons and higher ranks, helmets with varying numbers of gold grilles, at angles from profile to full face, according to rank; (3) royalty, an open facing helmet. In modern France the noblesse tend to use grilled helmets, and helms are denied to others. In most Germanic countries the plain, side facing steel helmet is employed for anobli, whereas the grilled helmet is for noblesse. In Italy a side facing steel helmet is for families of proved civility. Noblesse have silver-ornamented helmets with a collar and medallion, while higher ranks employ grilles and gold ornamentation.

In British heraldry the established forms of helmets are: (1) Gentlemen, in England and Ireland, a closed steel helmet in profile; in Scotland, a pot helmet with central bar and without gold embellishments. (In Scotland the helm, whatever the rank, faces the direction best suited to the crest, and this practice appears to be spreading in England.) (2) Esquires, for Anglo-Irish, the same as above; in Scotland the steel tournament helm, or pot helm with one gold grille. (3) Scottish minor barons and chiefs, as for esquires. (4) Knights, full-faced open-vizored steel helmet. (5) Peers, a silver helmet, usually with five gold grilles. (6) Royalty, gold full facing helmet with gold grilles.

21. Value of Heraldry in Historical Studies.—Because heraldry arose for the purpose of identifying the nobles in the musters and on the fields of battle, and because arms therefore came to be associated with heroic deeds, it was natural that they should have been used also on the monuments of the great. Consequently, heraldry is an essential adjunct to all historical, topographical, architectural and archaeological exposition and research. Without knowledge of it, for example, the builder of a church often cannot be identified; nor can the marriage alliances of many important people be discovered. Therefore, in medieval English historical research, it is necessary to know what were the arms, for

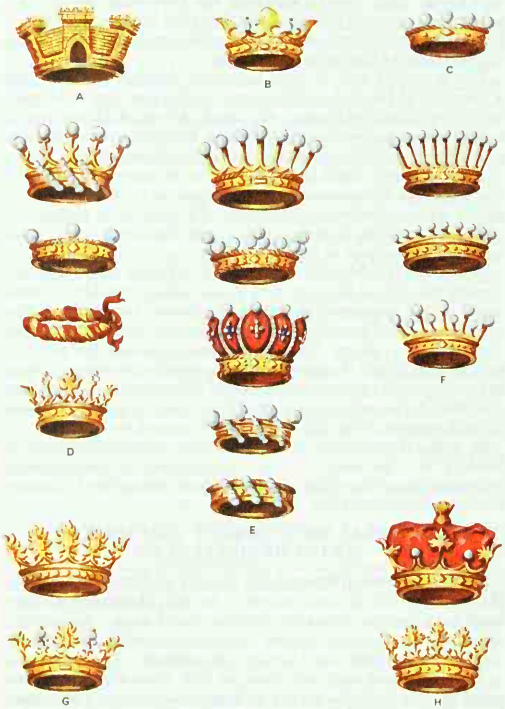


FIG. 27.—CONTINENTAL EUROPEAN CORONETS

(A) Mural coronet with towers. (B) Italian patrician's coronet. (C) Italian noble's coronet. (D) Knights' coronets: (top to bottom) Belgium and the Netherlands; circlet, hereditary knight, Italy; tortillon, France; Spain and Portugal. (E) Barons' coronets: (top to bottom) Austria, Belgium, Germany, the Netherlands and Russia; Scandinavia; cap and circlet, Belgium; Spain and Portugal; Italy and France. (F) Counts' coronets: (top to bottom) Austria, Belgium, France, Germany and Spain; Italy; Russia. (G) Marquises' coronets: (top) Belgium and the Netherlands; (bottom) Denmark, Italy, France and Spain. (H) Dukes' coronets: (top) Belgium and the Netherlands; (bottom) France, Italy, Spain and Portugal

FIG. 2B.—HELMETS (A) GENTLEMAN IN FRANCE; (B) KNIGHT IN FRANCE; (C) BARON IN FRANCE; (D) GENTLEMAN IN ENGLAND AND IRELAND; (E) GENTLEMAN IN SCOTLAND; (F) ESQUIRE IN ENGLAND AND IRELAND, CHIEF AND BARON IN SCOTLAND; (G) KNIGHT IN ANGLO-IRISH HERALDRY; (H) PEER IN THE BRITISH ISLES

instance, of Lord Bourchier, knight of the Garter, who died in 1431, or those of Lord Basset of Drayton, who died in 1390; while the pedigree of the Beauchamp family and the relationship of its branches one to another, with monuments concerning each, can only be worked out from a heraldically compiled pedigree, showing the arms of each person and branch. The association of arms with heroic deeds, to which allusion has been made above, may be seen in the arms of Douglas (containing the heart of the Bruce), Howard (with the augmentation of Flodden) and Nelson (with the augmentation of the battle of the Nile).

This is equally true in other countries. Without a knowledge of the arms of Douglas, earl of Angus; of Dunbar, earl of March; or of Randulf, earl of Murray, etc., much of Scottish history would be lost or remain inexplicable. Without knowledge that a serpent swallowing a child was the charge of the arms of the Visconti, dukes of Milan, not only would Italian history be the poorer but so would that of many a Swiss town where these arms are to be found carved on the walls of important buildings. The successive patrons of cathedrals can often be ascertained only by their arms, or by papal arms, upon some part of the work.

22. Nobiliary Aspects of Heraldry.—Yet no matter how attractive may be the historical and artistic side of heraldry, it continues to be a living reality through its nobiliary functions. Without them it would have been no more important than some system of rebuses or cyphers. However, because arms are the signs of authority (public in the case of states, monarchs, municipal bodies and corporations; private in the case of individuals), heraldry has continued to be administered, and it remains a subject capable of legal interpretation and adjudication in most realms.

In order, therefore, to understand these essential functions of heraldry, it is necessary to study more closely its development, its association with nobility and its ultimate principles of administration and interpretation.

III. GENERAL DEVELOPMENT AND MODERN STATUS OF HERALDRY

1. Noble Status Obtained Previously to Ennoblement by the Crown.—In the early stages of heraldic development there could have been no laws governing the use of arms. Arms originated among great and ancient families, frequently of princely rank, and spread downward through the noblesse. The limitations on their use could only have been, at first, those which were imposed by feudal custom on the noblesse among whom they arose. It follows from this that the ancient noblesse adopted and discarded arms as they saw fit, until the clearly hereditary character of arms became established.

Thus the original noblesse had an unquestionable (*i.e.*, prescriptive) right to assume arms. That this is so is made clear by the earliest legal authority on heraldry, Bartolus de Saxoferrato (1313–57), in his *Tractatus Bartoli de Insigniis et Armis*. He was attached to the court of the emperor Charles IV, by whom he was granted arms, *Or a lion (rampant) double-queued gules*, and made a count palatine and counsellor. Bartolus says that anyone had the right to assume arms, besides having the right of redress against any who might later adopt the same coat in the same jurisdiction. This was the common law of most realms of Europe at that time.

However, Bartolus adds that arms granted by a prince were to be considered of the highest authority, and that they took precedence of those assumed by a man's own authority unless these had been borne long before, in which case their owner had the right to object to their being bestowed on another. Thus by the 14th century there had been a transition from the method of assumption of arms by prescriptive right to that of the control of arms by rulers. Indeed, the sovereign's power over arms had so increased that persons already armigerous had to justify their claim to arms before him, whenever there was any question of arms which they considered theirs being granted to others.

In England, by 1417, there was the writ of Henry V addressed to the sheriffs of the shires, forbidding anyone to carry arms unless he had them by right of ancestry or by the grant of lawful authority, excepting only persons who had fought at Agincourt in 1415. This probably meant that these last arms, whether acquired by ancestry, grant or personal prescriptive assumption, had been enrolled in 1415, and that no further evidence of right to them need be advanced by their bearers.

Thus, by the early 15th century, it is clear that the prescriptive right to arms had come to an end in England; and, since English developments were largely paralleled by those on the continent of Europe—because heraldic law was grounded on the civil or Roman law, which was common to all continental Europe—it may be assumed that prescriptive right was dying out on the continent too.

By the 16th century it was the rule practically everywhere in western Europe that new arms could be acquired only by grant from the sovereign. This is implicit, *e.g.*, in the Scottish act of 1592; but by the act of 1672 the king of arms could grant arms to "virtuous and well-deserving" persons (*i.e.*, to those who held noble charges, although the modern interpretation of this provision is broader). In England, despite the lack of such statutes, the heralds proceeded in their visitations on identical law and theory.

2. Administration of Arms; the Heraldic Authorities.—The compound Germanic word *herold* means both "army" and "sway." Among the early duties of heralds were the recitation of the deeds of magnates and of their ancestors. Pursuivants were the followers of the heralds. The earliest mention of heralds in French literature, for instance, in the 12–13th centuries, is in connection with the announcement and summoning of tournaments, the proclamation of each joust and the name and condition of each combatant. Out of these early functions grew the later ones of recording the names, styles and ultimately the pedigrees of leaders and ambassadors. Nevertheless, for a long time after the development of these powers the granting and control of arms lay only with sovereigns.

Gradually, however, the sovereign delegated to the principal heralds (*i.e.*, the kings of arms) the enrolment of the arms, first of the fighting gentry and later of all the noblesse, and from this developed the heralds' powers of matriculation or enregistration. Ultimately, when the crown ceased to grant arms direct, its powers were delegated to the kings of arms as commissioners, with authority to issue letters patent.

The growth of these duties and powers was gradual. In England, even at the time of the Scrope and Grosvenor dispute (1385–90), there is no mention of a herald being involved. Nevertheless, as early as 1386 and 1398–99, the authority of the heralds was beginning to be established, for there are grants of Lancaster and Bardolf heralds in those years. In 1420 William Bruges, already Guienne king of arms, was appointed the first Garter king. From 1439 he was issuing letters patent. A patent of his, the earliest known to survive, is the grant to the Drapers' company, London, in that year. Its terms have been shown to be in fact a grant *ex proprio motu*. From this it is clear that in England by this time the king of arms was established as a commissioner for *nobilitas minor*. Also there were several kings of arms for England's overseas possessions; *e.g.*, Guienne (mentioned above), Aquitaine and Anjou. In 1725 George I created Bath king of arms, with the

right to grant arms in Wales; but this office was later annulled.

In Germany the heralds were divided into kings of arms, heralds and pursuivants, as in England. They had such titles as *Romreich* (an imperial herald) and *Deutschland*. *Suchenwirt* was herald of the ducal house of Austria. In France, the ten heralds and pursuivants were controlled by Mountjoye king of arms; and in 1406 Charles VI formed them into a corporation. This was the model for the later English incorporation of the College of Arms under Richard III in 1484; but this was canceled by his successor, Henry VII, and the present incorporation dates from 1555. His incorporation was by a charter (*Literae de incorporatione heraldorum*) in which are mentioned Garter king of arms for the English, Clarenceux for the southern parts of the kingdom, Norroy for the northern parts and Gloucester for Wales. (Wales no longer has its own king of arms.)

In Portugal there were at first two kings of arms, but later one was created for the Indies. A famous herald of the Low Countries was Gelre of the duke of Gueldres (*c.* 1371). The painting of this herald in the *Armorial de Gelre,* wearing the armorial tabard, shows the age of this costume, still worn today. Sweden had the royal Swedish herald (king of arms). In Ireland the king of arms eventually became known as Ulster, and his successor, in the Irish republic, is the chief herald of Ireland.

The great orders of knighthood had their own heralds; *e.g.*, the king of arms of the Golden Fleece. The Swedish order of the Seraphim had its herald, as did the orders of the Sword and of Vasa. The Sovereign Military Order of Malta still has its heraldic organization, while St. Lazarus of Jerusalem has a judge of arms in each priory and bailiwick.

Magnates too had their heralds and pursuivants, some of whom still exist. Thus Sir Richard Nanfan had Serreshal; and there were Chandos of Sir John Chandos, Vert Eagle of Nevill, Esperance and Crescent of Percy. There are still Slains of the earls of Erroll (lord high constables) and Eagle of the earls of Derby.

There are certain significant differences between the Scottish and English heralds as well as between Scottish and English heraldry. The Scottish heralds are still "familiar daylie servitors" of the crown. The lord Lyon is a great officer of state (not subordinate to an earl marshal), the supreme officer of honour and *conseiller du roi* in all matters armorial, genealogical and ceremonial. In consequence he has the title of right honourable (since 1554) and of lord (since 1663), and holds his appointment as a fief of the crown. The lord Lyon has within his power everything that appertains to chiefship of name and arms and, in addition, to changes of name by all bearers of arms. Finally, as controller of her majesty's messengers at arms, he is the head of the whole executive department of the law in Scotland. The English kings of arms have less extensive powers depending from the earl marshal, do not exercise judicial powers and cannot change names. Their functions are otherwise, however, much the same; *e.g.*, they record arms and pedigrees, grant arms, take part in high ceremonial, settle matters of precedency and so on.

The heralds of England and Scotland still wear the full dress of the tabard, with the royal arms of the United Kingdom on it. The Scottish heralds have also a blue service uniform similar to that worn by Lord Lyon Brodie when he accompanied the duke of Cumberland in 1746 during the campaign of the second Jacobite rising.

3. Heraldic Visitations.—In order to correct abuses of arms within the various heraldic jurisdictions during the 16th and 17th centuries, a number of heralds were called upon to carry out visitations, as, for instance, in Piedmont, Italy. The Scottish act of 1672 likewise gives such powers. But nowhere was visitation done so thoroughly as in England. The English visitations proceeded on the basis of a notice to the sheriffs of the counties, to order those bearing arms to assemble at certain administrative centres in their shire with proofs of their descent and right to arms for demonstration before the visiting heraldic authority.

4. Rise of the New Men.—The great activity which occurred in heraldic administration through acts of parliament (in Scotland and the Netherlands) and through visitation (in England, Piedmont and Ireland), and the rapid evolution of the kings of arms from mere heraldic officers of a sovereign to commissioners for nobility, granting arms of noblesse under their own seals, was largely due to the vast social changes of the 15th and 16th centuries. There were, for example, the destruction of the ancient noblesse by the Wars of the Roses in England, the great increase of wealth in the hands of overseas adventurers (in England, the Netherlands, Spain and Portugal), and the effects of these changes on other realms not directly affected.

The new men were wholly dependent upon the Fountain of Honour for their advancement. They were not of the ancient nobility and could not claim any prescriptive right to arms. Consequently, the transition from the position in the time of Bartolus (14th century) to that in the reign of Henry V (15th century, when prescription was beginning to be denied as a right to new men) was completed by the 16th century, when a grant alone remained as the means of acquiring arms.

With the passing of the prescriptive right of the ancient noblesse and the attainment of complete control by the sovereign, there died also the right of great nobles (*e.g.*, peers and chiefs) to grant arms or augmentations of arms to their followers.

5. Character of the Grants of Arms in Ancient Times.—Thus far the evolution and status of arms in the western countries of Europe have been discussed; and there can be no doubt that these arms were signs of nobility, despite the fact that nobility existed before arms and could exist without them in certain circumstances. Arms were not necessarily everywhere of equal status, however. In Austria, for instance, they could be granted without nobilitation. The Wappenbürger families had arms of this description, and similar arms existed in Italy as arms of citizenry. Austrian arms of this kind were a concession from the crown; and since they were controlled by the office of arms and the achievements were recorded in the sovereign's official registers of nobility, it is clear that they conferred some status, although not that of full nobility. Evidence of this appears from Italian practice, where such arms, when recognized by the crown, are called those of proved civility.

Of a higher status in the towns were the arms of patricians, as, for example, in Constance, Brescia, Bergamo or Venice. Although the bearers of such arms did not depend for their status on the possession of a fief (and so were not feudal nobility) but on their membership of their city senates and on the recording of their arms in the civic golden books, yet they were accepted by the noblesse as equals in rank. The arms of citizenry appear to have been assumed by families who had achieved some status in their city and who had begun to occupy noble offices. At this stage they often married into established patrician houses and gradually grew to be accepted until, after several generations, they were elevated to patrician rank. In consequence, arms of distinct civility have some of the characteristics of those of the anoblis, who, although ennobled by patent, are not accepted as gentlemen until three generations have passed.

In Hungary citizens used shields of arms and these were not recorded in the royal registers.

In Austria (especially in the Tirol) and in Switzerland, arms of petty landowners are found, so-called "peasant arms." Like Wappenbürger arms, these must have conveyed some status, otherwise there would have been no demand for them; but they were of lower than noble rank.

In France, citizens were allowed arms, but at first without helms, for these were restricted in most western countries to the established noblesse as distinct from the anoblis. This state of affairs was somewhat comparable with that pertaining in Italy. Such arms tended to proliferate, and more than once the French monarchs had to restrict them. Yet, in 1696, Louis XIV allowed a general registration of arms to all and sundry in order to raise revenue for war. This action was disowned by Louis XV in 1760. Despite a considerable amount of ambiguity, the fact remains that, generally speaking, arms which were recognized by the crown were noble in status. This is seen by the ultimate method of achieving such status, which was for the petitioner to become an extraordinary secretary to the king (a noble charge); and in that capacity to receive arms.

Therefore, up to the 17th and 18th centuries, there is no doubt that arms conferred or recognized by the crown were normally *tesserae nobilitatis* or, in certain states where they were not, as under the empire, at least conferred recognition of a certain civil status. In other states, arms not specifically noble (as, for instance, Italian arms of citizenry and probably, often, arms of French citizens) approached in status arms of anoblis, and were borne or tolerated because their bearers were holders of noble charges.

That merchants may have used devices on shields (as in many Dutch towns) does not affect the issue. The "arms" of commercial families were of no more significance to the crown than so-called "arms" (*i.e.*, trade-marks) on the bonnets (hoods) of mass-produced motorcars or than those merchants' marks which were sometimes put on shields. However, in countries where the sovereign or the noblesse were strong, even such "arms" as these were not possible.

6. Heraldic Courts; Courts-Martial or Courts of Chivalry.—In most realms courts-martial existed before heraldic officers became their principal members. Their purpose was to deal with all questions pertaining to the laws of arms (*i.e.*, to the duel, whether conducted by single combat or by tournament) and to the settling of military disputes in general. The tournament, which incorporated the most formalized and legalistic aspect of the duel, was governed by very stringent laws.

The need which created the courts-martial for the regulation of the conduct of persons involved in war under the laws of arms survives into modern times, and its requirements are now met in the military courts-martial in the armies of the world.

At first the courts-martial were presided over by the monarch or the grand officers of state, such as the earls marshal. With the passage of time, however, the heralds became the principal officers and practitioners before these courts, through their supervision of nobiliary records. Gradually, therefore, the law of arms became more and more concerned with nobiliary law, and particularly with rights in and succession to armorial bearings.

The courts of chivalry continued to supervise dueling long after the tournament was discontinued. This is conclusively shown from the proceedings in the English earl marshal's court as late as 1688, when cases were still coming before it for causes "of scandalous words provocative of a duel." But the likelihood of provocation of a duel was most likely to centre upon doubts as to whether a person was a gentleman (*i.e.*, a noble) or not; and conclusive proof one way or the other lay in the production of his pedigree and arms before the court.

In Scotland the court of chivalry is her majesty's Lyon court, which, unlike the English earl marshal's court, is continuously in session. In Spain, too, there is a heraldic judiciary somewhat similar to that of Scotland. The Scottish Lyon court exercises both a civil and a penal jurisdiction under the old common law of Scotland and under Scottish parliamentary statutes. Its duties are to establish rights to arms and pedigrees on the basis of which an interlocution (provisional judgment) can be granted either to record them in the court registers or to protect the rights of private persons, corporate bodies and the crown. The unauthorized use of another person's arms is a "real injury," and the court can pronounce an interdict against the offender. The court has powers of fine, imprisonment and *horning* (forfeiture of freedom on failure to pay a debt or fine) and power to erase unwarrantable arms. The ministerial functions of the lord Lyon are different, and consist of the granting of arms, of birthbrieves and of diplomas of nobility or chiefship.

In Sweden, heraldry is administered by a branch department of state under a state herald or *Statsheraldiker*. In Italy the equivalent government department used to be the *Consulta araldica*, but the noblesse later set up their own institution, to which King Humbert accredited his minister for heraldic affairs; and the functions of the *Consulta araldica* are still carried on by this council. In the Republic of Ireland the heraldic officers function in the former Ulster office (now the Genealogical office) in Dublin castle. In Switzerland too there are official heraldic officers.

In several republics, where no heraldic administration has survived, there are many imposters, both in arms and in titles, for there is nothing but public opinion to restrain the bogus. In France, by contrast, there is complete protection before the civil courts for all arms legally recorded under the monarchy. (*Cf.* a case, Dec. 20, 1949, in the court of Paris, where a champagne company, having discovered arms upon one of the chimneys on its premises, printed them on labels. The family to which the arms belonged sued the company and obtained judgment.) In French law, to use a man's arms is the same thing as using his name, and is therefore an offense which can be brought before the civil courts.

7. Prescriptive Right to Arms in the 20th Century.—Some have argued that the prescriptive right to arms still exists; and this doctrine is enunciated by some armorists in the United States, France, Germany, Finland and even Sweden.

It has been seen that prescription came to an end from the 14th century onward. By the 16th and 17th centuries, vigorous steps were being taken in more than one realm to put down the abuse of self-assumption of arms. Where the heraldic authorities have continued with unimpaired legal rights, as in Scotland, the proposition of the survival of prescriptive right is not even arguable. In England the law of arms can be exercised through the earl marshal's court, while in Sweden the state does not recognize any self-assumed arms.

In the republic of Italy, where there are provincial heraldic councils under a supreme national council for the purpose of carrying on the work of the *Consulta araldica* (*see* above), no self-created arms are recognized by this body. Since the basis of prescription is the recognition by his equals and superiors of the arms assumed by a man, it is obvious that refusal of this by the whole corporate nobility of Italy invalidates any individual's pretensions to prescriptive right.

In Germany and the United States it is argued that anyone may be his own herald. The weakness, however, of all claims to arms on this basis is the fact that the conditions in which prescription can exist are lacking. In the first place, if the United States be taken as an example, the government does not recognize officially any titles or arms. Second, there does not exist a noble society to accept or reject any man's prescriptive pretensions. Furthermore, inherent in a society where prescriptive right could be established, there was always the possibility of legal arbitrament (by duel or litigation) when any party claimed that his rights were infringed by another; but in the United States there is no arbitration machinery for this purpose.

In France, where the right to arms can still be maintained in the courts of law, it may be said that there still exists a prescriptive right. But the difficulty is to see how such arms could be protected at law, especially as French law gives no protection to the use of crest, helm and coronet with such assumed arms, because these are looked upon as the prerogatives of the noblesse.

8. Continued Status of a Coat of Arms.—There can be no doubt that in England, down to the 17th century, a coat of arms constituted insignia of noblesse, as it had throughout the middle ages. A grant of arms from the sovereign direct (or through the crown's commissioners, the kings of arms) was a patent of admission into the rank of minor nobility.

Owing to the failure of the English court of chivalry to exercise its jurisdiction from 1737 onward, the understanding of the significance of arms in England gradually declined. As it was possible to argue that prescriptive right existed, so it was also possible to maintain that arms did not signify any rank. The one idea naturally arose out of the other; for if any man could create his own arms, then obviously arms were meaningless.

This argument, however, is fallacious, because it cannot be shown that the legal significance of a modern coat of arms is not the same as that of one granted 500 years ago. Furthermore, it cannot be said that arms are granted now more easily than in past ages, while in point of fact knighthoods and peerages are. Although the whole currency of titles has declined in value (because they are enjoyed by a larger proportion of the people than formerly), that does not affect their nobiliary status, which remains the same as in ancient times. It cannot therefore be argued that the status of arms has changed, when grants have not proliferated.

It has been said that arms are bought, because fees have to be paid for them—but fees were required also for all ranks of peerage until the 20th century. Fees have still to be paid by knights of Malta, St. John and Constantine St. George; but they are none the less knights for that. It has been argued that the English kings of arms cannot ennoble; but they are exercising the sovereign's commission in *nobilitas minor*. The lords lieutenant in Ireland (who were commissioners for the crown) actually made knights, including hereditary ones. A Scottish grant has continued status as a diploma of nobility; while in 1941 it was pronounced that arms are feudal heritage and constitute an "armorial fief." The surname then becomes a *nomen dignitatis nobilitatis minoris*. In Sweden a grant continued to be associated with noble status until the beginning of the 20th century, when the title of nobleman was still conferred, and up to the middle of the century in connection with knighthoods. Generally speaking, wherever the state either grants or recognizes arms they are regarded as insignia of noblesse.

9. Proofs of Nobility.—The international orders (Sovereign Military Order of Malta, Venerable Order of St. John, Constantine St. George and St. Lazarus of Jerusalem) all have regulations on the proofs of nobility, and all proofs admitted by them are based upon arms.

10. Cadency and the Armorial Family.—At a very early date in the development of heraldry there grew up the conception not only that arms were heritable but that all a man's descendants inherited armorial rights in his arms.

In practice, however, there was a very pressing need for a given coat to denote a single individual, whether it was depicted on his shield in the herald's rolls at a beginning of a campaign, on the battlefield, in the tournament or on a seal. This was found easier to achieve through the differencing of the ancestral coat of arms than through the allotment of a different coat to each descendant; and thus arose the concept of the armorial family The heir by primogeniture or designation (tanistry) inherited the ancestral arms and was the chief of the arms of his name. The arms became the tokens, evidence and title deeds of that name (*see* below).

The methods adopted to difference arms were not at first governed by any clear rules, but in time they developed into the two basic systems of major and minor brisures. The major system consisted mainly of the addition to arms of labels with varying numbers of points, plain or charged with other symbols, and also bordures. Cantons or quarters were also used and sometimes inescutcheons were added; in other cases the field or the charges or both had their tinctures changed. In time this method of major brisure cadency became systematized, and by the 15th and 16th centuries there had evolved the basis of the existing so-called Scottish system, which bears this name not because it is found only in Scotland but because it is more thoroughly enforced by the Scottish heraldic administration than by any other. Under this system, a basic ancestral coat is capable of indefinite variation to distinguish every cadet of any line or branch, with his relationship to the rest of his kin and the position of his branch within the larger family.

In addition to this major brisure system there is that of minor brisures; *i.e.*, the so-called English system. This consists of putting minor marks on a shield to indicate the order of sons within a family; *e.g.*, a crescent stands for a second son, a mullet for a third, etc. In ancient times this was used, along with the system of major brisures, to denote the sons of a family, and these differences as a rule became hereditary only where the character of the arms and the limited number of branches of the house allowed the use of such simple devices. The system is so unfitted for the recording of cadetship in a great and numerous familial organization that all armorists are agreed upon its inadequacy. It arose in France and fell into disuse there as an independent system for that very reason.

In England, however, it was the system of major differencing which fell into disuse; only that of minor differencing survived. This was probably due to the destruction of the feudal nobility in the Wars of the Roses and their replacement by new men who did not need a system of cadency to differentiate widely spread branches of an ancient house. They needed at most the simple minor marks to ornament their brand-new shields of arms. By the time they had accumulated sufficient generations to need any more thorough system of cadency, the application of major brisures had fallen into desuetude in English heraldry and, consequently, the English heralds tried to make do with minor brisures.

In such jurisdictions as Italy, France, Spain, Portugal and the Netherlands there are clear indications of the general use of brisures. But in some others, such as Germany, they are rare, although not unknown. As far as Germany is concerned, this is probably due to the fact that inheritance often followed the mode of gavelkind, wherein all sons shared equally in the inheritance, without the modifications found among the Celts. Therefore when German cadets came to distinguish their armorial bearings they did not do it so much by changing the arms (for they were all equal heirs-portioner) as by adding a different assemblage of crests to each undifferenced shield.

In Italy, despite the lack of any legal machinery for the administration of arms in the republic, more than one case of the application of major brisure cadency to arms is known. Consequently, it should not be thought that the surviving application of cadency is limited to British heraldic processes.

11. Arms as Feudal Heritage.—Medieval users of arms were all possessors of feudal fiefs, from which more often than not they drew their surnames. It followed therefrom that the arms that became associated with a particular name had also an association with the principal fief of that name. From the association of a coat of arms with a *noble terre*, or fief noble, there grew up the concept that, just as in most realms the possession of such a fief ennobled its possessor, so also the acquisition of arms, which originally had this intimate association with a feu, might itself equal the obtaining of a *fief anoblissant*. Therefore arms were feudal heritage and ennobled their possessor; and this is still the unmistakable law of Scotland. Arms thus became the title deeds of nobility and that is why, in the great orders of knighthood, they are accepted as the principal basis for proof of nobility. Arms in fact became a feudal fief and, as such, a piece of property; and that fact was established by expensive litigation as late as 1922, when the case *Stewart-Mackenzie* v. *Fraser Mackenzie* actually reached the house of lords.

When it is realized that arms are feudal heritage it can be seen how essential it is that they should be differenced by cadets, in order to ensure that these do not claim the representation of the armorial fief of their chief. At the same time, through their chief's armorial feudal heritage, they inherit their portion in their differenced arms and this in its turn is a feudal fief, holding of the chiefly arms.

In the light of this can be seen the consistency in the Germanic principle of not differencing the arms. Because gavelkind inheritance gave all sons equal rights as heirs-portioner in the original ancestral territorial fief and the arms of that fief, all inherited the arms undifferenced. But in western Europe, where primogeniture or tanistry dominated the principles of inheritance, the territorial fief went only to one son, and so the relevant arms were inherited only by one person.

There is not, therefore, in the laws of arms of most of the western European nations such a thing as a "family coat of arms" in the sense that all cadets of the original bearer can use them without any reference to higher authority.

In the late 1950s a pronouncement was made to the effect that Irish heraldry is not bound by the same rules as English, and that any member of a sept can use his chief's arms (E. MacLysaght, *Irish Families*, 1957). But this is quite inconsistent with the practice of the Irish kings of arms, whose records furnish abundant evidence of the use of cadency in Ireland. In Hungary, on the other hand, members of certain "noble tribes" of the Magyars all bear the same arms. But heraldry came very late to Hungary, and conditions there were not identical with those in western Europe, so that Hungarian customs do not establish any rule for western heraldry of feudal or modern times.

12. Arms of Bastardy.—The Celtic and Germanic tribes whose leaders formed the original nobility of western Europe paid little

FIG. 29.—ARMS OF BASTARDY: (A) BORDURE WAVY. (B) BORDURE COMPONY. (C) BATON COUPED SINISTER

regard to illegitimacy. The church, however, did, and consequently opposition was placed in the way of illegitimate succession. Nevertheless the two forces—the feudal and nobiliary law deeply rooted in practices outside the Roman world on the one hand, and the church and the civil law on the other—had to find a modus vivendi. Where church appointments and preferments were concerned, this was achieved by ecclesiastical dispensation of the illegitimate person, so that he could enjoy the emoluments from which, strictly speaking, he was absolutely debarred.

In view of this it is not surprising to discover these two opposing principles operative where arms were concerned. Both civilian and canon lawyers held that the illegitimate person had no rights and no beginning; and this harsh law has entered into the common law of England. On the other hand, actual feudal practice was absolutely at variance with this concept. Bastards succeeded to their father's fiefs, the most notable instance of this being the inheritance of the duchy of Normandy by William the Conqueror. Even baronies were inherited by illegitimate descendants, and bastards were admitted to the great orders of knighthood, bearing their father's arms with only a brisure to denote their cadency.

The fact is that feudal law recognized rights to illegitimate persons and even forced that recognition on the church (save for the need for a dispensation) even where ecclesiastical emoluments were concerned. Consequently illegitimate children inherited their father's arms like all other cadets, with a brisure, and there were no characteristic marks of bastardy as now. A bastard, in heraldic practice and so in that part of the nobiliary law which grew out of feudal custom, was as much a cadet of his father's house as any legitimate child, the only difference being that he was normally out of the succession. Even so, for as long as any illegitimate line survived which the sovereign could legitimate, there was always the possibility for him of ultimate succession to the chiefship on the extinction of legitimate descendants.

There subsequently arose the practice (in England, for instance) of imposing a bordure wavy (in Scotland a bordure compony) as difference in most arms of bastards, with a baton couped sinister in the case of royalty. Some heralds have called these marks of distinction, as opposed to those of cadency or difference. Marks of distinction are already used where there is no blood relationship, however, and so the term may be thought incorrectly applied to bastardy. Its adoption has been influenced by English common law, which holds (as against feudo-nobiliary practice) that a bastard has no beginning and no inheritance; but this law has no warranty in this matter of nobiliary or martial law.

The result is that modern English and Scottish practices diverge completely on this point. In England an illegitimate person must petition for a grant of arms as *homo novus*. In Scotland he (or she) has an absolute right to matriculate the inherited arms, subject always to the brisure (normally a bordure compony or a riband). This latter is the ancient feudal practice.

13. Corporate Heraldry.—In an age in which arms were needed for seals and for use on ensigns, it followed that corporations (towns and cities, colleges, universities and city companies) found it necessary to possess them. In consequence, by the 15th century the English kings of arms were frequently granting arms to city companies. This practice has continued to the present time in all heraldic jurisdictions, and in Sweden it forms the principal work of the *Statsheralldiker*.

Those bodies which are the recipients of grants of arms become corporations-noble; *i.e.*, public legal entities which are known or received by the crown in respect of their having become armigerous corporations. As a result they have the same redress as any other armiger before the courts of chivalry. This was demonstrated effectively in England in 1954, when Manchester corporation brought Manchester Palace of Varieties, Ltd., into the earl marshal's court for using the city's arms in its auditorium and on its seal. Furthermore, it should be observed that burghs in Scotland which had used arms prescriptively have been successfully prosecuted for doing so (the city of Edinburgh in 1732 and Dunfermline in 1909). It might also be observed that a coat of arms granted to a corporate body in England cannot be regularly employed in Scotland unless it has first been matriculated (*cf.* Matriculations of the British Broadcasting corporation, the Eagle Star Insurance company, the London and Lancashire Insurance company, etc.).

Arms granted to corporations can be divided into those received by cities, towns, livery companies, guilds, certain types of schools, colleges, universities, public state or quasi-state organizations (such as British railways), public companies such as the banks and big insurance companies and county councils. In England arms are also granted to rural district councils and in Scotland to kirk sessions. In Sweden much the same usage pertains as in England.

A feature which should be observed in relation to burghal heraldry throughout Europe is that for some of the oldest towns the arms are actually derived, in many cases, from "pictures" of the towns depicted on their earlier seals as, for example, Prague. In others, such as the burgh of Elie and Earlsferry, there are allusions to the arms of a feudal superior. Other arms may have allusion to the name (*e.g.*, Florence, which has *Argent a fleur de lys gules*) or to the cause of the town's growth (*e.g.*, Leeds, with a sheep to represent wool); while others have historical allusions, such as Lancashire county council with the red rose.

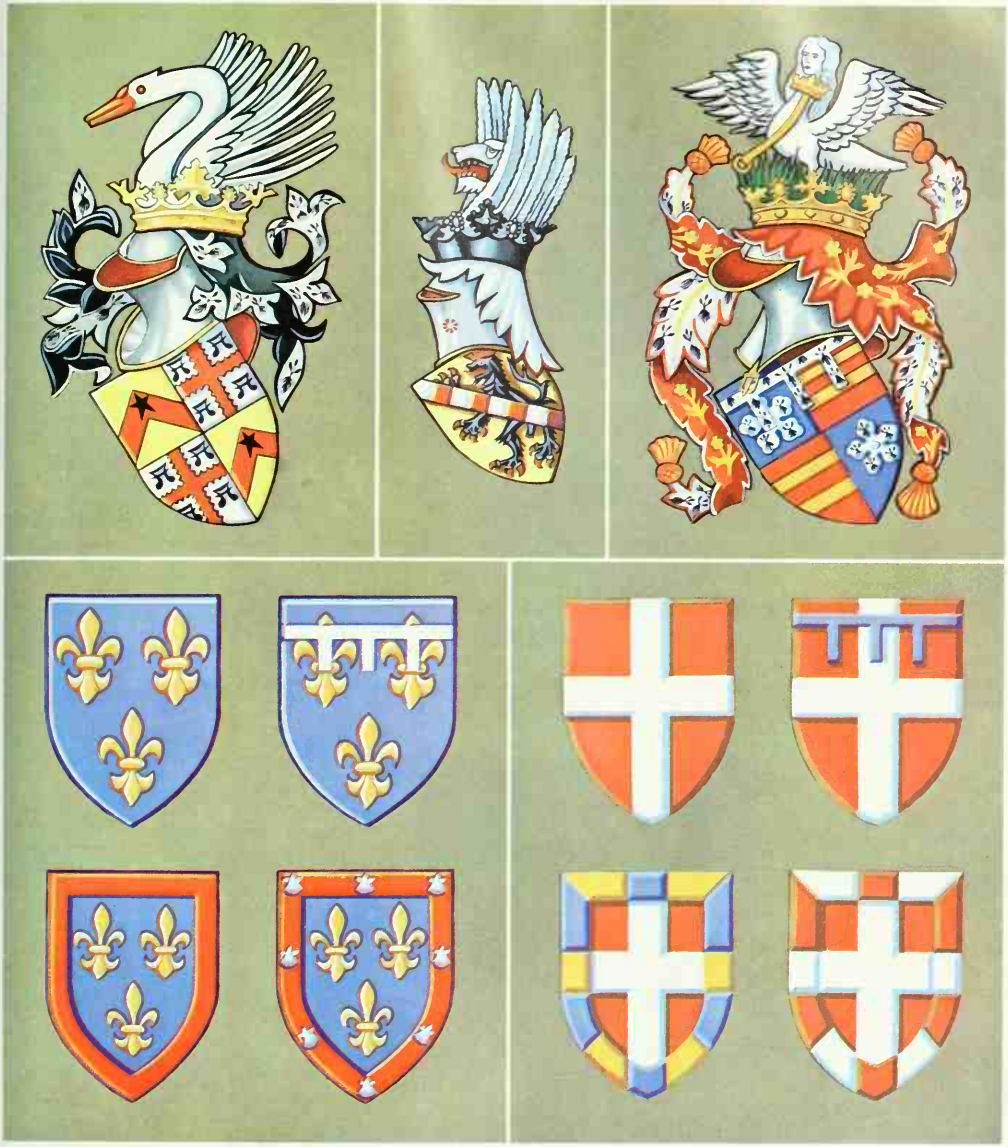
Reference should be made to the practice of some commercial firms of embellishing their advertising propaganda with trademarks of bogus arms as "status symbols." In the United States this appears to be a common practice. In England, through the earl marshal's court, such impostures can be put down; while in Scotland they have been stopped as being in defraud of the treasury and to the confusion of the public.

Just as the descendants of any armiger bear arms subject to brisures for cadets, so a corporate body can have "cadet" corporations which may be matriculated in their own names. Thus, Scottish masonic lodges matriculate their arms and receive in consequence a differenced version of the arms of the grand lodge. This illustrates how close are the principles governing corporative heraldry to those of the rest of the armorial noblesse. In another particular also is this made evident. The head of an Oxford or Cambridge college, of any London guild or livery company or of any corporation-noble (or armigerous public body) is entitled to combine his arms with those of his corporation as though he were "married" to it, by bearing the corporation's arms on the dexter side and his own on the sinister.

FIG. 30.—ARMS OF THE BRITISH BROADCASTING CORPORATION

14. Arms as Property.—Arms are not only dignities but also feudal heritage and property. As property they can even possess monetary value; and the arms of an assurance company or of a bank have considerable good-will value. This consideration enters in also where the personal arms of a noble appear on the labels of, for example, wines produced by him in France, Italy, Spain or Portugal; or on those of honey and other estate products in the British Isles and elsewhere. Any unwarrantable simulation of such arms can be an offense before whatever nobiliary courts exist (as well as before the civil courts in France).

15. Arms and the Surname.—The relationship between the feudal fief, the name and the arms has already been shown. The



EXAMPLES OF ANCIENT ARMS AND MARKS OF CADENCY

Top left: The arms as they are recorded on the Garter stall plate of Sir Hugh Stafford, Lord Bourchier, K.G., 1418 or 1419–20, showing the arms of Stafford in the first and fourth quarters and those of Stafford's wife, Elizabeth Bourchier (baroness in her own right, and in the right of whom her husband became Lord Bourchier), in the second and third quarters. The mullet in the arms of Stafford is for cadency

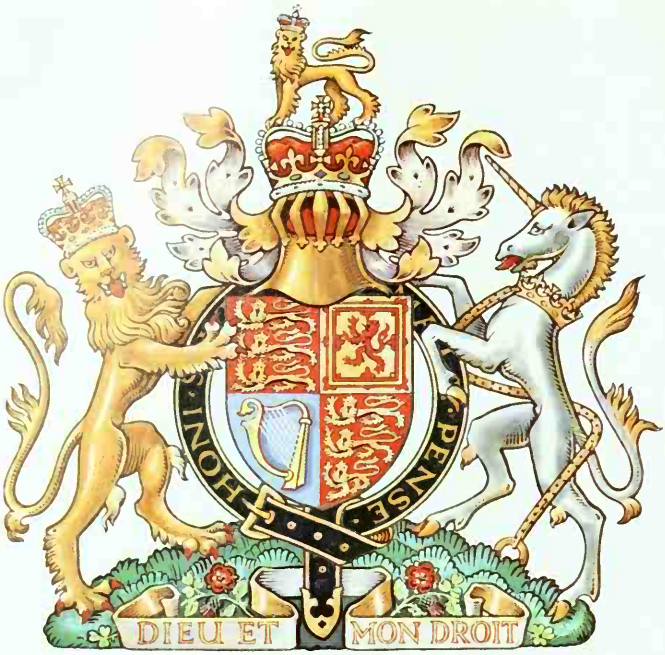
Top centre: The arms as they are recorded of Sire Henry de Flandres, in the *Armorial de Gelre*, a roll of arms belonging to the mid-14th century, the manuscript of which is in the Bibliothèque Royale, Brussels. The roll was named after the herald Gelre of the dukes of Gueldres

Top right: The arms as they are recorded on the Garter stall plate of Sir John Astley, K.G. (1461–86), who bore the arms of his father, Sir Thomas Astley, quartered with those of his mother (daughter and heir of Sir Robert Harcourt), and differenced them with an ermine label for cadency

Bottom left: The cadency of the principal branches of the royal house of Bourbon, showing the differencing for cadency in the royal arms of France in each of the branches of the family: upper left, Bourbon of France; upper right, Bourbon-Orléans; lower left, Bourbon of Spain and Naples; lower right, Bourbon of Parma

Bottom right: The cadency of the principal branches of the royal house of Savoy, showing the differencing for cadency as follows: upper left, King Umberto II of Italy; upper right, label used by the children of the king; lower left, Savoia-Aosta; lower right, Savoia-Genova

HERALDRY



Form of the arms used in England, Wales and Northern Ireland

The English arms occupy the first and fourth quarters, the Scottish the second and the Irish the third. The English lion is on the dexter and the Scottish unicorn (uncrowned) is on the sinister side of the shield. The crest is the English royal crest, and the shield is surrounded by the device of the Order of the Garter with its motto, *Honi Soit qui Mal y Pense*. Below the shield is the English royal motto, *Dieu et Mon Droit*

Form of the arms used in Scotland

The Scottish arms occupy the first and fourth quarters, the English the second; the Scottish unicorn (crowned) is on the dexter and the English lion on the sinister side of the shield. The crest is that of Scotland in the form of a lion *sejant affrontee* holding the sword of justice and the sceptre of dominion; above its head is the motto *In Defens*. The shield is surrounded by the collar of the Order of the Thistle, and below the shield is the motto *Nemo Me Impune Lacessit*. A further difference is the inclusion of the national flags of Scotland (left) and England (right)

ROYAL ARMS OF GREAT BRITAIN

BY COURTESY OF (BOTTOM) THE DIRECTOR OF [illegible] OF EDINBURGH. PHOTO BY DAVID S. YERBURY ESPECIALLY FOR ENCYCLOPÆDIA BRITANNICA, INC.

result is that a name derived from a fief and associated with the arms of that fief, or at a subsequent date linked with arms as feudal heritage, is a "name of dignity" in the rank of a simple noble or gentleman. If, however, the name is a feudo-tribal or feudal designation, such as The O'Connor Don, or Innes of Learney, or Scrope of Danby, it is in fact a title. For this reason, in Scotland, the name of an armigerous person comes under the jurisdiction of the court of chivalry, the Lyon court, whereas the names of those outside the noblesse fall to the control of the court of session.

In Scotland, the name associated with a coat of arms is inherited with it in the same way as a peerage title. In consequence, if the name be changed for any legal purpose, there is usually a change in the arms as well so that the two correspond. In England, name and arms are not necessarily inherited together.

In France, arms are considered by the courts of law to be an engraved, painted or sculptured form of the name, and in Liechtenstein the relationship of arms to name and credit is recognized under article 39 of the civil code.

16. Grants of Arms in the Second Half of the 20th Century.—The number of realms in which arms are granted is now very considerably reduced, first, because of the widespread collapse of the organic social structures in many realms, particularly during the first half of the 20th century; and second, because where this has not occurred, the creation of nobility has sometimes ceased, as, for example, in Sweden.

In Italy there is no doubt that the monarch, even if not reigning, has the right to allow arms, and these would be acknowledged by the Italian nobility as valid. In the Republic of Ireland the chief herald grants arms. In the Vatican a special pontifical heraldic commission makes its own grants of arms. Likewise arms are allowed with titles by the ruling prince of Liechtenstein and by such republics as San Marino. There is an establishment and supervision of arms in Switzerland; and grants are made in Belgium and the Netherlands as well as in England and Scotland, while in 1962 the Heraldry act was passed in South Africa to establish from April 1963 the state bureau of heraldry for the control of arms in the republic.

Not only can suitable persons resident in the United Kingdom or the Republic of Ireland obtain grants of arms from their own authorities, but also persons resident overseas and overseas corporations, so long as they are under the British crown, can apply to the English or Scottish kings of arms, according to the circumstances of their case; *i.e.*, as to whether they are of English or Scots descent or, in the case of public bodies, according to their nature. Thus, a St. Andrew's society would undoubtedly be justified in applying to Lyon, as was the city of Dunedin, New Zealand. (Dunedin is the Gaelic form of the name Edinburgh.)

The English kings of arms will grant honorary arms to eligible foreigners, including United States citizens of English descent. Such arms are not admissible in Scotland. There it is normally necessary to prove Scottish ancestry, when a grant of arms for the ancestor who left Scotland will be made. The petitioner will then be able to matriculate his own arms off the arms of this ancestor.

The cost of a grant of arms and crest in England in 1962 was £131 5*s*.0*d*.; in Ireland, £65; in Scotland, for arms and motto £50, with crest approximately £80. The English grant is more expensive because the college of arms is maintained out of fees and is not, like the Scottish and Irish heraldic offices, a department of state.

The cost of registering a pedigree to prove a person's descent from an armiger in the records of the English college of arms is about £1 1*s*.0*d*. per generation; whereas the cost in Scotland of matriculation (which records the same descent and assigns the brisures for the petitioner) is approximately £21.

IV. SERVICE HERALDRY

1. Military Insignia.—The medieval military use of heraldry, while tending to decline with the passing away of feudal armies, was never entirely extinguished, but it changed its character. In consequence it has survived in all countries as "service heraldry." While this subject cannot be discussed in detail, it should be observed that in all countries, and not least in the British Commonwealth, service heraldry has given rise to the various modern military badges, flags and liveries. These differ from earlier, medieval, devices which also were evolved for identification in war, only in being less efficient. Many regimental badges have to be minutely examined before their identity is beyond doubt. However, during the 20th century, English heralds had a part to play in designing some of the military formation, naval and other badges; and in Scotland, Lyon court came to be always consulted. Consequently the standard of art for service heraldry in England and Scotland greatly improved. In Sweden, the heraldic officers are likewise consulted on all such matters. (*See* also INSIGNIA, MILITARY.)

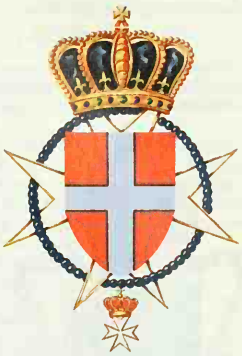


FIG. 31.—ARMS OF THE SOVEREIGN ORDER OF THE KNIGHTS OF MALTA

2. Heraldry and the Orders of Chivalry.—Closely related to the military use of arms is the development of the arms of the great international orders of chivalry: the Sovereign Order of the Knights of Malta, the Temple, the Teutonic, St. Lazarus and the like. A principal consideration in connection with most of the military and some of the dynastic orders is that concerned with the proofs of nobility which they demand from members. The Temple no longer exists and the Teutonic order no longer requires such proofs in view of its changed condition as a religious order, but most of the others still do; as, for example, Malta, or St. John with its Protestant counterpart, St. Lazarus, and Constantine St. George.

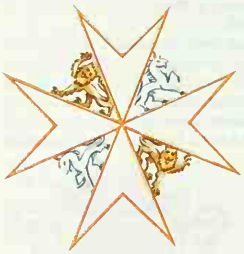


FIG. 32.—BADGE OF THE VENERABLE ORDER OF ST. JOHN IN THE BRITISH REALM

Professed knights of Justice and knights of Honour and Devotion in the Sovereign Order of the Knights of Malta have to provide proofs of nobility, which vary according to their *langue* (*i.e.*, "tongue") or subdivision. In Britain and Ireland unbroken legitimate use of authorized armorial bearings from at least 1485 is required; in Hungary, Poland and Czechoslovakia 450 years' use; in Italy, four quarters (*i.e.*, the four grandparents' arms) with evidence that each coat has existed for 200 years; in Germany, 16 quarters. After 1959 new statutes were adopted establishing a grade of Grace and Devotion, the knights of which have to prove 200 years' armigerousness in the paternal line only or, in certain exceptional cases, in the maternal line only.

In the British order of the Hospital of St. John of Jerusalem the proofs of nobility are still maintained for knights of Justice, but they consist only of evidence from the kings of arms that both parents are or were armigerous.

It will be observed that the proof of nobility is not evidence based upon title, or peerage, but upon *nobilitas minor;* and this is settled by assize of arms—*i.e.*, by the *tesserae nobilitatis*, the possession of legal arms and the

FIG. 33.—BADGE OF THE SACRED MILITARY ORDER OF CONSTANTINE ST. GEORGE

necessary descents. (*See* also KNIGHTHOOD, CHIVALRY AND ORDERS.)

V. ECCLESIASTICAL HERALDRY

From an early period, arms have been associated with the church's administrative and collegiate bodies. Thus, abbeys, priories and dioceses all have their own arms, and high ecclesiastics have always impaled these with their personal arms. Indeed, arms are in theory necessary to all grades of ecclesiastics, who used to be considered to acquire noble status by virtue of their ordination.

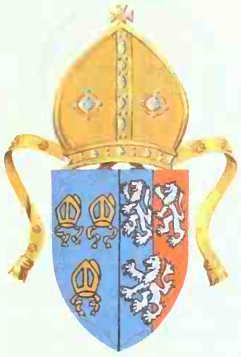


FIG. 34.—ARMS OF THE BISHOP OF NORWICH OF THE ANGLICAN CHURCH

There is little doubt that originally, in most realms, the church assumed arms *motu proprio*. This is still the normal practice, not only in countries such as the United States or France where there is no heraldic jurisdiction, but also in England for the Roman Catholic Church. In the Roman Catholic Church armorial jurisdiction is maintained by a special pontifical heraldic commission; the arms of the Church of England and of Anglican dioceses overseas are the subject of grants of the English kings of arms.

Anglican bishops in England place over their shield a mitre; but the bishop of Durham, as a bishop palatinate, has the mitre in a ducal coronet and behind his shield a sword and crosier in saltire. Archbishops have two crosiers in saltire behind the shield.

According to international Roman Catholic usage a cardinal bears over his arms a red hat with 15 red fiocchi (tassels) on each side and behind his shield an archbishop's cross (*i.e.*, a cross with two horizontal limbs) and the pallium. A Western patriarch has a green hat with 15 green tassels on each side and behind the shield an archbishop's cross.

FIG. 35.—ARMS OF A CARDINAL (WOLSEY)

The arms of an Eastern patriarch are more like those of an Anglican bishop in so far as they are surmounted by a mitre. Behind the shield there are in saltire the episcopal crosier and patriarchal baton on one side and the patriarchal cross and doctoral baton on the other. An Eastern archbishop has the same additaments as a Western patriarch but with ten green tassels, while a bishop has only six green tassels with an episcopal cross behind the shield.

A prince-bishop has the shield surmounted by a mitre and a bishop's cross and crosier in saltire; in addition to a red state mantle doubled ermine surmounted by a prince's crown.

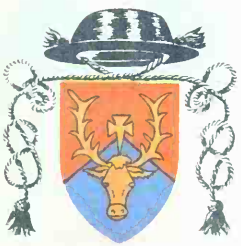


FIG. 36.—ARMS OF THE MINISTER OF THE KIRK OF HOLYROODHOUSE

An abbot *nullius* ("of no diocese"; *i.e.*, exempt from episcopal jurisdiction) has over the shield a green hat with six green tassels depending from each side, a mitre over the shield and a gold cross with a white veil, usually ornamented.

An ordinary abbot has a black hat with six black tassels on each side, and a gold crosier with a veil behind the shield; a mitre may be used instead of the crosier. A prelate *di fiocchetto* has a purple hat with ten red tassels on each side, while a protonotary apostolic has the same with six red tassels on each side. A domestic prelate has a purple hat with six purple tassels on each side and a privy chamberlain a black hat also with six purple tassels on each side. A canon has a black hat with three black tassels on each side, a rector a black hat and two black tassels and a simple priest a black hat and one black tassel on each side. (This last is allowed in Scotland to a parish minister of the Church of Scotland, to a rector of the Episcopal Church or to a Roman Catholic priest.) An abbess places behind her oval cartouche or lozenge an abbatical crosier with a veil.

Moderators of the general assembly of the Presbyterian Church are entitled to a black ecclesiastical hat with ten blue tassels on each side; and moderators of synods and of presbyteries to a hat with six and three tassels respectively on each side. The clergy of her majesty's Chapel Royal have red tassels and chaplains of a royal castle blue.

The Presbyterian Dean of the Chapel Royal of Scotland (who is also Abbot of Crossragual and Dundrennan and Dean of the Order of the Thistle) has a green quigrich (pastoral staff) behind his shield. This is also correct for the moderator.

VI. ROYAL AND DOMINION ARMS

Certain arms early became associated with principalities. In consequence, even when the royal line changed, the arms of the royal house remained the same and the paternal arms of the new occupants of the throne were abandoned. Today, therefore, the arms of realms or "dominions" remain constant, whatever lines succeed to the throne.

Most realms and republics have a national flag distinct from the arms of dominion (*e.g.*, England and St. George's cross, Denmark and the white Danish cross [Dannebrog], Scotland and St. Andrew's cross). In some cases the dynastic arms have become those of the state and so are used as dominion arms as well as national (*e.g.*, Austria, with its simple *Gules a fesse argent* of the archdukes of Austria).

Sometimes, where there is no national cross symbol, the national flag is composed of a divided field of the livery colours of the royal or state arms. Thus, the Belgian flag is derived from the *sable, or* and *gules* in the royal arms and the Polish white eagle on its red ground provided the basis for the red and white flag of Poland.

The position of the arms of dominion in the several realms and states of the British commonwealth should be noted. While the British royal arms (in either their English or their Scottish form) are the arms both of the dynasty and of dominion for the United Kingdom (or for England and Scotland separately according to their specific use in various circumstances), they are not the arms of dominion outside the United Kingdom and its colonies —although they remain the arms of the dynasty. For in every other state there is the coat of arms of dominion of that state. Thus, Canada, Australia, New Zealand, Zambia, India, Ceylon, Pakistan, Ghana, Nigeria and Tanzania all have their own state arms.

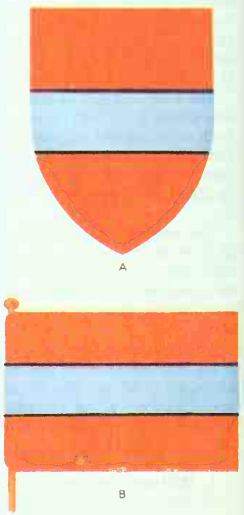
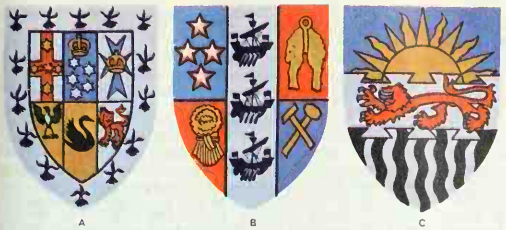


FIG. 37.—DYNASTIC ARMS OF THE ARCHDUKES OF AUSTRIA (A) SEEN IN THE NATIONAL FLAG OF AUSTRIA (B)

Similarly, the union jack, while accepted as the flag of the United Kingdom, is strictly the monarch's flag for the united realms. Consequently it has the same status in the other realms of the commonwealth as the royal arms of the dynasty. It serves to represent and to symbolize the peoples of that dynasty as well as be-



A B C

FIG. 38.—ARMS OF DOMINION: (A) AUSTRALIA; (B) NEW ZEALAND; (C) RHODESIA

ing the monarch's flag for the United Kingdom. But because it has this latter significance in addition to its wider connotation, the other states have had to create their own national flags; and from such have been developed their mercantile and other ensigns. (*See* also FLAG.)

VII. HERALDIC ART

While the purposes of heraldry were identification in war, indication of precedence in assemblies, authentication of documents by seal and, finally, production of a machinery of government for noble houses and for corporations, it gave rise also to the by-product of heraldic art.

1. Historical Conspectus.—As material for the study of the development of heraldic art there are the medieval and later rolls, the armorial seals and monuments and the work of heraldic artists in these continuing media as well as in the great collections of the registers of arms of the various heraldic administrations, in addition to the illuminated manuscripts which these artists also produced as letters patent of grants, confirmations, matriculations and exemplifications.

Early heraldic art is extremely simple, as regards composition of shields, crests and exterior ornament. There is general agreement that the gothic period reached the height of armorial art. Arms consisted of a shield, very often leaning on its side, a simple tournament helm, mantling and crest. There were few conventions concerning the form or position of the helmet, so that the artist of this period was freer than his successors.

With the coming of the Renaissance the helmets became bound to positional rules, the mantling took on involved and twisted floral-like patterns; and the helmet and crest shrank in size in order to accommodate these flamboyant ornaments. Therefore, whereas in the middle ages the helm and crest dominated the achievements, by the 16th and 17th centuries the shield had become enlarged and the mantling, no longer naturalistic, was draped around the shield and usually terminated in golden tassels. The tournament helm had been largely replaced by the vizored helmet. The spirit of the Garter stall plates of the 15th century, which had already developed this type of mantling but had retained the original vigour of design with powerfully portrayed helmets and crests, had been entirely lost.

In southern Europe the gothic was ousted for a series of styles which led directly to the baroque and rococo.

In Germany, by the 16th century, the work of Albrecht Dürer exemplified the heraldic art of this period; but it retained more vigour and spirit than that of contemporary England within the framework of over-all design and decoration composed of trees, human and animal figures. Yet, at the same period, other German artists were continuing to produce achievements which did not require such adjuncts and, although influenced by the trend toward reduced size for helmets and involved floristic mantling, they designed with a strength and virility which belong to the medieval tradition.

The 17th and 18th centuries saw a very considerable decline not only in the administration of the nobiliary aspects of heraldry but also in heraldic art. The shields of this period lost their naturalistic forms and became encrusted with embellishments of sprays, flutings and heavy molded frames; and the all-important charges tended to become subordinate features, losing all clarity and boldness of design. Lions and other animals became contented-looking beasts and the ordinaries shrank in size; while in all too many cases conventional charges, such as the fleur-de-lis, ceased to be things of beauty in themselves and needed the surrounding ornament to distract the eye from their poor draftsmanship. Supporters rested not on solid compartments but on ornamental brackets. Coronets of rank were tipsily perched on top of flourishes emanating from shields and cartouches.

These defects, however, did not constitute the nadir of heraldic art, which was to be reached in the early 19th century. Instead of baroque efflorescences, there were now plain shields with lugs at the top corners, surmounted by minute helmets with, often enough, a space above where, riding unsupported by anything more solid than the air, were to be seen the crests.

After the mid-19th century, however, there was a revival of heraldic administration, especially in its legalistic aspects; and with this there went a gradual return to heraldic art of character comparable with that of many of the earlier periods of armorial design. In general the trend was to return to gothic forms within the limitations placed on the artists by the more involved regulations and types of arms of modern times and the greater use made of such additaments as standards, banners, motto scrolls, supporters, badges and compartments. In this restoration of heraldic art the jurisdictions, through their artists, particularly in London and Edinburgh, played a leading part. Among names which may be mentioned are those of G. W. Eve, C. W. Sherborn, Forbes Nixon, G. Scruby, C. Helard and John Vinycomb in England, and in Scotland those of Graham Johnston and Leonard Samson.

It should be observed that, while early heraldry was simple in all its forms, with the multiplication of arms in every state coats could not but become more complex. However, whereas in the late 18th and early 19th centuries arms were deliberately made complicated (as by the depiction of battle scenes and the like), heralds strive today to produce a simple coat, despite the need for several charges on most new ones. It can be said in consequence that modern heraldry is much nearer in spirit to that of the middle ages than it is to that of the 18th and early 19th centuries.

2. Rolls of Arms.—Although the purpose of rolls of arms was solely to record the arms of persons mustering with an army or of heads of houses, and although these rolls are therefore of great historical importance, they are also excellent examples of heraldic art. Among them are English ones starting in the 13th century. These possess a character which is clearly consistent with the later English style of heraldic art at its best. They include the roll of Matthew Paris.

Among German collections of this period are the Weingarten book of songs and the great Heidelberg song book with the poems of the Minnesingers and accompanying armorial illustrations. To the 14th century belongs the Zurich roll of arms, which is a collection of the arms of medieval Germany.

Of considerable interest for the Netherlands and England, but most of all for Scotland, is the roll of Gelre (the Gelre herald) of the mid-14th century. The art exemplified in it stands closer to that of the English and Scottish heralds than to that of the Germans and Swiss. As in all medieval heraldry the crest is of adequate size and dominates in most cases the whole achievement, while the mantle is realistic and just sufficient to cover, and so to protect, the back of the helmet.

Another 14th-century roll of some significance is that of the Brotherhood of St. Christopher of the Arlbert, which is in Vienna. The coats and their mantling show more flamboyance, typical of German heraldry, and the mantles have become longer and split into pieces cut to resemble leaves, thus foreshadowing the later considerable development of mantling in the achievements. From the 15th century there is the Scheibler book of arms, which is notable for the long, naturally portrayed cloth mantlings.

In England by Tudor times the rolls began to introduce exotically shaped shields, a development to be noted at the same time in German rolls, while in the Konrad Grünenberg armorial book are found considerable elaboration of the mantling and the loss of the earlier simplicity.

From the 16th century there is a noted Swiss roll of the Patrician

society called "Zur Katze" in Constance. This too is of typically Germanic character. The achievements are close to medieval feeling, with the mantlings very much restrained.

English work of this time includes Prince Arthur's book (notable for its display of banners), which is a great deal more like earlier art than is much contemporary production elsewhere. Of the 16th century, also, are Sir David Lindsay's so-called Workman manuscript and other Scottish manuscripts. These earlier rolls and manuscripts are carried down to the present time in the official registers of both the Lyon court and the college of arms as well as in the registers of other heraldic administrations. Consequently there has been no essential break in the compilation of books and rolls of arms for official purposes since the 13th century.

3. Heraldic Memorials.—Nowhere is heraldry more effectively employed than in memorials, whether these take the form of stained glass windows, effigies or monumental brasses of the great and others, or memorials on church walls and in graveyards.

Two types of memorial are particularly noteworthy. The first is the stone slab customary on the continent of Europe. Achievements of arms generally cover the slab, which may bear also a gothic tracery design; and the inscription either surrounds the edge of the slab or is placed above or beneath the arms. The second type of memorial is the hatchment (*q.v.*), in which England is particularly rich, and which seems to have been mainly restricted to the British Isles and the Netherlands. Although not strictly memorials, in the sense that they normally are not accompanied by the name of any person, there might be mentioned also the carved and painted arms of benefactors and others on public buildings such as abbeys, cathedrals and churches.

4. Heraldic Bookplate.—Chief among modern heraldic devices is the heraldic bookplate. A well-produced plate enhances the dignity of a volume as well as being of bibliographical interest and an aid to the safeguarding of the property. In the 19th century the armorial bookplate was extremely common, although not all users were entitled to the arms thereon displayed, because numerous people of a certain degree of prosperity had come to feel that it was the "done thing" to have a "crest." In the first part of the 20th century the trend was toward the pictorial bookplate, perhaps because of the considerable social revolution which had occurred, accompanied as it may have been by a less pretentious outlook and a more scrupulous regard for the armorial rights of other people. However, the armorial bookplate revived again, especially in the British Isles, and this may well be related to the fact that the new classes, as they became established, were gradually granted arms which they were entitled to display in this useful and interesting manner. The quality of heraldic bookplates in the Celto-Anglo-Saxon and Germanic countries by mid-20th century could be said on the whole to be of a high order, and the Latin countries were being influenced by it.

5. Heraldry and Inn Signs.—Important persons used to hang their banners or standards outside the inns where they took temporary lodgement, outside their own town dwellings and outside the hospices where, near their homes, they lodged guests, travelers and pilgrims. These uses gave rise to the familiar inn sign. Thus, in England, the White Hart refers to the white heart badge of Richard II; the Swan to the badge of the de Bohuns, earls of Hereford; the Rose and Crown to the badge of England, and so on.

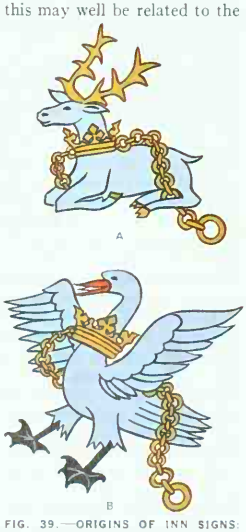


FIG. 39.—ORIGINS OF INN SIGNS: (A) WHITE HART BADGE OF RICHARD II; (B) SWAN BADGE OF BOHUN, EARLS OF HEREFORD

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(R. G. G. N.)

HERAT, a city and capital of the province of Herat in northwest Afghanistan, is situated about 3 mi. from the right bank of the Hari Rud, 400 mi. W. of Kabul. Pop. (1962 est.) 63,771. The massive walls of the city, constructed by the military engineers of the Russian-Afghan boundary commission in 1885, which once distinguished it from all other oriental cities, were destroyed in the 1950s. Only the great earthwork of the citadel remains in the centre of the modern town as a reminder of the many sieges it has undergone.

The city has wide main streets and extensive bazaars. A notable feature is the well-kept and highly decorated gharries (horse-drawn cabs). There are government buildings, a modern high school for boys and a hotel with an imposing façade. The only ancient building of any consequence is the Jamma Masjid or Great mosque, which comprises an area of 800 sq.yd. and was (in 1959 and 1960) extensively rebuilt and repaired. It was erected *c.* 1200 under the Ghorids and embellished late in the 15th century during the reign of the Timurid sultan Husain. It is said to have measured (in its original state) 465 by 275 ft. with 460 cupolas, 130 windows, 444 pillars, 1,300 arches and 6 entrances, and to have been adorned in the most splendid manner with gilding, carving, precious mosaics and other elaborate and costly embellishments. The city contains numerous ancient ruins. To the northwest a large area is scattered with Timurid remains.

Only one minaret remains to bear witness to the glory of the mosque built by the remarkable woman Gohar Shad, wife of Shahrukh and daughter-in-law of Timur, who built magnificent buildings in Herat, Meshed and Samarkand. This minaret with its matchless tilework is supported by a modern school building. Its last surviving sister minaret collapsed in 1956. A single, more slender minaret is all that remains of Gohar Shad's *mosalla* ("theological college"). Nearby stands the tomb of the great lady herself, a small structure with a brilliant blue ribbed dome (whose

like is found only in Samarkand) and delicate interior paintings (which are probably not, however, the original ones). These three monuments stand in a park full of flowering shrubs. A little farther away from the city stand the most striking of the monuments of Herat, the four vast and exquisitely decorated tapering minarets which are all that remain of the college founded by the last great Timurid ruler of Herat, Sultan Husain Bayaqra. (An alternative theory suggests that these minarets mark the corners of Gohar Shad's *mosalla.*) These great towers, which dwarf the city, are leaning precariously and may fall if not supported. The craftsmanship, design and delicate blending of colours in the tilework on these monuments give some idea of the glory and refinement of Timurid architecture.

Along the slopes of the northern hill the surface of the plain for about 4 by 3 mi. is strewn with pieces of pottery and crumbling bricks. It is marked here and there by earthen mounds and ruined walls, the debris of palatial buildings. Few structures have survived in a sufficiently perfect state to bear witness to the grandeur and beauty of the old city.

Scarcely inferior in beauty to the minarets (though of more moderate dimensions) is the shrine of the poet and saint Abdullah Ansari, situated on the rising ground north of the city. This place, called Gazargah, consists of buildings containing fine oriental tilework and carving surrounding a courtyard. In the place of honour before the high central decorated arch stands the marble tomb of the saint encased with wood. The shrine is held in high veneration. It was erected by Shahrukh Mirza, grandson of Timur. Adjoining the tomb are marble sepulchres of princes of the house of Timur and the famous amir Dost Mohammed Khan is himself buried in the courtyard, which is full of tombs. Especially deserving of notice is a royal building tastefully decorated by an Italian artist, Geraldi, who was in the service of Shah Abbas the Great. The gardens of two other former royal palaces, named respectively Bogh-i-Shah and Takht-i-Safar, are on the same rising ground somewhat farther to the west.

Herat city is one of the chief commercial centres of Afghanistan. There are important handicraft industries (carpets, silks, textiles, camel-hair products); cotton ginning, flour, rice and oilseed milling are also carried on. Karakul sheep are reared in the surrounding hills and there is an active trade in pistachio nuts. The city is connected by good roads to Meshed in Iran and to the Russian railhead at Kushka as well as to Kandahar. A difficult road leads over the mountains to Maimana and Afghan Turkistan and a treacherous track, passable only in summer, runs due east through the mountains to Kabul. Herat has a civil airport. It is also a military centre. (*See* AFGHANISTAN: *Communications.*)

Ancient cities have stood on or near the site of Herat, including one known as Alexandria Ariorum built by Alexander the Great. The city's most splendid era was during the rule of the Timurids, from the time of Shahrukh to that of Sultan Husain Bayaqra, when the city was a famous centre for science and art, music and literature. The youthful Babur was dazzled by the splendour and sophistication of Sultan Husain's court. Throughout history Herat has preserved a strategic importance because it guards the only major gap in the chain of mountains stretching from Burma to the Black sea. For a long time the British considered it to be the key to India and resisted the efforts of Persian monarchs of the Kajar dynasty to make the city part of their kingdom.

HERAT PROVINCE, with an estimated population (1960) of 1,150,000, is bounded west by Iran, northwest by Turkmen Soviet Socialist Republic, north by Maimana province, east by Ghor province and south by Farah province. The subsidiary ranges of the Hindu Kush mountains penetrate the province on the east: Band-i-Turkistan, the Paropamisus mountains northeast, and Safed Koh ("white mountains") and Band-i-Bayan southeast. It is drained by the Murghab, Hari Rud, Adraskan and Farah Rud rivers.

The long narrow valley of the Hari Rud, starting from the western slopes of the Koh-i-Baba (16,873 ft.), extends almost due west for 300 mi. before its northern bend at Kuhsan, thus passing through the western extremity of the Paropamisus range toward Sarakhs (on the Turkmen S.S.R. border). On the south of the plateau a succession of narrow valleys dividing parallel flexures, or anticlines, have formed under geological conditions. From its source to Obeh (55 mi. E. of Herat) the Hari Rud is a valley of sandy desolation. The cultivated portion of the valley starts from Obeh and extends, with a width which varies from 8 to 16 mi., to Kuhsan (40 mi. W.N.W. of Herat), presenting a remarkable scene of luxurious fertility. The valley about Herat includes a flat alluvial plain. On the north about three miles from the city lie the barren, broken sandstone hills, the Koh-i-Mulla Khwaja, separated from the Paropamisus range by a stretch of sandy upland about 20 mi. in width called the Dasht-i-Hamdamao or Dasht-i-Ardewan, formed by the drift of the higher mountains. A very considerable valley, the Karakh, has formed there which contains a few important villages and a well-known shrine marked by a group of pine trees unique in this part of Afghanistan. The valley leads to a group of passes (across the Paropamisus) into Afghan Turkistan, of which Zarmast was the best known. The Paropamisus range breaks into fragments by processes of denudation as it passes westward, until it is hardly recognizable as a distinct range. The direct passes across it from Herat (the Baba and the Ardewan) wind among masses of disintegrating sandstone, but farther west the rounded knolls of the rain-washed downs may be crossed almost at any point without difficulty. The main road to the north uses the Sabzak pass (8,200 ft.) east of Zarmast pass.

The climate is hot in summer and intensely cold in winter. The heat is aggravated by a hot wind which blows continuously from June to September, with a velocity reaching 110 m.p.h. The cold is usually accompanied by sudden northern blizzards. Masses of melting snow annually give rise to floods, frequently rendering the Hari Rud impassable and cutting off the brick bridges at Herat and Tirpul. Rainfall is moderate, but any excessive local rain produces difficulty and danger from the floods of liquid mud and loose boulders which sweep like an avalanche down the hillsides.

The Heratis are agricultural people and ethnically diverse. Tajiks (Tadzhiks), similar to the Iranians of Khurasan, live in Herat and in the main valley of the Hari Rud. Many Pashtuns are also found, particularly in the northwest and in the valley of the Murghabs to the northeast. In the mountain and desert areas live the group of tribes known as the Chahar-Aimak (four races), probably of mixed Turkish and Iranian origin. Today the Chahar-Aimak are divided into five tribes: the Jamshidis, the Taimuris, the Taimenis, the Firuzkuhis and the Hazaras of Kala Nou.

The population and agriculture of the provinces are concentrated in a few oases which produce grain, beans, oilseed, opium, cotton and fruit. This is the only province of Afghanistan where large landowners are the rule and not the exception. Crude petroleum has been discovered near the city and there are brine deposits. Other chief towns, apart from the capital, are Shindand (south), Bala Murghab (north), and Obeh (east), where there are hot springs. (X.)

History.—There have been settlements at Herat in the valley of the Hari Rud, where routes to Kandahar, Meshed and Merv skirt the Hindu Kush, since the times of the Avesta (the Zoroastrian Bible). The Haroyu of the *Vendidad* (the Zoroastrian priestly code), Haraiva of Achaemenian inscriptions and Aria of the Greeks, Herat has always been a bone of contention between the powers established in Persia, central Asia and Afghanistan. The Achaemenidae from Darius I onward made Herat a satrapy; Alexander the Great conquered it; Greeks, Seleucid or Bactrian, fought for it until the Parthian Mithradates I (*c.* 170–138 B.C.) overran both. From the Parthians it passed in the 1st century A.D. to the Kushans and thence, early in the 3rd century, to Ardashir I, the first Sasanian emperor. Persian control was threatened two centuries later by Hephthalite (White Hun) invaders who for some time made Herat their headquarters.

From 643 Herat felt a new power, that of the Arab armies of Islam. At their hands both the Sassanid empire and the Nestorian church, with its bishopric at Herat from 540, suffered eclipse. The Omayyad caliphs, having crushed revolts in 652 and 662, made

Herat one of their four Persian provinces. A century later Abu Muslim secured Herat for the Abbasids, under whom the city was ruled by several local dynasties: the Tahirids from 820, the Saffarids from 867 and the Samanids from 903.

From the 11th century nomads from the east began to press upon Herat. First came the Seljuks, against whom the Samanids called in the rulers of Ghazni. The latter's success was brief, for the Seljuks took Herat in 1040. The Ghorids then took up the struggle. Ala-ud-din seized but then lost Herat to the Ghuzz-Turkmens. His nephew Ghiyath-ud-din recaptured Herat in 1176; his successor lost it again. Then came the Mongol cataclysm. In 1220 Tului took the city, killing the garrison; in 1221, after a rebellion and prolonged resistance, he massacred the whole population.

A minor dynasty, the Kurts, then emerged in 1245 to restore Herat's prosperity, as the Arab traveler Ibn Batutah saw. (Herat had been noted for fine inlaid metalwork and weaving.) They were overthrown in 1383 by Timur. Shahrukh (d. 1447), Timur's fourth son, appointed governor of Khurasan, rebuilt the city, attracting traders, artists and men of letters; his son, Baisunqur Mirza, assembled a superb library employing the finest bookbinders, calligraphers and miniaturists. Later the renaissance continued under Husain Bayqara (1468–1506), the patron of Behzad the painter, Jami the poet and Mirkhond the historian.

After Husain Bayqara's death, Herat fell first to the Uzbek, Shaibani Khan; then in 1510 to Shah Ismail Safawi, who harshly imposed Shi'ism upon the Sunni city; to the Uzbeks again in 1588; and finally to Shah Abbas in 1598. Thereafter it remained in Persian hands until the 18th century.

In the 18th and 19th centuries new contenders for Herat arose, the rulers of an emerging Afghanistan. Between 1716 and 1732 Abdali Afghans settled at Herat by Shah Abbas repeatedly rose and were repeatedly suppressed by Nadir Shah. On his death, however, Ahmad Shah was elected ruler of Afghanistan and in 1750 annexed Herat. Princes of his line governed Herat until 1842.

Several Persian attempts were made upon Herat: in 1800 at British prompting, to counter an Afghan threat to India; later in 1833 and 1837–38 with Russian encouragement. In 1838 British pressure was applied to Persia to save Herat, and in 1857 to secure its restoration after capture in 1856. In 1863 Dost Mohammed Khan defeated the last independent Afghan ruler of Herat. Abdurrahman Khan's defeat of Ayub Khan in 1881 confirmed Herat's incorporation in a united Afghanistan. *See* AFGHANISTAN: *History;* PERSIAN HISTORY. (J. B. HA.)

HÉRAULT, a *département* of the extreme south of France, fronts the Mediterranean seacoast west of the Rhône delta. It was formed in 1790 from Languedoc (*q.v.*) and is bounded northeast by Gard, northwest by Aveyron and west by Tarn and Aude. Area 2,403 sq.mi. Pop. (1962) 516,658.

In front of the uptilted edge of the Massif Central in the Cévennes mountains, where the *département* rises above 4,000 ft., the fringing limestone foothills are succeeded in turn by the fertile plain of Languedoc, with a smooth sand dune and lagoon coast line. Throughout history this plain has been a great thoroughfare, leading from Provence and the Rhône valley to Spain and Aquitaine. It was threaded by a Roman highway, the Via Domitia, as it is in modern times by important road, rail and canal links. The streams from the Cévennes, notably the Hérault, crossing the plain toward the coastal lagoons, have torrential seasonal flows.

The mild winters and hot, dry summers of the Mediterranean coastland made possible the traditional association of Mediterranean crops, including the olive as well as the vine and corn, but this has been largely replaced by culture of the vine only. Among French *départements,* Hérault has the largest area under the vine and is the largest producer of wine. Most of this is *vin ordinaire,* produced by small holders who are organized in co-operative associations. Distilling of liqueurs is important and, among dessert wines, the muscatel of Frontignan is noteworthy. Behind the sea of vines that now covers the plain, the rocky limestone country shows patches of vines among a wilderness of scrub and degraded woodland, known as the *garrigues.* Only a few sheep now cross this tract on their way from the plain to summer grazings in the Massif Central, and in the valleys of the Cévennes the mulberry is no longer cultivated. Some textile industries persist, including woolen manufactures at Lodève and silk and nylon factories at Ganges. The coast line is devoid of natural harbours, and Sète is an artificial port created by cutting and protecting a channel from lagoon to sea. It is especially engaged in importing wine from north Africa, and in importing and processing chemicals that are required in its vine-growing hinterland. Oil refining is also important. From Sète the Canal du Midi extends west toward Toulouse, and eastward there is connection with the Rhône at Beaucaire through the lagoons. There is some fishing in the lagoons and sea fishing is carried on from Sète. Salt is produced by brine evaporation along the coast and bauxite is worked inland, but mineral production is generally unimportant.

Montpellier (*q.v.*), seat of one of Europe's oldest and most illustrious universities, is the capital of the *département* and major centre of its wine trade. It is the centre of the bishopric, its cathedral having replaced an earlier one at Maguelonne on the coast nearby. Montpellier is also the headquarters of educational and judicial administration. Béziers (*q.v.*), another great market centre of the vine-growing area, is an important railway junction. Montpellier, Béziers and Lodève are the centres of the three *arrondissements* into which the *département* is divided.

(AR. E. S.)

HÉRAULT DE SÉCHELLES, MARIE JEAN (1759–1794), French politician whose career during the Revolution seems to have been motivated chiefly by personal opportunism, was born in Paris on Sept. 20, 1759, of a noble family related to the houses of Contades and of Polignac. Rich, handsome and witty, he was received at court and, thanks to Queen Marie Antoinette, became king's attorney at the Châtelet in 1777. He was made attorney general in the Paris *parlement* in 1785. He published an *Éloge de Suger* in 1779 and an account of an interview with Buffon in 1785. In 1789, at the outbreak of the Revolution, Hérault de Séchelles broke with the court and took part in the attack on the Bastille (July 14). In Dec. 1790 he was elected judge for the tribunal of the 1st district of Paris. After a mission to Alsace (February–April 1791), he was made king's commissioner in the tribunal of appeal. He soon became an ardent "patriot." Deputy for Paris in the legislative assembly from Oct. 1791, he was attached to its diplomatic committee and drew up the call to arms of July 11, 1792, declaring "the fatherland in danger." He was chairman of the Jacobin club in June 1792 and president of the assembly in September.

Elected to the Convention by the *département* of Seine-et-Oise, Hérault de Séchelles was sent on Nov. 29, 1792, to organize the new *département* of Mont-Blanc. After this he was with the army of the alps till May 1793 and so took no part in Louis XVI's trial. He was president of the Convention during the overthrow of the Girondins (*q.v.*) in June 1793. Attached to the committee of public safety from May 30, 1793, he was entrusted with presenting to the Convention the draft of the democratic and radical constitution of June 1793, on which he had worked and which was enacted but never operated. On July 10 he was elected a full member to the committee of public safety. Subsequently, however, his dubious conduct of a mission to the *département* of Haut-Rhin, his relations with refugees, with *émigrés* and with the Hébertists and his loose talk about the committee's meetings, together with his blatant cynicism and his numerous amours, aroused suspicion. Arrested in March he was guillotined with the Dantonists in Paris on April 5, 1794.

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HERB, any plant whose stem or stalk dies entirely or at least down to the ground each year and does not have, as in shrubs or trees, a woody or permanent stem above ground; such plants are also called herbaceous.

The term herb is also applied to those herbaceous plants that possess certain aromatic properties and are used for medicinal pur-

poses, for flavouring or garnishing in cooking and for perfumes (*see* FOOD PREPARATION: *Herbs and Spices*). Some herbs are slightly woody, but have no true bark.

For herbs used in cookery, *see* FLAVOUR. For their use in medicine, *see* MEDICINE AND SURGERY, HISTORY OF. *See* PERFUME; SCENTED PLANTS; individual herbs; *see* also references under "Herb" in the Index.

HERBAL, an ancient manual facilitating the identification of plants for medicinal purposes. Hundreds of medicinal plants were known in India before the Christian era, and the Chinese have a compilation, still authoritative, of about 1,000 ancient herbals. The Greeks had written accounts and, according to the elder Pliny, the physician Crateuas (*c.* 120 B.C.) produced a herbal with coloured illustrations. This has not survived but was probably largely embodied in the *De materia medica* of the Greek physician Pedanius Dioscorides (*see* DIOSCORIDES, PEDANIUS). A Byzantine version of his famous herbal is the Constantinopolitan or Viennese codex of *c.* A.D. 512. Some of its illustrations are probably derived from Crateuas, together with plant names, such as *Anemone* and *Anagallis*, still in use. Many manuscript herbals, drawing largely from Dioscorides and Pliny, were published in medieval Europe; during the 15th century several were printed, a notable one being Konrad von Megenberg's *Das puch der natur* (or *Buch der Natur*). As brought out in 1475, this included the first known woodcuts for botanical illustration. Very few original drawings were prepared for herbals before the 16th century: illustrations were copies and copies of copies. They became highly stylized, not only ceasing to resemble the plants depicted but also incorporating mythological notions. "Narcissus," for example, in Jacob Meidenbach's *Hortus sanitatis* (Mainz, 1491), is unidentifiable as such; a human figure, instead of the plant's sex organs, emerges from each perianth.

A complete break from these degraded, fabulous forms was provided by Otto Brunfels' *Herbarium vivae eicones* (Strasbourg, 1530s), containing excellent and accurate drawings by the wood engraver Hans Weiditz. This transformation, affecting also the subsequent herbals of Hieronymus Bock and Leonhard Fuchs, probably owes much to Dürer. Plants brought back by explorers then began to be depicted. Nicolas Monardes' *Dos libros* (Seville, 1569), for example, contains the first published illustration of tobacco. A latinized version of an Aztec herbal (Mexico City, 1552) contains formalized illustrations resembling European ones, which suggests that the artists were following the traditions of their Spanish masters rather than an indigenous style of drawing. Among other well-known herbalists of those times were John Gerard, Konrad von Gesner and Gaspard Bauhin (*qq.v.*).

Alongside the genuine herbals probably always existed lesser works of a superstitious nature, many of them having been concerned with the fanciful medical theory of the "doctrine of signatures." In England these culminated in Nicholas Culpeper's *A Physicall Directory* (1649), which was a pseudoscientific pharmacopoeia of lasting appeal to the credulous. The reputable herbals gave place in the 17th century to floras in which plants were studied for their own sake. *See* also BOTANY.

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(P. R. BE.)

GRAPHIS PRESS, ZURICH

AN ASTER (ASTER ATTIKOS, SILENE LINOIDES) IN DIOSCORIDES' CODEX ANICIAE JULIANAE. THIS ILLUSTRATION, DATING FROM THE 6TH CENTURY, WAS PROBABLY COPIED BY DIOSCORIDES FROM AN EARLIER ONE MADE BY THE GREEK HERBALIST CRATEUAS

HERBARIUM, a collection of dried and pressed plants preserved and mounted to illustrate as far as possible their characters. A herbarium can be a very useful teaching aid or an absorbing hobby, but far more important is its use as a reference collection for botanical identification of plants and as a body of information for botanical research. Because the same kind of plant may vary greatly according to the environmental conditions, both as a direct response and by genetic adaptation, it is only by gathering together for comparison and study a large series of specimens of each species that the limits of variation within species, and the differences among them, can be satisfactorily determined.

Herbarium specimens of flowering plants, ferns and the larger algae are customarily dried between sheets of heavy blotting paper or construction felt under pressure so that the dried specimen is flat. Most specimens will dry in about a week, if the blotters are changed several times. The drying can be hastened by interspersing ventilators of corrugated cardboard among the blotters, and by the gentle application of heat.

Although the colours of flowers and leaves eventually fade, herbarium specimens last indefinitely, some being more than 300 years old.

After being dried, the specimens are customarily attached to sheets of heavy white paper for permanent storage. Heavy all-rag (linen) paper is preferred because of its lasting qualities. The standard size of a herbarium sheet in the United States is $11\frac{1}{2} \times 16\frac{1}{2}$ in.; in Europe a slightly longer and narrower sheet is more common. One or more plants (depending on the size of the individuals) of the same kind, collected at the same time and place, are mounted on a herbarium sheet. Traditionally the specimens have been attached to the sheet with gummed cloth tape, or glue, or both glue and tape, the coarser parts sometimes also being sewn. During the 1950s many institutional and research herbariums, especially in the United States, began using a plastic containing ethyl cellulose and a proprietary resin in place of glue and tape.

A label is affixed to the lower right hand corner of a herbarium sheet. The label properly bears the name of the plant, the exact locality and habitat in which it was collected, the date of collection, the collector's name and a number. All specimens of the same kind collected at the same time and place are given the same number; these specimens may thereafter be deposited at several different herbariums. The colour of the flowers and any other significant information that may not be permanently shown by the specimen should also be given on the label. Many herbariums also stamp a serial specimen accession number on each sheet.

The mounted specimens are arranged according to the species, genus and family, placed in folders of heavy paper, and filed on shelves in airtight cases, preferably metal, since they lessen the

chance of damage by fire or destructive insects. The sequence of species in a genus, and genera in a family, differs in different herbariums.

Some herbariums have a strictly alphabetical order for ease in filing and reference. Others have a systematic sequence according to supposed relationship to facilitate comparison and identification of specimens. In large herbariums the species of a genus are often also segregated geographically, with a separate sequence for each region.

Herbarium specimens of mosses, liverworts and some of the smaller algae are customarily put in small paper packets rather than being mounted, and boxes of these packets are stored in the herbarium cases. Fleshy fungi are usually dried without pressure and filed in small cardboard boxes in the cases.

Herbarium specimens are subject to attack by the larvae of several species of skin beetles (family Dermestidae) and sometimes by other insects as well. Mildly aromatic plants such as the composites, crucifers and umbellifers are especially favoured by these insects, whereas other groups, such as grasses and ferns, are seldom eaten. Newly dried specimens are particularly subject to attack. In some herbariums the specimens are treated with an alcoholic solution of mercuric chloride when mounted. This protects them for usually several years, but eventually the poison flakes off, and there has been some concern about its being a health hazard. Repellents such as paradichlorobenzene and naphthalene ("moth balls") may also be placed in the cases, and the specimens may be periodically fumigated.

A herbarium is the most essential tool for research in plant classification, serving as a permanent record of the distribution of each species, its range of variability and the correlation of that variability with the geography and habitat. A botanist writing a flora of a region relies largely on herbarium specimens, which he studies against a background of his own observation on living plants. In more critical studies of smaller groups of species, cultural and breeding experiments, determination of chromosome number and other detailed analyses are also customary. The herbarium, however, remains the essential foundation for the work, because no one individual can expect to see each of even a small group of species in all localities and all habitats in which they occur, and under the varying conditions of different years and seasons.

Although herbariums serve as samples of natural populations of plants, they must be interpreted with caution because they tend to be biased toward the unusual. When a region is first explored, collectors have all they can do to make specimens of the common plants. Thereafter, the less common species and unusual forms of common species are likely to be collected out of proportion to their abundance. Thus the usefulness of a specimen may be greatly enhanced by some indication on the label as to the frequency of such specimens in the wild.

In a plant group that produces occasional hybrids, the hybrids are likely to be over-represented in herbariums, obscuring the relatively clear distinction that can be seen in nature. Thus the usefulness of a specimen is greatly enhanced by some indication on the label as to the abundance of such plants, and especially by a record of any evidence suggesting that it may not be typical of a population.

Herbariums are repositories for type specimens on which names of species are founded. A scientific name, in order to be accepted, must be properly published together with a description, but it is the type specimen that permanently determines the application of the name. In many herbariums the types are segregated from the rest of the collection in order to minimize the likelihood of damage.

Of the major herbariums, the one at Kew Gardens (*q.v.*), England, has about 6,000,000 specimens and is the largest in the world. The Berlin herbarium, almost as large as the one at Kew, suffered damage during World War II. Other herbariums with 3,000,000 or more specimens are at Leningrad, Paris, Geneva, Florence, Washington, D.C., Cambridge, Mass., and New York city. The original herbarium of Linnaeus was purchased from his widow for the Linnean Society of London, which continues to maintain it.

Cultivated plants, not well represented in most institutional herbariums, are strongly emphasized in only one major herbarium in the United States, the Bailey Hortorium in Ithaca, N.Y., with about 300,000 specimens. (A. Cr.)

HERBART, JOHANN FRIEDRICH (1776–1841), German philosopher, the founder of a system embracing logic, metaphysics and aesthetics but of particular importance for its psychology and for the educational theory stemming from it, was born at Oldenburg on May 4, 1776. After studying under J. G. Fichte at Jena (1794), he worked as a tutor at Interlaken in Switzerland from 1797 to 1800, during which period he made the acquaintance of J. H. Pestalozzi (*q.v.*). Becoming a licentiate of Göttingen university in 1802, he was appointed extraordinary professor there in 1805. At the close of 1808 he went as professor to Königsberg. There he also conducted a seminary of pedagogy till 1833, when he returned as professor of philosophy to Göttingen. He died at Göttingen on Aug. 14, 1841.

Philosophical System.—Philosophy, in Herbart's view, is the analysis and elaboration of experience. Logic is the clarification of concepts and reasoning, being concerned with the form of thought; metaphysics and aesthetics are concerned with the content of thought. Logical analysis reveals contradictions in the concepts with which thought begins, and much of Herbart's analysis is devoted to the resolution of these contradictions. He develops a philosophical methodology which can be compared with the Hegelian dialectic (*see* Hegel, Georg Wilhelm Friedrich). In his metaphysics he starts from the scepticism of Hume and Kant (*qq.v.*) and attempts to determine by reflection alone the nature of what is real. The position finally reached is a "pluralistic realism"—the doctrine that there is a multiplicity of things which have absolute existence.

When one and the same thing, A, given in experience, combines a number of contradictory characters, it must be concluded that A is resolvable into a plurality of things, $A_1+A_2+A_3$, etc. Analysis ends in the conception of a plurality of absolutely simple beings. Such things tend to disturb each other, and each resists the disturbing effect exercised by the others. In so doing it manifests a variety of "self-preservations." This general metaphysical doctrine has profoundly important implications for Herbart's psychology.

Psychology.—Herbart's position in the history of philosophy is mainly due to his contributions to the philosophy of mind. These contributions are presented in two works: the *Lehrbuch zur Psychologie* (Königsberg, 1816; Eng. trans., *A Textbook in Psychology*, New York, 1894) and the *Psychologie als Wissenschaft, neu gegründet auf Erfahrung, Metaphysik und Mathematik*, 2 vol. (1824–25). His central thesis was that the facts of experience with which psychology is concerned are to be explained, not by reference to "faculties," but by reference to the laws governing the combination and interaction of those ultimate mental states variously described as sensations, images, ideas or presentations (*Vorstellungen*). This conception was derived from his general metaphysics. The soul is one and simple, and its separate acts of "self-preservation" must also be simple. Presentations are the simple elements of mind. Though derived by Herbart from a distinctive metaphysical theory, the doctrine itself does not require to be supported by this theory. It is indeed closely similar to that of the associationist school derived from the British empiricists (*see* Empiricism). He differs from the latter in the attempt to develop, in mathematical form, the statics and mechanics of mental processes and, more importantly, in distinguishing, within the interactions of presentations, conflicts or repulsions from combinations or associations.

The soul has no inherent tendency to change from one state to another. Once in a given state there is no reason why it should change unless there is interference from the outside. Hence, the disappearance of any presentation from consciousness constitutes a problem. There is no problem of explaining memory either as persistence of an idea in consciousness or as recall; the problem is to explain the passage from consciousness and to explain forgetting. The explanation is found in the mutual conflict of presentations opposed in quality. Ideas are forces which exercise

attractive or repulsive effects on each other. Presentations may be similar, as one sensation of blue is similar to another sensation of blue a moment before; or they may be disparate, as blue is disparate from sweetness; or they may be contrary, as blue is contrary to yellow. Similar presentations fuse into a unity; disparate presentations combine to form complex presentations; contrary presentations are mutually exclusive. The fundamental laws of the interaction of presentations describe the processes of fusion, of compounding and of arrest. Arrest, or the expulsion of a presentation from consciousness, does not involve its annihilation. The excluded idea continues to exist in an unconscious form and tends, on the removal of obstacles, to return spontaneously to consciousness. The process varies in degree. Arrest may involve not complete repression but only obscuration. When arresting forces are adequate, and no more than adequate, to obscure a presentation, it is said to be "on" the threshold of consciousness. When the forces are greater, it is said to be "below" the threshold. If it is in consciousness at all, it is "above" the threshold. If it is above, on or below the threshold when the conditions require it to be so it is said to be above, on or below the "statical" threshold. If it is above, on or below the threshold when conditions require that it should not be so, it is said to be above, on or below the "dynamical" threshold. Presentations below the statical threshold have no influence on conscious processes, but those below the dynamical threshold may profoundly influence the course of events in consciousness.

All this part of Herbart's doctrine shows striking resemblances to doctrines prominent in 20th-century psychology and might seem to anticipate the laboratory findings which were to establish the influence upon consciousness of certain forms of subliminal stimuli. Especially notable are the similarities between the Herbartian doctrine of conflict and the theories of conflict and repression in Freudian theory. The Herbartian doctrine, however, was "intellectualist," attributing the conflict to the ideas themselves conceived as "forces," whereas in modern theories conflicts between ideas are taken to reflect and derive from conflicts between affective or instinctual forces. It is likely, however, that the Herbartian doctrine was influential in determining the earlier form of Freudian theory, in which the concept of a "complex" had much in common with the Herbartian concept of an "apperception mass."

Herbart's doctrine of "apperception" is likewise of interest by reason of its influence upon general theories of motivation and, especially, upon the course of educational psychology.

Presentative activity is exhibited not only in conflicts and repulsions but also in the combination and attraction of ideas. Presentations attract other presentations so as to form complex systems. Presentation masses are formed corresponding to the many "interests" of the individual (*e.g.*, his home and his hobbies) and to larger or smaller systems of concepts such as a philosophy or a body of religious doctrines. "Apperception" is the process by which a presentation mass assimilates new material or works smaller into larger systems. In the course of mental development certain constellations of ideas acquire a permanent dominance which exercises a powerful selective facilitating influence upon the ideas struggling to enter or re-enter consciousness. One most important constellation is the ego itself. This is a mass which enters into every activity which is described as an activity of oneself; *e.g.*, I remember, I think, I feel, etc.

"Feeling," "desire," "volition" are all concepts which in Herbart's psychology are defined and described in terms of the interaction of presentations and presentation masses, the rise and fall of sensations and ideas into consciousness under facilitating conditions and against resistances. As in many earlier accounts, "agreeable feelings" are said to arise under conditions of facilitation; disagreeable feelings under conditions of inhibition and resistance.

Desire exists when a presentation rises by help of another in spite of resistance by a third. This involves feeling, pleasant or painful, generally both. When a presentation reaches a certain stage of distinctness, action follows, if action is possible. A characteristic feature of desire is the state of tension persisting when action is not immediately possible. The disposition of the psychological mechanism which results from desire and issues in action when opportunity occurs is called "volition."

Theory of Education.—As Herbart's metaphysical system lay behind and supported his psychology, so his psychology lay behind and supported his pedagogic theory. It was in having a general theory that he was distinguished from educational reformers such as Friedrich Froebel (*q.v.*) and Pestalozzi, with whose practice he was in general sympathy. The essential principles are set out in two works: the *Aesthetische Darstellung der Welt* (Göttingen, 1804), which, though complete in itself, was published as part of the second edition of his *Pestalozzi's Idee eines A B C der Anschauung* (1st ed., 1802); and the *Allgemeine Pädagogik* (Göttingen, 1806), which put forward ideas that had been formed and expressed while Herbart was tutoring at Interlaken several years earlier. In rejecting the traditional doctrines of faculties and the doctrine of innate ideas Herbart was in the line of development of the educational theory which derived from Locke (*q.v.*) and other philosophical empiricists, but in his dynamical treatment of presentational activity he introduced something in advance of the associationist psychology with which empiricism had been generally combined. In the importance that he attached to observation (*Anschauung*) he was following Pestalozzi, but in his psychological analysis of the mental processes involved he provided a theoretical basis for Pestalozzi's practice. In his systematic account of the nature of education, Herbart conceives the process as beginning with the presentation masses which the child has previously acquired from experience and from social intercourse. The teacher, through an "educating instruction," creates knowledge from the former and "sympathy" from the latter. The ultimate objective is the formation of character by the development of an enlightened will, capable of making judgments on right and wrong. Moral judgments are absolute, springing from contemplation, incapable of proof and not requiring proof. They are like the judgments passed on harmonies and discords in music.

Ethics is thus, in the Herbartian system, a branch of aesthetics. It is concerned with "relations among volitions which unconditionally please or displease." Five such relations are distinguished, corresponding to five comprehensive concepts: (1) inner freedom; (2) perfection; (3) benevolence; (4) right; (5) equity or retribution. The application of ethics to social affairs, with a view to the realization of a well-ordered social life, can be described as a moral technology, comprising politics and pedagogy.

Herbart's educational theories thus form part of a comprehensive and closely knit philosophy. But, though presented as "deduced" from general principles, they are also the expression of his personal cast of mind. His own talents and interests were such that the "educating instruction" which he imparted to his pupils combined science and the humanities in a balanced way seldom achieved in systems of education. The conflict between the demand for specialization and the demand for a general education was resolved by him in the formula "Every man must have a love for all activities, each must be a virtuoso in one." Similarly, his resolution of the conflict between the demand for freedom and self-expression and the demand for discipline had its theoretical basis in his treatment of the subject of "individuality."

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For biography *see* T. Fritzsch, *J. F. Herbarts Leben und Lehre* (1921); Georg Weiss, *J. F. Herbart: Grundriss seines Lebens* (1926). The best introduction to Herbart's philosophical psychology in English is G. F. Stout's essay (1888), republished in *Studies in Philosophy and Psychology* (1930). *See* also Christian Ufer, *Introduction to the Pedagogy of Herbart*, Eng. trans. (1895); H. M. and E. Felkin, *An Introduction to Herbart's Science and Practice of Education* (1895); Charles

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(C. A. Ma.)

HERBERT, a family with widespread ramifications throughout Wales and the borderland, is descended from four stocks of common origin in the 15th century, when the surname of Herbert was first assumed instead of keeping to the Welsh custom of retaining pedigrees. Originally freeholders and minor officials in southeast Wales, the family established its fame and fortune outside Wales when the first Herbert (*c.* 1423–69), known as "Black William," became a London merchant. He rose under the patronage of Warwick the kingmaker to be a prominent Yorkist and was made earl of Pembroke (1468), but was defeated at the battle of Edgecote and beheaded (1469). His son William (*c.* 1455–91), 2nd earl, exchanged the earldom of Pembroke for that of Huntingdon (1479), leaving one daughter from whose marriage to Sir Charles Somerset are derived the Welsh interests of the earls of Beaufort and Worcester.

The second line of descent was from William Herbert (*c.* 1506–70) whose father was an illegitimate son of Black William. From modest beginnings at court William Herbert rose to be earl of Pembroke, a title re-created in his favour (1551); married a sister of Queen Catherine Parr, retained great influence at court over four reigns and founded one of the wealthiest landed families in England and Wales, with the family seat at Wilton House, built by Inigo Jones. Sidney Herbert (1810–61) (*see* HERBERT OF LEA, SIDNEY HERBERT, 1st Baron) statesman and supporter of Florence Nightingale, also came from this branch of the family. Sidney Charles Herbert (1906–) succeeded his father as 16th earl in 1960.

Sir Edward Herbert (d. 1595), a younger son of William, the Tudor earl of Pembroke, and Ann Parr, founded the third line by the purchase (1587) of the lordship of Powis, with its castle near Welshpool. The barony of Powis was created (1629) in favour of Edward's son, William (*c.* 1573–1656), whose grandson William (*c.* 1626–96), was made earl of Powis (1674) (*see* POWIS, EARLS AND MARQUESSES OF).

In many ways the most interesting branch of the family is that founded by Black William's nephew, Sir Richard Herbert (1468–1539), who settled at Montgomery (*c.* 1509) and rose to prominence in local affairs in the reign of Henry VIII. Offshoots of this branch are later found in every corner of south and mid-Wales. Among Sir Richard's great-grandchildren were the poet George Herbert (1593–1633) and Edward (1583–1648), Lord Herbert of Cherbury, the diplomat and writer (*see* HERBERT OF CHERBURY, EDWARD HERBERT, Baron).

(T. J. P.)

HERBERT, GEORGE (1593–1633), English devotional poet, of the metaphysical school of John Donne, was born on April 3, 1593, the fifth son of Sir Richard and Lady Magdalen Herbert and a brother of Lord Herbert of Cherbury. His father died when George was three years old and his mother watched over the education of her seven sons (the youngest, William, was born posthumously) and three daughters. She was a woman of exceptional gifts of character and intellect and her influence over George was strong. John Donne, who was her friend for over 20 years, eulogized her in a funeral sermon and in his poem "The Autumnal." George was taught by a tutor until he was 12 and then, or soon after, was sent to Westminster school. In 1608 he was elected to a scholarship at Trinity college, Cambridge. In the following year his mother married her second husband, Sir John Danvers, 20 years her junior. In 1610 Herbert sent his mother, for New Year's day, two sonnets upon the theme that the love of God is a fitter subject for verse than the love of woman. These are his earliest known poems, and religious devotion was to remain his sole poetic theme. In 1614 he was elected to a minor, and in 1615 to a major, fellowship at Trinity college. On Jan. 21, 1620, he was elected public orator of the university, a position which he described to his stepfather as "the finest place in the university." His two predecessors in this office became secretaries of state. His mother had long believed that George's vocation was the church and she proved to be right, but for a time he was attracted by worldly ambition. However, between 1624 and 1625 his three principal patrons died, the duke of Richmond, the marquis of Hamilton and King James I.

In 1625 Herbert was ordained deacon, which meant that he had abandoned all thought of a secular career, although he did not formally resign the oratorship until Jan. 1628, six months after his mother's death. On March 5, 1629, he married his stepfather's kinswoman, Jane Danvers. On Sept. 19, 1630, he was ordained priest and for the brief remainder of his life (he died on March 1, 1633) he lived and worked as a rural parish priest at Bemerton, Wiltshire. George and Jane had no children of their own but they made a home for the three orphaned daughters of his sister. His saintly devotion to his duties as country parson were described by his friend Nicholas Ferrar in a preface to the first edition of Herbert's poems, published in 1633. At Bemerton Herbert wrote *The Priest to the Temple,* a prose treatise on the duties of a parish priest; he also revised his earlier poems and wrote many more—probably more than half the extant poems were written there. He also translated Luigi Cornaro's *Treatise on Temperance* and annotated Valdesso's *Considerations* (his comments demur at the unorthodox mysticism of Valdesso and reassert the orthodox doctrine upon grace and salvation). Both at Cambridge and at Bemerton music was Herbert's recreation; he played the lute and composed musical accompaniments for some of his own poems.

Herbert's poems were not published in his lifetime though some must have circulated in manuscript since he was well known as a poet many years before his death. On his deathbed he sent a manuscript volume to Nicholas Ferrar for him to publish or destroy, as he thought fit. He described the poems as "a picture of the many spiritual conflicts that have passed between God and my soul, before I could subject mine to the will of Jesus my Master, in whose service I have now found perfect freedom." Ferrar published the volume and gave it the title *The Temple* which has remained in all the subsequent editions. Herbert's account of his subject matter applies better to some of the poems than to others. A few poems, notably the first, "The Church Porch," are aphoristic, didactic reminders of Christian morals and observances. Others are renderings of particular Christian doctrines or of church ritual. Many, however, do record a conflict between the love of God and the temptations of worldly ambition, or the oscillations between religious joy and spiritual lassitude. But neither are the doctrinal poems coldly impersonal nor the personal poems merely autobiographical. The latter express the common experience of devout Christians and imply precise doctrinal beliefs, so that no sharp dividing line separates the personal from the less personal poems.

Herbert is usually described as a metaphysical poet (of the school of John Donne). He resembles Donne in his preference for words in common use, in his ability to imitate in verse the rhythms of speech and in the logical structure of many poems. But his conceits are less startling than Donne's and less dependent upon wide-ranging intellectual curiosity. In Herbert's poems the paradoxes of Christian doctrine are illustrated by emblems, by allegories and by analogies with homely workaday experiences. He wrote for a less sophisticated audience than Donne although he assumed that his readers would have an intimate knowledge of the Bible and of the doctrines and ritual of the Anglican Church. Herbert was a versatile master of metrical form and of all aspects of the craft of verse.

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(Jo. Be.)

HERBERT, VICTOR (1859–1924), U.S. composer of operettas and light music, was born in Dublin, Ire., Feb. 1, 1859. He received thorough musical training in Germany, where he became active as a composer and violoncello virtuoso (studying with Max Seifritz and Bernhard Cossmann respectively). In 1886 he went to the United States with his wife (Therese Förster), who became a prima donna in the Metropolitan Opera, and played in the Metropolitan orchestra and under Anton Seidl and Theodore Thomas. His earlier compositions, romantic and melodious, were performed by the New York Philharmonic society; he himself was soloist in his two cello concertos.

In the United States Herbert won fame as a composer of brilliant operettas and also as a conductor. In 1893 he assumed leadership of the celebrated 22nd regiment band (formerly P. S. Gilmore's); from 1898 to 1904 he conducted the Pittsburgh Symphony orchestra; in the latter year he organized his own concert orchestra, which was immensely popular throughout the country. He energetically led the fight for favourable copyright legislation, passed in 1909, and he benefited all American composers by taking a leading role in the founding of ASCAP (American Society of Composers, Authors and Publishers) in 1914.

Herbert's first operetta was *Prince Ananias* (1894). It was followed by more than 40 others, many of them of great importance in operetta literature. Among the best are *The Serenade* (1897), *The Fortune Teller* (1898), *Babes in Toyland* (1903), *Mlle. Modiste* (1905), *The Red Mill* (1906), *Naughty Marietta* (1910), *Sweethearts* (1913), *The Only Girl* (1914), and *Eileen,* first performed as *Hearts of Erin* (1917). His operetta music was superbly orchestrated. He also wrote two grand operas, *Natoma* (1911) and *Madeleine* (1914), and the music for the motion picture *The Fall of a Nation* (1916). The last-named work was probably the first original symphonic score composed for a feature film, thus a landmark in music and cinema history. Late in life he wrote for revues, notably the *Ziegfeld Follies.* He died in New York city May 26, 1924.

See E. N. Waters, *Victor Herbert: a Life in Music* (1955).

(E. N. W.)

HERBERT OF CHERBURY, EDWARD HERBERT, Baron (1583–1648), courtier, soldier, diplomat, poet, historian and philosopher, was born at Eyton on Severn on March 3, 1583, and educated at University college, Oxford. On the accession of James I in 1603, he presented himself at court and was created a knight of the Bath. He served in the Netherlands in 1610 under Sir Edward Cecil, and distinguished himself at the capture of Jülich from the emperor Rudolph II. He then traveled in Italy. On his return in 1617 Herbert fell ill and at that time, while at his castle at Montgomery, he began work on his book *De Veritate.* Shortly afterward, through the influence of the duke of Buckingham, he was made ambassador at Paris, but a quarrel with the duc de Luynes occasioned his recall in 1621. Herbert resumed his embassy in Feb. 1622, and tried to promote the marriage between Charles and Henrietta Maria and thus secure the assistance of Louis XIII for the unfortunate elector palatine. On being dismissed in April 1624, he received the Irish peerage of Castle Island and belatedly, in 1629, the English barony of Cherbury. He was appointed a member of the council of war in 1632, attended Charles I at York in 1639, and was imprisoned by parliament in May 1642 for urging the addition of the words "without cause," to the resolution that the king violated his oath by making war on parliament. He retired to Montgomery castle and refused the king's summons. Herbert's attitude in the Civil War, like that of many peers, tended toward neutrality. He had received little return for the expenses incurred in the royal service and perhaps his conduct toward Charles I was affected by the ingratitude with which he believed himself to have been treated. On Sept. 5, 1644, he surrendered the castle to the parliamentarians, making special stipulation for the safety of his library, which indicates the direction in which his interests had increasingly turned. In the *Autobiography,* first published by Horace Walpole in 1764, Herbert wrote, "a man may have quickly more than he needs of philosophy and logic." But this book, which has formed posterity's idea of Herbert's character, distorts the truth about him. He died in London on Aug. 20, 1648. Herbert's epitaph, written by himself, recorded nothing but the fact of his authorship of *De Veritate.*

The *De Veritate prout distinguitur a revelatione, a verisimile, a possibile, et a falso* (English translation by M. H. Carré, 1937) was Herbert's most important book and his most significant achievement. First published in Paris in 1624, it was translated into French in 1639, but not into English until 1937. Abstract, obscure, repetitious, and couched in barbarous Latin, it had no contemporary influence, but was nonetheless an original and important book. In revulsion from the dogmatic confusion of the period after the Reformation, Herbert advanced a scheme of natural religion, consisting of five basic notions which he believed to be common to all religions and to be in accordance also with reason. Later exponents of these and similar ideas acclaimed Herbert as the founder of a school, and as the father of the English deism. Herbert's argument was indeed the first of its kind to be published by a British writer, but the originality was less in having the ideas than in daring to publish them. However, a religion consisting of the simplest elements believed to be common to all creeds, was the outcome of the application of Herbert's thinking to only one sphere of experience, and this particular application of Herbert's thought obscured and even perhaps contradicted the most original and profound of his insights. For Herbert, with his "common notions," was attempting the study, not of history or of comparative religion, but of the formal conditions of all experience. His deepest preoccupation was not with ideas on morality and religion which could be said to be common to all peoples, but with the uniformities of the processes of the mind. His method was less an appeal to universal consent than to introspection. Herbert, by the imprecision of his thought, was himself responsible for confusion here. Moreover, his own interest in the problems of religion, as witnessed by his further works, *De Causis Errorum* (1645), *De Religione Laici* (1645) and *De Religione Gentilium* (1663), which were all in a sense appendices to the appendix to *De Veritate,* meant that his great work came at the head, not of a school of metaphysics, but of a dynasty of English antiecclesiastical theologians. At its profoundest level the thought of *De Veritate* marked Herbert out as an isolated and prophetic figure. At his best he anticipated not only the Anglo-Scottish philosophers of "common sense," as they themselves recognized, but also Kant and modern critical philosophy.

Herbert's other works include *Expeditio Buckinghami ducis* (1656), *The Life and Reign of Henry VIII* (1649), written at the request of Charles I and for long a standard work, and a volume of poems (1665; mod. ed. by G. C. Moore Smith, 1923). An important book of 242 lute pieces collected by Herbert and including some of his own compositions is in the Fitzwilliam museum, Cambridge.

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HERBERT OF LEA, SIDNEY HERBERT, 1st Baron (1810–1861), English statesman notable for his association with Florence Nightingale to improve sanitary conditions in the British army during the Crimean War, was born at Richmond, Surrey, on Sept. 16, 1810. He was educated at Harrow and Oriel college, Oxford, where he was a member of that group of brilliant young men, including his close friend W. E. Gladstone, who first attained prominence as admirers of Sir Robert Peel.

Sitting for Wiltshire from 1832 onward, Herbert served under Peel as secretary of the board of control in 1834–35, and as secretary to the admiralty between 1841 and 1845, when he joined the cabinet as secretary at war. The ministry resigned in 1846 after the repeal of the corn laws, and Herbert soon emerged as a leading Peelite. From 1852 he was again secretary at war until Lord Aberdeen's coalition fell in 1855, when he briefly became colonial secretary under Lord Palmerston. During the Crimean War, which revealed grave weaknesses in military administration, Herbert strove for improvement, and the Sebastopol committee on the conduct of the war reported favourably on his ef-

forts. Thereafter, in conjunction with Florence Nightingale, his personal friend, whom he had first sent out to Scutari, Turkey, Herbert promoted successive inquiries, notably the royal commission of 1856, with a view to extensive reform. His opportunity came when he entered Palmerston's ministry of 1859 as secretary for war; but under protracted strain his health broke down. Herbert was raised to the peerage in 1860, and died at Wilton, near Salisbury, on Aug. 2, 1861, shortly after his resignation.

Highly regarded and much loved by his contemporaries, Herbert was a charming, talented man, who failed to fulfill his early promise and is best remembered for his collaboration with Florence Nightingale. Frail and sensitive, with a keen sense of personal responsibility, he could not survive the physical and psychological stresses of the Crimean War and its aftermath; but he succeeded in initiating important reforms at the war office. (A. F. T.)

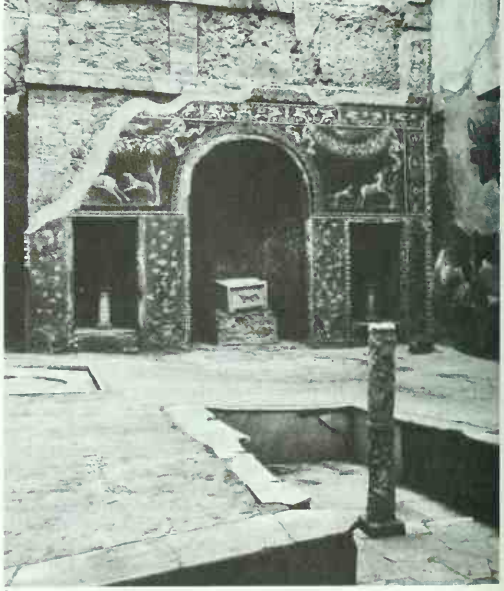
HERBIG, GUSTAV (1868–1925), German scholar in Etruscan, was born on June 3, 1868, at Kaiserslautern (Pfalz) and educated at the universities of Munich and Leipzig. He came much in contact with Carl Pauli, the university librarian at Munich, who was also editor of the *Corpus Inscriptionum Etruscarum* (begun in 1893, still incomplete), the foundation of all modern scientific study of Etruscan. His successive appointments as Pauli's successor, as professor at Rostock (1913), where he served as rector in its quinquecentennial celebrations (founded 1419), at Breslau (1921) and finally at Munich again (1922) gave him enough leisure to pursue his study of Etruscan. Besides his editorial work, he contributed many articles directed at the solution of its problems on the combinatorial method. He died in Munich on Oct. 1, 1925. (J. WH.)

HERCEGOVINA: *see* BOSNIA-HERCEGOVINA.

HERCULANEUM, an ancient city of Campania, Italy, with not more than 5,000 inhabitants, destroyed, together with Pompeii and Stabiae (*qq.v.*), by the Vesuvius eruption of A.D. 79; in modern times the town of Resina lies over part of it. The city was situated about 5 mi. from Neapolis (Naples), at the foot of Mt. Vesuvius, along the coast road which led from Neapolis to Pompeii and from there on to Stabiae and Nuceria (Nocera Inferiore). Its position on a promontory deeply channeled by stream beds is known from the ancient writers Strabo and Sisenna; but the original features of these places were greatly altered as a result of the eruption of 79, when the town and its surroundings were buried beneath an enormous semifluid mass of volcanic matter which solidified into tufa.

Ancient tradition connected Herculaneum with the name of the Greek hero Heracles, an indication that the city was of Greek origin; and in fact its plan suggests that of the Greek city of Neapolis, although the remains of the monuments so far discovered relate to the Samnite and even more to the Roman period of the city rather than to its more ancient phase. There is, however, historical evidence that toward the end of the 6th century B.C. a primitive nucleus of Oscan inhabitants (the most ancient Campanian people) came under the Greek hegemony first of Cumae and then of Neapolis, which ruled the whole of the Campanian coast and the islands of the Bay of Naples, and that it was not until the 4th century B.C. that Herculaneum came under the domination of the Samnites. The city became a Roman municipium in 89 B.C. when, having participated in the Social War ("war of the allies" against Rome), it was defeated by T. Didius, a legate of Sulla. Herculaneum was severely shaken by an earthquake in A.D. 62 or 63 and the serious damage suffered by its public and private buildings had not yet been repaired when it was buried by the Vesuvius eruption of 79. As the number of human remains found during the excavations was exceedingly small, it may be assumed that, unlike the people of Pompeii, most of the inhabitants succeeded in escaping toward Naples, in the opposite direction to the fall of lapilli and ashes.

The particular circumstances in which Herculaneum was buried, very unlike those of Pompeii, led to the formation over the city of a compact mass of tufaceous material, from about 50 to 60 ft. deep. This, although making excavation very difficult, preserved Herculaneum from being tampered with and looted and, because of the special conditions of humidity of the ground, made possible the conservation of wooden frameworks of houses, wooden furniture, cloth and food. Thus Herculaneum offers a detailed impression of private life that is only with difficulty achieved in other centres of the ancient world. Excavation began in the 18th century, when all memory of the existence of Herculaneum had been lost for centuries and the only available reports of it were those which had come down through the ancient authors, without any precise information as to the exact position of the ancient city. Quite by accident, in 1709, during the digging of a well, a wall was discovered which was later found to be a part of the stage of the Herculaneum theatre; this was lined with precious columns and statues that unfortunately have been largely dispersed among various museums outside Italy. More regular excavations were started in 1738 under the patronage of the king of Naples, Charles of Bourbon (later Charles III of Spain), with the sole object of recovering statues, paintings, mosaics and domestic furniture and with no particular interest in architecture of the buildings. Because of the depth and the hardness of the ground, the excavations were carried out by means of wells and underground tunnels, and the objects discovered served to form a museum in the neighbouring royal villa of Portici, from which they were subsequently transferred to the National museum at Naples. By the excavations carried out between 1738 and 1765 the Portici museum was enriched with magnificent paintings and a group of portrait statues which came from a building thought to be the ancient basilica of Herculaneum and, in addition, with a large number of bronze and marble works of art recovered from a suburban villa, called "the Villa of the Papyri" because of its having contributed a whole library of ancient papyri in Greek. These papyri, on philosophical subjects of Epicurean inspiration, preserved in the *Officina dei papiri* in the Biblioteca Nazionale of Naples, have been only partly read. Of this fruitful period of excavation there is extant an outline plan, traced by Francesco la Vega, showing the network of tunnels, as well as a plan of the Villa of the Papyri



EDWIN SMITH

HOUSE OF POSEIDON AND AMPHITRITE, SHOWING THE INTERIOR COURTYARD WITH FOUNTAIN AND MOSAICS

produced by the Swiss Carl Weber. The excavations were resumed in 1823 with the intention of discontinuing the tunneling and working from above ground, a method used with success at Pompeii; up to 1835 the work proved of value by bringing to light the first houses of Herculaneum, among which was the peristyle of the House of Argus. Abandoned and again resumed in 1869, after the unification of Italy, the excavations continued until 1875 when, because of the poor results obtained and the presence of the inhabited dwellings of Resina, they were abandoned altogether.

After the efforts of the English archaeologist Charles Waldstein to internationalize the excavations at Herculaneum (1904) by collecting contributions for this purpose from various nations in Europe and America, the work was finally resumed in May 1927 with Italian state funds and with the object of conducting the excavations with the same continuity as those of Pompeii. The results of this work, interrupted only by World War II, make it possible to have a clear idea of the ancient city. The larger *decumanus* ("main road"), which also formed one side of the quarter of the forum with its public buildings, marks the limit between the completed excavations and those still in progress. The insulae (blocks) to the south of the *decumanus* have developed in a strictly geometrical pattern facing the *cardines* ("crossroads"), as far as the rim of the promontory. This was blocked by a wall, above which project the nobler houses, enjoying a view of the bay (House of the Deer, House of the Mosaic Atrium). Inside the residential quarter houses of rich republican and patrician construction (Samnite house, House of the Bicentenary, House of the Wooden Partition) alternate with houses of the middle class, also finely decorated (House of the Skeleton, House of Poseidon and Amphitrite, House of the Carbonized Furniture), or with houses of the commercial and workshop variety, of no less interest for the daring variations to be found on the traditional scheme of the ancient house (*e.g.*, the House of *opus craticium* [walls of timber, rubble and mortar], a typical example of a house containing separate apartments).

The public monuments uncovered include the palaestra (sports ground), with a large portico surrounding a vast central piscina (swimming pool), and two thermae (baths), of which one is next to the forum quarter and the other outside the city gate; the second bath is in a remarkable state of preservation, having remained practically entirely protected against the flow from the eruption.

Excavation continues, since the demolition of part of Resina, in the area of the forum of the ancient city in search for its principal civil and religious buildings: temples, basilica and senate house.

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HERCULANO DE CARVALHO E ARAÚJO, ALEXANDRE (1810–1877), Portuguese historian, novelist and poet, who with Almeida Garrett introduced romanticism into Portugal. He was born in Lisbon on March 28, 1810. After taking part in the revolt against the absolute power of Dom Miguel, he fled to England and France, returning in 1832 with the army that established the liberal regime in Portugal. His first important works are *A Voz do Profeta*, a lampoon against the popular revolution of 1836, and *A Harpa do Crente* (1838), poems referring mostly to the civil war between 1832 and 1834. From 1837 to 1839 he was editor of *O Panorama*, a review influenced by the English *Penny Magazine*, in which he first published the historical novels issued later in book form (*Lendas e narrativas*, 2 vol., 1851) and also essays propagating the new European literary tendencies. He was inspired by the conviction that an important cultural reform should complete the reform of political institutions. Elected to the *cortes* in 1840, he campaigned for a democratic reform of education.

In 1841 António Bernardo da Costa Cabral established an authoritarian regime and Herculano withdrew from politics. As librarian from 1839 of the Royal Library of Ajuda he was able to devote all his time to the composition of the *História de Portugal*. This work was preceded by some preparatory essays (*Cartas sobre a história de Portugal*, 1842; *Apontamentos para a história dos bens da Coroa e dos forais*, 1843–44); and by historical novels, all showing the influence of Sir Walter Scott and Victor Hugo, which introduced this literary genre into Portugal: *Eurico o presbítero* (1844), a narrative in poetical prose of the Arab invasion of the peninsula; *O Bobo* (1843), dealing with the origins of the Portuguese monarchy; and *O Monge de Cister* (1848), set in the reign of John I.

In 1846 appeared the first volume of *História de Portugal*. One of the finest achievements of romantic historiography, this work covers the political and social history of Portugal to 1279 and resembles Jacques Thierry's *Histoire du Tiers État* (1853) in stressing the origin and rise of a middle class. To his contemporaries its most striking characteristic was its exposure of many traditional legends, such as the appearance of Christ to the first king of Portugal in the battle of Ourique. Attacked by the clergy, Herculano answered by denouncing their ignorance and fanaticism.

In 1851 the Costa Cabral regime was overthrown by the movement of the *"Regeneração,"* in which Herculano took part. To support the new regime and to combat the right-wing elements which were undermining it, he helped to found two newspapers, *O País* (1851) and *O Portuguez* (1853), in which he wrote against political centralism and the increase in clerical influence. To this period belongs *Da origem e estabelecimento da Inquisição em Portugal* (1854–59; Eng. trans. 1926). Based on hitherto unknown documents, it attempted to demonstrate that royal absolutism and clerical power were allies in the confiscation of the property of the "New Christians" (converted Jews) through the Inquisition. Herculano was a Roman Catholic of strong opinions and during his early literary career he tried to reconcile Catholicism and liberalism (*Pároco da Aldeia*, 1844), but his quarrel with the clergy and the revival of clerical influence made him consider Ultramontanism the main enemy of liberal institutions. He protested against the Concordat of 1857, led the campaign against the restoration of the monastic orders and advocated civil marriage. His book on this subject, *Estudos sobre o casamento civil* (1866), was immediately placed on the Roman Index. From 1871 he was openly critical of the new dogmas of the Immaculate Conception and papal infallibility.

The fourth and last volume of the *História de Portugal* was issued in 1853. Grieved by the appointment of a personal enemy as director of the national archives in 1856, Herculano then ceased to write and turned to farming in Vale de Lobos, near Santarém. However, he continued to direct the compilation of the *Portugaliae Monumenta Historica* (vol. 1, 1856) and began to collect his essays and polemical writings in *Opusculos*, 6 vol. (1873–84), which contains some of his best work: vigorous polemic, forceful in expression and terse and elegant in style. He died at Santarém on Sept. 13, 1877.

Herculano impressed his contemporaries deeply not only by his works but by his austere and adamant character. He refused all official honours but enjoyed a national prestige equalled only by that of Victor Hugo in France. His collected works were edited in 33 vol. by Livraria Bertrand.

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HERCULES, the latinized form of the name of the most famous Greek legendary hero, HERACLES (Greek *Herakles*). Its probable meaning, "glorious gift of Hera," shows that he cannot have been originally a god, for no Greek god ever has a name compounded of that of another deity. Behind his very complicated mythology there is probably concealed a real man, perhaps a chieftain-vassal of the kingdom of Argos.

His legend gives him divine parentage. Zeus, wanting a son who should be powerful among both gods and men, begot him by Alcmene, granddaughter of Perseus, taking for this purpose the likeness of her absent husband, Amphitryon (*q.v.*). Zeus then solemnly swore that the son of the Perseid house whose birth was expected should become ruler of Greece. But his wife, Hera,

furiously jealous, frustrated this design by bringing to premature childbed the wife of Sthenelus, another descendant of Perseus, and by simultaneously delaying the birth of Heracles. It was therefore Sthenelus' son, the sickly Eurystheus, who was born first and became king; and when Heracles grew up he had to take service under him and suffer besides, throughout his life, the vengeful persecution of Hera. His first exploit, indeed, was the strangling of two serpents which she sent to kill him in his cradle.

WAGNERSMUSEUM, WÜRZBURG

AMPHORA WITH FIGURE OF HERCULES CARRYING OFF THE DELPHIC TRIPOD: BY THE "BERLIN PAINTER," 5TH CENTURY B.C. IN THE WAGNERSMUSEUM, WÜRZBURG

Heracles spent his early youth in learning accomplishments and in developing his strength. He began his saga of deeds by killing the lion that was ravaging the herds of his mother's husband, Amphitryon. Then he waged a victorious war against the kingdom of Orchomenus in Boeotia, and married Megara, one of its royal princesses. But he killed her and their children in a fit of madness sent by Hera; and, probably in consequence of this, was obliged to become the servant of Eurystheus. He it was who imposed upon Heracles the famous Labours, later arranged in a cycle of 12, usually as follows: (1) the slaying of the lion of Nemea, whose skin he thereafter wore; (2) the slaying of the nine-headed hydra (*q.v.*) of Lerna; (3) the capture of the elusive hind (or stag) of Arcadia; (4) the capture of the wild boar of Mt. Erymanthus; (5) the cleansing, in a single day, of the cattle stables of King Augeas (*q.v.*) of Elis; (6) the shooting of the monstrous man-eating birds of the Stymphalian marshes; (7) the capture of the mad bull that terrorized the island of Crete; (8) the capture of the man-eating mares of King Diomedes of the Bistones; (9) the taking of the girdle of Hippolyte, queen of the Amazons; (10) the seizing of the cattle of the three-bodied giant Geryon, who ruled the island Erytheia ("Red") in the far west; (11) the bringing back of the golden apples kept at the world's end by the Hesperides; (12) the fetching up from the lower world of the triple-headed dog Cerberus (*q.v.*), guardian of its gates.

This stylized cycle is composed of various elements quite separate in origin and significance. There is little doubt, for example, that the 11th and 12th labours, which take place in the other world, represent a forcible seizure of immortality and are parallel to the adventure in Homer's *Iliad* where Heracles fights and wounds Hades. Even the tenth is only a more disguised version of the same theme; for the killing of the giant Geryon and the plundering of his cattle is a "harrowing of Hell." The fifth labour is a typical local folk-tale. King Augeas' immense herds included 12 white bulls sacred to his father, the sun-god Helios. When Heracles had cleansed their stables by turning the river Alpheus (mod. Gr. Alfios) through them, Augeas refused him his promised reward of a tenth of the herd and so deserved his eventual destruction in a war with Heracles.

The cycle of the Labours contains, in addition to the main exploits, a series of minor adventures. For example, during the fourth labour, Heracles met and fought the fabulous centaurs, half men, half horses; during the 11th, he wrestled with and finally slew the giant Antaeus, son of Earth. Having completed the Labours, Heracles undertook further enterprises, including warlike campaigns. Other notable incidents are his struggle with Apollo for the sacred tripod of the oracle at Delphi, which Zeus stopped by throwing a thunderbolt between the combatants; and his share in the battle of the gods and giants. He also features, as somewhat of an intruder, in the story of the Golden Fleece. Some last adventures precede his death and apotheosis.

He fought and vanquished the river-god Achelous for the hand of Deianeira, whom he wished to make his second wife. As he was taking her home, the centaur Nessus tried to violate her, and Heracles shot him with one of his arrows, which he had envenomed by dipping them in the poison of the hydra. The centaur, dying, bade Deianeira preserve the blood from his wound, for anyone wearing a garment rubbed with it would love her forever. After several years of married life with Deianeira, Heracles fell madly in love with Iole, daughter of Eurytus, king of Oechalia. He was repulsed by Eurytus when he demanded her, and the matter was further complicated by his killing Eurytus' son, for which he had to go into exile for a year as slave to the Lydian queen Omphale, who set him to do women's work. According to some accounts, Heracles loved her and served her to gain her favours. Returning, he captured Oechalia and took Iole prisoner. His wife, Deianeira, realizing that this maiden was a dangerous rival, sent Heracles a garment smeared with the blood of Nessus. This, however, proved to be a powerful poison, and Heracles was seized with terrible agonies. At last he had himself carried to the top of Mt. Oeta (modern Greek Oiti), where a huge pyre was built. On this he was burned. His mortal part was consumed, but his divine part ascended to heaven, was reconciled to Hera and wedded Hebe. The story of the burning is connected with a very ancient ceremony on Oeta at which victims and also puppets in human shape were burned, and is the latest form of the persistent theme of the winning of immortality.

Heracles' saga is thus seen to be very complex. His Peloponnesian adventures may well be in origin an exaggerated account of the exploits of a real man, a great fighter and hunter; many of the others may have been originally accredited to some local hero afterward absorbed by him. The incident of Omphale sounds like the tale of some Oriental mother-goddess and her male consort. There are several other traces of the identification of Heracles with foreign gods; for example, he is equated with the Phoenician Melqart.

In cult he is sometimes a hero, sometimes a god; Athens claimed to have been the first locality to give him divine honours. His titles are numerous, among the most characteristic being "averter of evil" (also a title of Apollo) and "nobly victorious." In art and literature he is represented as an enormously strong man of moderate height; a huge eater and drinker, very amorous, generally kindly but with occasional outbursts of brutal rage. He generally wears the skin of the Nemean lion; his characteristic weapon is the bow, but frequently also the club (whether this is original or not is doubtful). Numerous representations of him survive, of which the best known is the statue, now at Naples, known as the Farnese Hercules.

In Italy, his name was corrupted into various forms, the most familiar being "Hercules" (Latin). He was worshiped as a god only (hero-cult not being Italian) and was principally a god of merchants and traders, although others also prayed to him for his characteristic gifts of good luck or rescue from danger. Tithes of commercial profits, etc., were often presented to him, and feasts held in his honour. His best-known cult was at the Ara Maxima in the Forum Boarium (cattle market) at Rome. This cult, though very early, is probably not to be identified with that of any native deity. Late and artificial legends represented Hercules as returning from the raid on Geryon's cattle by way of Italy; visiting the future site of Rome with Evander, its first legendary settler, and there introducing more humane rites in place of human sacrifice and teaching Evander's people to worship himself, having earned their gratitude by killing the giant Cacus (really an ancient fire god).

There is a completely different Heracles called the Dactyl, the precise significance of whose title (literally "finger") is unknown. He seems to be a kind of gnome or wizard. He founded the Olympic games.

See also references under "Hercules" in the Index volume.

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HERCULES, in astronomy, a constellation of the northern hemisphere. Represented by a man kneeling, this constellation was first known as the man on his knees, and was afterward designated Cetheus, Theseus and Hercules by the ancient Greeks. Hercules contains a famous globular star cluster (Messier 13) which is the finest example of such clusters in the northern hemisphere. The sun's motion through space is directed toward a point in this constellation. The light of the third-magnitude star α Hercules varies irregularly. For the position of Hercules in relation to other constellations *see* CONSTELLATION.

HERCYNITE: *see* SPINEL.

HERCZEG, FERENC (1863–1954), Hungarian novelist and playwright, a leading conservative-nationalist writer of the early 20th century, who also played an active part in politics, was born at Versecz, Sept. 22, 1863. He published his first novel in 1890. In 1895 he founded *Új Idők*, which remained for half a century the literary magazine of the right-wing upper and middle classes. His many novels contained just enough irony and social criticism to cause a harmless shock to the conservative public for whom they were written, and brought him great popularity. The main interest of even the best of them, such as *Gyurkovics lányok* (1893), which describes the foibles of the gentry, is in the insight they give into the tastes of Herczeg's public. His social comedies, such as *A három testőr* (1895) and *Kék róka* (1917), are amusing and skilful. *Bizánc* (1904) and *A híd* (1925) are the best of many historical dramas: the former is set in 15th-century Constantinople, the latter deals with the conflict between the 19th-century statesmen Louis Kossuth and István Széchényi. Herczeg died in Budapest, Feb. 24, 1954. (Ds. Sr.)

HERDER, JOHANN GOTTFRIED VON (1744–1803), German critic, philosopher and Lutheran theologian who exercised a great influence in the history of German thought, was born on Aug. 25, 1744, at Mohrungen in East Prussia, the son of poor parents. From the summer of 1762 he studied theology, philosophy and literature at Königsberg, coming into close contact with Immanuel Kant and Johann Georg Hamann. In Nov. 1764 he went to teach and preach in Riga, where he published his first works: *Über die neuere deutsche Literatur* (three collections of fragments, 1767) and *Kritische Wälder, oder Betrachtungen, die Wissenschaft und Kunst des Schönen betreffend* (1st–3rd series, 1769; a 4th series appeared in 1846). A sea voyage from Riga to Nantes, on which he set out in the summer of 1769, brought Herder to a deeper understanding of his destiny: the *Journal meiner Reise im Jahr 1769*, which he concluded in Paris in December, bears witness to the change that it effected in him. During a visit to Strasbourg, where he arrived in Sept. 1770 as the companion of Prince Peter Frederick William of Holstein, he had his momentous meeting with the young Goethe, who was stirred to recognize his own artistic faculties by Herder's observations on Homer, Pindar, Shakespeare, Ossian, folk songs and Hamann.

In April 1771 Herder went to Bückeburg as court preacher. The works which he produced at Bückeburg were fundamental to the *Sturm und Drang* movement, without which German classical and romantic literature could not have come into being. Apart from his *Abhandlung über den Ursprung der Sprache* (1772) on the origin of language in human nature, his *Auch eine Philosophie der Geschichte zur Bildung der Menschheit* (1774) against rationalism in historiography, his *Älteste Urkunde des Menschengeschlechts* (1774–76) on Hebrew antiquities, his *An Prediger: funfzehn Provinzialblätter* (1774) and his *Erläuterungen zum Neuen Testament* (1775), he published two especially important works, the essay on "Shakespeare" and "Auszug aus einem Briefwechsel über Ossian und die Lieder alter Völker" in the manifesto *Von deutscher Art und Kunst* (1773), to which Goethe and Justus Möser also contributed.

Thanks to Goethe's influence, Herder was appointed general superintendent and consistory councilor at Weimar in 1776. There he completed his transition to classicism in such works as *Von Ähnlichkeit der mittlern englischen und deutschen Dichtkunst* (1777), *Plastik* (1778), *Vom Erkennen und Empfinden der menschlichen Seele* (1778), *Über die Wirkung der Dichtkunst auf die Sitten der Völker in alten und neuen Zeiten* (1778), *Briefe, das Studium der Theologie betreffend* (1780–81), *Vom Geist der ebräischen Poesie* (1782–83) and his collection of *Volkslieder* (1778–79). His work at Weimar reached its peak in *Zerstreute Blätter* (1785–97) and in the unfinished *Ideen zur Philosophie der Geschichte der Menschheit* (1784–91), the latter work the result of his intercourse with Goethe. The basic premises underlying the *Ideen* are resumed in the dialogues *Gott* (1787; 2nd ed., *Einige Gespräche über Spinozas System*, 1800), in which Herder combines the views of Leibniz, Spinoza and Shaftesbury. In 1788–89 Herder went on a tour of Italy.

Financial difficulties, differences of opinion over the French Revolution and above all, his self-assertive nature which could not bear the proximity of a greater man, led to an estrangement of Herder from Goethe. On Herder's side this resulted in a bitter enmity toward the whole classical movement in German poetry and philosophy. His *Briefe zu Beförderung der Humanität* (1794–97) and his *Adrastea* (1801–03) emphasized the didactic purpose of all poetry, thus contradicting that very theory of the autonomy of the work of art which he himself had helped to establish. With the *Christliche Schriften* (1794–97), the *Metakritik zur Kritik der reinen Vernunft* (1799) and the *Kalligone* (1800) Herder began his attack on Kant, whose philosophy he saw as a threat to his own historical view of the world. In this attack he had the support of C. M. Wieland and of Jean Paul. Herder died at Weimar on Dec. 18, 1803.

Herder's Thought.—Developing the image of his sea voyage of 1769, Herder saw himself as a literally groundless existence, having left the safe shore behind him and journeying into a future whose character it would be his vocation to decipher from the past so that he might call it into being in the hearts of his contemporaries. Thus the present was for Herder not an end, as it was for the historical consciousness of the Enlightenment, but rather the beginning of a development. The possibilities of this development he anticipated, generations ahead, in his fruitful criticisms of the state of affairs in his own time: thus he anticipated Goethe, the brothers A. W. and F. Schlegel and also the brothers Jacob and Wilhelm Grimm in poetical and aesthetic theory; W. von Humboldt in the philosophy of language; G. W. F. Hegel in the philosophy of history; W. Dilthey and his followers in epistemology; A. Gehlen in anthropology; and the Slav nationalists in political thought. By nature Herder was "more inclined to examine and to stimulate than to direct and lead" (Goethe, *Dichtung und Wahrheit*).

For Herder the medium of thought is feeling (*Gefühl*), which he compares to the sense of touch. Whereas sight, which his contemporaries held to be the noblest of the senses, apprehends things at a distance, feeling has an immediate experience of reality as a power which reacts against man's vital energy and makes him a limited being. Yet man at the same time experiences his own individual body as a whole which is animated throughout by himself and in which his vital power tries to assert itself against the universe. At the moment when man conditions his environment as much as his environment conditions him, when, that is to say, he recognizes his limits with respect to his environment without becoming dependent on it, then that precise balance of forces is achieved in which the individual body is converted into the *Gestalt* or "form" consummating the identification of the individual with reality, of the internal with the external. The necessary precondition for this reconciliation of opposites was discerned by Herder in God himself, who reveals himself in the very process whereby the form comes into being, yet without exhausting his nature in that process.

In describing the constitution of the form, Herder uses Leibnizian concepts to illustrate ideas that J. J. Winckelmann had derived from the study of Greek sculpture. He does not however restrict the notion of form to individual bodies, but exalts it into a general principle whereby reality can be known. Its function is to reveal the world in its contradictions and at the same time in its unity, as a plurality of individuals in which the whole is yet reflected.

For Herder, the pupil of Hamann, every act of knowledge is only possible through the medium of human language.

First of all, this is a structure of sound in which an individual situation of the human being in reality, experienced through feeling, finds immediate expression. Language, however, reaches its perfection in the objective meaning of the word. This has its origin in the fact that man and the world, which are united in feeling, separate themselves in consciousness in order to link themselves anew in an "intentional" act expressly designating what had been dimly apprehended but not specifically recognized in feeling. Feeling and reflection thus interpenetrate each other; and the word, being at once sound and significance, is the cause of this union: "Man perceives with his understanding and speaks, whenever he thinks." This unity of thought and expression accounts for the fact that every signification of something includes a certain emotional attitude toward that something. Thus each language represents a structure of categories, in which the particularity and the outlook of its users, individuals or peoples, express themselves.

Herder also regarded poetry as a mode of coming to terms with reality. Whereas most of his contemporaries saw it either as a product of learning or as a means of amusement, he considered poetry to spring from the natural and historical environment experienced by feeling, rather as an involuntary reaction to the stimulus of events than as a deliberate act; poetry's first mode is the interjection. A poem so understood does not conform to the traditional doctrine that "poetry is like a picture" (*ut pictura poesis*), since the feeling from which it springs is the organ of a dynamic relationship between man and the world which is expressed far more readily in the sound of words and in the stresses and rhythms of speech than in an image or an idea. Like music, poetry has in its lyrical essence something incommensurable with anything else, and its particular "logic of emotion" can be detected only by a "creative ear." This "voice of feeling" achieves the status of art only when the poet succeeds in giving it form as an articulated whole. Then the expression of experience detaches itself from the man and from the historical environment which created it and becomes rounded off to constitute a world by itself. Even in this autonomy, however, the poem, like every form, is still related to the environment "which has embodied itself in it and transformed itself in a feeling of itself." Such a presentation of time in poetic work signifies, as Herder showed in his exposition of Shakespeare and Homer, the extension of that time: in the genuine poetic utterance, hitherto hidden aspects of man's life are revealed by virtue of the creative function of language. Thenceforward these aspects can influence the understanding of man and his world within a linguistic community. "A poet is the creator of the nation around him: he gives them a world to see and has their souls in his hand to lead them to that world." Poetic ability, effective in the individual according to time, place and language, belongs to man as such and is no special preserve of the educated. As the true "mother-tongue of mankind" (Hamann), it appears in its greatest purity and power in the uncivilized periods of every nation: this for Herder was proved by the Old Testament, the Edda, Homer and Ossian (until his old age he always regarded Ossian as authentic). In such ancient poetry each nation possessed a treasury of linguistic possibilities on which even later poets should draw for their own work. Hence Herder's concern to retrieve the remains of ancient German poetry as represented in the folksongs, and his attention to Norse poetry and mythology, to the work of the Minnesänger and to the language of Luther.

Herder's philosophy of history grew up from his attempt to use the past in order to assess the present situation and future probabilities by means of the genetic idea. This is the general background of all his thought. In this sense he had outlined in the *Fragmente* the scheme of a typical development on the analogy of the ages of a man's life, by means of which he tried to determine the actual situation of German poetry as it then was. The essay on Shakespeare and *Auch eine Philosophie der Geschichte zur Bildung der Menschheit* were however the first writings in which, combining the effect of his personal experiences during his sea voyage with influences from Luther and Hamann, he gave proof of a deeper understanding of historical actuality, the product of the contradiction between individuation and cohesion. At the same time he had the fruitful idea of making this contradiction itself the logical basis of historical development. Here again he exploited his concept of form (*Gestalt*): where two forces are in conflict, one can be seen as striving to persevere and to emerge from the whole as an individual structure; and in the structure, which has its purpose in itself, development has as it were already attained its goal. Yet the whole is not satisfied in any single form: in historical catastrophes it frees itself from the chain of existing circumstances to shape a new form of things, which it shatters again in turn when its time is past. Without detriment to its being an end in itself, individual entity is at the same time also a means, a blind unfree instrument taken or rejected by God in the moment of its historical significance, without consideration for fortune or misfortune, good or evil. Even the philosopher, himself a link in the chain of events, cannot foretell the future exactly: he can only trace the conditions of what is to come from patterns of past development, in order to counteract it.

In his *Ideen zur Philosophie der Geschichte der Menschheit*, under Goethe's influence, Herder attempted to demonstrate that nature and history obey a uniform system of laws. Already in the development of the earth, plants, animals and even mankind, a striving of forces was at work, aiming to establish a balance in "determined form, individual existence." This same phenomenon Herder believed could be observed as a law of "humanity" in mankind's communal life. This expression means simply the measure for the inner condition of a historical structure in which contending forces are reconciled. In this sense Herder traces all changes back to the establishing or the disturbing of an equilibrium. At any passing moment the measure is individual, but the principle of development toward form is general. If this principle does not in fact rule history with the necessity of a natural law, then, Herder expressly emphasizes, the fault lies with man, who in his freedom works against nature just so long as his sense of the measure of things and his reason are immature. Meanwhile one must trust that growing insight and good will will lead men to act according to the truth that they recognize and, through the conflict of the nations, to reach the equilibrium of a structure embracing all mankind.

The first collected edition of Herder's works was produced by his widow, M. C. von Herder, 45 volumes (1805–20). There is a critical edition by B. Suphan, 33 volumes (1877–1913).

See also references under "Herder, Johann Gottfried von" in the Index volume.

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HEREDIA, JOSÉ MARIA DE (1842–1905), French poet renowned for his sonnets, the most representative of the Parnassians (*q.v.*), and the favourite disciple of Leconte de Lisle. He was born at La Fortuna, a coffee plantation near Santiago de Cuba, on Nov. 22, 1842. Through his father he was descended from the Conquistadores, whom he celebrated in his poetry. He always retained an interest in Spanish culture, translating Diaz del Castillo's *Véridique Histoire de la conquête de la Nouvelle Espagne* (4 vol., 1877–87) and the life of *La Nonne Alferez* (1894). His mother was French, and France was always, he claimed, "the country of my mind and my heart." He was educated at the Collège Saint-Vincent, a Catholic school at Senlis, near Paris. In 1859 he went back to Cuba and, after reading Leconte de Lisle, began writing verse. On his return to Paris in 1861, to study at the École des Chartes, Heredia made the acquaintance of François Coppée, Sully Prudhomme and Paul Verlaine, and went to the Saturday receptions of Leconte de Lisle, who painstakingly cor-

rected his manuscripts. He also met the poet and Hellenist Louis Ménard, with whom he studied Greek literature and mythology. His verse was published in *Le Parnasse contemporain* (1866, 1871 and 1876) and in *Le Tombeau de Théophile Gautier* (1873), and he was well known even before the publication of his only book of verse, *Les Trophées* (1893), which made him famous. Elected to the Académie Française in 1894, he was appointed librarian of the Bibliothèque de l'Arsenal in 1901. He died at his home, the Château de Bourdonné, near Houdan (Seine-et-Oise) on Oct. 2, 1905, having completed his edition of André Chénier's *Bucoliques* (1907).

The 118 sonnets in *Les Trophées* are grouped under headings ("La Grèce et la Sicile," "Rome et les Barbares," "Le Moyen Age et la Renaissance," etc.) giving the impression of a miniature version of Hugo's *Légende des siècles*. Like Gautier, Heredia delighted in "transposing" into poetry *objets d'art; e.g.*, a vase, a coin, an old binding. He sought technical perfection, incorporating into his own verse reminiscences of poets he admired, Théodore de Banville and Leconte de Lisle in particular. He looked for precise details, double rhymes, sonorous words and exotic names, and concentrated on making the fourteenth line of his sonnets the most striking.

See M. Ibrovac, *J.-M. de Heredia: sa vie, son oeuvre* (1923), and *J.-M. de Heredia: Les sources des "Trophées"* (1923). (E. M. So.)

HEREDIA, a city of the province of the same name in Costa Rica, northwest of San José, on the central plateau and the Inter-American highway. Probably founded in the 1570s, the city was originally called Cubujuquí and Villavieja. Its first church was established in 1706, and the name Heredia was adopted in 1763. Throughout most of the colonial period the little village was second to Cartago in importance in Costa Rica. The majority of its citizens were small farmers engaged in the tobacco trade. With the independence of Mexico in 1821, Heredia took the lead among Costa Rican towns in urging annexation to the Mexican empire of Agustín de Iturbide if Costa Rica could not remain attached to Spain. In the 1830s Heredia was briefly the capital of Costa Rica. In commercial and industrial growth it did not keep pace after World War II with some of the other Costa Rican cities. Pop. (1960 est.) 17,701.

Heredia is the capital of Heredia province (area 1,119 sq.mi.; pop. [1960 est.] 72,004) and centre of an important agricultural region. Both the coffee and the tourist industry benefited from improved communications. (T. L. K.)

HEREDIA Y CAMPUZANO, JOSÉ MARÍA DE (1803–1839), Cuban poet, whose compositions are characterized by a pervading melancholy and a deep awareness of nature, was born in Santiago on Dec. 31, 1803. His father was a diplomat of liberal principles, in Venezuela (1812–17) and in Mexico (1819–21). The son studied law in Mexico and wrote his famous ode "En el Teocalli de Cholula" in 1820. After his father's death he returned to Cuba, completed his education and practised law. In 1823 he participated in a conspiracy to free Cuba and was exiled, taking refuge in the U.S. After visiting Niagara falls (June 1824), he wrote his celebrated ode "Al Niágara," included in his volume of poems published in New York city in 1825. At the invitation of Pres. Guadalupe Victoria, Heredia went to Mexico in 1825, where he married and, except for a short visit to Cuba, spent the rest of his life. A revised edition of his poems appeared in 1832. He died in Mexico City on May 7, 1839.

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HEREDITY is the property in all living organisms that ensures that the biological qualities of parents reappear in their offspring. The exact study of heredity lies in the province of the science of genetics. Hereditary transmission consists in the passage from ancestors to descendants of an organized collection of elementary living units, known as genes, that condition the organism's reaction to its environment.

This article, being mainly a discussion of the mechanisms of hereditary transmission, complements the article GENETICS, which considers in broad scope the history and special disciplines of the science. The article GENETICS, HUMAN should be consulted for a special discussion of inheritance in man; *see* also EUGENICS.

The following sections are included in this article:

I. Introduction
  1. Heredity and Environment
  2. Genes, Chromosomes and Life Cycles
II. Mendelian Inheritance
  1. Inheritance in Diploid Organisms
  2. Inheritance in Haploid Organisms
  3. Lethal Genes
  4. Inheritance of Several Genes
  5. Multiple Alleles
  6. Chromosome Theory of Heredity
  7. Linkage and Crossing Over
  8. Polyploidy
III. Heredity of Quantitative Characters
  1. Apparent Disparity With Mendel's Laws
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IV. Mutation
  1. Occurrence
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V. Heredity of Biochemical Characters
  1. In Man
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I. INTRODUCTION

1. Heredity and Environment.—What is biologically inherited is a range of capacities (determined by the genes) by which the new individual responds during its development to the components of the external environment on which its living activities depend: food and other essential substances, water, heat, light, etc. Under the influence of genes, nonliving substances are converted into living substances of the same kind as those possessed by the parents. Inheritance has thus been defined as the recurrence, in successive generations, of like forms of metabolism. An essential feature of heredity must therefore be the replication of the genes of the ancestors and the passage of these to descendants.

All characteristics of organisms are thus due both to heredity and to environment. Different characters, however, differ in the degree to which they are affected by variation in the environment. At one extreme are certain hereditary deficiencies which show their effects only when one specific substance is missing from the environment; when this is present no difference is apparent between those who have this defective gene and those who have its normal counterpart. At the other extreme are the genes controlling individual differences in the human blood groups which express themselves in the same way under all known conditions in which survival and growth are possible. In between are such cases as dwarfism. Individuals which have inherited a gene for dwarfism fail to achieve normal size under the same conditions which permit normal growth in related individuals with an alternative gene for normal growth. The latter, however, may be stunted in growth if undernourished. The former might be called hereditary dwarfism, the latter environmental, but these of course express the relative degrees of influence of internal and external factors. Such distinctions cannot usually be made offhand but only by carefully controlled experiments.

Having agreed that the final form of an organism is related to the environment in which the organism has lived from the start of growth and development (*i.e.*, from the moment of fertilization of the egg), it is necessary next to consider the extent to which the environment of parents affects the development of their offspring. In mammals the development of a fetus may be favoured or disturbed by the state of health of the mother and this in turn may be modified by the environment. But maternal effects of this kind do not affect the hereditary constitution of the young; *i.e.*, are not transmitted to further generations.

Only changes in the hereditary material of the germ cells (egg and sperm) are transmitted to successive generations. Environmentally induced changes of somatic (body) characters do not

affect the hereditary material of the gonad; hence, they are not transmitted. Indeed, the hereditary materials, the genes, are remarkably stable and may remain unchanged (unmutated) over many generations. Genes may be caused to undergo random changes (mutations) by various agents such as ionizing radiation, heat, chemicals and other genes, but this does not constitute inheritance of acquired characters (*see* LAMARCKISM). To reiterate, environmentally induced somatic characters are not inherited.

Precise experiments on the inheritance of environmentally induced variations were first carried out by W. Johannsen, a Danish botanist (1857–1927), with negative results. He self-fertilized bean plants for several generations and obtained a number of pure lines. The average weights of beans from different pure lines were sometimes different, and such differences were consistent from generation to generation; *i.e.*, they were hereditary. Within a given pure line variation in bean weight also occurred, but this variation was not inherited, for the heaviest and the lightest classes of beans from the same pure line gave progeny not significantly differing from one another in the average weight of beans produced.

In considering heredity it is constantly necessary to bear in mind that the various parts of an organism are not received intact from the parents but are developed out of comparatively simple structures present in the egg. There is no real analogy between heredity and the legal notion of inheritance of property. One speaks loosely of a given hereditary character being "transmitted" from parent to offspring, but obviously this is impossible since the only materials that can be thus transmitted are those contained in the uniting sex cells, the eggs and sperm in higher animals. An individual receives from his parents not a set of fully formed characters but a set of determinants or genes, as a consequence of whose activities the hereditary characters are developed. This concept of hereditary determinants is fundamental for an understanding of the nature of heredity.

2. Genes, Chromosomes and Life Cycles.—According to the theory of genetics the basis for heredity in all organisms is a unit named the "gene" by Johannsen in 1909. Genes are hypothetical entities in the sense that they cannot be individually seen under the microscope. But their existence is inferred from a series of rigorous experiments, starting with those first performed by Gregor Johann Mendel (*q.v.*) during the 1850s and '60s. Just as in physiology are studied the effects of varying environmental factors on the course of development of an organism, so in genetics are studied the effects of varying the internal factors, the genes. Experiments of this kind inevitably involve methods permitting replacements and recombinations of genes. The primary method for accomplishing this is sexual reproduction.

As knowledge has accumulated, the conception of the gene has undergone changes. But for the present it can be said that genes are made up of a complex chemical substance called deoxyribonucleic acid (DNA).

Genes are arranged linearly in threadlike structures known as chromosomes, of which every organism has a characteristic set. When an egg is fertilized by a spermatozoon, a set of chromosomes from the mother is mixed together with a similar set from the father. In man the unfertilized egg and sperm nuclei each contain a set of 23 chromosomes, which is known as the haploid number. In the fertilized egg there are 46 chromosomes, consisting of 23 pairs in females and 22 pairs and two odd chromosomes in males. Forty-six is the diploid chromosome number in man, and as a result of a very precise duplication of the chromosomes at every cell division, by mitosis, sets of chromosomes are distributed to all the cells of the organism. Thus every part of the body is permeated with hereditary materials like those derived from the two parents. In higher organisms the actively dividing cells contain diploid sets of chromosomes, while the unfertilized eggs and the sperm cells, or gametes, contain the haploid number. These haploid cells arise from diploid ones by a complex reduction division known as meiosis. It should be mentioned that the chromosomes of paternal and maternal origin are distributed at random to the gametes; *i.e.*, all the "paternal" chromosomes are not found in one gamete, and all the "maternal" chromosomes in another, except by chance. Fusion of the male and female gametes restores the diploid number of chromosomes. In general the cell in which this occurs is called a zygote (fertilized egg). (*See* CYTOLOGY; SEX.)

The life of every organism showing sexual reproduction is differentiated into two phases, the haploid and diploid phases. In higher animals the haploid phase is very brief, consisting only of the gametes themselves. In flowering plants also there are very few haploid cells—just a few nuclei in the pollen tubes and embryo sac. But among lower organisms the situation is quite different. In mosses haploid and diploid phases are roughly of equal duration, while in some fungi (*e.g.*, the mold *Neurospora*, with which much work on heredity has been done) there is only a single diploid nucleus, namely the zygote itself, all other nuclei being haploid. These variations in life cycles have important consequences that affect the behaviour of hereditary characters in the different groups of organisms.

The fact that the genes are located on the chromosomes, and the precise behaviour of the latter, aids the regular distribution of the genes to the various cells of an organism, and through the gametes to the zygote and the cells of the next generation of organisms. However this is not a passive transport of inert material, but essentially involves the synthesis of new genes at every cell division. In fact the genes are duplicated with extraordinary exactness for enormous numbers of cell cycles. Very rarely indeed there may be a mutation of a gene from one form (allele) to another; this change is recognized by the sudden appearance of a new hereditary character in some part of the organism or in its progeny. The new, mutant gene then continues to be replicated in the same regular manner as the one from which it arose by mutation. *See* GENE; NUCLEIC ACIDS.

II. MENDELIAN INHERITANCE

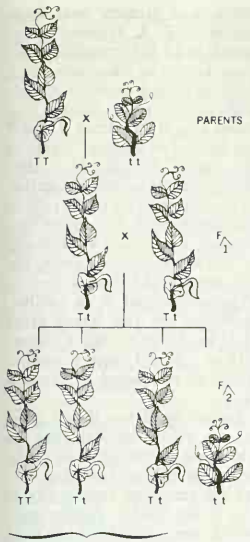
Mendel studied inheritance in garden peas (*Pisum sativum*) which were cultivated in the monastery garden at Brünn, Moravia (now Brno, Czech.). His most important results were published in 1866 and 1869 but received practically no notice from the biologists of the time; it was not till 1900, after Mendel's death, that the value of his work was recognized. In that year H. de Vries, K. E. Correns and E. Tschermak von Seysenegg (often written E. von Tschermak) simultaneously and independently rediscovered and confirmed Mendel's results. Thereafter a great many workers, notably W. Bateson (*q.v.*), performed similar experiments on many different kinds of animals and plants, and it soon became clear that Mendel's conclusions were valid for the most diverse organisms, from protozoa to man. A few examples from different groups are considered here.

1. Inheritance in Diploid Organisms.—Since the genes are on the chromosomes and the chromosomes in diploid organisms occur in pairs (except in the gametes in which each chromosome occurs but once), it follows that each gene must be represented twice (except in the gametes). To generalize, if the two representatives of the gene are in the same condition (a condition of the gene is called an allele), *e.g.*, both in condition *A* so that the zygote is *AA*, the individual is said to be "pure" or homozygous (noun, homozygote). If the two representatives are in different conditions, *e.g.*, one is allele *A* and the other *a* so that the zygote is *Aa*, the individual is said to be "hybrid" or heterozygous (noun, heterozygote).

The gametes (egg or sperm) receive one of the two representatives of the gene. Hence, the gametes of the *AA* homozygote will all carry allele *A*, those of the *aa* homozygote will all carry *a*, while half of the gametes of the heterozygote will carry *A* and half will carry *a*. Such dominant traits as tall stems (T) in garden peas and short hair (S) in rabbits are inherited in this manner.

If an *AA* individual is crossed with another of the same genetic composition (genotype), all offspring will be *AA* because all the gametes will carry *A*. If, however, the cross is between an *AA* and an *Aa* individual, only half the offspring will be *AA* while the other half will be *Aa*.

In many cases the heterozygote appears to be identical with one of the homozygotes. The allele in the latter is said to be dominant



FROM H. J. FULLER AND O. TIPPO, "COLLEGE BOTANY"; HOLT, RINEHART AND WINSTON, INC.

FIG. 1.—DIAGRAM OF MENDEL'S FIRST "LAW" ILLUSTRATING THE INHERITANCE OF HEIGHT IN THE GARDEN PEA

to the allele in the alternate homozygote, whose allele is said to be recessive. A dominant allele is one that can be readily detected in the heterozygote, whereas a recessive allele is one that cannot be readily detected in the heterozygote. The dominant allele is symbolized with a capital letter, the recessive with a small letter. Thus it may be said that *AA* is a dominant homozygote and that *aa* is a recessive homozygote.

In contrast to the genotype, the appearance of an organism is referred to as its phenotype. Hence, if dominance is present, the homozygous dominant (*AA*) and the heterozygote (*Aa*) have the same phenotype (*i.e.*, show the trait A), and the ratio of those with the dominant phenotype to those with the recessive phenotype among the offspring of a cross between heterozygotes is 3:1 [($\frac{1}{4}$ *AA* + $\frac{1}{2}$ *Aa*):$\frac{1}{4}$ *aa*].

The foregoing discussion illustrates Mendel's first "law" of inheritance—the law of segregation—which states that there are genes that affect development, that these genes retain their individuality from generation to generation, that alleles do not become contaminated when they are mixed in a hybrid; and that one half the gametes have one allele while the other half of the gametes have the other allele.

2. Inheritance in Haploid Organisms.—Many microorganisms, such as the fungus *Neurospora*, yeasts, bacteria and viruses, have only one representative of each gene. In these organisms the formation of the zygote is rapidly followed by meiosis to yield the haploid form, or, as in the viruses the diploid may never really be formed. Nevertheless the basic principles of genetics are the same for these organisms as for all others.

3. Lethal Genes.—Sometimes the expected Mendelian ratios are not seen to appear because certain types have a much lower viability than others. In fowls there is a breed known as "creepers," with shortened wings and legs. When creepers are crossed with normal fowl, the result is an equal proportion of creepers and normals; when creepers are crossed together, creepers and normals are found in the ratio 2:1. More careful examination of the results of the last cross shows that there is a third class of progeny that die in the shell at about the fourth day of incubation. Creepers are in fact heterozygotes (*Cc*), and on intercrossing them we really obtain normals (*cc*), heterozygous creepers (*Cc*) and the lethal homozygous type (*CC*) in a ratio 1:2:1. The creeper condition is due to an incompletely dominant gene; the dominant homozygote being lethal, the heterozygote being creeper and the recessive homozygote being normal.

Completely recessive lethal genes are also found very commonly. For example in corn (maize) the most frequent of all genic variations results in a failure to develop chlorophyll, and such plants when homozygous die because they cannot achieve photosynthesis; the heterozygotes are normal. In some breeds of cattle a proportion of the animals are heterozygous for a lethal gene, and when two such animals happen to be mated together, one quarter of the progeny die at an early age. (If death occurs very early, in the uterus, it may not be noticed.) The only way to eliminate these recessive lethal genes from a population is by determining which animals are heterozygotes and which homozygotes by preliminary matings and examination of the progeny. The proved homozygotes should then be used for further breeding even though the heterozygotes may appear to be more desirable in their appearance. (*See* also ANIMAL BREEDING.)

4. Inheritance of Several Genes.—Mendel also studied the inheritance of two pairs of differentiating characters simultaneously. An example may be taken from rabbits. Short hair, dominant over long hair, is due to a gene that may be labeled *S*. Black hair (*I*) is dominant over "blue" (*i*). If a homozygous short-haired black (*SSII*) is mated with a long-haired (so-called "Angora") blue (*ssii*), the first generation offspring (F_1) are double heterozygotes (*SsIi*) and in appearance short-haired blacks. Half their gametes carry *S* and half *s*, and the same is true for *I* and *i*. The significant finding here is that the four possible classes of gametes *SI*, *sI*, *Si* and *si* are formed in equal numbers, and it can be shown that random fusion of two lots of such gametes (one from the male F_1 and one from the female F_1) will produce in the second generation (F_2) four classes of rabbits: namely, short-haired blacks (*SSII, SsII, SSIi, SsIi*), long-haired blacks (*ssII, ssIi*), short-haired blues (*SSii, Ssii*) and long-haired blues (*ssii*), in a ratio of 9:3:3:1. Thus in the F_2 not only the two "parental" types of rabbit are obtained but also two new

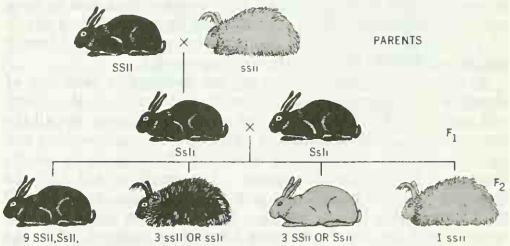
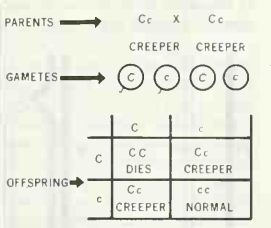


FIG. 3.—DIAGRAM OF MENDEL'S SECOND "LAW" ILLUSTRATING THE INHERITANCE OF HAIR LENGTH AND COLOUR IN RABBITS

"recombination" types in which characters from two different individuals have been combined in a single individual. The genetic behaviour of double heterozygotes is precisely the same whether they are made by the mating *SSII* × *ssii* as above, or from *ssII* × *SSii* (long-haired black × short-haired blue).

Experiments of this kind illustrate the second "law" of Mendel—the law of independent or random assortment—which states that each pair of genes behaves independently of every other pair. Further work, to be described below, will show the limitations of this law.

That there are such limitations was shown as early as 1906 by Bateson and R. C. Punnett working with sweet peas (*Lathyrus odoratus*). Crossing together two varieties, the one bearing purple flowers and long pollen, the other red flowers and round pollen, they obtained an F_1; in the F_2 derived from the latter the following phenotypes and their numbers were: purple flowers and long pollen 1,528; purple flowers and round pollen 106; red flowers and long pollen 117; red flowers and round pollen 381. Clearly these figures do not conform to a 9:3:3:1 ratio. There is a surplus



(LEFT) BY COURTESY OF THE STORRS (CONN.) AGRICULTURAL EXPERIMENTAL STATION; (RIGHT) FROM L. H. SNYDER AND P. R. DAVID, "THE PRINCIPLES OF HEREDITY," 5TH EDITION, COPYRIGHT 1957. BY PERMISSION OF D. C. HEATH AND COMPANY

FIG. 2.—(LEFT) A CREEPER FOWL; (RIGHT) DIAGRAM OF THE INHERITANCE OF THE CREEPER CONDITION

of the parental classes and a deficit of the recombination classes of F_2 offspring. The reason for these discrepancies will be made clear below, under *Linkage and Crossing Over*.

5. Multiple Alleles.—Thus far the gene has been treated as though it may exist in only two conditions, that is, have only two alleles. Actually there is no theoretical upper limit to the number of alleles that may exist for a given gene. In cattle, for example, a gene affecting blood groups is known to have 160 alleles. Since each diploid individual has only two representatives of each gene, it follows that each individual has at most only two of the 160 alleles of this gene. Because each individual has only two representatives of the gene regardless of the number of alleles, it follows that Mendel's laws of segregation and independent assortment hold for this situation also.

The dominance relations among a series of multiple alleles varies not only from series to series but also among the alleles of a series. Thus in one series of alleles in the mouse, A^y (yellow coat) is dominant to A (agouti coat), which is dominant to a^t (black back, tan belly), which is dominant to a (nonagouti). In another series of alleles in the mouse, C (full color) is dominant over all other alleles at this locus while c^{ch} (chinchilla dilute, black reduced to dark slate, yellow to cream), c^h (himalayan dilution, black reduced to pale brownish-gray, yellow reduced to white) and c (albino, all pigment absent) are semidominant to each other.

6. Chromosome Theory of Heredity.—As early as the 1880s some investigators believed that the chromosomes were the actual seat of the hereditary factors. It was not until 1903, however, that the relation was adequately adduced on theoretical grounds. This was done by Walter S. Sutton, then a graduate student at Columbia university. The genetic and cytological proof required to satisfy all biologists was not completed until about 1925.

In 1902 C. E. McClung in a detailed discussion suggested that sex was determined by the chromosomes. Subsequent work amply confirmed his view. In the female of mammals and many other organisms, the members of each chromosome pair (including those determining sex) are morphologically identical. This is true in the male also, except for the sex chromosomes, in which one member is usually larger than the other. The female is then said to have two X-chromosomes (XX); the male to have one X and one Y (XY). (Figure 4 shows the chromosomes of a male and female pomace or fruit fly [*Drosophila melanogaster*].)

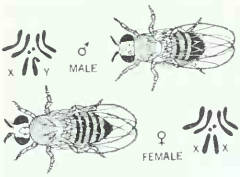
As has already been shown, only one member of each pair of chromosomes enters the egg or sperm. Hence, half the sperm will carry a Y-chromosome and half an X-chromosome, but all the eggs will carry an X-chromosome (half will carry one member and half the other). Fertilization is equally likely to be by an X-bearing as by a Y-bearing sperm. The result is that half the fertilized eggs will be XX and give rise to females, and half will be XY and give rise to males. Note that the male offspring receive their lone X-chromosome from their mothers, while the female offspring receive an X from each parent. The males receive their Y from their fathers.

The Y-chromosome is essentially devoid of genes; hence males have only one representative of each gene on the X-chromosome and that one is received from their mothers. As one would expect, the pattern of inheritance of genes on the X-chromosome (sex-linked genes) is different from that for genes on the other chromosomes (*see* GENETICS).

Similar patterns of inheritance are known in other animals, including man, and in some plants. The association between the pattern of distribution of sex chromosomes and a series of genes offered strong evidence that the genes are on the chromosomes. Other evidence was derived from linkage studies and from the study of various chromosomal abnormalities, including multiple sets of chromosomes (polyploidy).

7. Linkage and Crossing Over.—There are many more genes than there are chromosomes. Since the genes are on the chromosomes, it follows that many genes must be on each of the chromosomes. Genes on the same chromosomes are said to be linked and tend to be transmitted as a unit from parent to offspring. This association of genes is known as linkage.

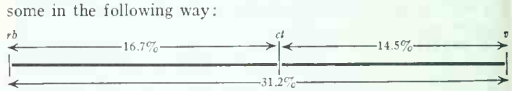
In 1909 T. H. Morgan (*q.v.*; 1866–1945) put forward his hypothesis of crossing over (suggested by F. A. Janssens' interpretation of the crosslike structures known as chiasmata which hold the pairing chromosomes together at meiosis). Morgan proposed that if two genes A and B are located at different points of the same chromosome, they would usually be linked together in one chromosome in the cells of the descendants, but sometimes, through breakage and rejoining of the chromosome threads, the two genes could be separated, so that A would be borne on one chromosome and B on another. Thus, if an organism were heterozygous for two linked genes (AB/ab), most of the gametes would be AB or ab, but a proportion would be "crossover" types Ab or aB, and these if used in the production of the offspring would be recognized by the new combinations of characters produced.



FROM T. I. STORER AND R. L. USINGER, "GENERAL ZOOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK COMPANY, INC

FIG. 4.—THE FRUIT FLY DROSOPHILA MELANOGASTER, WITH CLOSE UP OF CHROMOSOMES FROM SOMATIC CELLS

Morgan also proposed that the farther apart two linked genes were, the more likely would they be to cross over, and thus the distance apart of two genes on the same chromosome could be estimated, in a relative manner, by the frequency of crossing over between them. (Crossover values are expressed numerically as the proportion of crossover gametes to the total.) Furthermore, considering three linked genes, crossing over between the two most extreme ones would be the sum of the crossing over between each of the other two. All these possibilities have been verified. For example, C. B. Bridges (*q.v.*; 1889–1938) studied the simultaneous inheritance of the following three genes in the fruit fly *Drosophila melanogaster:* ruby eye (*rb*), cut wing (*ct*) and vermilion eye (*v*). He found the following crossover values: between *rb* and *ct* 16.7%; between *ct* and *v* 14.5%; between *rb* and *v* 31.2%. Hence the three genes can be "mapped" on the chromosome in the following way:



A vast amount of work has been done on linkage in *Drosophila.* There are three large linkage groups (one of them sex-linked) and a fourth very small linkage group. These four groups correspond to the four pairs of chromosomes known in *Drosophila melanogaster* (*see* fig. 4). It is known that crossing over at a given point on the chromosomes involves only two out of the four strands present in the paired chromosome "bivalents" (*see* CYTOLOGY) for, of the four cells in a tetrad, two contain crossover and two noncrossover chromosomes (*see* fig. 5).

Detailed chromosome maps have been constructed for a number of organisms, the most elaborate being those of *Drosophila melanogaster.* Here the presence of the giant chromosomes in the salivary glands has enabled cytogeneticists to establish the positions of the genes with great precision (*see* fig. 6). In corn or maize (*Zea mays*) also much chromosome mapping has been done. In this plant there are ten linkage groups and ten pairs of chromosomes. In both maize and *Drosophila* this work has been much

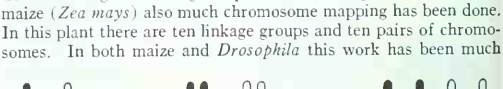


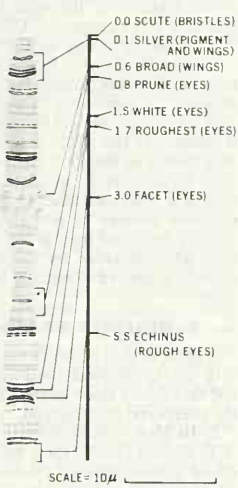
FIG. 5.—DIAGRAM OF CROSSING OVER, SHOWING FORMATION OF TWO CROSSOVER AND TWO NONCROSSOVER CHROMOSOMES THAT RESULT FROM THE PAIRING OF THE TWO BIVALENTS DURING MEIOSIS

aided by the fact that chromosomes can be broken and variously rearranged by treatment with X-rays (see *Mutation* below).

Where the number of chromosomes is large, linkage studies are very laborious, and in man they are particularly so because of the impossibility of deliberately breeding together individuals containing certain rare genes suspected of being linked.

The conformance between the linkage groups inferred from breeding experiments and the chromosomes observed directly under the microscope is good evidence for the chromosome theory of heredity. More exact proofs of the latter are furnished by certain structural modifications of the chromosomes and the consequential altered behaviour of the genes located on them. Among these modifications are deficiencies (absence of a portion of a chromosome), inversions (rotation of a portion of a chromosome through 180°), duplications (presence of an extra piece of chromosome, so that regions are present three times rather than twice), and translocations (exchange of parts between nonhomologous chromosomes), all of which occur in nature.

8. Polyploidy.—Many cultivated plants contain multiple sets of chromosomes. Organisms containing in their somatic cells three times the haploid number of chromosomes are called triploids, those with four times, tetraploids, and so on. Among wheats are found, for example, *Triticum monococcum*, diploid with 14 chromosomes; *T. durum* (macaroni wheat), tetraploid with 28 chromosomes; and *T. vulgare* (bread wheat), hexaploid with 42 chromosomes. Other polyploid plants are to be found among varieties of oats, apples, pears, plums, cherries, strawberries, raspberries, roses, dahlias, etc. Moreover, among wild plants the different species of a genus often contain series of chromosomes which are all simple multiples of a basic number. Evidently polyploidy has played a role in the evolution of such species. In animals the condition is much less common in nature, and when artificially induced may lead to serious disturbances. Among amphibia (*e.g.*, some newts) triploids occur occasionally in nature and may be produced artificially by exposing the eggs to unusually low or high temperatures. Triploid and tetraploid newts are sometimes able to complete metamorphosis, but they are all sterile. In some parthenogenetic animals (*i.e.*, those able to bring forth young without fertilization of the ova), polyploidy is known to occur in nature; *e.g.*, among certain weevils, earthworms, etc.



FROM C. B. BRIDGES, "JOURNAL OF HEREDITY," VOL. 26 (1935); BY COURTESY OF THE AMERICAN GENETIC ASSOCIATION

FIG. 6.—SECTION OF A CHROMOSOME MAP OF DROSOPHILA MELANOGASTER
The location of eight genes, as determined by crossing over, is shown, with corresponding sections of a salivary gland chromosome

In both animals and plants, cells which have ceased division (especially differentiated cells) may contain highly polyploid numbers of chromosomes. In plants, a certain part of the seed known as the endosperm consists entirely of triploid cells, formed by the fusion of two haploid nuclei from the embryo sac and one haploid nucleus from the pollen tube. These quantitative variations do not in any way contradict the concept of a regular distribution of chromosomes to cells in all parts of the body, a concept which led the early cytologists to foresee the chromosome theory of heredity. Regularly dividing somatic tissues, and especially those of the germ line, show a remarkable constancy in number of chromosomes per cell, characteristic for the species.

Polyploidy in plants has two effects: (1) it may result in an increase in size; and (2) a certain degree of sterility usually follows. The increase in size is by no means universal, though polyploid cells are usually larger than diploid ones. As for the sterility, this could be an advantage or a disadvantage, according to the nature of the crop and the method of propagation. Edible fruits may be better without seeds; *e.g.*, the banana, of which the common varieties are triploid. Again, among ornamental plants, failure to set seed may lead to a prolongation of flowering. On the other hand, with grain crops it is obvious that no reduction in seed setting could be tolerated.

With the aid of colchicine, tetraploid races of certain cultivated plants, such as clover, have been developed, notably in Sweden. Such races on first development are often sterile, but it is possible to eliminate this disadvantage by prolonged programs of selection and breeding.

Mendelian heredity is complicated in polyploids by the existence of multiple sets of genes at each locus and by the occurrence of complex chromosomal configurations at meiosis. Simple genic segregation is therefore not usually found.

III. HEREDITY OF QUANTITATIVE CHARACTERS

1. Apparent Disparity With Mendel's Laws.—Mendel's laws and the chromosome theory of heredity were developed from experiments on easily distinguishable characters. For example, in Mendel's own experiments there was never any difficulty in assigning a given plant to one of the two classes—tall or dwarf—for the differences were so striking that variations in height resulting from environment did not obscure the segregation. However, much hereditary variation is not of this kind. For example, the height of men varies from about 60 to about 78 in., with a mean of about 68 in. (these figures vary, of course, for different nations). No Mendelian segregation appears to occur for such quantitative variation. Commonly it is found that offspring of two individuals differing markedly in such a character are intermediate between the two parents, and in the F_2 a range of types is obtained, extending continuously between those of the two parents and sometimes beyond them.

Francis Galton (*q.v.*; 1822–1911), who was the first to study this matter statistically, formulated the regression law, according to which parents which deviate from the average type of the "race" in a negative or positive direction beget progeny which on the average deviate in the same direction, but to a lesser extent; the children's type shows regression toward the population mean. At first it was thought that quantitative characters did not obey the Mendelian rules, and a violent controversy arose in England early in the 20th century between two schools known as the biometricians, led by K. Pearson (*q.v.*; 1857–1936), and the Mendelians, led by Bateson. The issue was confused by the failure of those concerned to distinguish between the hereditary characters of an organism and the underlying determining factors, or genes.

2. Multiple Factors.—The conflict between the biometricians and the Mendelians was resolved when it was realized that quantitative characters were governed by Mendelian factors, but that there were many such factors, each individually having only a small effect on the phenotype, all together acting cumulatively. Such views were put forward by H. Nilsson-Ehle (1908) and E. M. East (1910), and later developed mathematically by R. A. Fisher (1918), K. Mather (1949), I. M. Lerner (1958) and others. Consider two plants differing in respect of three pairs of alleles, *A-a*, *B-b*, *C-c*, concerned with a metric character such as height. Imagine that each of the three genes written with capital letters makes a small contribution to the height. Thus tall plants (*AABBCC*) would contain six effective genes, and small plants (*aabbcc*) none. The F_1 derived by crossing these two plants (*AaBbCc*) would contain three height-producing genes and would be intermediate between the two parents, assuming no dominance. In the F_2 as many as 27 genotypes are possible, and this would result in the production of a large assortment of plants of different height, ranging between the two parents. If small environmental changes also occur, then a practically continuous range of gradations would be easily understood. If one of the parents had been *aabbCC* and the other *AABBcc*, one could get in the F_2 the two types *AABBCC* and *aabbcc*, which would both be more extreme than either parent.

Such a hypothesis of multiple factors, sometimes called polymeric factors or polygenes, satisfactorily accounts for the facts of quantitative inheritance and is consistent with Mendelian theory, but direct proof is difficult to obtain. One piece of supporting evidence is the fact that when two inbred lines (*e.g.*, of maize) are crossed together and F_1 and F_2 generations produced, the variance in F_2 is usually greater than in F_1. Again, in *Drosophila* it is possible to assess the effects of genes on given chromosomes on a particular metric character. Difficulties arise, however, when one has to consider nonadditive "interactions" of the effects of different alleles at one locus or of genes at different loci. That such interactions must occur is evident from the widespread occurrence of heterosis (or hybrid vigour), a phenomenon having very great economic value in the maize-growing industry (*see* PLANT BREEDING).

In maize, and also in many other plants and animals, hybrids between individuals of two different inbred lines are often strikingly more vigorous than either parent. This may be due to two causes: (1) heterozygotes for genes at certain loci are more vigorous than either homozygote; *i.e.*, there is an "overdominance" of the heterozygote; and (2) there may be a complementary interaction between dominant genes at different loci.

Another feature of hybrids, which may be allied to heterosis, is their greater stability, under varying environments, as compared with the inbred parents. This is of some importance when using laboratory animals such as mice for assaying drugs, nutritional factors, etc. In testing a given drug, it is desirable that the reaction of the animal be as consistent as possible. If unselected mice obtained from a dealer are used, different mice differ in their genotypes, and may respond differently to the drug. If a single strain of mice is inbred, genotypic variation is reduced, but the reactions of such animals to slightly varying environments may be erratic. If two different inbred lines are hybridized, the result should be mice which are the most uniform of all.

IV. MUTATION

1. Occurrence.—Genes are ordinarily said to be very "stable"; *i.e.*, they are reproduced with great constancy for very long periods. But genic changes do occur, and the new or mutant allele is then reproduced in the same regular manner as the original; reverse mutations from a mutant to a wild-type allele also occur. In diploid organisms mutations involve only one of the two genes present in each cell at homologous loci, thus showing that the cause of the mutation process must be localized in very small volumes, possibly limited to the gene itself.

Gene mutations can be recognized only by the appearance of an organism of altered phenotype—a mutant—and this may not be seen till long after the actual genic event. Mutations, which occur at a certain rate in nature, can be made to appear at a more rapid rate by agents (called mutagens) such as ionizing radiation and certain chemicals. (*See* MUTATION; RADIATION: BIOLOGICAL EFFECTS.)

2. Mutation, Crossing Over and Function of the Gene.—It has been a basic tenet of genetics that the gene is the indivisible unit of inheritance. Accordingly it was believed that alleles, being different conditions of the same gene, would not show crossing over and, as a corollary, that genes showing crossing over would not act as alleles. The test for allelism, at least for recessive mutations, is to cross two organisms, each of which is homozygous for one of the mutations, and to examine the offspring. If the offspring have not reverted to the phenotype associated with the dominant allele, the two mutations are said to be alleles. Another way of stating this is to say that recessive mutations of the same gene are noncomplementary in the heterozygous condition, that is, one does not correct the change in the other that results from the mutation. On the other hand, two recessive mutations that are not allelic will produce the dominant phenotype when combined in the heterozygote. They are said to be complementary.

The demonstration in 1945 that alleles (that is, noncomplementary mutations) in *Drosophila* do cross over, albeit very rarely, followed by similar demonstrations in plants and microorganisms compelled geneticists to redefine the gene. The gene may now be defined as a unit of function. A mutational change anywhere in this unit affects some (one?) biochemical process (synthesis of a protein?) in the metabolism of the cell. Mutations may occur at any one of an unknown number of sites within the gene. It is not known whether a mutational site is identical with the smallest physical unit of crossing over, although there is evidence to suggest they are the same.

It is not known how many mutational sites may be present in a gene; but more than 300 have been reported for one locus in a bacteriophage (a virus that attacks bacteria). Since individual mutational sites are recognized only if they can be separated by crossing over, only organisms in which very large numbers (hundreds of thousands as a minimum) of individuals may be observed are useful for these experiments. The more offspring observed the more likely it is that a rare crossover will be discovered; hence, it is not surprising that the most mutational sites per locus have been found in colonies of microorganisms. Nevertheless, seven mutational sites have been demonstrated for a gene in *Drosophila*. Mutations at different sites of a gene seem to affect different phases of the same biochemical function (perhaps the synthesis of an enzyme). Different sites within a gene (at least in some genes) mutate with different frequencies.

Presumably the gene functions normally only when all its mutational sites are unchanged; but unchanged mutational sites are not sufficient in themselves to guarantee normal functioning of the gene. If the position of the gene in the chromosome complement is changed as the result of a chromosomal anomaly, its function may change as though it had mutated. Return of the gene to its usual location results in a return to its usual function. The gene then is a functional unit of inheritance that is composed of an unknown number of mutational sites, which are separable by crossing over, and that, at least in higher organisms, is dependent upon adjacent genes for its proper functioning. Richard Goldschmidt suggested essentially the above definition of the gene in 1938.

V. HEREDITY OF BIOCHEMICAL CHARACTERS

A great deal of research has been done on problems concerned with the biochemical processes that are initiated by the genes and that finally result in the formation of some product by which the phenotype is recognized.

1. In Man.—Attention was first directed to such problems by A. E. Garrod (1857–1936), whose studies of the genetically determined human diseases, cystinuria, alkaptonuria, fructosuria and albinism, were published in 1908 under the well-chosen title *Inborn Errors of Metabolism*. It is of interest that the first studies of the biochemical action of the gene were done on diseases of man and that there is more detailed knowledge of the action of the gene in man than in any other organism. (*See* GENETICS, HUMAN.)

2. In Microorganisms.—In microorganisms, many studies have been made on inherited biochemical variations, following a principle established in 1941 by G. W. Beadle and E. L. Tatum working with the mold *Neurospora crassa*. This fungus will grow on a minimal medium consisting of water, inorganic salts including sulphate and nitrate, glucose and a trace of biotin. Growth is somewhat better on a complete medium containing, in addition to the minimal medium, yeast extract, malt extract and vitamins. A large number of mutants will grow on the complete medium but not on the minimal medium, since they are unable to synthesize substances present in the former but absent in the latter. By adding to the minimal medium a series of substances it is often possible to discover what synthetic process the mutant is unable to carry out.

For example, mutants may require various amino acids, vitamins or nucleic acid constituents (purines and pyrimidines) to be added to the medium, or they may require reduced sulphur or nitrogen.

Different organisms may produce different arrays of auxotrophic (as they are called) mutants; *e.g.*, inositol-requiring mutants are common in some fungi, but have not been found in *Neurospora*. But many organisms produce similar auxotrophic mutants; *e.g.*,

arginine-requiring mutants occur in the fungi *Neurospora, Penicillium, Aspergillus* and also in the bacterium *Escherichia coli.*

Examination of a large number of independently arisen auxotrophic mutants in a given organism permits inferences to be drawn regarding certain biochemical steps in intermediary metabolism. For example, in *Neurospora* there are three kinds of mutants which are unable to grow unless the amino acid arginine is added to the medium. In class 1 are mutants which can utilize only arginine; in class 2 are mutants which can utilize not only arginine but also, as an alternative, citrulline; in class 3 are mutants which will grow when any one of the three substances arginine, citrulline or ornithine is added to the medium. It may thus be assumed that the synthetic sequence in the wild-type fungus is ornithine → citrulline → arginine. Mutants of class 1 are unable to achieve the step citrulline → arginine; those of class 2 are unable to achieve the step ornithine → citrulline; and class 3 mutants cannot form ornithine from some precursor.

Such conclusions are open to various objections, however. Blocks in metabolism are often partial, so that growth is not completely stopped but merely slowed down; and it is to be expected that organisms have a number of alternative pathways by which a given end product may be synthesized.

3. In Drosophila.—Another approach to the biochemistry of gene action was made by B. Ephrussi and G. W. Beadle in their eye transplantation experiments with *Drosophila melanogaster.* Two eye-colour mutants, which are mutually indistinguishable, vermilion and cinnabar, differ from the wild type in having brighter red eyes as a result of the absence of a brown pigment which is present in wild-type eyes. If eyes from a cinnabar or vermilion fly are implanted into the body cavity of a wild-type fly, the eyes containing these mutant genes develop the normal deep red colour of the wild type (with the brown pigment present), because substances synthesized by the wild-type flies diffuse into the mutant eyes. Eyes containing the gene vermilion when implanted into cinnabar flies also develop the wild-type pigment; but eyes containing the gene cinnabar when implanted into vermilion flies fail to form the wild-type pigment, and develop the cinnabar colour. Biochemical studies have shown that the following synthetic sequence is involved: tryptophan → kynurenine → hydroxykynurenine → brown pigment (with some steps omitted). Vermilion flies are unable to carry out the transformation from tryptophan to kynurenine, while cinnabar flies are unable to carry out the transformation from kynurenine to hydroxykynurenine. It should be added that *Drosophila* is not able to synthesize tryptophan, which must be added to the food, or no brown pigment will be formed.

4. In Flowers.—Hereditary flower-colour variations were investigated biochemically by M. W. Onslow, R. Scott-Moncrieff and others. For example, in the sweet pea, purple flowers contain an anthocyanin pigment based on delphinidin, red flowers contain an anthocyanin based on cyanidin, and salmon flowers contain pelargonidin. Red sweet peas differ from purples genetically by a single recessive gene, and chemically by having pigments with one fewer hydroxyl group; salmon flowers differ further from reds by another recessive gene and by another hydroxyl group. Similar rules are found to be followed in many other plants. Flower colour variation can be brought about, however, by a number of other biochemical mechanisms, such as variations in copigments, pH and so on.

5. Summary.—To sum up, genes may act, in biochemical terms, in the following ways: (1) by enabling the organism to carry out a particular synthetic step or a step in the breaking down of a compound derived from the food; (2) by altering the ability of some or all cells to absorb particular substances from the surrounding medium; and (3) by diverting synthesis from one path to another. All these effects may be considered to be brought about through the mediation of enzymes (*q.v.*) formed by the genes. Many of the effects of genes are known to be carried out by enzymes, and sometimes the absence of a particular enzyme in a mutant can be demonstrated. The specificities of enzymes and other macromolecules are thought to be determined by direct gene action in which the genes participate by serving as molds or templates for the formation of messenger ribonucleic acid, which in cooperation with soluble ribonucleic acid and the ribosomes determines the amino acid sequence in the enzyme.

VI. CYTOPLASMIC HEREDITY

Mendel found that hybrids, and their progeny in later generations, did not vary according to which of the original strains of peas had been used as female and which as male parent. Reciprocal crosses yielded essentially the same results, and this has been found to be so generally, except for sex-linked characters. It is therefore concluded that there is usually no appreciable transmission of hereditary determinants through the cytoplasm, since female gametes contain a large amount of cytoplasm and male gametes very little. Moreover in species such as *Drosophila melanogaster, Zea mays* and *Neurospora crassa,* where extensive chromosome mapping has been done, hereditary characters have been shown to be under the control of genes situated in particular linkage groups.

Nevertheless, the literature contains a number of references to traits that do not conform with the above rule. Reciprocal crosses yield divergent progeny when certain species or wild races of various plants (*e.g.*, the moss *Epilobium*) are crossed. Commonly the viability of the pollen is affected differentially. By the method of repeated backcrossing, it is possible to obtain a plant containing substantially all its genes from one race and cytoplasm from another. Such plants may differ from the original paternal parent and give evidence that some cytoplasmic factors have been autonomously reproduced in the cytoplasm for generation after generation.

Characters connected with the green chloroplasts in plants may or may not be determined by hereditary factors in the plastids or in the cytoplasm. In maize and other plants many mutations result in a failure to synthesize chlorophyll, but in most of these mutants the deficient plastids are under strict genic control. In four-o'clock plants (*Mirabilis jalapa*) the seed borne by white parts of variegated plants gives rise to nothing but white-leaved (and therefore inviable) seedlings, no matter what plant supplies the pollen. In other variegated plants, such as the florists' geranium (*Pelargonium*) and evening primrose (*Oenothera*), a few deficient plastids may be transmitted through the pollen, but not so many as through the embryo sac. Hence there may be some autonomous determinants within the plastids.

Marcus Rhoades demonstrated that pollen sterility in a particular strain of maize is not dependent on genes in any of the ten chromosomes; there is suggestive evidence to indicate that a cytoplasmic factor may be responsible. It may be an included particle (virus?) as has been demonstrated for CO_2 sensitivity in *Drosophila,* the killer factor in paramecium and the "milk-factor" causing breast cancer in mice.

In brief, some examples of hereditary factors have been reported and have not yet been shown to be due to included particles, viral or bacterial in nature. These examples are few and not completely studied. Several examples originally thought to demonstrate cytoplasmic inheritance were subsequently shown to be due to included particles whose continued existence depends, in some instances at least, on the genetic composition of the host. Nevertheless, cytoplasmic inheritance may occur. It cannot, however, be a frequent phenomenon and it cannot have played an important role in evolution; nor does it play a significant role in heredity as the agent determining an organism's capacity to react with its environment.

VII. HEREDITY IN BACTERIA AND VIRUSES

Bacteria were at one time considered to be simple types of cells not exhibiting any forms of sexual phenomena and even lacking nuclei. More recent genetic work has shown without doubt that some at least of these organisms possess a complex hereditary apparatus, consisting of at least one group of linked genes, and that recombination of genes from different strains and species may be achieved by a number of remarkable processes, some of which resemble the sexual fusions of gametes in higher organisms, while others involve a transfer of genelike material from cell to cell via

the exterior, a process that has not yet been successfully accomplished in any higher organism.

In 1946 J. Lederberg and Tatum demonstrated a recombination of hereditary factors in *Escherichia coli,* utilizing a number of biochemical mutants. If very large numbers of bacteria of two different kinds, the one unable to grow in the absence of one substance, the second unable to grow in the absence of a different substance, are mixed together in a liquid medium, and the mixture plated out on agar medium lacking both substances, a very small proportion of recombinant types of cells are formed. These are "prototrophs" (*i.e.,* able to grow on a minimal medium) and are selected out, since neither of the parental types could grow there. Further work established the existence of many genes in *E. coli* concerned with various biochemical, antigenic and morphological characters, arranged linearly in a single linkage group. Recombination involves some process analogous to crossing over, but the details are not understood and cytological studies have not satisfactorily revealed the chromosome in microscopic preparations.

The nature of the sexual process in *E. coli* is not entirely understood, but there is evidence that one member of a mating pair transfers its chromosome to the other. The rate of transfer is known, as is the number of nucleotide pairs. This information plus knowledge of the relative length of a gene has been used to estimate the number of nucleotide pairs in a gene, and, within the gene, the average number of pairs for a mutational site.

Transfer of genetic material from cell to cell via nonsexual processes has been accomplished by two methods. In the first, nonliving extracts of *Pneumococci* are prepared, and may be purified till they consist entirely of DNA. These extracts (containing the so-called transforming principles) are then applied, under certain special conditions, to a different strain of *Pneumococcus.* If a selective technique is available whereby all nonrecombinant bacteria are eliminated, and recombinants grow, a small proportion of bacteria can be obtained having certain characters from both strains of *Pneumococcus* used. Many different hereditary traits can be transferred in this way; *e.g.,* antigenic characters, resistance to drugs and ability to synthesize particular enzymes. Usually only a single factor is transferred at a time, but double characters (*e.g.,* capacity to ferment the sugar mannitol and resistance to streptomycin), due to pairs of closely linked genes, can occasionally be transferred simultaneously. Transformations of this kind have been demonstrated in bacteria other than *Pneumococcus;* for example, in *Hemophilus influenzae* and *Meningococcus.*

The second method is known as transduction and was first used by N. D. Zinder and Lederberg. It is similar to that used in the *Pneumococcus* transformations described above, except that in place of the chemical extract a phage lysate is used (*see* below). The method has been demonstrated with *Salmonella typhimurium, E. coli* and *Shigella dysenteriae.* It is believed that when lysis (dissolution) of a bacterium occurs as a result of phage activity, small fragments of the bacterial chromosomes may be incorporated in the phage particles, and when the latter infect a new bacterium the fragments become incorporated in the chromosomes of the newly infected bacterium. If the latter is not lysed, it may develop characters derived from the donor bacterium, though many details are obscure. As with transformations of the *Pneumococcus* type, phage-induced transduction involves single bacterial genes, but occasionally pairs of linked genes are simultaneously transduced.

Exchange of genetic material has been demonstrated even in viruses. Most of this work has been done with the T series of bacteriophages, which are intracellular parasites of the bacterium *Escherichia coli.* When outside the bacteria, phage consists of minute particles containing a core of DNA and a coat of protein. Under appropriate conditions the DNA part enters a bacterium leaving the protein outside, and after a short period the bacterium bursts, liberating possibly several hundred phage particles. If two types of phage (*e.g.,* differing in host range and in size of plaques formed by lysis of bacteria on solid media) enter a single bacterium, the resulting lysate may contain not only the two parental types of phage but also the two recombinant types. It is even possible to infect a bacterium with three different phages and to obtain phage particles with characters derived from all three, apparently as the result of two successive matings inside the bacterium. Linkage has been demonstrated in phage genetics, but the exact mechanism by which recombination occurs is unknown. Similar recombination studies have been made with other viruses, including those causing influenza. Hybridization of viruses may be extremely important in giving rise to virulent strains, such as that causing the pandemic of 1918.

Some viruses do not normally destroy their host bacteria but establish a stable symbiotic relationship with them. These viruses are called temperate as opposed to lytic. When a temperate phage enters a bacterium it may give rise to a particle called by A. Lwoff "prophage," which is situated at a particular locus on the bacterial chromosome and is regularly duplicated in the same manner as the bacterial genes. The system may be disturbed by ultraviolet irradiation or other stimulus, active phage is produced, and lysis then occurs. In this system the phage appears to be behaving at one stage as a distinct infectious organism, at another as a bacterial gene. On the other hand, the DNA of phage is chemically distinct from that of bacteria or any other organism, in certain respects.

VIII. SOMATIC CROSSING OVER

In somatic cells (cells of the body) and in cells or organisms that do not reproduce sexually, another mechanism for bringing about recombination of linked genes is known. Curt Stern demonstrated in 1936 that crossing over may occur in the somatic cells of *Drosophila.* His findings were subsequently extended to other organisms and particularly to fungi.

In many fungi the hyphae (threadlike processes) may contain two or more different kinds of nuclei, and such cultures are known as heterokaryons. They arise from fusions of hyphae from different strains, not followed by fusions of nuclei. Just as in diploid organisms heterozygotes are often more vigorous than homozygotes, so in fungi heterokaryons may be more vigorous than the homokaryons from which the two kinds of nuclei are derived. For example, one mutant strain of *Neurospora* may be unable to grow on a medium lacking adenine, another may be unable to grow on a medium lacking tryptophan. But a heterokaryon derived from the two strains can grow on a medium lacking both substances. Heterokaryons can give rise to homokaryons by spore formation, since some spores contain only a single nucleus. Thus a kind of rough segregation may occur, but this is a segregation of whole genotypes and not of individual genes. Heterokaryons are very common in nature.

G. Pontecorvo and his colleagues produced from heterokaryons diploid strains of some sexual species of fungi (normally only haploid), and with the aid of certain selective techniques were able to show in these diploid strains a low rate of genic recombination due to crossing over in the somatic cells. In sexually reproducing fungi, such as *Aspergillus nidulans,* linkage maps constructed with the aid of somatic crossing over showed the same order of genes as maps made in the usual way, though the numerical values varied.

Somatic crossing over is a valuable technique for obtaining gene recombination in organisms that cannot be mated in the usual way. It may prove a valuable tool for studying crossing over and other problems in cells of large mammals (including man), which cannot be readily bred for experimental purposes. Somatic crossing over, transduction and transformation experiments on mammalian cells grown in tissue culture with modern techniques are expected to provide important basic information in genetics.

Aspects of inheritance are also considered in related articles such as EVOLUTION, ORGANIC; SELECTION; VARIATION. Application of principles of heredity is the basis for selection of animals and plants utilized by man; *see* ANIMAL BREEDING and PLANT BREEDING. *See* also references under "Heredity" in the Index volume.

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(G. H. BE.; A. G. SR.)

HEREFORD, a city, municipal borough and county town in the Hereford parliamentary division of Herefordshire, Eng., on the Wye river, 28 mi. N.W. of Gloucester by road. Pop. (1961) 15,734. Hereford was founded, after the crossing of the Severn by the West Saxons early in the 7th century, as a settlement near the Welsh march. Probably founded by Earl Harold, afterward Harold II, the castle was taken by Stephen and was the prison of Prince Edward during the Barons' War. The pacification of Wales deprived Hereford of military significance until the Civil War, when it changed hands several times between the parliamentarians and the king and the Scots. In 1086 the town included fees of the bishop, the dean and chapter and the Knights Hospitallers, but was otherwise royal demesne. Incorporation dates from 1189, when Richard I sold the town to the citizens at a fee farm rent. The charter was confirmed several times. Hereford, the site of a provincial mint in 1086, later had a grant of an exclusive merchant guild in 1215–16. The wool trade was important in 1202 but declined in the 16th century.

The Cathedral Church of the Blessed Virgin Mary and St. Ethelbert exemplifies all styles from Norman to Perpendicular. The see was detached from Lichfield in 676, Putta being its first bishop. The removal of murdered Ethelbert's body from Marden to Hereford led to the foundation of a superior church, reconstructed by Bishop Athelstane between 1012 and 1052 and burned by the Welsh in 1055. Begun again in 1079 by Bishop Robert de Losinga, it was carried on by Bishop Reynelm (or Reinhelm) and completed in 1148 by Bishop R. de Betun. In 1786 the western tower fell and carried with it the west front and the first bay of the nave. Restoration of the west front was completed in 1904–08. The total length of the cathedral exterior is 342 ft. and of the interior 327 ft. 5 in. The principal features are the central tower (165 ft.), of Decorated work, and the north porch, rich Perpendicular with parvis. The Bishop's cloister, of which only two walks remain, is Perpendicular, of curious design, with heavy tracery in the bays. Within, the nave has Norman arcades, and there is a Late Norman font. The south transept is Norman and Perpendicular; the north transept was rebuilt about 1260 and contains the beautiful Early English shrine of Bishop St. Thomas de Cantilupe where many miracles were reported. The dark choir is Norman in the arcades and the stage above, with Early English clerestory and vaulting. At the east end is a Norman arch, blocked until 1841 by a Grecian screen erected in 1717. The choir stalls are largely Decorated. The organ contains original work by Renatus Harris and was presented by Charles II. The Lady or "Ladye" chapel, dated about 1220, shows elaborate Early English work, and on its south side opens the little Perpendicular chantry of Bishop Audley (1492–1502). In the north choir aisle is the fan-vaulted chantry of Bishop Stanbury (*c.* 1470), and on the wall is the 13th-century *Mappa Mundi,* a vellum world map by a Lincolnshire monk, Richard of Haldingham. The crypt is Early English. There is a large "chained library" and the cathedral has a collection of rare manuscripts, early printed books and relics.

From the southeast transept of the cathedral a cloister leads to the quadrangular College of the Vicars Choral, a Perpendicular building. On this side of the cathedral, too, the bishop's palace, originally a Norman hall, lies near the Castle green, the site of the historic castle, now utterly effaced. In Gwynne street a plaque on the wall of the Bishop's garden marks the reputed birthplace of Nell Gwyn. The Church of All Saints with its tall twisted spire is Early English and Decorated and has a chained library. One only of the six gates and a few fragments of the old walls survived in modern times. On the Brecon road, the White cross, erected in 1347, commemorates the departure of the Black Death. The "Old Guild house," a half-timbered building in the wide commercial street called High Town, dates from 1621 and was made a Jacobean museum. In Widemarsh street is the Raven inn (formerly the Angel), the birthplace of David Garrick; farther on is the Coningsby hospital (almshouses), built in 1614, whose gardens are the 12th-century chapel of the Knights Hospitallers and the ruins of the 14th-century Blackfriars monastery. Old-established schools are the Cathedral grammar school (1384) and the Blue Coat school (1710). Hereford has an art gallery and a museum.

The Three Choirs festival of Hereford, Gloucester and Worcester is held annually in rotation at these cities. Trade is chiefly agricultural, with sales of Hereford cattle and the making of cider and jam, fruit canning and brewing. Manufactures include furniture, glass, leather, nickel alloys and bricks.

HEREFORDSHIRE, an English county on the Welsh borderland, is bounded north by Shropshire, east by Worcestershire, south by Gloucestershire and Monmouth, west by Breconshire and Radnorshire. It is a roughly oval-shaped area of 842.3 sq.mi.

Physical Features.—The physique is saucerlike in terms of geological structure and relief; the underlying rocks are in the form of a syncline, somewhat flexed and tilted to the south, while the surface is a lowland encircled by hills. The older rocks outcrop on the flanks of the syncline, with Silurian shales and limestone forming the northwest scarplands or "edges," the Woolhope Dome in the southeast, and in the east the Malvern foothills, while the main core of the Malverns is of Pre-Cambrian crystalline gneisses and volcanic rocks. The centre of the syncline is floored by rocks of Old Red Sandstone Age, predominantly red marls, sandstones and conglomerates, occupying four-fifths of the county's area. In the extreme south younger rocks of Carboniferous Age fringe the Forest of Dean area. During the great Ice Ages glaciers stemming from the west deposited wide spreads of boulder clay, sands and gravels, which mask the solid rocks over much of the county.

In detail both hill and plain, while reflecting the synclinal structure, are considerably diversified. The hills are highest in the west, where the Black mountains of Old Red Sandstone exceed 2,200 ft. although as they extend discontinuously southeast to the southern tip of the county they fall in elevation. In the northwest a series of northwest facing escarpments in the Aymestrey and Wenlock limestones of the Silurian rise to more than 1,000 ft. enclosing the Wigmore basin. The eastern margins are dominated by the striking north to south ridge of the Malverns rising to over 1,000 ft., but in the northeast a dissected plateau rising to 800 ft. is less determinate. In the southeast the northern edges of the Forest of Dean plateau form the county boundary.

Within this upland framework lies the lowland plain of Herefordshire, gently undulating between 150 and 400 ft. above sea

level, except where crossed by the line of the Wormsley and Dinmore hills, which rise to over 700 ft. The lowland is further diversified by the river Wye, which flows east from the Welsh border to the centre of the county and then south and southwest and by its main tributaries the Lugg and Frome, which drain the northern and eastern areas of the lowland respectively before their confluence with the Wye south of Hereford. In the lowlands these rivers are flanked by broad floodplains, usually meadows, above which are often a series of terraces, remnants of older floodplains, isolated by the down cutting of the river in post-glacial times.

The climate is transitional between Wales and England to the east. The average annual rainfall is a reflection of relief, the highest totals of up to 50 in. being recorded in the more elevated west, the lowest totals in lowlands leeward of the hills. The greater part of the county has, however, between 25 to 35 in. yearly (Hereford 26.3 in.). Temperature conditions are characterized by a fairly high annual range of monthly mean temperatures, being contributed to by both relatively high summer and low winter temperatures. (Hereford, July mean daily temperatures 15.9° C. [60.7° F.]; Jan. 4.2° C. [39.5° F.].) The length of the growing season, although variable, is usually from March to November.

The major contrasts in soils is between the fertile red soils of the lowland, largely based upon or derived from Old Red Sandstone formations, and the poor thin soils of the uplands of west and east. Within plain and valley areas are some excellent farming soils, which vary considerably according to parent materials and site. Heavy clayey loams predominate in the east and southwest, lighter sandy soils in the south, while in the centre of the county a more medium loam prevails.

There are fairly extensive areas of seminatural heath and moorland and of mixed woodland. In the *Census of Woodlands 1947–49*, 8.6% of the county area was covered by woodland, although only about 13% of this was under Forestry commission ownership, and a similar proportion coniferous as opposed to broadleaved species. While woodlands are widely distributed, heathland and moorland, occupying about 5% of the county area, are mainly confined to the peripheral uplands where heather, bracken and cotton grass moors are found. More than 4,500 ac. are owned by the National Trust. (J. B. H.)

History.—The prehistoric period in Herefordshire is represented by several sites. Sutton Walls, Croft Ambrey and Herefordshire Beacon are of note. Recent excavation, especially at Leintwardine, has shown that the Roman occupation was of greater significance than had before been realized. During the 7th century the West Saxons pushed across the Severn and established themselves between Wales and Mercia, with which kingdom they soon became incorporated. The district was occupied by a tribe, the Hecanas, who congregated chiefly about Hereford and in the mining districts round Ross-on-Wye. In the 8th century Offa (*q.v.*) extended the Mercian frontier to the Wye, securing it by the earthwork known as Offa's dike, portions of which are visible at Moorhampton and near Kington. The district was the scene of constant border warfare with the Welsh under Gruffydd ap Llewelyn, prince of Gwynedd. Harold Godwinson, whose earldom included this county, only restored order in 1063 when he overcame the Welsh, caused them to assassinate Gruffydd and added to the county Stradel and Archenfield on the Welsh side of the Wye.

Richard's castle in the north of the county and Ewyas Harold in the southwest were the first Norman fortresses erected on English soil, and Wigmore, Clifford, Weobley, Hereford and Kilpeck were all sites of Norman strongholds. Hereford and Weobley castles were held against Stephen by Milo, earl of Hereford, but were captured in 1138. Edward, afterward Edward I, was imprisoned in Hereford castle and made his famous escape thence to join the Mortimers in 1265. In 1326 after the deposition of Edward II the parliament assembled at Hereford and proclaimed his son as Edward III. In Herefordshire the influence of John Wycliffe's teaching was widely felt, and at the end of the 14th century and at the beginning of the 15th Lollardry was widespread. During the Wars of the Roses the county supported the Yorkist cause, and Edward, earl of March afterward Edward IV, raised 23,000 men in the neighbourhood. The battle of Mortimer's Cross was fought in 1461 near Wigmore. During the Civil War of the 17th century the county was royalist, and Hereford, the centre of activity, changed hands several times. Brampton Brian castle, the home of Sir Robert Harley, a noted parliamentarian, was the scene of one of the most famous sieges of the war. Lady Harley, who commanded the castle in the absence of her husband, withstood the siege which lasted from July 25 until Sept. 6, 1643.

Herefordshire probably originated as a shire in the time of Aethelstan, and is mentioned in the Anglo-Saxon Chronicle in 1051. At the time of the Domesday survey the divisions of the county were very unsettled. As many as 19 hundreds (subdivisions) are mentioned, but these were of varying extent, some containing only 1 manor, some from 20 to 30. Of the 12 modern hundreds only Greytree, Radlow, Stretford, Wolphy and Wormelow retain Domesday names. Herefordshire has been included in the diocese of Hereford since its foundation in 676. It was governed by a sheriff as early as the reign of Edward the Confessor, the shire court meeting at Hereford where later the assizes and quarter sessions were also held. In 1606 an act was passed declaring Hereford free from the jurisdiction of the council of Wales, but the county was not finally relieved from the interference of the lords marchers until the reign of William and Mary.

Herefordshire has always been a rich agricultural area, manufactures being unimportant, with the sole exception of the woolen and the cloth trade which flourished soon after the Conquest. Iron was worked in Wormelow hundred in Roman times, and the Domesday survey mentions iron workers in Marcle. At the time of Henry VIII, the towns had become much impoverished. Hops were grown soon after their introduction into England in 1524. In 1580 and again in 1637 the county was severely affected by the plague, but in the 17th century it had a flourishing timber trade and was noted for its orchards and cider.

Herefordshire was first represented in parliament in 1295, when it returned two members, the boroughs of Ledbury, Hereford, Leominster and Weobley being also represented.

Architecture.—There are remains of several of the strongholds which Herefordshire possessed as a march county, some of which were maintained and enlarged, after the settlement of the border, to serve in later wars. To the south of Ross are those of Wilton and Goodrich, commanding the Wye. Of the several castles in the valleys of the boundary river Monnow and its tributaries, those in Herefordshire include Pembridge, Kilpeck and Longtown. In the north the finest example is Wigmore.

In addition to the cathedral of Hereford and the fine churches

NOEL HABGOOD

HALF-TIMBERED HOUSES (17TH CENTURY) WITH DETACHED TOWER OF THE NORMAN CHURCH OF ST. MICHAEL IN BACKGROUND, LEDBURY, HEREFORDSHIRE

of Leominster, Ross-on-Wye (*qq.v.*) and Ledbury, the county contains some churches of almost unique interest. In that of Kilpeck the work of the Herefordshire school of Romanesque sculpture is seen. It consists of nave, choir and chancel divided by ornate arches, the chancel ending in an apse, with a remarkable and elaborate west end and south doorway. A similar plan is seen in Moccas church, above Hereford. The church at Bromyard exhibits Norman details. At Abbey Dore, the Cistercian abbey church, still in use, is a large and interesting specimen of Early English work. At Madley, south of the Wye, 5 mi. W. of Hereford, is a fine Decorated church (with earlier portions), with the rare feature of a Decorated apsidal chancel over an octagonal crypt. Of the churches in mixed styles, those in the larger towns are the most noteworthy, together with that of Weobley.

The half-timbered style of domestic architecture beautifies many of the towns and villages. Among country houses, that of Treago, 9 mi. W. of Ross, is a remarkable example of a fortified mansion, parts of which may date back to the 13th century; Hellens, at Much Marcle 5 mi. S.W. of Ledbury, is a medieval manor dating from 1292. Rudhall, near Ross-on-Wye, is a good specimen of 15th century work, and portions of Hampton Court, 8 mi. N. of Hereford, are of the same period. Holme Lacy, 5 mi. S.E. of Hereford, was built in the latter part of the 17th century. Downton castle was designed in 1774 in a strange mixture of Gothic and Greek styles by Richard Payne Knight (1750–1824), a scholar and numismatist; while Eaton hall, now a farm, was the seat of the family of the famous geographer Richard Hakluyt.

Population, Administration and the Economy.—The administrative county had a population (1961) of 130,919. It contains 12 hundreds and is divided into two parliamentary divisions, Leominster and Hereford, each returning one member. There are two municipal boroughs, the city of Hereford, which is the county town (pop. [1961] 40,431), and Leominster (6,403). The urban districts are Bromyard, Kington, Ledbury and Ross-on-Wye. There are eight rural districts. The county is in the Oxford circuit and assizes are held at Hereford. It has one court of quarter sessions and is divided into ten petty sessional divisions. The city of Hereford has a separate commission of the peace and a separate court of quarter sessions. The county is almost entirely in the diocese of Hereford, with small parts in those of Gloucester, Worcester and Llandaff.

More than four-fifths of the total area of the county is under cultivation, and less than half of this is in permanent pasture. The county is more heavily wooded than most of the other western counties. It is famous for its pear and apple orchards, about half of which produce fruit for the cider industry. Cider at one time was the staple beverage, and the trade in cider and perry is still considerable. Hops are another staple of the county. The hop-yards occupy about 5,000 ac., mainly in the east, and their hop production is second only to that of Kent. Herefordshire has also given its name to a world-famous breed of beef cattle. The Hereford is characterized by its rich red body with white face, crest and underline which gives a striking appearance of uniformity to the breed. These colour markings, being a dominant factor, type-mark the calves, no matter with what breed of cow the Hereford bull is crossed (*see* CATTLE). Herefordshire's small, white-faced hornless, symmetrical breed of sheep known as the Ryeland, originally from the district around Ross-on-Wye, made the county famous. From its original form the breed has been improved in stamina by crossing with the Leicester. The chief breeds of sheep on Herefordshire farms in the mid-20th century were Kerry, Clun, Ryeland, Shropshire and Radnor.

Manufacturing enterprise is of growing significance. In support of the county's major industry, agriculture, there are factories for agricultural implements, fruit canning, jam making and milk processing. The cider industry is also concerned with the extraction of pectin. New industries are developing and are centred principally around Hereford city.

Hereford is the railway centre of the county. The Worcester and Cardiff line (Western region), entering on the east, runs to Hereford via Ledbury and then southwestward to south Wales. Another line runs north from Hereford via Leominster, proceeding to Shrewsbury, Crewe and Chester. None of the rivers is commercially navigable.

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HERERO, a group of closely related Bantu-speaking peoples of southwestern Africa. Their population in the 1960s was estimated at about 55,000. The Herero proper and Mbanderu segments (pop. about 36,000) inhabit parts of central South-West Africa and Bechuanaland protectorate; the Himba and related groups (pop. about 19,000) inhabit the Kaokoveld area of South-West Africa and western Huíla district of Angola. Herero were further divided into autonomous political units under local headmen. Local residential groups were formed about patrilineal extended families, to which matrilineal kinsmen were also frequently attached.

Herero formerly subsisted chiefly on the milk and meat of large herds of cattle, sheep and goats; following European contact in the mid-19th century several groups came to depend upon horticulture as well. Their clan organization, in which each person belongs both to an exogamous patrilineal clan (*oruzo*) and to an exogamous matrilineal clan (*eanda*), is unusual. The preferred mate for a man is of his father's matrilineal clan, and polygyny is common. Sacred fire, priesthood of the patrilineal clan and chieftainship descend patrilineally, while livestock is inherited in both lines. Traditional religion is a form of ancestor worship, but many Herero adopted Christianity and a nativistic church has arisen.

In 1904 the Herero in South-West Africa rose against the German administration, but troops put down the rebellion vigorously, reducing Herero numbers from about 90,000 to less than 20,000; several hundred fled into neighbouring territories.

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HERESY, a theological doctrine or system rejected as false by ecclesiastical authority. Heresy differs from schism (*q.v.*); the heretic sometimes remains in the church despite his errors, whereas the schismatic may be doctrinally orthodox but severs himself from it. The word heresy is derived from the Greek *hairesis*, which originally meant an act of choosing, and so came to signify a set of philosophical opinions or the school professing them. As so used the term was neutral, but once appropriated by Christianity it began to convey a note of disapproval. This was because the church from the start regarded itself as the custodian of a divinely imparted revelation, which it alone was authorized to expound under the inspiration of the Holy Spirit. Thus any interpretation which differed from the official one was necessarily "heretical" in the new, pejorative sense.

This attitude of hostility to heresy comes to light in the New Testament. St. Paul was insistent that his gospel was identical with that of the primitive apostles; the author of I John set out to oppose this to what he considered distorted versions of Christianity. In the later books the contrast between "the pattern of the sound words" (II Tim. i. 13) and heretical perversions was even more sharply drawn. It was in the 2nd century, however, that the church became increasingly aware of the need for keeping its teaching uncontaminated and devising criteria for testing deviations. The Apostolic Fathers (*q.v.*) appealed to "the prophets and apostles," and Irenaeus and Tertullian laid great stress on "the rule of faith," a loose summary of essential articles handed down from apostolic times. About this time Scripture and tradition were recognized as parallel norms enshrining the same truths. Later the ecclesiastical council became the instrument for defining orthodoxy and condemning heresy, and in the 4th century, beginning with that held at Nicaea in 325, universal councils began to be held. In the east such councils have always been considered the highest doctrinal authority, but in the west the theory that they

must be ratified by the pope came to be accepted. (*See* COUNCIL.)

Since it is impossible to give a complete list of Christian heresies, some of those that were prominent in the doctrinally creative epoch stretching from the 1st to the 5th century may be mentioned. In the 2nd century Gnosticism (*q.v.*), a strange welter of Greco-oriental theosophy, threatened to substitute salvation by esoteric knowledge for the religion of the gospels. Closely allied to it were Docetism (*q.v.*), which treated Christ's humanity as mere appearance, and Marcionism, which rejected the Old Testament and distinguished the God of love revealed by Jesus from the Jewish creator God (*see* MARCIONITES). The same century saw the emergence in Phrygia of Montanism (*q.v.*), an apocalyptic movement marked by ascetic traits which looked for the speedy outpouring of the Spirit. Most heresies, however, were theories about specific aspects of the revelation which the mind of the church as a whole judged inadequate. In Christology, for example, suggestions that Christ was only an inspired man (*see* ADOPTIONISM), or that the person of the Word was in effect identical with that of the Father (*see* SABELLIANISM), or that the Word, while infinitely superior to other creatures, was nevertheless himself a creature and in no real sense divine (*see* ARIANISM), were all repudiated by the church. So was Macedonianism, which denied the full personality and divinity of the Holy Spirit (*q.v.*). The chief heresies about the incarnation were Apollinarianism, which contended that the God-man lacked a human mind, its place being taken by the Logos; Nestorianism, which so emphasized the independence of Christ's two natures as to lose sight of his personal unity; and Monophysitism (a cruder form was Eutychianism), which refused to accept the orthodox definition that he has two complete natures, a human one and a divine (*see* JESUS CHRIST; APOLLINARIS; NESTORIUS; MONOPHYSITES; EUTYCHES). Two other striking heresies were Donatism, which limited church membership to such Christians as were in fact holy, and Pelagianism, which made man virtually responsible for his own salvation and reduced the role of divine grace to a minimum (*see* DONATISTS; PELAGIUS).

Since the patristic age the attitude of the Eastern churches to heresy has not materially changed. In the west a significant step was taken in the 12th and 13th centuries, when it was decided that the secular arm could properly be invoked to punish heretics (*see* INQUISITION). A new situation came about with the Reformation, which spelled the breakup of Western Christendom. The Roman Catholic Church, satisfied that it is the true church armed with an infallible magisterium, has alone remained consistently faithful to the ancient and medieval theory, regularly issuing decrees anathematizing doctrines or opinions which it from time to time considers erroneous. Most of the great Protestant communions, however, though starting with the assumption that their own particular confession embodied the final statement of Christian truth and hence being prepared to brand those who differed as heretics, have with the growth of toleration and of the ecumenical ideal drastically revised the notion of heresy as understood in the pre-Reformation church. It now does not seem to them inconsistent for a man to maintain stoutly the doctrines of his own communion without regarding as heretics those who hold different views. The Roman Catholic Church, too, draws a distinction between those who wilfully and persistently adhere to doctrinal error and those who embrace it through no fault of their own (*e.g.*, as a result of upbringing in another tradition).

BIBLIOGRAPHY.—For a general account *see* G. Cross in J. Hastings (ed.), *Encyclopaedia of Religion and Ethics*, vol. 6, pp. 614–622 (1913) and A. Michel in A. Vacant (ed.), *Dictionnaire de théologie catholique*, vol. vi, col. 2208–57 (1920). *See* also J. H. Blunt, *Dictionary of Sects, Heresies, Ecclesiastical Parties, and Schools of Religious Thought* (1874); J. N. D. Kelly, *Early Christian Doctrines*, 2nd ed. (1960).

(J. N. D. K.)

HEREWARD (fl. *c.* 1070), Anglo-Saxon rebel against William the Conqueror, now sometimes called THE WAKE (though this style has no contemporary warrant and probably arose from a supposed connection with the Wake family, lords of Bourne, Lincolnshire), was originally a vassal of Peterborough abbey with property in several villages in the extreme south of Lincolnshire bordering on the fens. In 1070, expecting a Danish conquest of England, he and some followers joined a Danish force that had come to Ely. Together they sacked Peterborough abbey (June 2) at Hereward's instigation; he apparently felt that the Danes might as well have Peterborough's treasures as the Norman abbot then on his way to take up his appointment. Very soon after this raid the Danes returned to Denmark; Hereward maintained himself on the island of Ely, countenanced by Thurstan, abbot of Ely (appointed by King Harold II). In 1071 Ely attracted several important fugitives, notably Morcar, earl of Northumbria, who had a connection with Hereward's part of Lincolnshire. A methodical assault by King William won the island, but Hereward, who had distinguished himself in its defense, made a bold escape with a few men. Marvelous tales of Hereward were popular among Normans and English by the middle of the 12th century. His end is, and probably was, obscure. Contemporary and nearly contemporary writers say nothing of his career after 1071, and its legendary endings, beyond suggesting that he survived for a time as an outlaw, command little confidence. His lands were held by others in 1086.

See J. H. Round, *Feudal England* (1909); *The Peterborough Chronicle of Hugh Candidus*, ed. by W. T. Mellows (1949), with Eng. trans. (1941).

(ER. S.)

HERFORD, a town of Germany, *Land* (state) of North Rhine-Westphalia, which after partition of the nation following World War II became part of the Federal Republic of Germany, is situated where the Aa joins the Werre, 93.5 km. (58 mi.) S.S.W. of Hanover by road. Pop. (1961) 55,663.

Herford possesses a *Gymnasium* founded in 1540 and several other educational establishments. Its churches include the Münsterkirche, a Romanesque building with a Gothic apse of the 15th century, and the Marienkirche, in the Gothic style. There is a museum and several old houses both of stone and half-timber. Herford is on the railway from Hanover to Bielefeld and the Ruhr. The industries include the manufacture of linen cloth, carpets, furniture, machinery, chocolate, tobacco and margarine.

Herford owes its origin to a Benedictine nunnery said to have been founded in 789 and confirmed by the emperor Louis the Pious in 823. From the emperor Frederick I the abbess obtained princely rank and a seat in the imperial diet. The foundation was secularized in 1803. Herford was a member of the Hanseatic league, and in 1631 it became a free imperial town, but in 1647 it was subjugated by the elector of Brandenburg. It came into the possession of Westphalia in 1807 and in 1813 into that of Prussia.

HERGENRÖTHER, JOSEPH (1824–1890), German Roman Catholic theologian and church historian, author of *Anti-Janus*, was born at Würzburg, Bavaria, on Sept. 15, 1824. He studied at Würzburg, at Rome and at Munich, where he became instructor in theology. In 1852 he was recalled to Würzburg as professor of ecclesiastical law and history. Hergenröther was one of the most learned theologians on the "ultramontane" side of the question of papal infallibility (*q.v.*) and in 1868 was sent to Rome to arrange the proceedings of the Vatican council (*q.v.*). In 1870 he wrote *Anti-Janus*, an answer to *The Pope and the Council* by Janus (J. J. I. von Döllinger; *q.v.*), which caused a great sensation at the time. In 1877 he was made prelate of the papal household, in 1879 cardinal deacon, and afterward curator of the Vatican archives. He died at Bregenz, Austria, on Oct. 3, 1890.

Hergenröther's works include a three-volume work on Photius (1867–69) and a three-volume church history (1876–80); he also wrote the last two volumes of the history of the church councils begun by K. J. von Hefele (*q.v.*).

HERGESHEIMER, JOSEPH (1880–1954), U.S. author, whose novels are typically concerned with the decadent and sophisticated milieu of the very wealthy, was born in Philadelphia, Pa., Feb. 15, 1880, and was educated at a Quaker school and at the Pennsylvania Academy of Fine Arts. Beginning with *The Lay Anthony* (1914), he established himself as a popular and prolific writer of novels, short stories, biography, history and criticism. His work is distinguished for the baroque lushness of its descriptive passages and its often penetrating psychological insights. He went into complete retirement in 1940 and died April 25, 1954, at Sea Isle City, N.J.

His publications include: *Mountain Blood* (1915); *The Three Black Pennys* (1917); *Gold and Iron* (1918); *Java Head* (1919);

Cytherea (1922); *The Bright Shawl* (1922); *Balisand* (1924); and *The Foolscap Rose* (1934).

See G. Hicks, *The Great Tradition* (1933).

HERING, EWALD (1834–1918), German physiologist and psychologist, whose chief work was in physiological optics and more especially the perception of colour, was born at Alt-Gersdorf, Saxony, on Aug. 5, 1834. He was lecturer in physiology at Leipzig (1862–65) and then professor of physiology at the medicosurgical Josephs-Akademie in Vienna (1865–70), at Prague (1870–95), and at Leipzig. He died in Leipzig on Jan. 26, 1918.

Hering challenged the colour-vision theory of H. L. F. von Helmholtz (*q.v.*), postulating instead three types of receptors each capable of a dual response to an opponent pair of colours (yellow-blue, red-green, or black-white). He also investigated respiration, and, with Josef Breuer, demonstrated the role of the vagus nerve in the self-regulation of breathing (1868).

HERKOMER, SIR HUBERT VON (1849–1914), a popular British painter of Victorian and Edwardian times, was born at Waal, Bavaria, on May 26, 1849, the son of a woodcarver. In 1857 he was brought to Southampton, where he began his art training. In 1866 he entered the South Kensington schools and established his reputation with "The Last Muster" (Royal Academy, 1875). He was elected an associate of the Royal Academy in 1879, a member in 1890 and was appointed Slade professor at Oxford in 1885. He worked in enamel, practised engraving and illustrating, and widely influenced art education through the Herkomer school (founded 1883) at Bushey. His pictures "Found" (1885) and "The Council of the Royal Academy, 1907" are in the Tate gallery, London. He was knighted in 1907. He died at Budleigh Salterton on March 31, 1914.

See J. Saxon Mills, *Life and Letters of Sir H. Herkomer* (1923); Sir H. Herkomer, *My School and My Gospel* (1908). (D. L. Fr.)

HERLIN (Herlen), **FRIEDRICH** (d. 1491), German artist, the most distinguished member of a family of painters of the Swabian school, in the 15th century. His name occurs in the archives of Nördlingen from 1461 until his death in 1491. In 1467 he was made citizen and town painter at Nördlingen, "because of his acquaintance with Flemish methods of painting." One of the first of his acknowledged productions is a shrine on one of the altars of the church of Rothenburg ob der Tauber, the wings of which were finished in 1466, with seven scenes from the lives of Christ and the Virgin Mary. In the town hall of Rothenburg is a Madonna and St. Catherine of 1467; in the church of Bopfingen portions of an altarpiece of 1472 representing the "Nativity" and the "Adoration of the Magi" and "Scenes From the Life of St. Blasius"; and in the town hall of Nördlingen a triptych of 1488, representing the "Nativity" and "Christ Amidst the Doctors," at the side of a votive Madonna attended by St. Luke and St. Margaret as patrons of the painter's family. In each of these works the painter's name certifies the picture, and the manner is that of a pupil of Rogier van der Weyden. Herlin's epitaph states that he died on Oct. 12, 1491. He was buried at Nördlingen.

HERM, a sacred object of stone connected with the cult of the god Hermes (*q.v.*). The adoration of holy or fetish stones (*see* Baetylus) was, and continued to be, a fairly common feature of Greek cult, particularly in the more backward districts such as Laconia, where, for instance, a meteoric stone received worship as Zeus Kappotas (Zeus the Flown Down; *i.e.*, Thunderbolt). Not dissimilar objects were the posts, pillars or heaps of rough stones set up along roads or to mark boundaries, which were similar to the Latin terminus (*q.v.*). According to some scholars, Hermes' very name may be derived from the word herma; *i.e.*, stone, rock, piece of ballast. With the development of artistic taste and the conception of the gods as having human form, these somewhat unsightly objects tended to be replaced, often by statues, frequently also by pillars, which were generally square and tapering toward the bottom, so as to suggest the human figure. These were surmounted by a head, usually that of Hermes (hence the name), and had a phallus in front, halfway up. They were used not only as cult-objects but for all manner of purposes, as, for example, milestones and boundary marks. But that most if not all of them were regarded with respect, if not actually worshiped, is clear from the famous incident of the mutilation of the hermae of Athens. Just before the ill-fated Athenian expedition sailed to Sicily (415 B.C.), according to Thucydides, "all the stone Hermae in the city of Athens . . . or most of them, had their faces smashed." The whole city was in an uproar of superstitious panic at this impiety, and numerous trials for sacrilege resulted.

Herms are not infrequent in Roman sculpture, and may have heads of the gods Silvanus or Jupiter Terminus. In later times all manner of fanciful herms were used as ornaments; these are commonly known by compound names, such as Hermathena, Hermanubis and the like; but it is not clear whether this means a herm with the head of Athena or Anubis instead of that of Hermes, or a double herm having the heads of both deities facing opposite ways, Janus-fashion. Certainly both single and double herms existed, and the heads were not always those of gods.

HERMANDAD, a Spanish word meaning "brotherhood," was the title given in medieval Castile to unions of municipalities for specific ends—normally for police purposes or for defense against the aggressions of magnates. They emerged in the 12th century as temporary associations but later became permanent. One of the most famous *hermandades* was that of Toledo, Talavera and Villa Real. The mounted constables of the *hermandades* were known as *quadrilleros*. Banditry and rural crime were their chief concern; they both apprehended and summarily tried suspects. Originally they were disliked by the crown, but Henry II accepted and regulated their organization and functions by royal decree (1370). During the reign of Henry IV the *hermandades* fell into decay and the Catholic kings suppressed them in 1476, substituting a highly organized rural constabulary for the whole kingdom, known as the Santa Hermandad, whose judicial powers were considerable and whose cost was borne only by non-noble taxpayers. Discontent compelled the Catholic kings to reduce the status and expense of the Santa Hermandad in 1498, but it survived as an inefficient rural police organization until the 18th century.

The famous Hermandad de las Marismas—a federation of northern Castilian and Basque ports—was concerned with protecting the trade and shipping of its members. It enjoyed wide powers from the end of the 13th century, negotiating directly with the kings of England and France as a diplomatic entity, but it was brought under royal control in 1490. (P. E. R.)

HERMAN DE VALENCIENNES, 12th-century French poet, was born at Valenciennes, of good parentage. He became a priest and wrote the *Histoire de la Bible*, including the Old and New Testaments in an abridged form, and a separate poem on the Assumption of the Virgin. The work is generally known as *Le Roman de sapience*, the name arising from a copyist's error in the first line of the poem, the first word *Comens* being miswritten in one manuscript *Romens*, and in another *Romanz*. Indeed, the work has the form of an ordinary romance and cannot be regarded as a translation. He selects Biblical stories to suit his purpose and adds freely from legendary sources, displaying considerable art in the use of his materials. This scriptural poem, very popular in its day, mentions Henry II of England as already dead and must therefore be later than 1189.

See R. Bossuat, *Manuel Bibliographique de la Littérature Française du Moyen Age*, no. 3017, 3018 (1951). (A. Mi.)

HERMANN I (*c.* 1156–1217), landgrave of Thuringia and count palatine of Saxony, was the second son of Louis II the Hard, landgrave of Thuringia, and Judith, or Jutta, of Hohenstaufen, sister of the Holy Roman emperor Frederick I. About 1180 Hermann received the Saxon palatinate from his brother Louis III and married Sophia, sister of a former count palatine. On Louis III's death (1190) Hermann frustrated the attempt of the emperor Henry VI to seize Thuringia as a vacant fief of the empire and established himself as landgrave. In 1197 he went on crusade. In 1198, when Philip of Swabia and Otto IV (*qq.v.*) were rival pretenders to the German kingship, Otto eventually secured Hermann's support by offering him more than Philip did, but in 1204 Philip invaded Thuringia and compelled Hermann not only to change sides but also to surrender his acquisitions of 1198. When Philip was dead (1208) and Otto was recognized as king, Hermann was among the princes who in 1211 invited Frederick of Hohenstaufen, afterward

the emperor Frederick II, to come to Germany and assume the crown. Otto's forces consequently attacked Thuringia, but the landgrave was saved by Frederick's arrival in Germany in 1212. After the death of his first wife in 1195 Hermann had married Sophia, daughter of Otto I, duke of Bavaria. By her he had four sons, two of whom, Louis IV and Henry Raspe, succeeded their father in turn as landgrave. Hermann died at Gotha on April 25, 1217. Walther von der Vogelweide and other Minnesingers were welcomed to his castle, the Wartburg (*q.v.*), and Hermann figures in story and in opera as the promoter of the famous singing contest there.

See E. Winkelmann, *Philipp von Schwaben und Otto IV. von Braunschweig* (1873–78); O. Dobenecker, *Regesta Thuringiae,* ii (1900).

HERMANN VON REICHENAU (1013–54), German chronicler, poet, composer and polymath, was born on July 18, 1013, the son of Wolferad II, count of Altshausen in Swabia, and his wife Hiltrudis; completely lame from youth, he was nicknamed Contractus (the Lame). Entering the school attached to the Benedictine abbey of Reichenau in 1020, he became a monk and later taught there himself. He died there on Sept. 24, 1054, and was buried at Altshausen.

Hermann's main work is a world chronicle from the birth of Christ to 1054 (edited by G. Pertz, with Hermann's poem on his mother's death, in *Monumenta Germaniae Historica,* series *Scriptores,* vol. 5, 1844; section from 901 onward edited by R. Buchner in *Ausgewählte Quellen zur deutschen Geschichte des Mittelalters,* vol. xi, 1961). This work, based on a critical revision of a lost Swabian chronicle for the years up to 1039, was continued to 1080 by his pupil Berthold, who also added a panegyric of Hermann.

Hermann further compiled a martyrology and a poem in several metres on the eight principal vices. On music, he wrote a theoretical treatise in which he propounded his own system of notation with letters (edited by W. Brambach, 1884, and by L. Ellinwood, 1936). He also wrote and set to music a series of saints' offices, one of which, for St. Afra, is extant (edited by W. Brambach, 1892). There are also hymns, sequences and antiphons doubtfully ascribed to him (edited by G. M. Dreves in *Analecta hymnica,* vol. 50, 1907).

Hermann's *De utilitatibus astrolabii* and the *De mensura astrolabii,* which is also ascribed to Gerbert of Reims (Pope Silvester II) are printed by J. P. Migne, *Patrologia latina,* vol. cxliii (1853). His *De mense lunari* is edited by G. Meyer in the *Programm Einsiedeln* (1887). There are other astronomical works of his in manuscript. Finally there are editions of Hermann's *De divisione* by P. Treutlein in *Bullettino Boncompagni,* vol. 10 (1877), of his *De conflictu rithmimachiae* by E. Wappler in *Zeitschrift für Mathematik und Physik,* vol. 37 (1892), and of his *De figura quadrilatera* by F. A. Yeldham in *Speculum,* vol. 3 (1928).

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HERMANN OF WIED (1477–1552), archbishop of Cologne during the Reformation in Germany, was born at Wied on Jan. 14, 1477, into the house of the counts of Wied. He became a canon at Cologne cathedral in 1483 and studied law. He took higher orders only after being chosen as archbishop in 1515. From 1527 onward he had a dispute with the papacy concerning appointments to ecclesiastical offices and benefices in the months when these were customarily reserved to the pope. A good administrator, Hermann in 1537–38 issued judicial and administrative regulations which formed the basis of the law of the electorate until its end (1794). Hermann was at first hostile to Luther and, under the influence of Johann Gropper, tried to bring about a reform within the Roman Catholic Church; a provincial council for the diocese of Cologne was held in 1536. After 1539, however, believing that a compromise could still be reached, he drew closer to the Reformers. Martin Bucer and then Philipp Melanchthon were at his court in Bonn in 1542–43, and in 1543 he persuaded the estates (especially the towns) of the electorate to permit freedom of worship, but there remained a strong opposition grouped around the cathedral chapter and the town council of Cologne. Though the progress of the Reformation in electoral Cologne was not stopped by the Holy Roman emperor Charles V's victory over Jülich-Cleves-Berg (1543), this victory robbed the archbishop of his only possible support, as he did not join the League of Schmalkalden. Pope Paul III excommunicated Hermann and declared him deposed in 1546, appointing the co-adjutor, Adolf of Schaumburg, to be the administrator of the see. After the Schmalkaldic league had failed in southern Germany the emperor intervened and forced the estates to recognize Adolf early in 1547. Hermann abdicated and withdrew to Wied, where he died a Protestant on Aug. 15, 1552.

HERMANN, EDUARD (1869–1950), German linguist, who specialized in comparative studies of the Indo-European languages, was born in Coburg on Dec. 19, 1869. He was professor successively at Kiel, Frankfurt, and Göttingen, and was the author of many articles in professional journals on widely varying linguistic subjects. His *Herkunft unserer Fragefürwörter* (1943) is a useful history of German interrogative pronouns, and his small volume of exhaustive linguistic commentary on certain passages in Homer (*Sprachwissenschaftlicher Kommentar zu ausgewählten Stücken aus Homer,* 1914) is a very nearly perfect example of that kind of exegesis.

Hermann died in Göttingen on Feb. 16, 1950. (MY. F.)

HERMANN, (JOHANN) GOTTFRIED (JAKOB) (1772–1848), German classical scholar and philologist who was leader of the school that held linguistic studies to be the sole aim of philology, was born at Leipzig on Nov. 28, 1772. He studied at Leipzig university, and spent his life there as lecturer and professor, dying on Dec. 31, 1848. August Boeckh and Karl Otfried Müller, the representatives of the historico-antiquarian school, opposed Hermann's view of philology, regarding it as inadequate and one-sided. His early work was done in grammar and metre, his most important books being *Elementa doctrinae metricae* (1816) and *De emendanda ratione Graecae grammaticae* (1801).

HERMAPHRODITE, after Hermaphroditus (*q.v.*) in Greek mythology, any organism having both male and female reproductive organs. Statues and pictures from the Greco-Roman epoch depicted humans with fully developed female bodies and male sex organs. This extreme combination, being a particularly rare abnormality, is probably the product of artists' imaginations rather than a record of actual observation.

Medicine and comparative biology have adopted the term hermaphroditism to designate conditions of various degrees of mixed male and female sexuality, in contradistinction to gonochorism, the state of separate male and female sexes. Most flowering plants and many invertebrate animals (*e.g.,* earthworms, slugs and snails) are hermaphrodites, some of them reproducing by self-fertilization. Also a few fishes produce eggs as well as sperms. However, the overwhelming number of vertebrate species, particularly reptiles, birds and mammals, are gonochorists. In an evolutionary sense hermaphroditism is the primitive form of sex distribution out of which gonochorism arose by gradual suppression of one sex.

Human Hermaphrodites.—Sex expresses itself in a number of characteristics which may be placed in five groups:

1. Every cell of the body carries the sex constitution. This is a combination of male-determining and female-determining hereditary factors (*see* GENE). Each cell type becomes recognizable under the microscope by characteristic chromosomal patterns. In resting cells, female nuclei contain sex-chromatin nucleoli not present in male nuclei (*see* fig.). The difference serves as indicator of cytogenetic sex.

2. The ovaries and testes (gonads or sex glands) at maturity release eggs and sperms. The embryologist recognizes sexual differentiation as early as the seventh week of development.

FEMALE (LEFT) AND MALE (RIGHT) CELL NUCLEI FROM HUMAN EMBRYOS
Arrow points to the sex chromatin of the female nucleus

3. The secondary sex characters are gonaducts, external sex organs and puberal features. The first two differentiate during the

embryo's development in the uterus. The ducts are either oviducts (tube, uterus, cervix, vagina) or sperm ducts (epididymis, deferent duct, prostate). Puberal sex characters (breasts, pubic hair, beard, change of voice) develop during adolescence.

4. Of adult endocrine organs, the hypophysis, or pituitary gland, releases gonad-stimulating hormones at a constant rate in men, but at 28-day cycles in women. The gonads are influenced to produce steroid hormones: testicular androgens stimulate male secondary sex characters; ovarian gynogens and progestins affect female secondary sex characters.

5. Many behavioural and mental traits are sex specific in animals. However, at the human level their development is strongly influenced by environmental and social factors.

In the normal individual the characteristics of these five groups show the same direction of differentiation, either male or female. Combinations fall into the hermaphrodite class (*see* table). Two other special types of sexual abnormalities are: the gynandromorph (*q.v.*), a mosaic individual, composed of female and male cell territories. This type is not known to occur in man but has been reported for birds and insects. The other special type, the transvestite, is entirely of one sex, as far as criteria of groups 1 to 4 are concerned, but is possessed by a yearning to dress and live like the other sex (*see* HOMOSEXUALITY).

Since statistical materials about incidence of all types are meagre, estimates of frequency in large populations can only be provisional, pending collection of more reliable data.

1. True hermaphrodites have gonads with ovarial and testicular territories: either ovotestes, or an ovary on one side and a testis on the other. Only about 200 cases have been reported.

2. Pseudomales have the female cell constitution, but male appearance. The testes produce sperm in subnormal quantity or are completely sterile. At adolescence the breasts often enlarge as in women. Usually the beard is sparse.

Hermaphrodites Classified According to Prevailing Combinations of Criteria of Sexual Differentiation

Class	Cytogenetic sex	Sex of gonads	Secondary sex characters	Hormonal type	Frequency estimate
True hermaphrodite	female or male	female and male	female and male	mixed	very rare
Pseudomale	female	male	male	male or mixed	1 out of 2,000
Pseudofemale	male	none	female castrate	castrate	1 out of 2,000
Male pseudohermaphrodite	male	male	female or mixed	female or mixed	1 out of 2,000
Female pseudohermaphrodite	female	female	mixed	male or mixed	1 out of 50,000

3. Pseudofemales have the male cell constitution, but gonaducts and external sex organs of female type. Gonads are absent, and the gonaducts consist of tubes, uterus, cervix and vagina. At puberty, stature and breasts remain infantile; menses do not become established.

4. Male pseudohermaphrodites have the male cell constitution and male gonads; but during embryonic development the testes do not adequately control the development of the secondary sex characters. In the extreme case, female gonaducts are present and the external appearance is that of a girl or woman. The lightest cases are males normal except for incomplete closure of the urethra on the underside of the penis (hypospadias). The testes may either remain in the body cavity or descend into the inguinal canals or the scrotal sacs.

5. Female pseudohermaphrodites have ovaries and are constitutional females. Development of the secondary sex characters starts along the female pattern. However, at some point in fetal or adult life pathogenesis of the adrenal glands or the ovaries causes a production of androgenic hormones, exerting a masculinizing influence. The clitoris is enlarged, so that the newborn baby sometimes is mistaken for a boy; adult women develop hairiness (hirsutism), beards and low voices.

Irregularities have been observed in the chromosome number of some hermaphrodites; their possible relationship to the abnormality of sex expression has been under investigation. It is thought that no human hermaphrodites, and few pseudohermaphrodites, have ever been able to reproduce. Their mental outlook, female or male, is mostly determined by how they are reared.

See SEX; *see* also references under "Hermaphrodite" in the Index volume.

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HERMAPHRODITUS, in Greek mythology a being partly male, partly female. The idea of such a being originated in the east, home of many deities of a dual nature. Within the Greek area it is found in Cyprus (where, according to the Latin grammarian Macrobius, there was a bearded statue of a male Aphrodite) but it was of no importance in Greek cult. The legend, of the Hellenistic period, makes Hermaphroditus a beautiful youth, the son of Hermes and Aphrodite. The nymph of the fountain of Salmacis in Caria became enamoured of him when he bathed in her waters, and entreated the gods that she might be forever united with him. The result was the formation of a being half man, half woman. This story is told by Ovid to explain the allegedly enervating qualities of the water of the fountain. Hermaphroditus was a favourite subject in later Greek art.

HERMAS, SHEPHERD OF, one of the works representing the Apostolic Fathers, a hortatory writing which "holds the mirror up" to the Church in Rome during the 2nd Christian century. The work's prime value is the light it casts on Christianity at Rome in the otherwise obscure period *c.* 110–140, when it had as yet hardly felt the influences—as, for example, Gnosticism—converging on it from other centres of tradition and thought. *See* APOSTOLIC FATHERS: *Hermas.*

HERMES, a Greek god, son of Zeus and of Maia, daughter of Atlas. He is often identified with the Roman Mercury (*q.v.*) and with Casmilus or Cadmilus, one of the Cabeiri (*q.v.*). The derivation of his name is probably from *herma,* the Greek word for a heap of stones, such as was used in the country to indicate boundaries or as a landmark (*see* HERM). The earliest centre of his cult was probably Arcadia, where Mt. Cyllene was reputed to be his birthplace. There he was specially worshiped as the god of fertility, and his images were ithyphallic, as also were the *hermae* at Athens. At Cyllene in Elis a phallus alone served as his emblem and was highly venerated in the time of Pausanias.

Both in literature and cult Hermes was constantly associated with the protection of cattle and sheep; at Tanagra and elsewhere his title was "the ram-bearer." (The myth of Argus and Io is interesting in this connection. *See* ARGUS; IO.) As a pastoral god he was often closely connected with deities of vegetation, especially Pan and the nymphs. His pastoral character is recognized in the *Iliad* and a later epic hymn, and his Homeric titles, "gracious," "the ready helper," "giver of good things," probably refer to his function as the giver of fertility. In the *Odyssey*, however, he appears mainly as the messenger of the gods and the conductor of the dead to Hades. Hence, in later times, he is often represented in art and mythology as a herald. The conductor of souls was naturally a chthonian god; at Athens there was a festival in honour of him and of the souls of the dead, and Aeschylus invokes Hermes, with Earth and Hades, in summoning a spirit from the underworld. With this go Hermes'

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HERMES LEADING A CHORUS OF SATYRS AS SEEN ON VASE OF DURIS, *c.* 5TH CENTURY B.C. NOW IN THE BRITISH MUSEUM, LONDON

functions as a dream-god; he is called the "conductor of dreams," and the Greeks offered to him the last libation before sleep. As a messenger he may also have become the god of roads and doorways, and he was the protector of travelers.

Treasure casually found was his gift, and any stroke of good luck was attributed to him; this and his function as a deity of gain, honest or dishonest, are natural derivatives of his character as god of fertility. The trickery and cunning of Hermes are a prominent theme in literature from Homer onward, though it is very rarely recognized in official cult. In his hymn he figures as a precocious child (a type familiar in folklore), who, when a newborn babe, steals the cows of Apollo. In many respects he was Apollo's counterpart, less dignified and powerful but more human than his greater brother. Like him, Hermes was a patron of music, and invented the cithara; he presided over the games with Apollo and Heracles, and his statues were common in the stadiums and gymnasiums. He was god of eloquence also and, like Apollo, something of a prophet (though a much inferior one), presiding over some kinds of popular divination. For his oracle at Pharae in Achaea, *see* ORACLE.

The sacred number of Hermes was 4, and the 4th of the month his birthday. In archaic art, apart from the stylized *hermae*, he was portrayed as a full-grown and bearded man, clothed in a long tunic and often wearing a cap or a broad-brimmed hat and winged boots. Sometimes he was represented in his pastoral character, bearing a sheep on his shoulders; at other times he appears as the messenger or herald of the gods with the kerykeion, or herald's staff, which is his most frequent attribute. From the latter part of the 5th century B.C. his art type changed in conformity with the general development of Greek sculpture. He then became a nude and beardless youth, the type of the young athlete. In the 4th century this type was probably fixed by Praxiteles in his statue of the god at Olympia.

See GREEK ART: *The Classical Period: The 4th Century; see* also references under "Hermes" in the Index volume.

See M. P. Nilsson, *Geschichte der griechischen Religion,* 2nd ed., vol i, pp. 501–510 (1955).

HERMES, GEORG (1775–1831), German Roman Catholic theologian, who, influenced by the rationalism and idealism of Kant and Fichte, attempted to demonstrate the rational necessity of Christianity for personal self-realization and human dignity, was born on April 22, 1775, at Dreierwalde, Westphalia, and was educated at the University of Münster. He was ordained in 1799 and in 1805 published his *Untersuchung über die innere Wahrheit des Christentums,* which earned him a professorship in dogmatic theology at the University of Münster. In 1819 he was appointed professor of dogmatic theology at the University of Bonn, and his doctrines began to spread to many German universities and seminaries. He died at Bonn on May 26, 1831.

Hermes' doubts concerning the traditional scholastic reconciliation of reason and faith caused him to seek a firm rational foundation of Catholic dogma. His *Einleitung in die christkatholische Theologie* (1819–29) tried to establish the rational certainty of the principal tenets of Christian faith. *Christkatholische Dogmatik,* published posthumously in three volumes (1834–35), derived the "necessity" of the contents of Catholic faith from the imperatives of duty and conscience. What has been demonstrated by the "faith of reason" must be freely appropriated by the "faith of the heart." A brief of Pope Gregory XVI (1835) condemned "Hermesianism" and placed the major works of Hermes on the *Index.* This censure was reaffirmed by the first Vatican council (1869–70).

(K. F. R.)

HERMESIANAX OF COLOPHON (b. *c.* 320 B.C.), Greek elegiac poet, has importance as an early exponent of the Alexandrian type of poetry. He was a pupil of Philetas of Cos. Athenaeus has preserved 98 lines from Hermesianax' chief work, in three books, named *Leontion* after his mistress. They catalogue with excessive sentimentality the love affairs (most of them quite fictitious) of Greek poets from Homer to Philetas and of the philosophers Pythagoras, Socrates and Aristippus. Other fragments from the *Leontion* are concerned with bucolic themes. A lost poem called *Persica* may have been an epic. Hermesianax possessed some skill in versification, but his merits have been exaggerated.

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(E. A. B.)

HERMES TRISMEGISTOS, the Greek name applied to the Egyptian god Thoth (*q.v.*) as the reputed author or source of the "Hermetic" writings, works of revelation on occult subjects and on theology. Thoth was the scribe of the gods, the inventor of writing, and the patron of all the arts dependent on writing, including medicine, astronomy and magic. At least as early as Herodotus, Greeks had identified him with their god Hermes, and by the 3rd century B.C. the identification was official; on the Rosetta stone (196 B.C.) Hermes "the great, the great" is evidently Thoth. The epithet Trismegistos (Gr. "thrice-greatest") occurs only rarely outside the Hermetic texts. It represents a development from the Egyptian *aa aa* ("great, great," *i.e.,* "greatest") which is found as an epithet of Thoth in late hieroglyphic.

The writings ascribed to Hermes-Thoth fall into two main classes: "popular" Hermetism dealt with astrology and the other occult sciences, "learned" Hermetism with theology and philosophy. From the Renaissance until the end of the 19th century little attention was paid to the popular Hermetic literature. More recent study has shown that its development preceded that of the learned Hermetism, and that it reflects ideas and beliefs which were widely held in the early Roman empire and are therefore significant for the religious and intellectual history of the time.

In the Hellenistic age it was chiefly works on astrology which were ascribed to Hermes; to these were later added treatises on medicine, alchemy, and magic. The concept which underlies astrology, that the Cosmos constitutes a unity and that all parts of it are interdependent, is basic also to the other pseudosciences. To make this principle effective in practice (and Hermetic "science," unlike Aristotelian, was intensely utilitarian) it was necessary to know the laws of sympathy and antipathy by which the parts of the universe were related. But since these assumed affinities did not, in fact, exist, and hence could not be discovered by ordinary scientific methods, recourse was had to divine revelation. There was a growing distrust of traditional Greek rationalism, and a breaking down of the distinction between science and religion. Hermes-Thoth was but one, if perhaps the most important, of the gods and prophets (chiefly oriental) to whom men turned for a divinely revealed wisdom.

The theological writings are represented chiefly by the 17 treatises of the *Corpus Hermeticum,* by extensive fragments in Stobaeus, and by a Latin translation of the *Asclepius,* preserved among the works of Apuleius; they date probably from the first three centuries A.D. All are marked by a sincere, if turgid, piety of a mystical type, but there is no single doctrine which is consistently set forth, and it is unlikely that there was any well-defined Hermetic community or "church." Though the setting is Egyptian the philosophy, like the language, is Greek.

Hermetism was extensively cultivated by the Arabs, and through them reached and influenced such men as Albertus Magnus in the west. There are frequent allusions to Hermes Trismegistos in late medieval and Renaissance literature.

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(F. R. WN.)

HERMIAS OF ALEXANDRIA (? fl. late 5th century A.D.), Neoplatonist philosopher, was a disciple of Proclus and belongs to the Athenian rather than the Alexandrian school of Neoplatonism, though he spent his later life in his native city and, probably, taught there. His chief works were a treatise on Porphyry's *Isagoge* and a commentary on Plato's *Phaedrus* (*In Platonis Phaedrum scholia,* ed. by P. Couvreur, 1901). This latter work shows clearly the Athenian method of interpreting Plato inaugurated by Iamblichus and developed on the largest possible scale by Proclus. *See* also AMMONIUS HERMIAE.

(A. H. AG.)

HERMIT is one who, for a religious motive, retires from society and lives in prayerful solitude. The word is used interchangeably with anchorite, although the two were originally distinguished on the basis of location—an anchorite selected a cell attached to a church or near a populous centre, a hermit retired to the wilderness.

Early Christian asceticism was first institutionalized in the eremetical life in the 3rd century in Egypt, where one reaction to the persecution by the Roman emperor Decius was the flight of many into the desert to preserve the faith and to lead a life of prayer and penance. Paul of Thebes, who fled to the desert about the year 250, was considered by St. Jerome to be the first hermit (*see* PAUL, SAINT, of Thebes). The excessive austerity and other extremes of the early eremetical life were tempered by the establishment of cenobitic communities. Anthony of Egypt, the first cenobite, a hermit-disciple of Paul of Thebes, gathered solitaries about him in loosely structured communities that met occasionally for instruction and for reception of the Eucharist. About 318, Pachomius gave organization to the cenobitic life and wrote a rule for the first monastery at Tabennisi.

Thus developed, the eremetic life laid a foundation for the institution of monasticism (*q.v.*) or common life according to an established rule. After Pachomius, further developments of the monastic rule were contributed by Basil in the east, and by Benedict of Nursia, whose famous rule still influences the spirit of modern religious orders in the west. (WI. J. BY.)

HERMIT CRAB, a marine crustacean of the order Decapoda (section Anomura), typically with a soft, asymmetrical abdomen, which the hermit in adult life protects by thrusting it into an empty snail shell. They are found in all seas, some at considerable depths; others lead a terrestrial existence in tropical and subtropical lands, returning, however, to the sea to spawn their young. Many live under symbiotic conditions by association with sea anemones, annelid worms and other animals. *See* CRAB; CRUSTACEA; MALACOSTRACA; SYMBIOSIS. (W. L. ST.)

HERMITE, CHARLES (1822–1901), French mathematician distinguished for the elegance of his algebraic research, was born at Dieuze on Dec. 24, 1822.

Most of his formal education was obtained at the Lycée Louis-le-Grand (1840–42) in Paris and at the École Polytechnique (1842–43). Although Hermite had great difficulty in his examinations, he was already a creative mathematician at the age of 20. Having barely passed his bachelor of science examination in 1848, he was given a minor teaching position at the Polytechnique before being appointed at the Collège de France. It was not until he was 47 that Hermite obtained a worthy position. In 1869 he became professor at the École Normale and in 1870 at the Sorbonne. He died at Paris on Jan. 14, 1901.

Hermite was one of the principal developers of the theory of algebraic forms, the arithmetical theory of quadratic forms and the theories of elliptic and abelian functions. Two isolated results testify to his originality and power: he solved the general quintic equation by means of elliptic modular functions; he proved the transcendence of the number *e* (the base of the natural logarithms). Most of his work is of high artistic quality. Of a generous disposition, Hermite encouraged many young mathematicians in their first serious work. (E. T. B.; X.)

HERMOCRATES (d. 408/407 B.C.) was the leader of the Syracusan moderate democrats in the late 5th century B.C. In 424, when Athens was supporting the Ionian cities against Syracuse during the Peloponnesian War, he persuaded the Sicilian cities to agree to a common peace, which forced the Athenians, isolated, to withdraw. When the Athenians returned with much larger forces in 415, Hermocrates was the main inspiration of the defense until Gylippus (*q.v.*) came from Sparta. After the total victory over Athens (413), Hermocrates took a small squadron of Syracusan ships to help the Spartans against the Athenians in the eastern Aegean, but in his absence Diocles seized power at the head of the radical democrats. Hermocrates was exiled and in attempting to force his way back in the winter of 408/407 was killed. (R. ME.)

HERMON, MOUNT ("forbidden [place]"), the highest mountain of the east coast of the Mediterranean, stands on the Lebanon-Syria border about 25 mi. W.S.W. of Damascus. The Sidonians called it Sirion and the Amorites Senir or Shenir (Deut. iii, 9); it is known in Arabic as Jabal ash Shaykh ("mountain of the chief") or Jabal ath Thelj ("snow mountain"). It is a shoulder of the Anti-Lebanon (Antilibanus), dominating the area from a height of 9,232 ft. From the top can be seen Lebanon, the plain around Damascus, Tyre, Carmel, the mountains of upper Galilee, the plains of lower Galilee, Lake Huleh and the Sea of Galilee. On a clear day, Hermon can be seen from the region of the north end of the Dead sea, more than 100 mi. distant. Throughout the summer some snow remains on its peak. At its foot rise the two major sources of the Jordan river. On the top of Hermon are three low peaks, the highest encircled with a wall. There are ruins of a temple on this peak and a rock-cut cave about 8 yd. square on the plateau separating the peaks. On the slopes are a number of small temples, dated *c.* A.D. 200, from which several Greek inscriptions have been recovered. Some scholars maintain that Hermon was the "high mountain" of Jesus' transfiguration (Mark ix, 2).

Mt. Hermon was the northeast limit of the Israelite conquests under Moses and Joshua. The mountain inspired various images of Hebrew poetry, being coupled with Tabor (Ps. lxxxix, 12), Lebanon (S. of Sol. iv, 8; Ezek. xxvii, 5) and Zion (Ps. cxxxiii, 3). In the Ugaritic Baal epic, Sirion is associated with Lebanon as a source of precious cedars. In a late 14th-century-B.C. treaty between Mursilis II of the Hittites and Dubbi-Teshub of Amurru, Mt. Sariyana (Sirion) is included among the gods invoked as witnesses. Hazael of Damascus made the mountain Senir his fortress against the invasion of Shalmaneser III of Assyria (859–824 B.C.). Shalmaneser won a victory but did not take Damascus. (E. D. GR.)

HERMONTHIS, classical name of PER-MONTH, an ancient town in upper Egypt (modern ARMANT), 10 mi. upstream from Thebes on the west bank of the Nile. Known also as "the southern Heliopolis," it was the seat of a sun cult and a crowning place of kings. The war god Month or Mentu was worshiped there in hawk-headed human form and also in his epiphany the bull Buchis, which had special markings and which, like Apis (*see* MEMPHIS), was buried in late times with divine honours. Hermonthis was the original home of the nomarchs of Thebes who reunited Egypt after a period of anarchy and inaugurated the prosperous rule of the Middle Kingdom (*see* EGYPT: *History*). Excavations undertaken between 1929 and 1938 uncovered the Bucheum (the necropolis of the mummified Buchis bulls), cemeteries of various periods from the predynastic downward, and part of the town area, including the temple of Month, which probably dates back to the Old Kingdom and contains finely sculptured blocks of 11th-dynasty work and a pylon of New Empire date. The *mammisi* or birth temple, built by Cleopatra in honour of her son Caesarion, is described by 19th-century travelers but has almost entirely disappeared.

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HERMOPOLIS MAGNA, a town of ancient Egypt, 188 mi. S. of Cairo and 24 mi. upstream from Al Minya; its ancient name was KHMUNU, "city of the eight (gods)," Coptic SHMOUN, hence the name of the modern village AL ASHMUNAYN, in Asyut province. It was also known as "Hare city (Wenu)," for it was the capital of the Hare nome, the 15th nome of upper Egypt. The great deity worshiped there was Thoth, the god of learning and patron of scribes, who was identified with Hermes by the Greeks. In Greco-Roman times the town was prosperous and the papyri give detailed information about the topography.

The site, which is very extensive, has been partly explored. The German Hermopolis expedition, exploring the 64-ac. temple precinct, uncovered part of the temple of Thoth containing a pylon of the Middle Kingdom and Ramesside remains and a Ramesside temple of Amon. Considerable remains were found of the temples, streets and public buildings of the Hellenistic and Roman city.

On the west bank, in the necropolis area of Tuna al Jabal, an Egyptian university expedition between 1930 and 1939 discovered a labyrinth of underground streets and catacombs connected with the cult of the ibis and the cynocephalus (baboon), both sacred to

Thoth; numerous statues and mummies of these creatures were found. The necropolis contains the well-known tomb of Petosiris, high priest of Thoth in the time of Alexander the Great, and a series of Roman house tombs decorated with remarkable frescoes.

See G. Roeder, *Hermopolis 1929–30* (1959); Sami Gabra, *Rapport sur les fouilles d'Hermoupolis ouest* (1941); G. Lefebvre, *Le Tombeau de Petosiris* (1923–24). (M. S. DR.)

HERNÁNDEZ (FERNÁNDEZ), **GREGORIO** (*c.* 1576–1636), Spanish sculptor, famous for his carved altarpieces and religious subjects, all in polychromed wood, was born in Galicia. He was a pupil of Francisco del Rincón at Valladolid. The Passion was his favorite theme, evoked with baroque intensity of expression and dramatic gravity. Attention was concentrated on the head and on the body surface. His work can be seen chiefly at Valladolid and other cities of northern Spain. The museum at Valladolid contains, among other pieces, a St. Veronica, a Pietà, a relief of the baptism of Christ and a St. Bruno. Two statues of Christ, stretched out on a sheet—an iconographical innovation of the artist—are at Madrid (the monastery of the Sacrament and the monastery of San Plácido), and another is at near-by El Pardo. Hernández died at Valladolid on Jan. 22, 1636.

See Maria Elena Gómez Moreno, *Gregorio Fernández* (1953); George Kubler and Martin S. Soria, *The Art and Architecture of Spain and Portugal and Their American Dominions, 1500–1800* (1959). (M. S. S.)

HERNÁNDEZ, JOSÉ (1834–1886), Argentine poet, best known for his depiction of the gauchos, was born in the Chacra de Pueyrredón, province of Buenos Aires, on Nov. 10, 1834. At the age of 14, because of illness, he left Buenos Aires to live in the pampas, where he read extensively and learned the ways of the gauchos. From 1853 to 1868 he took part in the political struggle between Buenos Aires and the provinces on the side of the latter. To defend the rights of the gauchos, he founded, in 1869, the newspaper *El Río de la Plata*. Because of his participation in the unsuccessful revolt against Pres. Domingo Sarmiento's government in 1870, he fled to Brazil (Jan. 1871). He later returned to Buenos Aires and published his famous poem *El gaucho Martín Fierro* (1872), depicting the life of a persecuted gaucho. A true American epic, the poem is recognized as the best example of *poesía gauchesca*. In the second part, *La vuelta de Martín Fierro* (1879), the hero is reintegrated into the society he had abandoned.

Hernández died at Belgrano (a suburb of Buenos Aires) on Oct. 21, 1886.

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HERNE, JAMES A. (JAMES AHERN) (1840–1901), U.S. playwright who helped bridge the gap between the 19th-century melodrama and the 20th-century "drama of ideas," was born in Troy, N.Y., Feb. 1, 1840. After several years as a traveling actor, Herne scored an impressive success with his first play, *Hearts of Oak* (1878). Subsequent dramas, *Drifting Apart* (1885), *The Minute Men* (1886) and *Margaret Fleming* (1890), did not achieve its popularity, but in retrospect *Margaret Fleming* seems his major contribution, since it anticipates the later U.S. social drama. Herne's most popular play, *Shore Acres*, was first presented in 1892, and his last two, *The Reverend Griffith Davenport* (1899) and *Sag Harbor* (1900), were both moderately successful. Herne was especially strong in character delineation. He died in New York city on June 2, 1901. (S. W. H.)

HERNE, a town of Germany in the *Land* (state) of North Rhine-Westphalia, which after partition of the nation following World War II became part of the Federal Republic of Germany, is in the Ruhr industrial area, 20 km. (12½ mi.) W.N.W. of Dortmund by road. Pop. (1961) 113,207. Herne has a station on the network of railways in the Ruhr area and is also served by the Rhine-Herne canal. The town has coal mines, boiler works, ammonia works and other factories. It was made a town in 1897.

HERNE BAY, a seaside resort and urban district in the Canterbury parliamentary division of Kent, Eng., 8 mi. N.E. of Canterbury by road. Pop. (1961) 21,273. It grew up after the coming of the railway in 1833 and has a sand and shingle coast line of more than 7 mi. and a pier about ¾ mi. long. The church of St. Martin, at Herne, 1¾ mi. inland, has medieval brasses. The *Te Deum* was first sung there in English when Nicholas Ridley, later martyred, was vicar. At Reculver, 3 mi. E. through Bishopstone glen, is the site of the Roman station of Regulbium. Only traces of the walls remain. In Saxon times it was converted into a palace by Aethelberht, and in 669 a monastery was founded there by Egbert. Parts of the Early English church, taken down about 1805 because of the encroachment of the sea, were incorporated in St. Mary's, but its twin towers, known as the Sisters, were preserved by Trinity house as a conspicuous landmark. The council owns caravan sites near the towers.

Catering for tourists and agriculture are the area's principal industries.

HERNIA, in surgery, the protrusion of an organ or tissue from its normal cavity. A hernia may develop in conjunction with many different parts of the body; *e.g.*, the brain, a lung or an intervertebral disc. The protrusion may extend outside the body or between cavities within the body, as occurs in a diaphragmatic hernia from the abdominal cavity through the respiratory diaphragm into the thoracic cavity. The term is usually applied, however, to an external herniation through the abdominal wall in the region where the wall meets the thigh. This article chiefly discusses abdominal hernias of the latter type.

An abdominal hernia, or rupture, may occur at any weak point in the abdominal wall. The common sites are the groin (inguinal), the upper part of the thigh (femoral) and the navel (umbilical). Hernias may be congenital or may be acquired later in life. For a hernia to occur, excessive length of the mesentery or of the omentum must be present, in addition to a weak spot in the abdominal wall. In inguinal hernia, the hernia descends along the canal in which lies the spermatic cord in the male and the round ligament of the womb in the female. If such a hernia occurs bilaterally, it is called a double hernia. A femoral hernia lies on the inner side of the large femoral blood vessels. An umbilical hernia protrudes through the navel.

A hernia may be present at birth as the result of defective development of the abdominal wall or it may occur later in life as the result of a strain or injury. An acquired hernia, as distinguished from a congenital hernia, usually is caused by overexertion, as in lifting a heavy weight, jumping off a high wall or violent coughing. Men develop hernias more frequently than do women because of their greater physical exertions and because the canal for the spermatic cord leading through the abdominal wall is wider than the canal for the round ligament of the womb. A special type of acquired hernia is the incisional hernia, which occurs at an incision following surgery.

A hernia may be as small as a marble at first but may increase gradually in size until it is as large as an infant's head. The swelling consists of three parts—the coverings, sac and contents. The coverings are the structures that form the abdominal wall at the point where the hernia occurs. The sac, which in rare cases is absent, is composed of the peritoneum, or the membrane lining the abdominal cavity; the neck of the sac is the narrowed portion where the peritoneum becomes continuous with the general peritoneal cavity. As a result of chronic inflammation, the neck of the sac often becomes thickened and hard; it then adheres to the surrounding parts. The hernia may contain intestine alone, omentum alone, or both. In young girls, an ovary may be present.

The hernia may be classified as reducible, irreducible or strangulated. A reducible hernia is one in which the contents can be pushed back into the abdomen. In some cases reduction is easy; in others it is difficult. At any moment a reducible hernia may become irreducible, perhaps from inflammatory adhesions in and around the fatty contents or from extra fullness of the bowel in the sac. A strangulated hernia is one in which the circulation of blood through the hernial contents is impeded by the pinching at the narrowest part of the passage. The interference is at first slight but quickly becomes pronounced; the pinched bowel in the hernial sac swells as a finger does when a string is tightly wound round its base. Congestion is followed by inflammation, infection and gan-

grene. The tighter the constriction, the more rapidly these events take place.

Reducible Hernia.—With a reducible hernia there is a soft compressible tumour (elastic when it contains intestine, doughy when it contains omentum), its size increasing in the erect and diminishing in the horizontal posture. As a rule, it causes no trouble during the night. It gives an impulse on coughing, and when the intestinal contents are pushed back into the abdomen a gurgling sensation is perceptible by the fingers. Such a tumour may occur in any part of the abdominal wall, but the chief sites are those mentioned above. Inguinal hernia is commoner in men, femoral in women. As an inguinal hernia increases in size it passes into the scrotum in the male and into the labium in the female, while a femoral hernia first heads downward and then gradually pushes upward to the abdomen.

The palliative treatment of a reducible hernia consists in pushing the contents of the tumour into the abdomen and applying a truss or elastic bandage to prevent their escaping again. The younger the patient the greater are the chances that the truss will act as a curative agent. It is sometimes impossible to push back a hernia by means of a truss, and an operation becomes necessary. The purposes of the operation are the emptying and the removal of the sac and the closure of the opening into the abdomen by strong sutures.

Irreducible Hernia.—The main symptom is large, long-standing swelling in one of the sites already referred to; the contents of the tumour, in whole or in part, cannot be pushed back into the abdomen. The irreducibility is the result of its large size or of changes that have taken place as the result of indurations or adhesions. Such a hernia is a constant source of danger; its contents are liable to injury from external violence; it may at any time become strangulated, or the contents may inflame, and strangulation may occur secondarily to the inflammation. It gives rise to pain, dyspepsia and constipation, which may lead to intestinal obstruction in the loop of intestine that lies in the hernia. When an irreducible hernia becomes painful and tender a local peritonitis has occurred. The only safe treatment is surgery.

Strangulated Hernia.—In strangulated hernia the bowel or omentum is pinched off at the neck of the sac, and the flow of blood into and from the delicate tissues is stopped. The symptoms are nausea; vomiting; a twisting, burning pain generally referred to the region of the navel; intestinal obstruction; pain on pressure over the tumour; a tense and drumlike abdomen; and absence of an impulse in the tumour on coughing. Sometimes there is complete absence of pain and tenderness in the hernia itself, and in an aged person all the symptoms may be slight. Sooner or later, from eight hours to eight days, if the strangulation is unrelieved, gangrene occurs at the neck of the sac and the patient develops hiccoughs, goes into shock and dies. The treatment of a strangulated hernia is immediate surgery.

HERNICI, an ancient people of Italy, whose territory was in Latium between the Fucine lake (modern Fucino) and the Trerus (modern Sacco) river, bounded by the Volsci on the south and by the Aequi and the Marsi on the north. In 486 B.C. they were still strong enough to conclude a treaty with the Romans on equal terms. They broke away from Rome in 362–358. In 306 their chief town, Anagnia (Anagni), was taken and deprived of its independence and their league was broken up, though Ferentinum (Ferentino), Aletrium (Alatri) and Verulae (Veroli), which had not rebelled, were allowed to remain free municipia (*see* MUNICIPIUM). By 195 B.C. their territory was not distinguished from Latium and they were regarded as Latins, both politically and in language. Their original language is unknown.

HERO (HERON) OF ALEXANDRIA, Greek geometer and writer on mechanical and physical subjects. Hero's reference in his *Dioptra* to a lunar eclipse, visible in Alexandria in A.D. 62, shows that he lived in the 1st century A.D.

Of Hero's mechanical works, the *Pneumatica, Automatopoietice, Belopoeica* and *Cheiroballistra* survive in Greek. The *Pneumatica*, in two books, describes many interesting contrivances such as siphons, "Heron's fountain," "penny-in-the-slot" machines, a fire engine, a water organ and arrangements employing the force of steam. The *Belopoeica* (on engines of war) purports by its title to be based on a work by Ctesibius, who lived about 250 B.C. in Alexandria. Hero's *Mechanics*, in three books, is extant in Arabic, though not in its original form. This work is cited by Pappus, as is also the *Barulcus*, "weight lifter," probably the same treatise under a different name. Book ii of the *Mechanics* deals with the five mechanical powers and mechanical problems of daily life, and Book iii with the construction of engines of all sorts. Both the *Belopoeica* and the *Mechanics* contain Hero's solution of the problem of the two mean proportionals.

The geometrical works attributed to Hero that survive in Greek bear the titles *Metrica, Definitiones, Geometria, Geodaesia, Stereometrica* (i, ii), *Mensurae* and *Liber Geëponicus*. The *Metrica* was not discovered until 1896 by R. Schöne in a manuscript at Constantinople. It is by far the most important, as it is the most authentic, of the geometrical works of Hero and proves him to have been an accomplished mathematician. The other works containing, like the *Metrica*, problems of mensuration are not Hero's in their present form. A good part of their contents is based on geometrical rules developed in Mesopotamia in the second millennium B.C. and was commonly known in the Hellenistic period. A remarkable feature is the statement of a variety of close approximations to the square roots of numbers that are not complete squares; the *Metrica* describes a general method of finding successive approximations to the values of such surds, as well as a method of approximating the cube root of a noncube number; the former throws light on similar approximations to surds stated in Archimedes and in astronomical works; *e.g.*, Ptolemy's *Almagest*. Book i of the *Metrica* includes the mensuration of triangles, quadrilaterals, regular polygons from the equilateral triangle to the regular dodecagon, circles and segments thereof, an ellipse, a parabolic segment, and of the surfaces of cylinders, right cones, spheres and segments thereof. Book ii shows how to measure the content of solid figures, including cones, pyramids, frusta of such solids, a sphere and a segment thereof, the five regular solids, besides the two remarkable solid figures measured by Archimedes in his *Method* (a solid like a hoof cut off by a plane from the end of the cylinder, and a solid made up of eight such "hoofs"). Book iii gives some problems of the same type as those in Euclid's treatise *On Divisions* (of figures). Akin to the geometrical works is that *On the Dioptra*, a remarkable book on land surveying, so called from the instrument described in it, which was used for the same purposes as the modern theodolite; this treatise contains also an astronomical chapter which describes a graphical method for the determination of the distance between Alexandria and Rome by means of the difference of local time in the simultaneous observation of a lunar eclipse. Chapter 30 gives the proof of "Heron's formula" for the area of a triangle of sides a, b, c where s is half their sum:

$$A = \sqrt{s(s-a)\ (s-b)\ (s-c)}$$

This formula is, however, older than Hero; al-Biruni (d. 1048) quotes Archimedes for it.

Hero also wrote *Catoptrica* (on reflecting surfaces); and it seems certain that this is extant in a Latin translation by William of Moerbeke of a work which was formerly thought to be a fragment of Ptolemy's *Optics*. Hero explains the rectilinear propagation of light as well as the law of reflection by the principle of minimal distance. Of other treatises by Hero only fragments remain. One on water clocks in four books is referred to by Pappus and Proclus. Another was a commentary on Euclid's *Elements*, quotations from which are found in the extant Arabian commentary by An-Nairizi.

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HERO. The word "hero" comes from the Greek *heros* and its etymology is not known. It is applied in the *Iliad* and the *Odyssey* to "any freeman of the ante-Hellenic age." Although in general use the word signifies a man of great courage, or the chief character in a literary work, it is also used in a specialized sense, to designate the leading figures in what is known as "heroic" literature. This literature has flourished at different periods in many different parts of the world, but is connected with an early stage in the history of the race, loosely called the "heroic" age.

Characteristics of the Hero and of Heroic Literature.— Heroic literature has certain well-defined characteristics. It deals with human beings who transcend ordinary men by their skill, strength and courage. In general, the creators of this type of literature look back, as Homer did, to a generation of superior beings, who excelled in war and adventure, and who valued above all else the pursuit of honour and renown. Sometimes these heroes possess supernatural powers, and often they are helped or hindered by supernatural beings, or do battle with monsters and demons. Their adventures are not necessarily confined to this world, but may lead them by strange paths into the other world—the kingdom of death or the realm of the gods. Their pre-eminence among men is sometimes accounted for by unusual circumstances of birth and breeding. Some, like Achilles, are of divine parenthood on one side; others, like Sinfjotli, the Scandinavian hero, are the offspring of a brother and sister. (Such heroes usually die young and childless.) Others, like Romulus or Perseus (*qq.v.*), are condemned to death in infancy, but escape through extraordinary circumstances and are brought up in ignorance of their origin, to fulfill in manhood the destiny allotted to them. Many heroes, like the Irish Cú Chulainn, are extremely precocious and have the strength and courage of a man at a very early age, while others, like Beowulf (*q.v.*), hero of the Anglo-Saxon epic poem bearing his name, are slow to develop and are thought to be of little account until they suddenly perform some mighty exploit.

Sometimes these heroes, like Romulus, are looked back to and revered as the founders of the race. But heroes may be remembered and praised in countries other than their own; for instance, Beowulf was not an Anglo-Saxon and was never represented as having visited Britain, but was a prince of the Geats, a small tribe in Sweden. Attila (*q.v.*), the king of the Huns, has found a place in Germanic heroic poetry under the name of Etzel (German) or Atli (Scandinavian), and the fact that he was of foreign origin seems to have been forgotten. The great heroic epics are singularly free from tribal and local prejudice, because the heroes belong to a princely class which transcends nationality in its interests, although the heroes themselves may be revered as national heroes. Struggles between different heroes and tribes certainly take place and are indeed the main inspiration of heroic literature, but they are based on motives such as revenge, desire for glory, envy of a neighbour's wealth or defense of family, rather than on national differences. Such motives are intensely personal and the loyalties of the heroes are also personal. The two main heroic obligations are loyalty to one's lord and loyalty to one's kindred; these spur men on to the pursuit of fame, since thereby the prestige of the leader and of the family will be increased. Moreover, personal achievement and reputation is regarded as something of enduring value which will survive death, and is therefore a worthy cause for which to die.

The heroes are usually of princely rank, and are either themselves kings and leaders of men or among the distinguished followers of a great prince. A leader must show himself to be possessed of courage and generosity, while his men must deserve the gifts which he has given them by unswerving loyalty and a readiness to die in his defense. The hero may be presented primarily as a member of a family, or as a solitary adventurer cut off from his kindred, as was Odysseus (*q.v.*) during his return from Troy, but the fact that he is of noble birth and a leader of men is never forgotten. This does not mean that he is expected to keep aloof from manual labour and the practical considerations of life. The idea found in the French *chansons de geste* (*q.v.*), that work with the hands demeaned a knight, was a medieval one, and shows that in France by this time the original heroic ideal had faded. The true hero looks after his horse, builds and sails a boat, directs the building of his own house, and can take care of himself in the wild as well as, and indeed better than, his men. If he can tell stories, compose poems and accompany himself on the harp, so much the better. In life in the heroic age there is no sharp division between martial, manual and intellectual pursuits such as is found in a more sophisticated society.

The literature in which the stories of heroes are preserved is derived from oral tradition. In time the stories may be recorded in writing either by the immediate successors of the storytellers, when the art of writing has been developed, or by later collectors who take down the stories from illiterate people, among whom they have been passed down orally for many generations. Heroic traditions may also continue to influence writers of a later age. An example of such literary influence is seen in Virgil's *Aeneid*, an epic dealing with the imagined origin of the Roman nation, composed in the reign of the emperor Augustus (27 B.C.–14 A.D.). In works written after the close of the heroic age, however, new elements and influences enter in, and the heroic traditions are gradually altered and weakened. Heroic literature proper is composed primarily for entertainment, not to point a moral or to express doubts and questionings. It is narrative in type, and often consists of long poems of some thousands of lines, deserving the name of epic. Shorter poems, such as panegyrics to heroes, laments at their deaths and accounts of single battles, are found in many parts of the world, and may represent an earlier stage of development in heroic literature. Heroic poetry was in general composed either for a royal court or for an audience which included men of rank. In consequence great emphasis is laid on correct behaviour, feasting and hospitality and the obligations of a prince. There is little that is crude or coarse in such literature, although deeds of cruelty and barbarity may be described in it. In some parts of the world, heroic traditions have been mainly preserved in the form of saga, that is, prose stories remembered orally (*see* IRISH LITERATURE: *Gaelic Literature;* WELSH LITERATURE). Such sagas may develop out of earlier poetry, or independently.

An interesting point is the important part played by women in much heroic literature, and the sympathy shown in many cases with their point of view. In Norse heroic poetry the chief characters are women, and Brunhild (*q.v.*) and Gudrun have become the main actors in the group of stories concerning the Volsung family (*see* also GERMANIC MYTHOLOGY AND HEROIC LEGENDS; NIBELUNGENLIED). It is possible that women played a major part in the composition and preservation of heroic literature in many countries. It is known that among the Tuareg of the Sahara, a people whose life is still one of warfare and adventure, women customarily compose and recite poetry.

Magic and the supernatural enter into heroic literature, although the primary interest is in the doings of men and women. In some cases, as in ancient Greece, there were religious cults connected with great heroes of the past, forming part of ancestor-worship (*q.v.*). Shrines were erected in honour of heroes, and games held to commemorate them. Sometimes there is confusion between the heroes and the gods, and such figures as Hercules appear as demigods. Kings and outstanding heroes are sometimes said to ascend to heaven, and there is a theory that the cult of the divine emperors at Rome may have developed out of the veneration of dead heroes. It has also been suggested that minor gods appearing in the myths were originally heroes who in the end came to be represented as deities. In the 19th century it was widely held that heroes such as Beowulf (who has never been identified as a historical figure) were either "degraded gods" or personifications of the powerful forces of nature, such as the sunshine or the storm. Now that understanding of the nature of heroic literature has been extended, owing to the large amount collected in modern times, such theories have been almost wholly abandoned. In some cases, nevertheless, it must be noted that the mantic element in early oral literature has proved stronger than the heroic one, and the hero has the

powers of a shaman or magician, whose adventures are in the realm of the supernatural, and not the real, world (*see* SHAMANISM).

Extant Heroic Literature.—An impressive body of heroic narrative poetry has been preserved from ancient times. The epic of Gilgamesh (*see* GILGAMESH, EPIC OF), fragments of which have been preserved in Babylonian, Hittite and Assyrian, is primarily heroic in quality, since the central figure is a human hero of outstanding powers. The finest and best-known example of the heroic poetry of the far past is that ascribed to Homer, dating back eight or nine centuries before Christ. There is also much heroic material in the ancient Indian epic *Mahabharata* (*q.v.*), although this was considerably altered by the Brahmans and contains much that is nonheroic.

In England a quantity of heroic poetry has survived from Anglo-Saxon times. One complete epic, *Beowulf*, and a number of fragments of poems are extant; these were composed several centuries before the Norman conquest, although not written down in their present form until *c.* 1000 A.D. The chief episodes of *Beowulf* are concerned with battles of the hero against monsters. At the outset of his career he kills two troll-like creatures, Grendel and his mother, who dwell under a lake in Denmark and have been attacking the court of the Danish king. After a long and glorious reign in his own land he overcomes a dragon which has been afflicting his people, and himself dies as the result of the struggle. In the course of the poem, however, there are many allusions to other heroic stories of a more realistic kind, to feuds, warfare between neighbouring tribes, royal marriages and episodes in the history of the Geatish and Danish royal families. Some of these tales are familiar from other sources, and it is clear that the small amount of heroic poetry which survives was only part of a vast body of traditions about heroes known to the Anglo-Saxons and other Germanic peoples. These relate, as far as can be ascertained, to events and persons of the Germanic Migration period, between *c.* 300 and 600 A.D., when unsettled conditions prevailed in northwestern Europe.

Of German heroic poetry, most notable are the Old High German *Hildebrandslied*, a fragment telling of a battle between a father and son, and the Middle High German epic, the *Nibelungenlied*, written *c.* 1200. Some of the characters of this epic are the same as those found in the Icelandic heroic poems, preserved in the *Elder* or *Poetic Edda* (*see* EDDA), a manuscript of the 13th century, and in some Norse sagas which were probably based on lost poems. The hero of the German epic, Siegfried (*q.v.*), is identifiable with the Scandinavian hero Sigurd the Volsung, and the events seem to be based on happenings at the court of the Burgundians in the Migration Period. Sigurd himself, like Beowulf, is of mysterious origin, but other German heroes can be identified from historical records. One of these is Theodoric (*q.v.*), king of the Ostrogoths in the 5th–6th centuries; he became a major figure in medieval German poetry, and some of the stories about him were taken to Norway and mixed with Scandinavian traditions in an extensive prose-work of the 13th century, *Thidhriks Saga* (*see* also ICELANDIC LITERATURE).

The Celtic people in Britain also had their own heroic traditions. References to Welsh heroes survive in early Welsh poems, much edited and highly obscure, and in some of the prose stories of *The Mabinogion* (*q.v.*). Among these heroes is King Arthur (*q.v.*), and about him and his band of knights a rich body of later stories in prose and verse developed in Brittany, in France and among the Normans in England (*see* ARTHURIAN LEGEND). The period in which the British heroic stories originated was apparently from about the 5th to the 7th centuries A.D. There are also abundant records of the doings of heroes in Ireland, preserved in poems and in prose sagas (*see* IRISH LITERATURE: *Gaelic Literature*). Cú Chulainn is the most famous of these, and the stories appear to extend over a long period and to go back to pre-Christian times. They were recorded in writing at various times between the 8th and the 11th centuries, and are mingled with tales of Christian saints. In the Welsh and Irish traditions of the heroes, the marvelous and fantastic play a large part, and consequently the atmosphere differs from that of the Homeric and Germanic heroic poems. Later stories of a more romantic type, the *chansons de geste*, developed out of Celtic heroic traditions in France. Of particular interest among the French material is a short epic, composed in the 11th century, the *Chanson de Roland* (*see* ROLAND, CHANSON DE), telling of the heroic fight of one of Charlemagne's heroes against the Saracens. A later group of poems which may be called heroic are the Spanish ones dealing with the history of Castile, of which the 12th-century *Poema de mio Cid* is the most important (*see* SPANISH LITERATURE: *Heroic Poetry*).

Some tales of early heroes have been preserved in Latin sources when the original ones have not survived. A Danish scholar, Saxo Grammaticus (*q.v.*), collected a large number of heroic stories in the first nine books of his *Gesta Danorum*, written in the 12th and early 13th century. A Latin epic, *Waltharius* (*q.v.*), written by a monk of the monastery of Sankt Gallen in the 9th or 10th century, tells the story of the hero Waldere, who is also mentioned in a fragment of an Anglo-Saxon heroic poem. Much heroic poetry has of course been wholly lost. Cicero lamented the disappearance of the old poems of the past, telling of the ancient heroes of the Romans, and the ancient heroic poetry of the Gauls, which must have been extensive, has completely vanished.

Besides the heroic works which have come down in a written form from earlier times, much material has been collected by travelers and scholars in the late 19th and 20th centuries, taken down from native poets and reciters. The remoter parts of Russia, Estonia, Yugoslavia, Bulgaria, the Ukraine, Albania and Greece have proved the most fertile regions for such poetry. Further east, narrative poems dealing with the exploits of heroes have been collected from Tatar peoples, speaking various dialects of the Turkish language, and some particularly fine examples come from the Kara-Kirghiz of the Tien Shan mountains. The Yakut of northern Siberia, the Ainu of northern Japan and some of the tribes of Arabia have also composed heroic poetry in modern times. No highly developed heroic poetry or figures of heroes on the grand scale have emerged from Africa, but tribes such as the Galla, the Tuareg and the Zulus have lived in modern times in conditions resembling those in heroic literature, and stories and short poems about rulers and local heroes are popular among them. The North American Indians have also many tales of past heroes, although these tend to be shamans and magicians rather than heroes in the true sense. This is also true of many of the heroes of Finnish oral tradition; a number of lays dealing with these were collected by Elias Lönnrot, and put together to form an epic, the *Kalevala* (*q.v.*; *see* also FINNISH LITERATURE). A great wealth of oral poetry and saga has been collected from the various islands in the Pacific ocean which make up Polynesia, from Hawaii to New Zealand. These deal with heroes of the past, and there are many stories of voyages of discovery, intertribal warfare and family feuds. Mingled with these are tales of the adventures of heroes in the supernatural world and, in particular, in the realm of the dead.

Heroic Treatment of History.—From examples of heroic poetry and saga collected in modern times, it is possible to gain some idea of how historical events are treated in heroic literature, and how historical characters come to be drawn on a scale larger than human, until they become figures comparable with the great heroes of antiquity. The revolution in Russia in 1917 inspired poems presenting Lenin as a type of hero. In style and treatment these are similar to the earlier Russian *byliny*, heroic narrative poems collected in the 19th century. From Yugoslavia poems have been collected which deal with the Slav revolt against the Turks in the early 19th century and must have been composed very soon after the events they describe. There are Achin poems describing the war against the Dutch East India company in western Sumatra, and the composer of one of these, Dokarim, is known to have died in 1897. He spent five years over his poem, consulting eyewitnesses when possible and continually revising his narrative, although nothing was written down. These Achin poems are an interesting example of how historical events are simplified and made more dramatic in tales of heroes, since here a struggle lasting for about 200 years is condensed into a war of short duration. From Anglo-Saxon times there is a poem on the historical battle of Maldon, which took place in Essex in 991, when the hero,

Byrhtnoth, who is also known from historical records, defended the shore against Viking raiders and went down fighting with his bodyguard. This poem is typically heroic in style and temper, and must have been composed very soon after the battle. In all these cases, poems have been composed after the close of the heroic age proper, inspired by struggles on a national scale rather than by the more personal conflicts between individual heroes of earlier times. Thus, in a society where men live a barbaric (though not necessarily primitive) life of warfare and adventure, and where they are familiar with heroic tradition, they may present their own contemporaries in song and story on a heroic scale, and celebrate a great achievement or a heroic defeat in the same way as earlier poets celebrated the deeds of ancient heroes. As the conditions of life change, however, and become more settled and sophisticated, while men learn to read and write, and new ideas and stories come in from abroad, the gap between the heroic stories and the familiar world gradually widens.

Thus it comes about that the heroic poem is replaced by the romance (*q.v.*), in which the hero carries out amazing and marvelous exploits in surroundings far removed from those of everyday life, either in far-off lands or in the highly artificial courts of chivalry.

See also the articles on national literatures, *e.g.*, GREEK LITERATURE; ENGLISH LITERATURE and their bibliographies. *See* also articles on CELTIC MYTHOLOGY; GREEK RELIGION, etc.; and articles on individual heroes and gods.

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HERO AND LEANDER, two lovers celebrated in Greek legend. Hero, virgin priestess of Aphrodite at Sestos, was seen at a festival by Leander of Abydos; they fell in love with each other, and he swam the Hellespont at night to visit her clandestinely, guided by a light from her tower. One stormy night the light was extinguished, and Leander was drowned; Hero, seeing his body, drowned herself likewise.

The story is preserved in Ovid (*Heroides* 18 and 10; authorship of both disputed), Musaeus (5th century A.D.), and in references elsewhere, none earlier than Virgil. It was also adapted by such later poets as Christopher Marlowe (*Hero and Leander*, completed by George Chapman) and alluded to by Lord Byron (*The Bride of Abydos*).

HEROD THE GREAT (73–4 B.C.), king of Judaea under Roman suzerainty, is historically important because it was into his kingdom that Jesus of Nazareth was born (*see* CHRONOLOGY: *Christian*). Furthermore, Herod's immediate descendants for three generations were the temporal or spiritual rulers of Palestine or parts of it during the ministries of John the Baptist, Jesus and the apostles.

Herod's father, Antipater, was an Idumaean, or Edomite, from southern Palestine where Herod was born. Antipater was a man of great influence and wealth, who increased both by marrying the daughter of a noble from Petra, at that time the capital of the rising Nabataean kingdom. Herod was thus, although a practising Jew, of Arab origin on both sides. When Pompey invaded Palestine in 63 B.C., Antipater aligned himself with Rome. Herod, then a boy of ten, was sent across the Jordan to Petra, where he spent part of his boyhood. Six years later he met Mark Antony, whose life-long friend he was to remain. Julius Caesar also favoured the family; he appointed Antipater procurator of Judaea in 47 B.C., and conferred on him Roman citizenship, an honour that descended to Herod and his children. Herod made his political debut in the same year, as governor of Galilee. Six years later Mark Antony appointed him tetrarch of Galilee. In 40 B.C., the Parthians invaded Palestine, civil war broke out and Herod was forced to flee to Rome. The senate nominated him king of Judaea and equipped him with an army to make good his claim. In the year 37 B.C., at the age of 36, Herod became unchallenged ruler of Judaea, a position he was to maintain for 32 years.

During the conflict between Octavian and Antony, Herod, notwithstanding the enmity of Cleopatra, who tried to ruin him, supported his friend Antony, and after Antony's final defeat at Actium in 31 B.C. frankly confessed to the victorious Octavian that he had done so. Octavian, who had met Herod in Rome, knew that he was the one man to rule Palestine as Rome wanted it ruled and confirmed him as king. Herod became the close friend of Augustus' great minister M. Vipsanius Agrippa, after whom one of his grandsons and one of his great grandsons were to be named. Both emperor and minister paid him state visits and Herod twice again visited Italy. Augustus gave him the oversight of the Cyprus copper mines, with a half share in the profits. He twice increased Herod's territory, in the years 22 and 20 B.C., so that it came to include not only Palestine but parts of what are now the kingdom of Jordan to the east of the river and southern Lebanon and Syria. He had intended to bestow the Nabataean kingdom on Herod as well, but by the time that throne fell vacant, Herod's mental and physical decay made it impossible.

Herod endowed his realm with massive fortresses and splendid cities, of which the two greatest were new, and largely pagan, foundations: the port of Caesarea Palestinae on the coast between Joppa (Jaffa) and Haifa, which was afterward to become the capital of Roman Palestine; and Sebaste on the long-desolate site of ancient Samaria. In Jerusalem he built the fortress of Antonia, portions of which may still be seen beneath the convents on the Via Dolorosa, and a magnificent palace of which part survives in the citadel. His most grandiose creation was the Temple, which he wholly rebuilt. The great outer court, 35 ac. in extent, is still visible as Al Haram-ash-Sharif. He also embellished foreign cities: Beirut, Damascus, Antioch, Rhodes and other towns. Herod patronized the Olympic games, whose president he became. In his own kingdom he could not give full rein to his love of magnificence, for fear of offending the Pharisees, with whom he was always in conflict because they regarded him as a foreigner. Nevertheless, Herod undoubtedly saw himself not merely as the patron of grateful pagans but also as the protector of Jewry in the Dispersion, whose gentile hosts he did all in his power to conciliate.

Unfortunately there was a dark and cruel streak in Herod's character which showed itself more and more as he grew older. As a young man he had married a certain Doris, by whom he had a son, Antipater. When he became king, he sought to end the feud with the Hasmonaeans by marrying the Hasmonaean princess Mariamme, with whom he was in love. Mariamme's mother, a woman of the vilest stamp, allied herself with Herod's sister Salome (not to be confused with her great-niece, Herodias' daughter) and

with Cleopatra to wreck the union. In the end Herod, maddened by jealousy and suspicion, to both of which he was pathologically liable, made away with Mariamme, her two sons, her brother (whom Mariamme had insisted on having appointed high priest), her grandfather and her mother. Besides Doris and Mariamme, Herod had eight other wives, by six of whom he had issue. He had 14 children altogether.

In his last years Herod suffered from arteriosclerosis. He had to repress a revolt, he became involved in a quarrel with his Nabataean neighbours and he lost the favour of Augustus. He was in great pain and mental and physical disorder. He three times altered his will, and finally disinherited and killed his first-born, Antipater. The destruction, shortly before his death, of the infants of Bethlehem was wholly consistent with the disarray into which he had fallen. After an unsuccessful attempt at suicide Herod died at Jericho at the end of March or beginning of April, 4 B.C. His final testament provided that, subject to Augustus' sanction, his realm would be divided among his sons: Archelaus (*see* HEROD ARCHELAUS) should be king of Judaea and Samaria, with Philip (*q.v.*) and Antipas (*see* HEROD ANTIPAS) sharing the remainder as tetrarchs. *See* also JEWS: *Earliest Times to A.D. 135.*

BIBLIOGRAPHY.—Josephus, *Antiquitates Judaicae*, XV, XVI, XVII, 1–8; A. H. M. Jones, *The Herods of Judaea* (1938); article "Herodes" in Pauly-Wissowa *Real-encyclopädie*, with complete family tree, supplementary vol. 2 (1913); S. H. Perowne, *The Life and Times of Herod the Great* (1956). (S. H. P.)

HEROD AGRIPPA I (10 B.C.–A.D. 44), king of Judaea A.D. 41–44, was the son of Aristobulus (Herod the Great's son by his second, Hasmonaean, wife, Mariamme), who had married his cousin Berenice. His original name was Marcus Julius Agrippa (Julius because Julius Caesar had made his great-grandfather a Roman citizen; Agrippa because M. Vipsanius Agrippa had been a close friend of Herod the Great). When, in 7 B.C., Aristobulus was executed, Agrippa was sent by Herod the Great to Rome, where he grew up in the imperial court, enjoying the favour of Antonia, mother of the future emperor Claudius, and the friendship of Drusus Caesar, her nephew. So long as his mother was alive, his love of display was kept within bounds, but after her death he soon became bankrupt. Returning to Judaea, he was rescued from utter poverty by his sister Herodias, who induced her husband Herod Antipas to give Agrippa a post as overseer of the market in his new capital, Tiberias. The two quarreled, however, and Agrippa was a wanderer once more. Eluding arrest in Palestine for his debts to the imperial treasury and raising a loan in Alexandria, he returned to Rome in A.D. 36. There, thanks to Antonia, Tiberius appointed him tutor to his grandson Tiberius Gemellus. Agrippa also ingratiated himself with Gaius (Caligula), Tiberius' heir. An indiscreet remark that he made to Caligula, to the effect that it was high time Caligula became emperor, was repeated to Tiberius who imprisoned Agrippa (Sept. A.D. 36). Six months later, Tiberius was dead and Agrippa in favour with the new emperor, Caligula. He received the tetrarchy of Batanaea and Trachonitis, to the east of the Sea of Galilee, formerly held by his uncle Philip. Herod Antipas and Herodias tried to discredit him with the emperor, but only brought about their own banishment, Antipas' tetrarchy passing in A.D. 39 to Agrippa. Agrippa was in Rome when Caligula was assassinated in 41 and he played a leading part in the elevation of Claudius, who rewarded him with the government of Judaea (which since the banishment of Archelaus had been ruled by Roman procurators) and made his brother (usually called Herod of Chalcis) king of Chalcis in southern Lebanon.

Agrippa was now king of all the territories formerly ruled by his grandfather. He showed himself a zealous champion of Jewry and Judaism (he had already used his influence with Caligula to prevent the erection of a statue of him in the temple in Jerusalem). He was therefore popular with his subjects, and his brief reign marked the peak of their material felicity. He did all in his power to crush the nascent Christian church, and after executing James, the son of Zebedee, he arrested Peter, who escaped from prison (Acts xii). Agrippa also started to build a third wall on the north of Jerusalem, to enclose the New City which the security of the previous 50 years had brought into being. His sudden death in A.D. 44 (at Caesarea, during games in honour of Claudius) was a disaster for Jewry, because, with all his faults of sycophancy and ostentation he had successfully kept the balance between Rome and the Jews and had shown that the two could coexist to the advantage of both.

See A. H. M. Jones, *The Herods of Judaea* (1938); S. H. Perowne, *The Later Herods* (1958). (S. H. P.)

HEROD AGRIPPA II (A.D. 27–*c.* 100), king of Chalcis in southern Lebanon from A.D. 48 and tetrarch of Batanaea and Trachonitis from A.D. 52, was the son of Herod Agrippa I (*q.v.*). Like his father, he was brought up at the Roman court. As he was only 17 when his father died in A.D. 44, the emperor Claudius re-established procuratorial government in place of the kingdom of Judaea, but Nero added Tiberias and other places to Agrippa's tetrarchy. As spiritual head of the Jews, with power to appoint the high priests, Agrippa II played a prominent role in the events which led up to the Jewish War (A.D. 66–73) and in the war itself. He was an ardent collaborator with Rome and did all in his power to prevent the rupture between Rome and Jewry, but in vain. He was known to have had incestuous relations with his sister Berenice, and this, combined with his "romanizing" views, deprived him of any real authority over his people. With his death (*c.* 100), the family of the Herods, of which he was the last representative, sank back into the obscurity from which his ancestor Antipater, father of Herod the Great, had raised it. It was before Agrippa that St. Paul appeared at Caesarea (Acts xxvi), and it was he who supplied Josephus with much of the material for his history of the Jewish War.

See works cited under HEROD AGRIPPA I. (S. H. P.)

HEROD ANTIPAS (*c.* 21 B.C.–A.D. 39), son of Herod (*q.v.*) the Great by his Samaritan wife Malthace, was tetrarch of Galilee at the time of Christ's crucifixion. Originally designated as successor by his father, he was relegated by the latter's final will to the tetrarchy of Galilee and Peraea (4 B.C.). He divorced his first wife in order to contract an incestuous union with Herodias, the wife of his brother Herod Philip (not the tetrarch Philip). It was for this that John the Baptist denounced him, which led to John's imprisonment and execution. At the time of the trial of Christ, Antipas was in Jerusalem for the Passover. Pontius Pilate, learning that Jesus was a Galilean, sent him to Herod Antipas as tetrarch of Galilee, thinking thereby to shift the responsibility for Jesus' condemnation onto Herod's shoulders. But Herod, "that fox" (Luke xiii. 32), was too clever to be thus compromised, and sent Jesus back (Luke xxiii). He held his tetrarchy for 43 years, and founded the city of Tiberias as his capital. Urged by Herodias, he tried to oust his nephew Herod Agrippa I (*q.v.*), with the result that he and Herodias were banished by the emperor Caligula and his realm and fortune given to Agrippa (A.D. 39). He died the same year.

See Stewart Perowne, *The Later Herods* (1958). (S. H. P.)

HEROD ARCHELAUS (22 B.C.–A.D. 18), fourth son of Herod (*q.v.*) the Great by Malthace, the Samaritan, is a background figure of some importance in the life of Christ. In Herod's final will Archelaus was named as king of Judaea and Samaria, the northern provinces of the kingdom being distributed between his brother Herod Antipas and half brother Philip the tetrarch (*qq.v.*). This division was approved by Augustus, after much deliberation, with the proviso that Archelaus was to be ethnarch only. Of half Idumaean and half Samaritan blood, educated at Rome, Archelaus was an alien in the eyes of his subjects. He was dissipated and cruel, and it was for this reason that Joseph was afraid to return to Judaea (Matt. ii, 22). The parable of Luke xix, 11–27 seems to refer to him. Archelaus antagonized not only the Jews but the Samaritans as well, and they jointly denounced him to Augustus. In the year A.D. 6 he was summoned to Rome and banished. Judaea then became a Roman province. Thus, Archelaus, by his misdeeds, was responsible for the political framework of Judaea as it was during the ministry and passion of Jesus of Nazareth. He died in A.D. 18.

See Stewart Perowne, *The Later Herods* (1958). (S. H. P.)

HERODAS (HERONDAS) (3rd century B.C.), Greek poet, probably of Cos, was the author of mimiambi, short dramatic scenes in verse, which, apart from their intrinsic merit, are in-

teresting in the history of Greek literature as being a new species illustrating Alexandrian methods. Mimes, of which Sophron was a leading exponent, were the Dorian product of southern Italy and Sicily—scenes of popular life written in the language of the people. They were adapted by Herodas in his mimiambi under strict conditions of technique. He used the scazon ("lame") iambic (with a dragging spondee at the end), but although he wrote in the old Ionic dialect with which that metre is associated, the structure of the sentences is close-knit Attic. The grumbling metre and quaint language suit the tone of common life which Herodas aims at realizing. His characters talk in vehement exclamations and emphatic turns of speech, with proverbs and occasionally the most naked coarseness of expression.

In mime I the old nurse calls on Metriche, whose husband is away in Egypt, and tries to interest her in a young man who is in love with her. Metriche declines with dignity, but consoles the old woman with a glass of wine. Mime II is a monologue by a whoremonger prosecuting a merchant for breaking into his establishment at night and attempting to remove one of the inmates, who is produced in court. The whole oration is a burlesque of an Attic speech at law. In III a desperate mother brings to the schoolmaster a truant urchin. In a stream of interminable sentences she narrates his misdeeds and begs the schoolmaster to flog him. Hoisted on another's back the boy is flogged, but his spirit does not seem to be subdued.

Mime IV is a visit of two women with an offering to the temple of Asclepius at Cos. While the cock is being sacrificed they admire the works of art, among them a highly praised procession by Apelles "the Ephesian." In V a jealous woman accuses her favourite slave of infidelity, has him bound and sent to receive 2,000 lashes. The only pleasing person in the piece is the maidservant, who suggests to her mistress an excuse for postponing execution of the threat. A private conversation is related in VI; the subject is an ugly one, but the dialogue is clever. Interest centres on Cerdon, an artistic shoemaker who appears again in VII. In VIII Herodas, posing as a farmer, narrates his dream of how a goat belonging to him was torn in pieces by goatherds, votaries of Dionysus, thus symbolizing contemporary criticism of his poems, and of how he afterward won a prize for leaping on greased skins, thus representing his recognition as the true successor to Hipponax, the premier choliambic poet. Of IX, "The Women at Breakfast," only a few lines survive. A few other short fragments are preserved by Athenaeus and Stobaeus.

Within the limits of 100 lines or fewer Herodas portrays an entertaining scene and characters clearly drawn. Some of these had been perfected no doubt upon the Attic stage, where the tendency in the 4th century had been to evolve accepted types. The execution has the qualities of first-rate Alexandrian work in miniature, and these little pictures bear the test of all artistic work; they do not lose their freshness with familiarity but gain in interest with increased appreciation of their subtler points.

BIBLIOGRAPHY.—The papyrus containing Mimiambi I–IX was first published by F. G. Kenyon (1891). For editions *see* J. A. Nairn, *The Mimes of Herodas* (1904); W. Headlam and A. D. Knox, *Herodas: the Mimes and Fragments*, with Eng. trans. (1922); A. D. Knox, in Loeb series, with Eng. trans. (1929). For verse translation *see* H. Sharpley, *A Realist of the Aegean* (1906). (E. A. B.)

HERODES ATTICUS (LUCIUS VIBULLIUS HIPPARCHUS TIBERIUS CLAUDIUS ATTICUS HERODES) (*c.* A.D. 101–177) was the most celebrated of the Greek orators of the "second sophistic," an age of professors and savants whose intimate lives, quarrels and epigrams were of passionate interest to the educated society of the day and are enshrined in Philostratus' *Lives of the Sophists*. Herodes Atticus came of an Athenian family of fantastic wealth and munificence which had received Roman citizenship in the time of Nero. He was a friend of the emperor Hadrian, who employed him as commissioner to correct abuses in the free cities of the province of Asia. He became consul in 143 and had a hand in the instruction of the destined successors, Marcus Aurelius and Lucius Verus. He built numerous buildings all over Greece, including the Odeum (concert hall) at Athens. Of his huge output of speeches and writings nothing certainly genuine survives.

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HERODIAN (d. after A.D. 238), a Syrian, possibly of Antioch, is the author of an extant history in Greek of the Roman empire from A.D. 180 to 238. He held an official post in the Roman service. Though he is writing to some extent of contemporary events and from personal knowledge, his exposition is influenced by rhetoric not only in the mannered style, but also in the use of conventional formulae; for example, in the delineation of character and in the use of speeches. It is in keeping with this rhetorical approach that he is frequently vague or actually wrong in details of chronology and geography. His work is biographical rather than truly historical and, while he can give a lively account of the assassination of an emperor, he leaves unnoticed important events of a more complex character. His attitude is that of a superficial moralizer and he is incapable of analyzing causes or motives. There is, however, little or no evidence of any deliberate falsification in his narrative and his history is not without value, particularly where Dio Cassius is not extant. Herodian is, for example, the best source for the struggle between the emperor Lucius Septimius Severus (*q.v.*) and Pescennius Niger. His own sources remain obscure.

BIBLIOGRAPHY.—Edition by K. Stavenhagen (1922) in the "Teubner Series"; Eng. trans. by E. C. Echols (1961). *See* also Pauly-Wissowa, *Real-Encyclopädie der classischen Altertumswissenschaft*, vol. 8, col. 954–959 (1912). (AR. CA.)

HERODIANS, mentioned in the Gospels as taking up a hostile attitude to Jesus (once in Galilee and again in Jerusalem); *cf.* Mark iii, 6, xii, 13; Matt. xxii, 16; *cf.* also Mark viii, 15. In every case they are coupled with the Pharisees. Apparently what is meant is a party among the Jews who favoured the Herodian dynasty and were its political partisans.

HERODIANUS, AELIUS (2nd century A.D.), of Alexandria, Greek grammarian, also called Herodianus Technicus, is important primarily for his work on Greek accents. A son of the grammarian Apollonius Dyscolus, he settled in Rome under Marcus Aurelius (161–180) to whom he dedicated a treatise on accentuation and quantity entitled *Catholice prosodia* ("General Prosody"). Extracts from it survive. His *Peri monerous lexeos* ("Anomalous Language") survives complete and the titles of about 30 other works are known from which a few extracts survive. A number of spurious and doubtful works were also attributed to him, including an extant atticist lexicon, *Philetaerus*.

BIBLIOGRAPHY.—Works ed. by A. Lentz, 2 vol. (1867–70); *Philetaerus* ed. by A. Dain (1954). *See* also H. Schultz in Pauly-Wissowa, *Real-Encyclopädie der classischen Altertumswissenschaft*, vol. 8, col. 959–973 (1913); J. E. Sandys, *History of Classical Scholarship*, vol. i, 3rd ed. (1921). (G. B. KD.)

HERODOTUS (5th century B.C.), Greek author of a history of the Persian Wars, was born at Halicarnassus, a Greek city in southwest Asia Minor at that time under Persian rule. The precise dates of his birth and death are alike uncertain. There was an ancient tradition that he was born in 484, but this may mean no more than that he "must have been in his prime, *i.e.*, 40 years old, in 444," when he was thought to have been in Athens and met Sophocles, and to have left for Thurii. The latest event alluded to in his *History* belongs to 430, but how soon after or where he died is not known. There is good reason to believe that he was in Athens, or at least in central Greece, in the early years of the Peloponnesian War, from 431; and that his work was published and known there before 425. He had been in the west for some time before this and perhaps became a citizen of Thurii (founded in 444–443).

Nor is there any means of dating his travels, which were very wide. His journey in the west indeed may well have been, as suggested, later than 443. His longer wandering covered a large part of the Persian empire: he went to Egypt, at least as far south as Elephantine (Aswan), and his visit there, or one of his visits, was after 460; to Libya; Syria; Babylonia; Susa in Elam; Lydia; Phrygia; up the Hellespont to Byzantium; to Thrace and Mace-

donia; by land or sea or both, northward to beyond the Danube; and to Scythia eastward along the northern shores of the Black sea as far as the Don and some way inland. These travels would have taken many years. If he were born in 484, he could hardly have started them before 450, for his mind was already mature; he knew what he wanted to search for. But 484 is an uncertain date; he may well have been older.

Structure and Scope of the History.—Herodotus' theme in his *History* is the war between Greece and Persia and its preliminaries. As it has survived, it is divided into nine books (the division is not Herodotus' own): books i–v describe the background to the Greco-Persian Wars (*q.v.*); books vi-ix contain the history of the wars, culminating in an account of Xerxes' invasion of Greece (book vii) and the great Greek victories of 480–479 B.C. "I am giving," he says in his opening words, "the results of my enquiries (*historiai*), so that the memory of what men have done shall not perish from the world nor their achievements, whether of Greeks or of foreigner, go unsung: they form my theme, and the cause why they went to war." Then after a brief, light-hearted narrative of mythical "aggressions" by one side or the other, culminating in the Trojan War, with different versions of them by the two sides, he goes on: "However I am not concerned with these stories; what I am going to narrate is the first known aggression against Greek states, and from it I shall proceed onward, mentioning many cities of men, great and small (for many that were once great are now small, and many now great were small before—human prosperity is a fragile thing). Croesus was a Lydian by birth . . ." and so the great narrative begins. But this, though not at all inconsistent with the form of the *History* as it was published, yet is not at all a full introduction to it; for, though they are wonderfully well combined into an organic unity, there are two parts in the *History*, one the systematic narrative of the war of 480–479 with its preliminaries from 499 onward (including the Ionic revolt and the battle of Marathon, books vi–ix), the other the story of the growth and organization of the Persian empire and a description of its geography, social structure and history.

There has been much debate among modern scholars whether Herodotus from the first had this arrangement in mind or had begun with a scheme for only one part, a description of Persia, or a history of the war, and if so, with which; and the consideration which the problem has received is worthwhile even though no positive answer can be given, so skillfully has Herodotus combined all into one. The view put forward by A. Bauer in Germany, and most persuasively in England by R. W. Macan (see *Bibliography*) is the most probable, that he began with a plan for the history of the war, and that later he decided on a description of the empire when the question forced itself on his inquiring mind. For a man like Herodotus was bound to ask himself, "Yes, but what do we mean when we say the Persian (or often the Mede) invaded Greece?" "How did it happen that Xerxes included in his army Scythians and Cappadocians, Lydians, Lycians, Bactrians and Indians, besides his own Persians and Medes, and relied for his fleet on ships manned by Phoenicians and Egyptians, and by some Greeks?" For Herodotus was deeply impressed not only by the great size of the Persian empire compared with all the little Greek states together, but also by the varied and polyglot nature of its army, which was yet united in a single command, in complete contrast to the Greek forces with their political divisions and disputatious commanders, although the Greeks shared a common language, religion and way of thought and the same feeling about what they were fighting for. This difference, and the meaning of "the Persian," had to be explained to his readers, and to this end he describes the empire.

A logical link between the two main sections is to be found in the account (book vii) of the march of the immense army—as on parade and as if on a parade ground—from Sardis to the Hellespont (nearly 200 mi.) on the way to the crossing by the bridge of boats into Europe. First comes a story of Xerxes' arrogance and petulance, followed by another of his savage and autocratic cruelty, then the parade—the baggage train in the van, then half the fighting force, all nations together, then a gap, for none of them came near the king; then 1,000 select Persian cavalry and 1,000 select spearmen, 10 sacred horses called Nisaean, richly caparisoned, the chariot sacred to Zeus drawn by 8 white horses with the driver walking, reins in hand (no man might ride in it), then Xerxes himself standing in his chariot drawn by Nisaean horses with his driver, a noble Persian, standing beside him. So Xerxes rode out from Sardis and, when he so minded, he would change to his carriage. Behind him were another 1,000 spearmen and select cavalry, followed by 10,000 chosen infantry and 10,000 cavalry; then a gap of two furlongs, then the rest of the army, the nations all together. With this account and with the detailed enumeration of all the national and racial elements in the force, naval and military, at the subsequent muster in Thrace, Herodotus has completed one thing that he set out to do—to explain the meaning of Xerxes' "Persian" invasion, as well as of the preliminary events of the previous 20 years; all woven into one intricate pattern.

One detail of arrangement supports this view of the development of Herodotus' theme. His method in the account of the empire is to describe each division of it not in a geographical order, but as each was conquered by Persia—by Cyrus, Cambyses and Darius; thus a picture is given of the formation of the whole. The one exception to this arrangement is Lydia which is treated at the very beginning of the history not because it was first conquered, but because it was the first foreign country to attack and overcome the Greek cities of Asia Minor; and was also of course their nearest neighbour, with whom they were already well acquainted. It would be pedantic to suggest that Herodotus would not have started in this fashion if his earliest project had been the description of the Persian empire; but for all that the form of the first section of book i fits very well with the other hypothesis and with the wording of his preface.

The first section, the history and description of Lydia and its conquest, is followed by the story of Cyrus himself, his defeat of the Medes and a description of Persia proper, his attack on the Massagetae (in the northeast, toward the Caspian) and his death. Book ii contains the succession of Cambyses, Cyrus' son, his plan to attack Egypt, and the immensely long account of that unique land and its history. This account is too long for the proportions of the whole book and is Herodotus' one failure as artist; but his zeal as historian and inquirer would not let him make it shorter. Book iii describes the conquest of Egypt, the failure of invasions to the south (Ethiopia) and west; the madness and death of Cambyses; the struggles over the succession in Persia, ending with the choice of Darius; the organization of the new vast empire by him, with some account of the most distant provinces as far east as Bactria and northwest India; and the internal revolts suppressed by Darius. Book iv begins with the description and history of the Scythian peoples, from the Danube to the Don, whom Darius proposed to attack by crossing the Bosporus, and of their land and of the Black sea.

Then follows the story of the invasion of Scythia, which carried with it the submission of more Greek cities, such as Byzantium; of the simultaneous attack from Egypt on Libya, which had been colonized by Greeks; and the description of the country and its colonization. Book v describes further Persian advances into Europe from the Hellespont and the submission of Thrace and Macedonia and many more Greek cities; then the beginning of the revolt of the Greek cities of Ionia against Persia, and so to the main subject of the whole work.

Method of Narration.—This bald account of the first half of Herodotus' *History* not only conceals its infinite variety, but is positively misleading in so far as it suggests a straightforward geographical, sociological and historical description of a varied empire. The *History* is more complex than that, and Herodotus' method of narration has also to be described. A more detailed account of the first section of the whole (Lydia), which is typical, will help to make clear the many sides of his problem.

First, he had, of course, no need to explain Greek geography, customs or political system, to his Greek readers; but he did wish to describe the political situation at the relevant times of the many Greek cities later involved in the war. This he does by

means of digressions skillfully worked into his main narrative. Croesus, the king of Lydia, wishing to act before Cyrus, who had just conquered Astyages the Mede, consulted many oracles of which that at Delphi seemed to him the truest when it appeared to encourage him in his purpose and advised him to seek Greek allies. He found that Athens and Sparta were then the most powerful of Greek cities, the one Ionian, the other Dorian (a digression on the past history of Ionians and Dorians explains the division in Greece). Athens, however, was at the time (546 B.C.) prevented from action by the struggle between Peisistratus, who was trying to confirm his position as tyrant, and the nobles; but Sparta had only a generation before established its own hegemony in the Peloponnese, and was ready to help (but was too late, Cyrus acting far more quickly than Croesus and his allies had thought possible). Similarly, much further on in the history the story is told of how Aristagoras from Miletus asked for help from Sparta and Athens for the Ionians in revolt (*c.* 500 B.C.), but was rebuffed at Sparta because he was too truthful about the size of the Persian empire and especially the length of the royal road from Ephesus to Susa, the Persian capital (with its regular stations and security posts and postal system—something quite unknown in Greece). However, he was welcomed at Athens which had recently freed itself from tyranny and was full of energy and optimism. This carries with it the story of the overthrow of the tyranny, in which Sparta played a double part, which itself connects with the 6th-century history of tyranny at Corinth and Sicyon as well. Later again there is an account of fighting between Athens and Aegina, and of the heavy defeat of Argos by Sparta. All of this, and much besides, some of it only included because of Herodotus' personal interest, helps to explain the positions of these Greek states in 490 (battle of Marathon) and 480 (invasion of Xerxes).

Gift as a Storyteller.—There is a feature of Herodotus' *History* which is of the first importance and among the most remarkable—his love of and gift for storytelling: that is to say, his love of narrating history in the storyteller's manner (which is not unlike Homer's). For this he uses (besides narrative) dialogue and speech in the words of the speaker, which he can do because the storyteller knows what his own characters said as well as what they did. In the first chapters of his *History,* Herodotus begins with a story told in this manner of the accession to the throne of Lydia of Gyges, the first of the dynasty of kings of which Croesus was the fifth and last. This is followed by further stories: of Solon and Croesus; of Croesus and Adrastus (a tragic short story, told by a master of the art); of Croesus, now a captive; and of Cyrus. Such stories occur throughout the *History*, and are in every mood: the boyhood of Cyrus; Rampsinitus and the clever thief (an *Arabian Nights* sort of tale which Herodotus heard in Egypt); the comedy of the birth of Cypselus who became first tyrant of Corinth, and the grim tale of his son Periander (another masterpiece) and the latter's son Lycophron; the humorous little story which Herodotus himself does not believe but cannot refrain from telling, of Xerxes' narrow escape from shipwreck when he was returning from Greece. But this method of narration is not confined to the more or less separate "short story" told in digression, nor to the distant past; it is employed in the very core of the history, for instance, Miltiades' exhortation to Callimachus on the field of Marathon, Artabanus' warnings to Xerxes of the difficulties and risks of the invasion, the debates between the Greek leaders before the battle of Salamis. There is no need to doubt that Miltiades made such an exhortation, though not on the battlefield but to the assembly or council in Athens before the army moved out; and was, though not commander, the moral author of the victory; nor that such warnings as those of Artabanus were given to Xerxes; the strife between the Greek leaders and the tireless insistence of Themistocles is, without doubt, historically true. But these things are the more easily credible because of the convincing reality of Herodotus' writing, much of it in the storyteller's rather than the historian's manner.

Outlook on Life.—The story of Croesus in book i gives Herodotus the occasion to foreshadow, as it were, in Croesus' talk with Solon (a conversation chronologically impossible, but not of course invented by Herodotus), the generalized meaning of the story of the Persian Wars, and so of his whole *History*—that great prosperity is "a slippery thing," and may lead to a fall; more particularly if it is accompanied by arrogance and folly as in Xerxes, but not only then. Croesus is throughout a sympathetic figure, kindly, generous in the extreme to one in misfortune, only childishly pleased with his great wealth and confident that nothing can go wrong—so he laughs at Solon's warning that no man can be called happy before the end of his life, until tragedy comes to him, the death of his son; then he recovers, and lightheartedly, without due thought, undertakes the attack on Cyrus "before Persia grows too strong"—and total disaster follows. The main story—Xerxes' invasion of Greece—is an even clearer case: a war, which by all human reasoning should have been won, was irretrievably lost. This does not mean that Herodotus, any more than his older contemporary, the poet Aeschylus, simply accepted the old moral "pride goes before a fall"; it was a matter of common observation and proved overwhelmingly true by the greatest event of his time.

In this connection another point must be made. It is often asserted that for Herodotus (and for Aeschylus and others) men are but puppets of an all-powerful fate and that in consequence his story of "pride and fall, sin and retribution, has for him no ultimate moral significance." (J. E. Powell: introduction to his translation of Herodotus, p. xxi, published by Clarendon Press, Oxford; see *Bibliography*.) This is thought to be confirmed by the story of Croesus, who had been such a generous giver to Apollo's shrine at Delphi only to be rewarded at the end by the deceiving oracle "that if he should attack Cyrus he would destroy a great empire"; then, when after his fall he upbraided the oracle and asked if it were the Greek gods' habit to be ungrateful, he received the reply: "it was caused by the wrongdoing of Gyges your ancestor, in seizing the throne, a sin which fate decreed should be atoned in the fifth generation after, and not even the gods can override fate." But Herodotus has related as clearly as he can that Gyges had the choice whether to commit a crime or die rather than commit it, and "he chose to live"; and Croesus himself, when Delphi reminded him that in so grave a matter he should have inquired more fully into the meaning of a dubious oracle, admitted his responsibility. The story of Glaucus the Spartan who sought, with Delphic aid, to defraud a Milesian of his money, has a similar structure. Herodotus was not an analytic philosopher, but he knew the meaning of a man's responsibility for his actions.

Qualities as a Historian.—Herodotus was a great traveler, with an eye for detail and for the whole, a good geographer, and a man with an indefatigable interest in the customs and past history of his fellow men, and of the widest tolerance, with no bias in favour of Greek and against the barbarian. He was neither naïve nor easily credulous. It is this which makes the first half of his work not only so readable but of such historical importance. In the second half he is largely, but by no means only, writing military history; and it can easily be shown that he knew little of military matters: he moves immensely large armies from place to place as though they were single travelers and problems of supply hardly existed; his detailed battle pieces are scarcely ever acceptable or even consistent. Yet he understood at least one essential of the strategy of Xerxes' invasion, the Persians' dependence on the fleet though they came by land, and therefore the decisive importance of the sea battle of Salamis (*q.v.*). Similarly in the political story: he is commonly content with a personal motive of a trivial (though psychologically revealing) kind—the contrast with Thucydides is as wide as can be. Yet here again he understood certain essentials: that the political meaning of the struggle between the great territorial empire of Persia and the small Greek states was not independence only, but the rule of law as the Greeks understood it; and that the political importance of the battle of Marathon for the Greek world was that it foreshadowed the rise of Athens (confirmed by Salamis) to a position of equality and rivalry with Sparta and the end of the long-accepted primacy of the latter. He knew that war was not only a question of victory or defeat, glorious as the Greek victory was, but brought its own consequences in its train, no matter

who won. "The ships which Athens sent to help the Ionians in their revolt (499 B.C.) were the beginning of suffering for Greeks and non-Greeks" (v. 97). There was an earthquake at Delos in 490, when the Persian armament had just passed on its way to Marathon, which was unique and a portent of the evils which were to fall on Greece, "for during the next three generations more evil befell than during the 20 before, partly caused by Persia, partly by the leading Greek states themselves quarreling for power." Not, it will be noted, simply a portent of the glorious victory of Greek over barbarian.

Was the History Finished?—It has been questioned whether Herodotus died before his work was finished, on two grounds. He makes a couple of promises which he has not fulfilled, one of them, the account of Assyria, leaving a notable gap in the whole; but it is impossible now to be sure of the reason for this. Others have thought that he could not have intended to end where he does with the Greek capture of Sestos on the Hellespont in 479 B.C., for the war went on for another 30 years and did not formally cease until 449. Herodotus' main theme, however, was the invasion of 480–479 and with the revolt of the Ionians and the fall of Sestos the Persians practically ceased to be on Greek soil. Aeschylus' framework for his tragedy was the same and Thucydides agreed in this, as in so many other things, with Herodotus.

Conclusion.—Herodotus had had his predecessors in prose writing (whose works are now lost), especially Hecataeus of Miletus (*q.v.*), a great traveler whom Herodotus mentions more than once—to criticize for inaccuracy in his book and to praise as a practical statesman. But they, for all their charm, says Dionysius, also of Halicarnassus, wrote either chronicles of local events, of one city or another, covering a great length of time, or comprehensive accounts of travel over a large part of the known world, none of them creating a unity, an organic whole. In the sense that he created a work that is an organic whole Herodotus was not only the first of Greek, and so of European, historians; he was also the first European writer of prose. His true predecessor, Homer, wrote in verse; and Aristotle's praise of Homer by contrast with other poets of epic—who thought that if they had a single title of a city or a hero, *Thebais* or *Heracleias,* they had achieved artistic unity—is analogous to Dionysius' just estimate of Herodotus. Herodotus' work is not only an artistic masterpiece; for all his mistakes (and for all his fantasies) he remains the leading authority not only for Greek history of the particular period with which he is concerned, but for much of that of western Asia and of Egypt.

See also references under "Herodotus" in the Index volume.

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(A. W. GE.)

HÉROET, ANTOINE (surnamed LA MAISON-NEUVE) (1492?–1568), French poet, who opposed the cynical view of woman and upheld the idea of virtuous love, was born in Paris of a family connected with the chancellor, François Olivier (1497–1560). He was a friend of Clément Marot (*q.v.*) and received a pension from Marguerite de Valois, sister of Francis I. He imitated Plato's *Symposium* (in the Latin version by Marsilio Ficino) in *L'Androgyne* (written 1536, publ. 1542). His chief work is *La Parfaicte Amye* (1542), which, like *La Contr'amye de Court* (1543) by Charles Fontaine (1513–87), was a reply to the cynical *L'Amye de Court* by Bertrand de la Borderie. Taking his inspiration from Ficino's commentary on the *Symposium,* Héroet developed the theories of the Italian Neoplatonists on virtuous love. His other works include *Autre Invention extraite de Platon* ("Eros and Anteros"), *La Complainte d'une dame surprise nouvellement d'amour* and *L'Amour de Cupido et Psyché.* He ceased to write poetry after his appointment in 1552 as bishop of Digne, where he died in 1568.

See his *Oeuvres poétiques,* ed. by F. Gohin (1943); also Jean Festugière, *La Philosophie de l'amour de Marsile Ficin* (1923).
(RA. L.)

HEROIN, a derivative of morphine (diacetylmorphine) having a similar action. As an analgesic it is from four to eight times more powerful than morphine, but it also produces more undesirable side effects in the form of respiratory depression. Heroin was introduced as a substitute for morphine to minimize the danger of addiction, but subsequent experience showed it to be even more dangerous in this respect. It makes addicts more easily than morphine does, and the addiction is harder to cure. Its most important use in medicine is to relieve cough, but any advantages are more than offset by the addiction liability. Its manufacture and importation are forbidden in the United States, and it was deleted from the British pharmacopoeia in 1953. Heroin represents a major addiction problem, contributing a large portion of the total illicit traffic in narcotics. It has been estimated that 75% of drug addicts on the eastern seaboard of the United States are users of heroin. *See* also DRUG ADDICTION; MORPHINE.
(V. E.)

HÉROLD, LOUIS JOSEPH FERDINAND (1791–1833), French composer of early romantic operas, was born in Paris Jan. 28, 1791. He was a pupil of Charles Simon Catel and Joseph Méhul, winning the Prix de Rome in 1812. His first opera *La Gioventù di Enrico V* (the overture to which became known under its French title, *La Jeunesse de Henri V*) was produced in 1815 at Naples where Hérold was court pianist. On his return to Paris he collaborated with François Boieldieu in the opera *Charles de France* (1816); he produced 12 light operas at the Opéra-Comique between 1817 and 1830. In 1823 he collaborated with Auber in *Vendôme en Espagne,* produced at the Paris Opéra where four of his ballets were given between 1827 and 1829, including the four-act *La Belle au bois dormant.*

In 1831 his *Zampa* and, the following year, *Le Pré aux clercs* were produced at the Opéra-Comique. Though these operas were later to be known only by their overtures, they revealed a novel use of instrumental colour deriving from Weber, and also a subtle sense of characterization. His last opera *Ludovic* was completed by François Halévy. Like Auber and Boieldieu, Hérold brought the *opéra-comique* to the borders of romantic opera, and anticipated in his later works the style of Berlioz. Hérold was also a prolific composer of piano and chamber music, which includes four piano concertos and works for unusual combinations of wind instruments. He died in Paris on Jan. 19, 1833.

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(E. LR.)

HERON, any long-legged, long-necked wading bird of the suborder Ardeae, order Ciconiiformes. The boat-billed heron (*Cochlearius cochlearius*), ranging from Mexico to Brazil, constitutes the family Cochleariidae. About 30 genera and about 60 species, widely distributed over the world but commonest in the tropics, form the family Ardeidae. They have broad wings and long, straight, sharp-pointed bills; the feet have comb-edged middle claws, probably used for grooming. Egrets (*q.v.*) develop lacy nuptial plumes over the back. Bitterns (*q.v.*) are smaller, stouter, browner herons with shorter necks.

Herons perch hunched in trees, stand quietly in shallows or wade slowly for fish, frogs or other small animals, which they capture with a quick thrust of their daggerlike bill. All of them fly low over water, or high with leisurely flapping wings, head folded against body and legs trailing loosely. The nests are usually grouped in colonies called heronries. Each nest consists of a rough platform of sticks constructed in a tree or bush near water. Three

ALLAN D. CRUICKSHANK FROM NATIONAL AUDUBON SOCIETY

GREAT BLUE HERON (ARDEA HERODIAS)

to five pale, dull-blue eggs are usually laid. Helpless downy young grasp the parents' bill and receive partly digested food.

Some herons are insect feeders and land dwellers. Among these is the cattle egret or buff-backed heron (*Ardeola ibis*) of Africa, Asia and southern Europe. It is often seen perched on the backs of water buffalo who transport the bird and serve as a source of ticks. During the period from about the 1940s to the 1960s, this species invaded the Americas where it has spread rapidly and has nested in numbers, especially in Florida and the tropics. It has been reported from Newfoundland to Bolivia.

The bluish-gray common heron (*Ardea cinerea*), 36 in. long, of Europe, Asia, Malagasy and Africa, was once hunted with falcons. The great blue heron (*A. herodias*), 50 in. long, ranges from Alaska and Nova Scotia to southern Mexico and the Galapagos Islands. Other large dull-coloured herons live in South America, Africa, southern Asia, the Philippines and Australia. Africa is the home of the giant or goliath heron (*A. goliath*) which stands 5 ft. tall. The great white heron (*A. occidentalis*) breeds in southern Florida, Cuba, Jamaica and Yucatán.

The medium-sized purple heron (*A. purpurea*) is common over most of the old world. The little green heron (*Butorides virescens*), 18 in. long, is common from southern Ontario and Oregon to Panama; a close relative (*B. striatus*) ranges over South America, Africa, southern and eastern Asia, Australia and nearby islands. The little blue heron (*Hydranassa*, formerly *Florida, coerulea*), 22 in. long, white when young, occurs from Delaware and the gulf states to Argentina; the white-bellied Louisiana heron (*Hydranassa tricolor*), 26 in. long, occurs in the Carolinas and Gulf states to northern South America.

Night herons have thicker bills, shorter legs and are more active in the twilight hours and at night. The black-crowned night heron (*Nycticorax nycticorax*) ranges over the Americas, Europe, Africa and Asia; *N. caledonicus* in Australia, New Caledonia and the Philippines; yellow-crowned night heron (*Nyctinassa violacea*) from New Jersey and Indiana to southern Brazil.

(G. F. Ss.; Ht. Fn.)

JOHN H. GERARD

YELLOW-CROWNED NIGHT HERON (NYCTINASSA VIOLACEA)

HEROPHILUS (*fl.* 300 B.C.), Alexandrian physician, the first and greatest anatomist of his era, was born at Chaludon and was one of the founders of a school of anatomy at Alexandria. Being one of the first to perform post-mortem examinations, he studied the eye and cataract, traced the sinuses of the dura mater to their meeting point, still called the torcular Herophili, and described the ventricles of the brain, which he regarded as the centre of the nervous system. The nerve trunks he distinguished into sensory and motor branches. He also gave careful accounts of the liver, salivary glands, pancreas and the genital tracts of both sexes, and emphasized the curative powers of drugs, dietetics and gymnastics. Herophilus wrote commentaries on the works of Hippocrates, a book for midwives and a treatise on the causes of sudden death.

HERPES is a term for skin eruptions of different origin in which grouped vesicles appear on a reddened base. Such eruptions are herpes simplex, herpes zoster, herpes gestationis, herpes tonsurans, etc. *See* SKIN, DISEASES OF.

HERPETOLOGY, the study of amphibians and reptiles. *See* AMPHIBIA; REPTILE.

HERR, HERBERT THACKER (1876–1933), U.S. engineer, made significant contributions to the field of steam turbine power by combining the highly efficient reaction element of the Parsons system with the lighter weight impulse elements of the Curtis-Rateau system (*see* TURBINE: STEAM). Herr covered this development in a paper published in 1913 entitled, "Recent Developments in Steam Turbines," for which he was awarded the Edward Longstreth medal of the Franklin institute, Philadelphia.

Herr also pioneered in production of "floating frame" reduction gearing, under Melville-McAlpine patents, for propulsion of merchant marine and naval vessels.

Born in Denver, Colo., March 19, 1876, he graduated from Yale university in 1899 with a degree in mechanical engineering. Herr became vice-president and general manager of the Westinghouse Machine company in 1908 and of the Westinghouse Electric and Manufacturing company in 1915. During World War I he served as advisory engineer to the Emergency Fleet corporation of the U.S. Shipping board. Herr died in Philadelphia, Pa., Dec. 19, 1933. (PL. H.)

HERRERA, FERNANDO DE (called EL DIVINO) (1534–1597), Spanish lyric poet, a leading member of a group of humanists who constituted an informal academy under the count of Gelves, was born in Seville and spent all his life there. He was a conscientious man of letters, ever seeking to elevate the tone of his writings in accordance with Renaissance theory and his own idealistic temperament, both illustrated in his meticulous and extensive *Anotaciones a las obras de Garcilaso de la Vega* (1580), which aroused the anger of certain critics. His sonnets and elegies, of delicate workmanship, on Petrarchan models, express his platonic love for "Luz," the countess of Gelves, but his finest work consists of patriotic odes, rich in Old Testament rhetoric, and melodious eclogues; all show an important advance in style over the previous generation. Herrera also composed two prose treatises on historical subjects.

See A. Coster, *Fernando de Herrera (El Divino)* (1908).

(C. C. SH.)

HERRERA, FRANCISCO DE (EL VIEJO) (*c.* 1576–1656/57), Spanish painter and engraver, was born in Seville. He is said to have studied under Francisco Pacheco and to have been for a short time the master of Velázquez, and he has been claimed as the originator of a new national style that culminated in the achievements of Velázquez. It seems, however, that Herrera was a follower rather than a forerunner of the new style. His earliest known works, an engraving of Saint Ignatius of Loyola (1610) and a painting of the "Pentecost" (1617; Toledo, Greco museum), are in the Mannerist tradition, far removed from the simple Caravaggesque naturalism of Velázquez' earliest works of about 1617. Later compositions, such as "The Apotheosis of St. Hermenegild" (*c.* 1624; Seville museum), echo the Venetian manner of Juan de las Roelas. A marked development in the direction of naturalism first appears in three scenes from the life of St. Bonaventura (Prado; Villandry) commissioned in 1627 by the Franciscan convent in Seville; and this may be attributed to the influence of Francisco de Zurbarán, who contributed four paintings to the series. Naturalism in Herrera is accompanied by a broad technique, akin to Jusepe de Ribera's; but in later works, like the "St. Basil" (1637; Louvre), his brushwork becomes so coarse that it distorts the forms.

Some time after 1638, when he is last documented in Seville, Herrera moved to Madrid, where he probably remained for the rest of his life. He seems to have been unaffected by the later development of Velázquez or by other court painters. But the elongated forms and elaborate draperies of "St. Joseph" (1648; Madrid, Lázaro museum), his last documented work, suggest that he may have been influenced by the style of Van Dyck.

Herrera appears to have acquired considerable fame in Seville in his own time and though he can have played no part in the formation of Velázquez' style, he does, with Roelas, mark the

transition from Mannerism to baroque and had some influence on the later development of the school of Seville. "The Miracle of the Loaves and Fishes" (Madrid, archiepiscopal palace), for instance, was the model for Bartolomé Murillo's painting of this subject in the Hospital de la Caridad, Seville.

See J. S. Thacher, "The Paintings of Francisco Herrera, the Elder," *The Chicago Art Bulletin*, 19 (Sept. 1937). (E. Hs.)

HERRERA, FRANCISCO DE (EL MOZO) (1622–1685), Spanish painter and architect, born in Seville, was the son and pupil of Francisco Herrera *el viejo*. After fleeing from his father (who was noted for his bad temper), Herrera the Younger is said to have continued his studies in Rome, where he became famous for his paintings of still life with fish and was known as *lo spagnuolo degli pesci*. But as a painter he is now known only for a few religious compositions. "The Adoration of the Blessed Sacrament" (1656) and "The Ecstasy of St. Francis" (1657), painted on his return from Italy for Seville cathedral, reflect the latest developments of Roman baroque (violent movement, theatrical effect, etc.), which he probably introduced into Seville. Thus he may have influenced the development of Bartolomé Esteban Murillo and, more particularly, of Juan de Valdés Leal.

In 1660 Herrera the Younger was appointed vice-president under Murillo of the newly founded Academy of Painting in Seville; but he soon left for Madrid where he was active as a painter of frescoes and altarpieces and as an architect and designer of retables. In 1672 he was appointed painter to the king and in 1677 surveyor general. As an architect he is said to have been the first to introduce the style of Francesco Borromini into Spain; and his design for the high altar of the church of Montserrat, Madrid, has been claimed as a model for José Churriguera. He died in Madrid, Aug. 25, 1685. (E. Hs.; X.)

HERRERA, a province in southern Panama, on the Gulf of Panama, is the smallest province of the country, and has the highest population density. Pop. (1960) 61,672; area 907 sq.mi. The province consists mostly of level to rolling plains and is especially important in the production of corn (maize), rice, sugar, and a variety of vegetables and fruits. It also ranks high in the number of beef and dairy cattle, swine and poultry. It ships quantities of these products by boat and truck to the Canal Zone, only about 100 mi. east. (C. F. J.)

HERRICK, MYRON TIMOTHY (1854–1929), U.S. lawyer, banker and diplomat, who won acclaim while ambassador to France at the outset of World War I for his organization of relief for war victims, was born at Huntington, O., on Oct. 9, 1854. He attended Oberlin academy for a year and a half and later studied for two years at Ohio Wesleyan university. He entered a law office in Cleveland and was admitted to the bar in 1878. Law practice at Cleveland drew him into banking and business activities, and in 1901 he became president of the American Bankers association. Interest in politics led to close associations with Marcus A. Hanna and William McKinley, and to Republican committee and convention service. He was elected governor of Ohio in 1903 by a record margin, but his vetoes of various bills and the opposition of the Anti-saloon league contributed to his defeat in 1905. Pres. W. H. Taft appointed him ambassador to France in Feb. 1912. After World War I broke out he continued as ambassador until Dec. 1914, at Pres. Woodrow Wilson's request, winning wide acclaim for his handling of emergency problems. He took charge of the embassies of several belligerent nations; remained in Paris when the French government moved to Bordeaux in September; set up a relief organization for Americans in Europe and other war victims; and with Mrs. Herrick established an American ambulance hospital at Neuilly. France honoured him with the grand cross of the Legion of Honour. After his return home he continued to devote much time to war relief activities. He ran for the U.S. senate in 1916 but was defeated. After the election of Pres. Warren G. Harding, Herrick was again named ambassador to France in April 1921, serving until his death on March 31, 1929.

See T. Bentley Mott, *Myron T. Herrick, Friend of France* (1929). (E. H. Ro.)

HERRICK, ROBERT (1591–1674), English poet in whom the spirit of the ancient classical lyric was born again, was the seventh child of Nicholas Herrick, of Cheapside, London, and was baptized there on Aug. 24, 1591. Nicholas died in 1592 under suspicion of suicide; his children inherited a few hundred pounds each. In 1607 Robert was apprenticed to his uncle, Sir William Herrick, one of the most prosperous and influential of London goldsmiths; and Robert doubtless took advantage of the situation to cultivate the society of the London wits. In 1613 he went to St. John's college, Cambridge, where he seems to have had a lively circle of friends. Apparently his money was still held in trust by Sir William, who had often to be reminded (in letters still extant) that the next instalment was due. Partly to reduce his expenditure he moved to Trinity hall and graduated from there in 1617, taking his M.A. in 1620. He was ordained in 1623. His reputation as a poet seems to have been highest about 1620–30, and he probably then lived in London again for a time, in touch with court society and enlarging his acquaintance with writers and musicians. In 1627 he went as a chaplain to the duke of Buckingham on the expedition to the Île de Ré. Two years later he was presented to the living of Dean Prior, Devonshire, where he lived, unmarried, for the rest of his life, except that in 1646, because of his Royalist sympathies, he was removed from his living and did not return to it until after the Restoration. He was buried at Dean Prior, Oct. 15, 1674. The only book he published was *Hesperides* with *His Noble Numbers* (1648), containing about 1,400 poems, mostly very short. From these and from other evidence it appears that he was sensible, affectionate and friendly, "much beloved by the Gentry for his florid and witty Discourse," occasionally bored in Devonshire, but appreciating the advantages of seclusion and simple living, the beauty of nature and the daily interest provided by the behaviour of ordinary men and women. And always there was the delight of composing and revising his poems and the faith that they would eventually make him famous.

The appeal of Herrick's poetry lies in its truth to perennial human sentiments and its perfection of form and style. Frequently light, worldly and hedonistic, and making few pretensions to passion or profundity, it yet covers a wide range of fancy and feeling, including moments of serious reflection and poignant sadness. It owes debts to ancient classical literature, especially to Anacreon, Horace, Ovid and Martial; to classical myths and English folklore; to English lyrics and Italian madrigals. It is also influenced by the Bible and patristic literature, the source of many doctrinal aphorisms in *His Noble Numbers;* and by contemporary English writers, notably Ben Jonson and Robert Burton. Variously intended and shaped, it includes elegies, epigrams, satires, love songs, marriage songs, complimentary verse to friends and patrons, celebrations of rustic and ecclesiastical festivals, and evocations of the superstitious beliefs and ceremonies of the countryside, the elves at their feasts and devotions, the night hag riding the storm, the charms to keep evil spirits at bay. Yet Herrick reveals himself less clearly in his poetry than a first reading may suggest. He had a dramatic bent and could easily slip into a fictitious character or an imaginary situation. One poem is addressed to "his supposed wife" and probably his numerous "mistresses," Julia, Anthea and the rest, were no more tangible. He believed, with reason, that he would be remembered as a poet of love; but he is remembered still more for poetry that tells of evanescence, of the rosebuds we are to gather while we may, the daffodils that fade too soon and the joyful meadows left desolate in autumn. "The Argument of his Book," prefixed to *Hesperides,* beginning

> I sing of Brooks, of Blossoms, Birds and Bowers,
> Of April, May, of June, and July-Flowers,

emphasizes his lighter subject matter, and does too little justice to his versatility.

But to Herrick, with his overruling concern for art, themes and occasions would be of smaller account than the poems that they help to create, the address to Julia more important than Julia herself. Sense or thread there must be, but often there is not much and attention fixes on the articulation, fluency and harmony of the phrasing. Often the effects are aural rather than visual or intellectual, and Herrick excels in the kind of poetry that comes nearest to music, by its "concord of sweet sounds," by its

precision of outline, and by asking to be accepted more for what it is than for what it conveys. Hence it is rewarding to study his workmanship in detail, the interplay of thought, imagery and rhythm, the metrical accomplishment, the tensions and relaxations, the "sweet disorder" and the "wild civility." Such technical mastery can seldom be long sustained and nearly all Herrick's best things are little things. But no one of his time, not even Milton, sought perfection more devotedly, and because of this he has taken his place among the most accomplished, if not among the greatest, lyrical poets.

Herrick's reputation has varied considerably. The esteem in which he was held for a time is shown by the number of manuscript commonplace-books (dating *c.* 1620–40) that contain poems by him. Few were published before 1648. Of printed miscellanies in which he is represented, *Witts Recreations* (1650) has the largest number (75). Some were printed in songbooks, from 1652 onward. Otherwise his poetry went largely unnoticed until about 1800, after which a great revival set in. The first of many 19th- and 20th-century selections appeared in 1810 edited by J. Nott, the first complete reprint in 1823 edited by T. Maitland.

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HERRICK, ROBERT (1868–1938), U.S. writer and novelist, was born in Cambridge, Mass., April 26, 1868. After graduating from Harvard in 1890, he taught composition at Massachusetts Institute of Technology for three years. He left in 1893 to teach in the English department of The University of Chicago, remaining on the staff until 1923. He spent much of World War I in Europe, where he wrote signed articles for the *Chicago Tribune*. In 1935 he was appointed secretary to the governor of the Virgin Islands. He died there Dec. 23, 1938.

Almost all Herrick's stories are set in Chicago. He classified them as "idealistic" or "realistic." The idealistic group includes *The Real World* (1901), *A Life for a Life* (1910), *The Healer* (1911) and *Clark's Field* (1914). His three most important novels, however, were realistic: *The Common Lot* (1904), *The Memoirs of an American Citizen* (1905) and *Together* (1908). Herrick also wrote short stories, critical essays and textbooks.

HERRIES, JOHN MAXWELL, 4TH LORD (*c.* 1512–1583), Scottish politician, was a leading supporter of Mary Stuart. He married Agnes, daughter of William Herries, 3rd Lord Herries, in 1547; he was known as Maxwell of Terregles until he obtained his title in 1567. For political reasons he was associated with John Knox and the religious reformers, strenuously supporting the movement to expel French influence from Scotland. After the return of Mary Stuart in 1561, his sympathies gradually changed, and by 1567 he was a staunch supporter of the queen, in spite of his personal dislike of her husband, the earl of Bothwell. He led her cavalry at Langside (1568) and, after her defeat, provided refuge for her in his lands. Later he accompanied Mary to England and acted as one of her chief commissioners at York. During the civil war which followed, he took the queen's part, not coming to terms with the regent Morton until 1573. For a time he accepted Morton's domination, but was active in the scheme to deprive him of his regency in 1578. He was an efficient warden of the west Marches, a post which he held almost continuously from 1552 until 1568, and his administrative abilities were recognized even by his enemy Morton. He seldom allowed personal interests to interfere with his principle of loyalty to the crown. He died at Edinburgh on Jan. 20, 1583. (T. I. R.)

HERRIN, a city of Williamson county, Ill., U.S., is 45 mi. N. of the Ohio river, about 55 mi. N.N.E. of Cairo. It is strategically located within a cluster of coal belt towns, and although no longer dependent on coal, abandoned mines and their lonely chimneys still linger. First settled in the early 19th century, the city was incorporated in 1900.

Though generally a quiet, conservative community, Herrin was the scene of a tragic labour dispute known as the "Herrin massacre" in 1922. In that year, when the nation's coal fields were closed by strikes and lockouts, a mining company attempted to operate a strip mine with nonunion labour. On June 22 several hundred striking union miners forced the nonunion workers at the mine to surrender and promised them safe conduct. After being marched to a point near Herrin the captives were ordered to run for their lives under fire; more than 20 were killed and others were wounded. A grand jury returned 214 indictments for murder and other offenses. After several acquittals by trial juries the remaining indictments were dismissed.

Soon after World War II, Herrin's citizens raised $900,000 to attract new industries. The effort was successful and local factories now make washing machines, neon signs, upholstery, dresses and staple machines. By the 1960s Herrin's economy was stabilized. Nearby Crab Orchard lake provides adequate water supply and a variety of recreational facilities. For comparative population figures *see* table in ILLINOIS: *Population*. (D. A. PR.)

HERRING, a name specifically given to two species of fishes, probably the world's most plentiful, belonging to the genus *Clupea* of the herring family (Clupeidae); they are the Atlantic herring (*C. harengus*) and the Pacific herring (*C. pallasi*). These two species are circumpolar in distribution and may be merely geographical varieties of the same species. They are beautifully coloured fish with silvery, iridescent sides and deep blue, metallic backs.

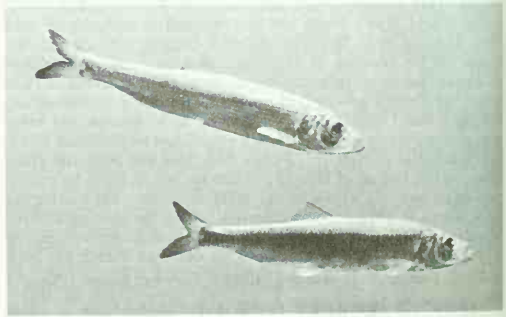
In the Atlantic ocean herring are caught from the Bay of Biscay northward to the White sea and in the Baltic. They extend westward and northward to Spitsbergen, Iceland, Greenland and along the North American coast from Labrador to Long Island. In the Pacific ocean they are caught from the United States-Mexican border north to Golovin bay, near Nome, Alaska, across the Aleutian chain, and along the Siberian coast south to Vladivostok and among the islands of Japan.

Herring move in vast schools and are caught with seines, gill nets, otter trawls and weirs or pound nets.

In Europe the majority of the catch is salted, pickled in barrels or cured by smoking as kippers or bloaters. In eastern Canada and northeastern United States most of the herring utilized are young fish, taken in inshore weirs or seines, that are canned as sardines. The bulk of the herring taken in the Pacific ocean is used in the manufacture of fish oil and meal, and smaller quantities are pickled and smoked.

Herring usually move shoreward to spawn; the female extrudes the eggs as she swims about on her side and rubs her body against clean seaweed, rocks or kelp, to which the adhesive eggs cling tightly. The male fish swims closely behind the female fertilizing the eggs as they are deposited. When a large school of herring is spawning, the sea water takes on a milky appearance from the white milt extruded by the males.

In the Pacific, herring have only one spawning season in each locality, which varies with the latitude and local temperature conditions. The season commences in December in California and becomes progressively later to the northward. Herring were observed spawning in June at St. Michael, near Nome. The majority of the herring in the Atlantic ocean also spawn as water temperatures become suitable in the spring, but certain populations of



D. P. SHARMAN

ATLANTIC HERRING (CLUPEA HARENGUS)

herring in western Europe south of Norway spawn in late summer and autumn; they are called autumn spawners to distinguish them from the spring spawners in the same localities.

The Atlantic herring usually spawns in water from a few fathoms to more than 100 fathoms deep, and may spawn on gravelly banks many miles from land. The Pacific herring, on the other hand, spawns chiefly on the seaweeds and kelp along the shore, and in many localities a large portion of the deposited spawn is exposed at each ebb tide. Each female deposits from 10,000 to 60,000 eggs per spawning, depending on her size and age. The eggs hatch in two to three weeks or longer depending on the temperature. The larval herring at first drift with the current, but they soon become free swimming, as indicated by the small areas occupied by local races of herring, even in localities such as southeastern Alaska with a strong residual current.

The growth rate of herring varies tremendously with the locality —usually it is slow in enclosed waters or waters of low salinity, as the Baltic, where mature herrings as small as four inches are found. Thus, slow-growing herring are found in the Baltic, the White sea, the Lyseforden (west Norway), the Zuider Zee, the east coast of Sweden, San Francisco bay and the interior waters of southeastern Alaska (Stephens passage). Herring in some of the fjord on the Baltic coast of Sweden are slower growing than those of the main Baltic. Fast-growing herring are found in the western North sea, the Atlantic ocean, around Iceland, the outside waters of Norway, around Kodiak Island and along the Aleutian Islands. Herring from Dutch Harbor in the Aleutians may exceed 1 lb. in weight and 15 in. in length.

Herring feed on a great variety of the smaller marine forms, such as decapod larvae, copepods and pteropods, and occasionally even feast on small fish. Herring mature chiefly at four years of age, but do not reach a suitable size for pickling until about five to eight years old, depending on the locality. They are normally long-lived and a study of the annual marks on their scales formed by the seasonal rhythm in growth shows that some may attain 20 years of age. Most herring, however, are either eaten by predators or caught before they are 10 years of age.

Different areas are inhabited by different races or populations of herring, as shown by studies of the number of vertebrae and other structural characters and by tagging. North American investigators devised means of tagging these small fish by inserting small steel or nickel tags inside the body cavity. After the liberated fish are recaptured, the tags are recovered either by an electronic device as the herring pass along a conveyer during unloading or from the fish meal as it passes over an electromagnet during continuous process manufacture.

After spawning, the schools of mature herring disperse, but the herring later gather in large schools on the feeding grounds. Different races may feed on the same grounds, but they return to their own localities for spawning. The herring fisheries are subject to great fluctuations, since the survival of the young varies widely from year to year. A fishery may thus for several years be largely dependent on the progeny from a single spawning. This circumstance also causes a change in the size of the herring taken each year in the same locality, as the herring of the single-year class increase in size. Variations in spawning success are keenly felt in the Maine sardine fisheries, which depend chiefly on the young immature herring for their supply.

About eight other species of the genus *Clupea* are recognized, including the sprat (*q.v.*) or brisling (*C. sprattus*) of western Europe and the Mediterranean sea, *C. antipodum* and *C. muelleri* of New Zealand, *C. juegensis* of the Strait of Magellan and the Falkland Islands, *C. benticki* of Chile, *C. bassensis* of southern Australia and New Zealand, *C. arcuata* extending from Uruguay to northern Patagonia, and *C. melanostoma* of the Río de la Plata.

The family Clupeidae embraces small species of fishes throughout the world. The subfamily Clupeinae, includes about 18 closely related genera, of which the most important are the sardines or pilchards (*Sardina* and *Sardinops*), the menhaden (*Brevoortia*), the shad (*Alosa*) and the alewife (*Pomolobus*). *See* SARDINE; MENHADEN; SHAD; ALEWIFE. *See* also FISH; and references under "Herring" in the Index. (G. A. RL.)

HERRINGBONE, in masonry construction, the use of courses or rows in which the individual bricks or stones are set at an angle of approximately 45° to the horizontal and with alternate courses at right angles to each other. Herringbone work is occasionally found in late Roman brick construction, and was common in Romanesque architecture (*q.v.*), sometimes decoratively, as in much of the brickwork of north Italy, sometimes structurally, with the apparent idea that long, thin stones could be more efficently used in this manner than if laid horizontally. In modern construction, the herringbone is almost entirely restricted to decorative brickwork and paving. A similar pattern is often used in hardwood floors.

HERRIOT, EDOUARD (1872–1957), French statesman and man of letters who personified in his time the Radical-Liberal tradition in French life and politics, was born at Troyes on July 5, 1872, the son of an army officer. Educated at the Paris Lycée Louis-le-Grand and at the École Normale Supérieure, he graduated with high honours in 1894. His book on the Jewish school of Alexandria, *Philon le Juif* (1897), was crowned by the Academy of Moral and Political Sciences. He taught at the *lycée* of Nantes and then at Lyons, where he won a high reputation as a scholar of distinction and a teacher of eminence. This reputation was enhanced by his study of *Madame Récamier et ses amis* (1904) and by the powers of acute literary criticism shown in his *Précis de l'histoire des lettres françaises* (1905). He also engaged in journalism and popular lecturing.

Like many French statesmen, Herriot entered politics through local government. He became a municipal councilor of Lyons in 1904, and mayor in 1905. He remained mayor of the city for the rest of his life with only one brief interruption during World War II. Under his guidance that growing industrial city developed every sort of municipal amenity and his local prestige became unshakable. In 1910 he became a member of the *conseil général* and in 1912 senator for the *département* of Rhône. He belonged throughout his career to the Radical party, consistent in his liberalism and his faith in republican democracy.

He first held ministerial office during World War I. from Dec. 1916 to March 1917, as minister of public works, transport and supplies in Aristide Briand's cabinet. He showed political acumen and administrative ability in his reorganization of the essential services of supplies and transport in wartime. Before the war ended he was turning his attention to problems of reconstruction. In 1916 he organized the Lyons fair and in the crisis of 1917 published *Agir,* pleading for continued faith in the culture and civilization of France as the path to national victory. In 1919, when victory had come, he published *Créer,* a program of reconstruction dedicated to the youth of France.

Herriot gave up his seat as senator in Nov. 1919 and was elected a member of the chamber of deputies for the *département* of Rhône. There he became leader of the Radical party. He owed his rapid rise in parliament to his powers of oratory and persuasion, and the genial warmth of his personality. He showed himself adept as a politician, skilful in managing committees and in the eloquent presentation of his arguments.

He led the opposition to the postwar *Bloc national.* When the *Cartel des gauches,* a left-wing coalition of Radicals and Socialists, was formed to fight the parliamentary elections of May 1924, it was led by Herriot, and its electoral triumph enabled him to form his first ministry in June 1924. He also took the ministry of foreign affairs. He forced the resignation of Alexandre Millerand, president of the republic, who had openly electioneered on behalf of the right. He extended *de jure* recognition of the U.S.S.R. which he had visited two years before. He arranged with the British prime minister, James Ramsay MacDonald, to hold conferences in London on the subject of reparations, wherein France accepted the Dawes plan and agreed to evacuate from the Ruhr the troops which Raymond Poincaré had sent in to enforce payment of reparations by Germany. The following autumn the two premiers prepared the so-called Geneva protocol, *i.e.,* a treaty of collective security. Although rejected by MacDonald's successor the protocol inaugurated the era of Locarno, of improved relations between France, Great Britain and Germany. In April 1925

Herriot's ministry fell, and in July 1926 his second ministry lasted only three days. He then joined the great Poincaré cabinet of national union in which he was minister of education (1926–28). It was June 1932 before another electoral swing to the left brought him back to power as premier and foreign minister. He fell six months later when the chamber refused to pay the December installment of France's war debts to the United States. He served as vice-premier under Gaston Doumergue in 1934 and again under Pierre Etienne Flandin in 1934–35. In June 1936 he was elected president of the chamber of deputies, an office which he filled with dignity and trust until France's capitulation in June 1940 during World War II.

Though criticized by some for his acquiescent attitude during German occupation (he abstained from voting when on July 10, 1940, at Vichy, the national assembly accorded full powers to Marshal Henri Philippe Pétain) and for having refused to leave France to help in resistance, he suffered no taint of collaboration with the invaders. When Pétain in Aug. 1942 dissolved the permanent bureaus of the chamber and senate, Herriot joined with Jules Jeanneney, president of the senate, in lodging a joint protest. For this he was arrested and was later deported to Germany. In April 1945 he was freed from his internment at Wannsee, near Berlin, by Russian troops. Having meanwhile been re-elected mayor of Lyons, he returned there to resume his duties. He also resumed his place as president of the Radical party, and was elected to the constituent assemblies of 1945 and 1946. In 1946, too, he was elected a member of the Académie Française. The following year he was elected president of the new national assembly of the fourth republic, retaining this office until his retirement in Jan. 1954.

He took part from 1948 onward in the body which became the Council of Europe, an advisory body urging a federal solution to European problems. In 1952–54, however, he opposed the European Defense Community because its consequence would be the rearmament of Germany. In June 1955 he was presented with the Soviet peace prize (the former Stalin prize). He died in Lyons on March 26, 1957. Herriot clung throughout his life to liberal ideals of international co-operation, and because of his intellectual gifts and honesty inspired respect and affection, though he lacked great powers of leadership.

In addition to Herriot's books quoted above, a few others are worth mentioning: *La Russie nouvelle* (1922); *Impressions d'Amérique* (1923); *The United States of Europe* (1930); *Eastward from Paris* (1934), being mainly an account of a second visit to the U.S.S.R.; *The Wellsprings of Liberty* (1940); *Jadis,* 2 vol. (1948–52).

See P. Grosclaude, *Edouard Herriot, écrivain et homme d'état* (1932); J. Rivet, *Edouard Herriot, ou le discrédit lyonnais* (1933). (D. Tn.)

HERRMANN, (JOHANN) WILHELM (1846–1922), a leading German theologian and disciple of Albrecht Ritschl (*q.v.*), was born Dec. 6, 1846, in Melkow (Altmark), the son of a pastor, Johann Wilhelm Herrmann. He studied at the University of Halle, beginning in 1866, and became *Privatdozent* there in 1875. In 1879 he was appointed professor at Marburg, where he remained to the end of his career. His profound influence, especially on his students, including numerous Americans, was exercised as much through the "unforgettable seriousness" of his teaching as through his writing. He died on Jan. 3, 1922.

Herrmann's chief concern was to set forth the essence of Christian faith as direct communion with God in Jesus Christ. This was the insight of Luther, he held, which needed to be recaptured. Faith is not belief in doctrines but a living personal relationship with God. Inner experience is the essence of religion and the central conception of theology. The certainty of faith does not come from any external proofs (*e.g.,* of scripture or rational argument). Rather, in Jesus men see the truly good disclosed and made actual, in a life lived in full confidence in God, and the historical appearance of Christ becomes an element in the believer's inner life (this is the real miracle for Christian faith), giving the power of deliverance from need and sin, and assurance of the reality of God. God is an object not of theoretical but of practical knowledge (in this Herrmann, with Ritschl, draws heavily from Kant); therefore theology can be neither supported nor attacked by science or philosophy. Theology is, however, essentially related to ethics and to history. Ethics formulates the problem of the achievement of moral fulfillment, of a true and free personal existence, but religion alone can provide the answer, in the Christian experience of salvation. And since personal life is in history, the answer must come in history—not, as in mysticism, by a relationship to God that rises above history, but by an immediate communion with God in the historical figure of Jesus Christ.

Herrmann's chief works are: *Der Verkehr des Christen mit Gott* (1886); Eng. trans., from 2nd ed., *The Communion of the Christian With God,* (1895); *Die Religion im Verhältnis zum Welterkennen und zur Sittlichkeit* (1879); and *Ethik* (1901). F. W. Schmidt (ed.), *Gesammelte Aufsätze* (1923), includes several of Herrmann's minor writings and a bibliography. (C. Wh.)

HERSCHEL, CAROLINE LUCRETIA (1750–1848), English astronomer, whose assistance was invaluable to her brother Sir William Herschel in his astronomical researches, was born at Hanover, Ger., on March 16, 1750. She assisted her mother in the management of the household until 1772, when her brother took her to Bath, Eng., where he had established himself as a teacher of music.

When her brother accepted the private office of court astronomer to George III in 1782, she executed the laborious calculations that were connected with his observations. During her leisure hours she swept the heavens with a small Newtonian reflector and by this means she detected three nebulae in 1783, and eight comets between 1786–97.

In 1798 she presented to the Royal society an Index to Flamsteed's observations, together with a catalogue of 560 stars omitted from the *British Catalogue,* and a list of the errata in that publication. She returned to Hanover in 1822, and in 1828 completed the cataloguing of 2,500 nebulae and many star clusters discovered by her brother. Caroline Herschel received the gold medal of the Astronomical society in 1828, and the gold medal for science from the king of Prussia in 1846. She died at Hanover on Jan. 9, 1848.

See Mrs. John Herschel, *Memoir and Correspondence of Caroline Herschel* (1876). (O. J. E.)

HERSCHEL, SIR JOHN FREDERICK WILLIAM, Bart. (1792–1871), English astronomer and able successor to his father, Sir William, in the field of nebular observation and discovery, was born in Slough, Bucks., on March 7, 1792. He was educated for a short time at Eton, then by a private tutor and then at St. John's, Cambridge, where he graduated as senior wrangler in 1813. During his undergraduateship he and two of his fellow students who subsequently attained to very high eminence, George Peacock and Charles Babbage, entered into a compact that they would "do their best to leave the world wiser than they found it"—a compact loyally and successfully carried out by all three to the end. As a commencement of this laudable attempt Herschel associated with these two friends in the production of a work on the differential calculus, and on cognate branches of mathematical science, which changed the style and aspect of mathematical learning in England, and brought it up to the level of the continental methods. Two or three memoirs communicated to the Royal society on new applications of mathematical analysis at once placed him in the front rank of the cultivators of this branch of knowledge. Of these his father had the gratification of introducing the first, but the others were presented in his own right as a fellow.

With the intention of being called to the bar, he entered his name at Lincoln's Inn on Jan. 24, 1814, and placed himself under the guidance of an eminent special pleader. Probably this temporary choice of a profession was inspired by the extraordinary success in legal pursuits which had attended the efforts of some noted Cambridge mathematicians. Be that as it may, an early acquaintance with W. H. Wollaston in London soon changed the direction of his studies.

He took up astronomy in 1816; and in 1820, assisted by his father, he completed for a reflecting telescope a mirror of 18-in. diameter and 20-ft. focal length. This, subsequently improved by his own hands, became the instrument that enabled him to effect the astronomical observations forming the chief basis of

his fame. In 1821–23 he was associated with Sir James South in the re-examination of his father's double stars. For this work he was presented in 1826 with the Astronomical society's gold medal; and with the Lalande medal of the French institute in 1825; while the Royal society had in 1821 bestowed upon him the Copley medal for his mathematical contributions to their *Transactions*. In 1831 the honour of knighthood was conferred on him by William IV, and two years later he again received the recognition of the Royal society by the award of one of their medals for his memoir "On the Investigation of the Orbits of Revolving Double Stars."

Before the end of the year 1833, Sir John Herschel had re-examined all his father's double stars and nebulae, and had added many similar bodies to his own lists; thus accomplishing, under the conditions then prevailing, the full work of a lifetime. For it should be remembered that astronomers were not as yet provided with those valuable automatic contrivances that at present materially abridge the labour and increase the accuracy of their determinations. John Herschel then determined to explore the southern, besides re-exploring northern, skies. "I resolved," he said, "to attempt the completion of a survey of the whole surface of the heavens; and for this purpose to transport into the other hemisphere the same instrument which had been employed in this, so as to give a unity to the results of both portions of the survey, and to render them comparable with each other." So, he and his family embarked for the Cape of Good Hope on Nov. 13, 1833; they arrived in Table bay on Jan. 15, 1834; and he began regular observations on March 4.

To give an adequate description of the vast mass of labour completed during the next four busy years of his life at Feldhausen would require the transcription of a considerable portion of the *Cape Observations* (published in 1847, nine years after the author's return to England), for the cogent reason that, as he said, "The whole of the observations, as well as the entire work of reducing, arranging and preparing them for the press, have been executed by myself." It contains catalogues and charts of southern nebulae and star clusters, a catalogue of the relative positions and magnitudes of southern double stars and his observations on the varying and relative brightness of the stars. Herschel returned to his English home in 1838, and was welcomed with an enthusiastic greeting. He was created a baronet by Queen Victoria at her coronation.

Herschel was a highly accomplished chemist. His discovery in 1819 of the solvent power of hyposulfite of soda on the otherwise insoluble salts of silver was the prelude to its use as a fixing agent in photography; and he invented in 1839, independently of Fox Talbot, the process of photography on sensitized paper. He was the first person to apply the now well-known terms "positive" and "negative" to photographic images, and to imprint them upon glass prepared by the deposit of a sensitive film. Perhaps no man can become a truly great mathematician or philosopher if devoid of imaginative power. John Herschel possessed this endowment to a large extent; and he solaced his declining years with the translation of the *Iliad* into verse.

But the main work of his later life was the collection of all his father's catalogues of nebulae and double stars combined with his own observations and those of other astronomers into a single volume. A complete list of his contributions to learned societies will be found in the Royal society's great catalogue, and from them may be gathered most of the records of his busy scientific life. Sir John Herschel met with an amount of public recognition that was unusual in the time of his illustrious father. He was a member of almost every important learned society in both hemispheres. For five years he held the same office of master of the mint, which a century before had belonged to Sir Isaac Newton.

He died on May 11, 1871, and was buried in Westminster abbey close to the grave of Sir Isaac Newton.

Besides the laborious *Cape Observations*, Sir John Herschel was the author of several books, one of which at least, *On the Study of Natural Philosophy* (1830), possesses an interest that no future advances of the subjects on which he wrote can obliterate. In 1849 came the *Outlines of Astronomy*, a volume still replete with charm and instruction. His articles, "Meteorology," "Physical Geography" and "Telescope," contributed to the 8th edition of the *Encyclopædia Britannica*, were afterward published separately. Less known are his volumes, *Familiar Lectures on Scientific Subjects* (1866) and *Collected Addresses* (1857), in which he is seen in his happiest and most instructive mood.

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(A. Po.)

HERSCHEL, SIR WILLIAM (originally FRIEDRICH WILHELM) (1738–1822), English astronomer, called the founder of sidereal astronomy for his systematic observations of the heavens, was born in Hanover, Ger., on Nov. 15, 1738. His father was a musician in the Hanoverian guard, and in 1757 Herschel was sent to England to earn his living as a musician.

Beginnings.—In 1766 he worked as organist in Bath. During the next five or six years he became the leading musical authority. In 1772 he revisited Hanover to bring to England his sister Caroline Lucretia Herschel (*q.v.*), whose services he much needed, as he was already studying astronomy in the time he could spare from his musical engagements. She thus describes her brother's life soon after her arrival: "He used to retire to bed with a bason of milk or a glass of water, with Smith's *Harmonics* and Ferguson's *Astronomy*, etc., and so went to sleep buried under his favourite authors; and his first thoughts on waking were how to obtain instruments for viewing those objects himself of which he had been reading." It was in this way that he was introduced to the writings of Ferguson and Keill, and subsequently to those of Lalande, whereby he educated himself to become an astronomer of undying fame.

In those days telescopes were rare, very expensive and not very efficient, and Herschel used a small Gregorian reflector of about two-inch aperture. Finding it impossible to obtain a reflector of larger dimensions, he decided to construct his own and, in 1774, had the satisfaction of viewing the heavens with a Newtonian telescope of six-foot focal length made by his own hands. He had from the very first conceived the gigantic project of surveying the entire heavens, and, if possible, of ascertaining the plan of their general structure. For this he required adequate instruments, and he, his brother and his sister toiled at the grinding and polishing of hundreds of specula. After 1774 every available hour of the night was devoted to the long-hoped-for scrutiny of the skies. In May 1780 his first two papers on the variable star Mira Ceti and the mountains of the moon were communicated to the Royal society.

Rotation of the Planets.—In 1781 he communicated to the Royal society the first of a series of papers on the rotation of the planets and of their several satellites. These inquiries occupy the greater part of seven memoirs (1781–97). While engaged on them he noticed the curious appearance of a white spot near to each of the poles of the planet Mars. On investigating the inclination of its axis to the plane of its orbit, and finding that it differed little from that of the earth, he concluded that its changes of climate also would resemble our own, and that these white patches were probably polar snow. He also discovered that the times of the rotations of the various satellites round their axes conform to the analogy of our moon by equalling the times of their revolution round their primaries.

In the same year (1781) Herschel made a discovery that completely altered the character of his professional life. In the course of a methodical review of the heavens he lighted on an object that averred itself to be a new planet, moving outside the orbit of Saturn. He assigned to it the name Georgium Sidus, but this was later changed to Uranus. The object was detected with a 7-ft. reflector having an aperture of $6\frac{1}{2}$ in. Seven memoirs on the subject were communicated by him to the Royal society (1781–1815).

For the discovery of the planet he was awarded the Copley medal of the Royal society, elected a fellow, and in the following year (1782) he accepted George III's offer to give up music and become his private astronomer. So Herschel and his sister moved first to Datchet, and in 1786 to Slough. There he resumed his astronomical pursuits with extraordinary vigour, although for a time he had to supplement his income by making and selling telescopes. The necessity for this interruption in his observations was overcome in 1788 when he married the wealthy widow of a London merchant.

Double Stars.—A material part of the task that Herschel had set himself embraced the determination of the relative distances of the stars from our sun and from each other. This resulted in a most important series of observations. He had observed many stars in apparently very close contiguity, but often differing greatly in relative brightness. He concluded that, on the average, the brighter star would be the nearer to us, the fainter enormously more distant.

In the hope, therefore, of detecting an annual parallactic displacement of one star with respect to another, he mapped down the places and aspects of all the double stars that he met with, and communicated in 1782 and 1785 very extensive catalogues of the results. His last scientific memoir, sent to the Royal Astronomical society in 1822, when he was its first president and already in his 84th year, related to these investigations. In the memoir of 1782 he threw out the hint that these apparently contiguous stars might be genuine pairs in mutual revolution. Eleven years afterward (1793), he remeasured the relative positions of many such couples and his prediction was verified, for he ascertained that some of these stars revolved round each other, after the manner required by the laws of gravitation. This discovery, announced in 1802, would of itself suffice to immortalize his memory.

In 1783 he wrote his first memorable paper on the "Motion of the Solar System in Space"—a sublime speculation, yet through his genius realized by considerations of the utmost simplicity. He returned to the same subject with fuller details in 1805. In a series of papers (1784–1818), he used his method of star gauging and concluded that our sun was a star situated not far from the bifurcation of the Milky Way, and that all the stars visible to us lie more or less in clusters scattered throughout a comparatively thin but immensely extended stratum. On either side of this assemblage of stars, Herschel discovered a canopy of discrete nebulous masses, such as those from the condensation of which he supposed the whole stellar universe to have been formed.

Hitherto there has been nothing said about his construction of the great reflecting telescope, of 40-ft. focal length and 4-ft. aperture. On the day that it was finished (Aug. 28, 1789) Herschel saw at the first view, in a grandeur not witnessed before, the Saturnian system with six satellites, five of which had been discovered long before, while the sixth he had glimpsed two years before, in his exquisite little telescope of 6½-in. aperture, but now saw in unmistakable brightness. On Sept. 17 he discovered a seventh, which proved to be the nearest to the globe of Saturn.

Herschel died at Slough on Aug. 25, 1822, a description of him given a few years before by Campbell being: "A great, simple, good old man. His simplicity, his kindness, his anecdotes, his readiness to explain his own sublime conceptions of the universe, are indescribably charming."

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HERSCHELL, FARRER HERSCHELL, 1ST BARON (1837–1899), English lord chancellor noteworthy for his quickness of apprehension, his common sense and his broad treatment of constitutional and social questions. He was born at Brampton, Huntingdonshire, on Nov. 2, 1837, the son of the Rev. Ridley Haim Herschell, a dissenting minister converted from Judaism. Farrer Herschell, being excluded by dissent from Oxford and Cambridge, was educated at University college, London. He entered Lincoln's Inn in 1858, and became a pupil of Thomas Chitty. In 1860 he was called to the bar, and joined the still undivided northern circuit, where at first he did not find much work. His prospects improved in 1866 when J. R. Quain, for whom he devilled (*i.e.*, worked and understudied), took silk.

In 1872 Herschell himself was made a queen's counsel. He had all the necessary qualifications for a leader—a clear voice; a calm, logical mind; a sound knowledge of legal principles; and an abundance of common sense. His only weak point was cross-examination.

Herschell entered parliament for Durham city as a Liberal in 1874. In 1880 he was appointed solicitor general by Gladstone, and knighted. Herschell's public services from 1880 to 1885 were of great value, particularly in dealing with the "cases for opinion" submitted by the foreign office and other departments. He helped controversial government measures through the house, notably the Irish land act, 1881. In 1886 he accepted Gladstone's offer of the lord chancellorship, and was created Baron Herschell. Losing office on the fall of Gladstone in Aug. 1886, he was again lord chancellor in 1892–95. His public services outside his judicial work included the chancellorship of the University of London (1894) and the chairmanship of the Imperial institute, which he held from its foundation (1892).

In 1898 Herschell was appointed, jointly with Lord Justice Collins, to represent Great Britain on the Venezuela Boundary commission, which assembled in Paris in the spring of 1899. He also sat, as president, on the joint high commission appointed to adjust certain boundary and other questions pending between Great Britain and Canada on the one hand and the United States on the other. Herschell died in Washington, D.C., on March 1, 1899, as the result of an accident. (W. T. Ws.)

HERSHEY, MILTON SNAVELY (1857–1945), U.S. manufacturer and philanthropist, was born in Derry township, Dauphin county, Pa., on Sept. 13, 1857. Following a rural school education he was apprenticed to a confectioner in Lancaster, Pa. At the age of 19 he was making candy and operating his own shop in Philadelphia; this venture proved unsuccessful. In New York city a second attempt to manufacture candy ended in failure. Returning to Lancaster, he succeeded in the manufacturing of caramels. In 1900 he sold the Lancaster Caramel company to his competitors for $1,000,000. He then concentrated on perfecting a chocolate bar. Near his birthplace, in 1903, ground was broken for a factory that was to become the world's largest chocolate manufacturing plant. The town of Hershey developed simultaneously.

In 1909, he and his wife, Catharine Sweeny Hershey (d. 1915), established the Milton Hershey school to provide a home and an education for needy orphan boys. Later, the institution was endowed with the major portion of his wealth. The school is situated on a 12,000-ac. campus surrounding the town of Hershey.

Additional funds, administered by the M. S. Hershey foundation, were stipulated for the support of public education in Derry township and for the establishment of a tuition-free junior college. He died Oct. 13, 1945, in Hershey. (E. G. Kl.)

HERSTAL, a town of Belgium, province of Liège, is situated at the mouth of the Albert canal on the Meuse river, on the road to the Netherlands, 2.5 km. (1.6 mi.) N.E. of Liège by road. Pop. (1961) 29,606. Probably deriving its name from the German *Heerstelle* (permanent or fortified camp), the town was also called Heristal. It is on one of the railways from Liège to Maastricht. An important industrial suburb of Liège, Herstal has collieries, an electrical apparatus factory and Belgium's national weapon factory, making not only small arms and guns but also motorcycles and jet engines. The town disputes with Aachen (Aix-la-Chapelle) the honour of being Charlemagne's birthplace. (R. M. An.)

HERSTMONCEUX, a village with a well-known castle in East Sussex, Eng., on the Brighton-Hastings road 12 mi. N. of Eastbourne. Pop. (1951) 1,856. It was known as Herste until about 1300; the distinguishing suffix was derived from the family of Monceux, one of whom married the heiress of the local family

de Herste (*c.* 1180). The castle, built in 1440 by Sir Roger de Fiennes as a fortified manor surrounded by a moat, is one of the finest early brick buildings in England. Towers flank the corners and there is a beautiful turreted entrance gate, but the interior was destroyed in 1777 when Canon Robert Hare-Naylor used the material to build Herstmonceux Place. The interior was rebuilt by Claude Lowther and Sir Paul Latham between 1911 and 1935. The removal to Herstmonceux castle of the Royal observatory (which had been at Greenwich since 1675) was started in 1948 and completed in 1958. All Saints church (late 12th century) contains a fine monument to Thomas, Lord Dacre (d. 1533). (L. F. S.)

HERTFORD, EARLS AND MARQUESSES OF. The English earldom of Hertford was first created (*c.* 1138) for GILBERT DE CLARE and was held by members of his family (*see* CLARE) until 1314 when the last earl of this line fell in battle at Bannockburn. The title was revived in 1537 for the future Protector Somerset (*see* SOMERSET, EDWARD SEYMOUR, Duke of). His son EDWARD (1537–1621) was styled earl of Hertford from 1547 until the protector's attainder and execution in Jan. 1552, when the title was forfeited. Edward was, however, created earl of Hertford in 1559. He secretly married in 1560 Lady Catherine Grey (1540–68), daughter of Henry Grey, duke of Suffolk, and great-granddaughter of Henry VII. Elizabeth I, furious at this marriage, had both husband and wife imprisoned, while the validity of their marriage was questioned. Catherine died on Jan. 27, 1568, and Hertford on April 6, 1621. Their son Edward, Lord Beauchamp (1561–1612), who inherited his mother's title to the English throne, predeceased his father; and the latter was succeeded in the earldom by his grandson WILLIAM SEYMOUR (1588–1660), who was created marquess of Hertford in 1641 and was restored to his ancestor's dukedom of Somerset in 1660. (*See* SOMERSET, EARLS AND DUKES OF.) The marquessate of Hertford became extinct when the 4th duke died in 1675, and the earldom when the 7th duke died in Feb. 1750.

In Aug. 1750 FRANCIS SEYMOUR-CONWAY (1718–1794), 2nd Baron Conway, a direct descendant of Protector Somerset, was created earl of Hertford. He was ambassador to France from 1763 to 1765, lord lieutenant of Ireland in 1765 and 1766, and lord chamberlain of the household from 1766 to 1782. He became earl of Yarmouth and marquess of Hertford in 1793 and died on June 14, 1794. His son, FRANCIS INGRAM-SEYMOUR-CONWAY (1743–1822), known during his father's lifetime as Lord Beauchamp, was sent as ambassador to Berlin and Vienna in 1793 and from 1812 to 1821 he was lord chamberlain. His son FRANCIS CHARLES (1777–1842), 3rd marquess, an intimate friend of the prince regent, is the original of the "marquis of Steyne" in Thackeray's *Vanity Fair* and of "Lord Monmouth" in Disraeli's *Coningsby*. The 4th marquess was his son, RICHARD (1800–1870), whose mother was the great heiress, Maria Emily Fagniani, and whose brother was Lord Henry Seymour (1805–1859), the founder of the Jockey club in Paris. When Richard died unmarried in Paris in Aug. 1870 his title passed to his kinsman, a descendant of the 1st marquess, FRANCIS HUGH GEORGE SEYMOUR (1812–1884), whose son, HUGH DE GREY (1843–1912) became 6th marquess in 1884. HUGH EDWARD CONWAY SEYMOUR (1930–) succeeded as 8th marquess in 1940.

The 4th marquess left his collection of works of art to his son, Sir Richard Wallace (1818–1890), also a collector. These two private collections were left to the nation by Lady Wallace in 1897 and are now known as the Wallace collection, at Manchester square, London.

HERTFORD, a market town, municipal borough and the county town of Hertfordshire, Eng., lies 24 mi. N. of London by road. Pop. (1961) 15,734. The Mimram (Maran), Beane and Lea rivers flow through the town. Hertford was the scene of the first synod in 673. Communication with London by way of the Lea and the Thames gave Hertford strategic importance during the Danish occupation of East Anglia. In 1066 and later it was a royal garrison and burgh; it was incorporated in 1554. Fairs were granted from the 13th century but these are now discontinued though there are still cattle markets. One of the first paper mills in England is said to have been established in Hertford by John Tate in the 15th century. Hertford is mainly residential and its economy is agricultural with a few industries such as motor engineering, brewing and the making of toothbrushes, stationery, gloves and leather goods. In the centre of the town, by the Lea, is the castle, now used as municipal offices. It stands in beautiful grounds where there is a part of the old Norman castle wall. In the town are 15th-century timber houses; the Shire hall by James Adam; the County hall (1939); the Longmore Senior Girls' (formerly Hale's grammar) school (17th century); Hertford Grammar school for boys (1930); Christ's Hospital school for girls, moved from London in 1683 (buildings date from 1695 to 1953). Bengeo, in the north of the borough, has a Norman church. Two miles southeast of Hertford is the Haileybury and Imperial Service college; Haileybury (founded in 1862) and I.S.C. (1912) were amalgamated in 1942. The college occupies the buildings formerly used by the East India company.

HERTFORDSHIRE, an English county bounded southwest by Buckinghamshire, northwest by Bedfordshire, north by Cambridgeshire, east by Essex and south by Middlesex. Under the London Government Act 1963 Middlesex would cease to exist on April 1, 1965; on the same date Hertfordshire would gain the urban district of Potters Bar from Middlesex and would lose those of Barnet and East Barnet to Greater London. (*See* LONDON; MIDDLESEX.)

Physical Features.—The county mostly belongs to the London basin structural trough. The outcrop of the chalk and the Chiltern crest line (though lowered) are continued past Hitchin, Letchworth and Baldock to Royston. The dip of the chalk and the general surface height fall southeastward toward the vale of St. Albans, which runs from Rickmansworth to Ware. The chalk then passes under Lower London Tertiaries and London Clay which form a belt of higher, hilly ground. Probably the earliest ancestor of the Thames flowed through the vale from southwest to northeast. Later, ice advancing from the north overrode the chalk hills northeast of Hitchin and a lobe penetrated the vale, diverting the proto-Thames, which was forced southeastward between Rickmansworth and Watford, and filling its valley with boulder clay. The Thames then flowed in a loop through Middlesex and rejoined its former course near Ware. A later readvance of the ice pushed one lobe toward St. Albans and another toward Finchley, finally blocking the old outlet. The ice meltwater cut the lower Colne valley and, later, the lower Lea valley. In overriding the chalk hills east of Hitchin the ice lowered them; now they do not exceed 550 ft., though Dunstable downs (Bedfordshire), untouched by ice, approach 800 ft.

The westward salient of the county boundary round Tring brings a small part of the high Chiltern crest within Hertfordshire, together with a tiny scrap of the Vale of Aylesbury at its foot. In detail the surface is dissected by many large brooks in deep valleys and the whole county is undulating and generally well wooded. The river Lea, rising near Luton, Bedfordshire, flows southeastward, passing to the north of Hatfield, then to Hertford and Ware, then turns southward in a great bend round the higher ground of the Tertiaries and London Clay. It is navigable from Ware to London docks. With its tributary the Stort it forms part of the boundary with Essex. Lesser tributaries, the Ash, Rib, Beane and Mimram (Maran) all flow from its northern side and join its left bank within a few miles of the great bend. They are known for their parklike valleys. The Ver and Gade, which flow down the chalk dip-slope parallel to the upper course of the Lea, join the Colne, which passes through Watford and Rickmansworth, then turns southward to join the Thames at Staines. The Tertiary hills in the southeast mostly drain by small streams, northward and eastward, to the Lea, but the Mimmshall brook, which flows northward from near Boreham Wood, disappears underground at Water End near North Mimms. It goes into swallow holes formed by solution of the chalk and it is not known whether the water subsequently joins the Lea or the Colne, or percolates through the chalk toward the centre of the London Basin, adding to the natural reservoir which can be reached by wells in London. The New River (1613), the first English canal, 23 mi. long, was cut from Chadwell and the Lea at Ware as an aqueduct to supply London

J. ALLAN CASH

THE NORMAN ABBEY CHURCH OR CATHEDRAL AT ST. ALBANS, HERTFORDSHIRE, BUILT OF ROMAN BRICKS FROM THE RUINS OF VERULAMIUM

with spring water, and it still augments the metropolitan supply. (A. M. F.)

Antiquities and History.—The bones of prehistoric animals and Palaeolithic flints from the older gravels, Mesolithic sites on the Lea, scattered finds and barrows (long and round on Therfield heath; beaker at Ware), and the Icknield way (*q.v.*), a main prehistoric track, suggest Hertfordshire was occupied, if sparsely, throughout the Neolithic and Bronze Ages as well as before. Iron Age camps are few and poor, but the county was a centre of Belgic power, with Cassivelaunus' *oppidum* at Wheathampstead, which Caesar took in 54 B.C., and towns at Braughing, Prae Wood and Welwyn; many coins and two chieftain burials have been found. The Roman occupation was thorough: Ermine street (*q.v.*) to Eburacum (York), Watling street (*q.v.*) to Deva (Chester), Stane street linking Verulamium (St. Albans) to Camulodunum (Colchester), and the Icknield way were the major roads. Verulamium, a *municipium*, was excavated in 1935, 1958 and 1959 and has Roman walls and theatre. The finds are displayed in the museum. A walled town at Braughing and posting stations at Cheshunt, Ware, Baldock, Welwyn and Elstree have been discovered. Villas or farms are common, but in stoneless country leave few structural traces beyond the barrows of their former owners.

Saxon settlement was early; pagan burials occurred along the Icknield way. Ermine street was the boundary of the East Saxon kingdom and later of the diocese of London. In 793 Offa of Mercia founded the abbey of St. Albans and endowed it with estates in western Hertfordshire, which became both an independent liberty (privileged district) and archdeaconry, maintaining these statuses until 1874 and 1845 respectively. Alfred's treaty of Wedmore included the county east of the Lea in the Danelaw; he defeated the Danish fleet in the Lea valley and Edward the Elder built a burgh at Hertford about 913.

William I reached Berkhamsted in 1066 in the course of encircling London and there received the submission of the Saxon leaders. He built castles there and at Hertford. The king confiscated at least 13 manors, while the abbey of St. Albans retained the 15 manors with which it had been endowed. The archbishop, the bishops of London, Winchester, Bayeux, Lisieux and Chester, and the abbots of Ely and Westminster all had their holdings. Count Eustace of Boulogne, the chief lay tenant, held a fief in the northeast of the county. At the time of the Domesday survey the boundaries were approximately those of the modern county. Of the nine Domesday hundreds (subdivisions), Danais and Tring were consolidated in about 1200 under the name of Dacorum; the modern hundred of Cashio, previously held by the abbots of St. Albans, was known as Albaneston, while the remaining six hundreds (Braughing, Broadwater, Edwinstree, Hertford, Hitchin and Odsey) correspond with those still in existence.

Hertfordshire was originally in the dioceses of London and Lincoln; but the abbot of St. Albans was exempt from all control except that of the pope. The bishopric of London embraced the area of the deanery of Braughing and of the archdeaconry of Middlesex. The deaneries of Berkhamsted, Hitchin, Hertford and Baldock were under the jurisdiction of the bishop of Lincoln. After the dissolution, the archdeaconry of St. Albans was placed under the bishop of London. In 1845 the whole county was formed into the archdeaconry of St. Albans and placed within the diocese of Rochester until 1877, when a new diocese of St. Albans was formed with jurisdiction over Hertfordshire, Bedfordshire and Essex; Essex later became an independent diocese.

Hertfordshire was the scene of several battles for the London area. Armies of the Danes, Maud, Stephen and John all fought for the possession of Hertford, and Berkhamsted has seen sieges, especially that of Louis, the dauphin, in the Barons' war. During the Peasants' Revolt in 1381 there was much rioting between the peasants and the servants of the abbot of St. Albans. In the Wars of the Roses the county witnessed two battles at St. Albans (1455 and 1461) and the battle of Barnet in 1471. The civil wars in the 17th century found Hertfordshire predominantly puritan, and no major battles were fought in the county.

Architecture.—The churches have been heavily, though well, restored. St. Albans abbey with its Norman brickwork and great size is outstanding. Reed has 11th-century work; Bengeo (Hertford), a Norman apsidal church, has wall paintings; and good Norman work can be found in Hemel Hempstead, Weston and Abbot's Langley. Royston and Baldock churches include portions of the 12th- and 13th-century buildings attributable to the Augustinian canons and Knights Templars, respectively. Ashwell and Wheathampstead are of the 13th and 14th centuries. The town churches of Ware and Hitchin and innumerable village churches have attractive Perpendicular work. Buntingford's Carolean brick, Offley's Georgian Gothic chancel and Ayot's classical St. Lawrence's are examples of work rare in Hertfordshire. Brasses, Jacobean and Georgian monuments form a remarkably fine series. The domestic buildings of Ware's friary are complete, as is much of its priory.

Castles at Berkhamsted (Norman earthwork), Hertford (13th-century walls and 16th-century gatehouse), Bennington (Norman keep) are not remarkable. Rye house (1445) is the earliest of a series of brick buildings of great interest which include Hatfield Old palace (*c.* 1480–90), Berkhamsted school, Standon Lordship (1546), Little Hadham hall (1570), Queenhoe (16th century) and Hatfield house (1608–12). Hertfordshire is a county of many lesser houses in timber and plaster, often medieval, and there are admirable Georgian country houses in fine parks of the period. A tablet in a field at Standon near Ware marks the spot where Vincenzo Lunardi landed in his balloon in 1784. The National trust owns 4,000 ac. at Ashridge. The Tring reservoirs were established as a nature reserve in 1955. They are visited by waterfowl and other birds on migration and many species nest there.

Population and Administration.—The population of the administrative county in 1961 was 832,088. To Letchworth, the pioneer garden city (1910), Welwyn Garden City was added in 1923 and Hatfield was linked with the latter; Hemel Hempstead and Stevenage, New Towns, were developed after World War II to accommodate industry and population from London, and the London county council built major housing estates at Boreham Wood and Oxhey. Watford (pop. 1961, 75,630), St. Albans city (50,276), Hertford (15,734) and Hemel Hempstead (55,165) are municipal boroughs and there are 19 urban districts, 11 rural districts and the New Town corporations.

From the time of the Conquest and up to the year 1567 the county shared a sheriff with Essex. The possessions of the abbot of St. Albans were formed into a liberty, over which he had wide jurisdiction, with his own jail. A separate commission of the peace was granted to the liberty, which held its own separate quarter sessions until 1874. The county sent two members to parliament in 1290. Before 1375 members were sent by Hertford, St. Albans, Bishop's Stortford and Berkhamsted, but this representation lapsed in the time of Henry V. St. Albans regained its franchise in 1553, but was deprived of it for malpractices in 1852. From 1623 Hertford had two members, reduced to one in 1868, representation being abolished in 1885.

For parliamentary purposes the county is now divided into seven county divisions and Watford borough.

The county is in the southeastern circuit and assizes are held

at Hertford, which is the administrative centre. Sessions sit at Hertford and St. Albans and there are 14 petty sessions. The southern part of the county is in the metropolitan police district.

Agriculture and Industries.—Hertfordshire has always been a grain-growing county and even at the time of Domesday Book the shire on its eastern side was noticeably free from wasteland; its grain markets were famous in the 16th century and malting and brewing of local barley were important from an early date.

Of the total acreage farmed about three-quarters is arable; grain covers about half of this, while there are substantial areas under potatoes and root crops. The other quarter is pastureland. The northern part of the county is chiefly arable. The southern part, particularly on the London Clay, has mixed farms carrying pedigree dairy stock. The southeast of Hertfordshire includes the Lea valley nursery and greenhouse district supplying salad vegetables and flowers to London. Crops include watercress, roses, and farm and garden seeds. The Rothamsted Experimental station at Harpenden, the first agricultural research station, was founded in 1843, and in 1949 the John Innes Horticultural institution moved to Bayfordbury.

Agriculture remains a basic industry together with papermaking and printing, which developed experimentally at Hertford and St. Albans respectively in the 15th and 16th centuries and now centre chiefly upon the Watford–Hemel, Hempstead area. During the 20th century, however, and particularly since World War II, there has been a vast increase in the range of manufacturing industry, especially in the light engineering, electrical, vehicles and aircraft fields. This has been accompanied by substantial increases in population, all reflecting the tremendous pressures which are exerted upon the Greater London area. This has made it necessary for the county council to expand its services, and particularly its educational facilities, at an unprecedented rate. There are many public, grammar and preparatory schools, some of ancient foundation, within the county.

Elstree in south Hertfordshire has motion-picture studios, established in 1927.

Communications.—The county is crossed by main railway lines from London to York and Edinburgh, to Crewe and the northwest, to Leicester and the Midlands, and to Cambridge. London Transport electric services serve the Watford and Rickmansworth areas. Hertfordshire also lies astride three main roads to the north. The Great North road (A.1) to Edinburgh enters the county at Mill Hill, bypasses Hatfield, follows old route to Welwyn, then by a motorway bypasses Stevenage to join its old route at Graveley, leaving the county at Baldock.

The London-Holyhead road (A.5), following the Roman Watling street, enters Hertfordshire at Elstree and passes through St. Albans and Markyate. The London-Carlisle road (A.6) branches off the Great North road at South Mimms and passes through St. Albans and Harpenden. The first motorway in England (M.1), from London to Birmingham, completed in 1959, runs across the county from Aldenham to the boundary near Luton. The London-Cambridge Road (A.10), the old North road, passes through the Lea valley to Ware, whence it follows the Roman Ermine street to Royston. Hertfordshire is well served by London Transport's central bus services in the south and by its country services over much of the remainder.

Water traffic by river and canal from Ware to London's dockland via the Lea and Stort navigation, and to the *Midlands* via the Grand Junction canal, is now slight.

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(W. H. C. Le H.)

HERTLING, GEORG, Graf von (1843–1919), German philosopher and statesman, chancellor of the *Reich* in the last year of World War I, was born at Darmstadt on Aug. 31, 1843. A neo-Thomist with a teleological conception of the world, he elaborated a political and social philosophy in which the conscious furthering of God's plan for the world was represented as a duty for man. As founder (1876) and president of the Görres-Gesellschaft, he exercised great influence on Roman Catholic social philosophy. From 1875 to 1890 and again from 1896 to 1912 he was a member of the Centre party (Catholics) in the *Reichstag;* and he also held chairs of philosophy at Bonn (1880) and then at Munich (1882). Appointed prime minister and minister of foreign affairs for Bavaria in 1912, he was created count by King Louis (Ludwig) III in 1914.

On Nov. 1, 1917, Hertling accepted the imperial chancellorship of Germany and the Prussian premiership. He introduced parliamentary ministerial responsibility but was too weak to withstand the continuing encroachments of the military leaders on political affairs and resigned on Sept. 30, 1918. He died at his home at Ruhpolding in Upper Bavaria on Jan. 4, 1919.

Hertling's writings include *Albertus Magnus* (1880), in the series *Beiträge zur Geschichte der Philosophie des Mittelalters; Recht, Staat und Gesellschaft* (1906; 4th ed. 1917); and *Erinnerungen aus meinem Leben,* two volumes (1919–20). There is an edition of his speeches and lectures by A. Dyroff (1929).

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HERTOGENBOSCH, 's: *see* 's Hertogenbosch.

HERTWIG, the name of two eminent German biologists, who were brothers.

(Wilhelm August) Oskar Hertwig (1849–1922) was renowned for his work in the fields of embryology and cytology. He was born on April 21, 1849, at Friedberg, Hesse, attended school in Mühlhausen, Thuringia, Ger., and then studied medicine and zoology in Jena, Zürich and Bonn. He obtained a lectureship in anatomy at the University of Jena in 1875 and was elected to the professorship in 1881. From 1888 to 1921 he was professor of anatomy and evolutionary history at the University of Berlin and director of the Anatomisch-Biologischen Instituts. He died in Berlin on Oct. 25, 1922.

Richard (Carl Wilhelm Theodor) von Hertwig (1850–1937) was particularly noted for his development of the germ-layer theory and for his contributions to the study of Protozoa. Born on Sept. 23, 1850, at Friedberg, he shared his brother's education. He became lecturer in zoology at Jena in 1875, professor of zoology at the universities of Königsberg in 1881, Bonn in 1883 and Munich from 1885 to 1925. He died in Munich on Oct. 3, 1937.

The brothers were influenced by the works of Ernst Haeckel (*q.v.*) (theory of evolution), Karl Gegenbaur (comparative morphology) and Max Schultze (cytology). Jointly they worked on Haeckel's "gastraea" theory of coelom formation and the germ-layer theory. Oskar was the first to recognize the fusion of ovum and sperm nuclei as the essential factor in fertilization; he was also the first to compare ovum and sperm maturation in the roundworm *Ascaris* and to recognize the significance of reduction division (meiosis). Other fields of study that Oskar investigated were: nuclear transmittal of hereditary characters (the idioplasm theory of K. W. von Nägeli; *q.v.*); biogenetic theory; and the effect of radium rays on somatic and germ cells. He was also concerned with the importance of biology in relation to social problems.

Richard Hertwig was the first to describe the artificially stimulated development of sea urchins (parthenogenesis; *q.v.*) He then turned to research on Protozoa, and interpreted the changes in the nucleus during the conjugation of paramecia as reduction and fertilization processes. He studied the nucleoplasmic ratio in association with cell division and sexuality problems, originated the chromidia theory and experimented in the determination of sex in amphibians.

Prominent among their numerous publications are: Oskar and Richard: *Die Cölomtheorie* (1881) and *Entwicklung des mittleren Keimblattes der Wirbeltiere* (1883); Oskar only: *Lehrbuch der*

Entwicklungsgeschichte des Menschen und der Wirbeltiere (1886; 10th ed., 1915; Eng. trans., 1892); *Die Zelle und die Gewebe* (1893–98; Eng. trans., 2nd ed., 1909); *Allgemeine Biologie* (1905; 7th ed. with Günther Hertwig, 1923); *Der Kampf um Kernfragen der Entwicklungs- und Vererbungslehre* (1909); *Das Werden der Organismen* (1916); *Der Staat als Organismus* (1920); Richard only: *Der Organismus der Radiolarien* (1879); *Die Aktinien der Challenger-Expedition* (1882); *Über die Konjugation der Infusorien* (1889); *Über die Entwickelung des Unbefruchteten Seeigeleies* (1896); *Lehrbuch der Zoologie* (1891–92; 15th ed., 1931); *Die Protozoen und die Zelltheorie* (1902); *Abstammungslehre und neuere Biologie* (1927). (P. Hg.)

HERTZ, GUSTAV (1887–), German physicist, was awarded the Nobel prize for physics jointly with James Franck in 1925 for work on the laws of impact between an electron and an atom. Hertz was born on July 22, 1887, at Hamburg, and studied in the universities of Göttingen, Munich and Berlin, in the last of which he was appointed in 1913 an assistant in physics. After service in World War I, in which he was severely wounded, he returned to Berlin as *Privatdozent* (official but unpaid lecturer) in 1917. From 1920 to 1925 he worked in the physics laboratory of the Philips organization (lamp manufacturers) at Eindhoven, Neth. In 1925 he was appointed professor of physics in the University of Halle, and in 1928 he became professor of physics at the Technische Hochschule in Berlin-Charlottenburg. He resigned on political grounds in 1934 and soon afterward became director of one of the research laboratories of the Siemens company.

Hertz was in Berlin in 1945 when the Russian forces entered the city and, while it was not known what happened to him, there had been a report that he survived and that he continued his researches for the U.S.S.R. The experiments of Hertz and Franck on the electron-atom collision showed that for ionization of the atom the electron must possess a certain minimum energy, measured in volts as "ionization potential," which varied for different gases; and the measurements made showed quantitatively that a series of spectral lines so obtained corresponded to a series of stationary states in the internal energy of the atom, as demanded by Niels Bohr's theory of the structure of the atom, which included the application of Max Planck's quantum theory, according to which energy could be taken up by the atom only in discrete quantities. Hertz succeeded in devising a method of separating the isotopes of neon by means of diffusion. (D. McK.)

HERTZ, HEINRICH RUDOLF (1857–1894), German physicist, was the first to demonstrate the production and reception of radio waves. He was born at Hamburg on Feb. 22, 1857. On leaving school he studied engineering, but abandoned it in favour of physics. Hertz went to Berlin, where he studied under Hermann von Helmholtz. In 1883 he went to Kiel, becoming *Privatdozent* (official but unpaid lecturer), and there he began the studies in Maxwell's electromagnetic theory which a few years later resulted in the discoveries that rendered his name famous. These were actually made between 1885 and 1889, when he was professor of physics in the Karlsruhe Polytechnic. Helmholtz drew Hertz's attention to a prize offered by the Berlin Academy of Sciences for the experimental establishment of a relation between electromagnetic actions and the polarization of a dielectric, and promised him the assistance of the institute if he decided to work on the subject. Hertz did not take it up seriously at that time because he could not think of any procedure likely to prove effective. Later he was able to discover the progressive propagation of electromagnetic action through space, to measure the length and velocity of electromagnetic waves and to show that in the transverse nature of their vibration and their susceptibility to reflection, refraction and polarization they are in complete correspondence with the waves of light and heat. The result was to establish beyond doubt the electromagnetic nature of light. In 1889 Hertz was appointed to succeed R. J. E. Clausius as ordinary professor of physics in the University of Bonn. There he continued his researches on the discharge of electricity in rarefied gases, only just missing the discovery of the X-rays described by W. C. Röntgen a few years later, and produced his treatise on the *Principles of Mechanics*.

This was his last work, for after a long illness he died at Bonn on Jan. 1, 1894. By his premature death science lost one of its most promising disciples.

See also ELECTRICITY: *Hertz's Experiments*.

Hertz's scientific papers were translated into English by D. E. Jones and published in three volumes: *Electric Waves* (1893), *Miscellaneous Papers* (1896) and *Principles of Mechanics* (1899).

HERTZ, HENRIK (originally HEYMAN) (1797 or 1798–1870), Danish author who, like his friend, J. L. Heiberg (*q.v.*), opposed the late romantic tendency to formlessness both in his critical writings and in his poems, plays and ballad operas. Born in Copenhagen of Jewish parents, probably on Aug. 25, 1797 or 1798, he received the first name Heyman, but took the name Henrik at his baptism in 1832. He graduated in law but never practised, instead devoting himself to belles-lettres. His first play, *Herr Burchardt og hans Familie*, a comedy in the line of direct descent from Holberg, appeared in 1827 and was followed by *Kærlighed og Politi* ("Love and the Police"), a vaudeville or ballad opera inspired by those of Heiberg. He greatly admired Heiberg with whom he allied himself, notably in *Gengangerbreve* ("Letters of a Ghost," 1830), in a campaign against the lack of form and intellectual content in Adam Öhlenschläger's mature romanticism. As a poet, Hertz was prolific, versatile and always distinguished, whether in lyric, narrative or didactic vein, but he has been overshadowed by his outstanding contemporaries, Ludwig Bødtcher, Christian Winther and Frederick Paludan-Müller. None the less, his carefully wrought and eminently actable plays, which continued to appear until 1869, are among the best of his time. They include *Amors Genistreger* ("Cupid's Pranks," 1830), a rhymed comedy, the charm and deftness of which are comparable to those of Alfred de Musset; *Debatten i Politivennen* ("The Debate in 'The Friend of the Police'," 1836) and other entertaining vaudevilles; *Sparekassen* ("The Savings Bank," 1836), a prose comedy; *Svend Dyrings Hus* (1837), a "ballad-tragedy"; and *Kong René's Datter*, a lyric drama anonymously produced in 1845 and soon translated (English by T. Martin, 1850) and acted in many European languages.

Hertz died in Copenhagen, Feb. 25, 1870. His collected poems, *Digte*, appeared in 4 vol. (1851–62); his *Dramatiske Vaerker*, in 18 vol. (1854–73).

See H. Kyrre, *Henrik Hertz, Liv og Digtning* (1916); M. Brøndsted, *Henrik Hertzes Teater* (1946). (B. W. D.)

HERTZ, JOSEPH HERMAN (1872–1946), chief rabbi of the United Hebrew Congregations of the British Empire, was born in Rebrény, Hung., on Sept. 25, 1872. Emigrating to the United States as a child he was educated at New York City college, Columbia university, where he took the degree of Ph.D., and at the Jewish Theological Seminary of America. He was a rabbi in Johannesburg, South Africa, from 1898 to 1911 and, during the Boer War, was expelled by Pres. Paul Kruger for pro-British sympathies and for advocating the removal of religious disabilities from Jews and Catholics. From 1906 to 1908 he was professor of philosophy at Transvaal University college. Hertz was elected to the chief rabbinate in succession to Hermann Adler in 1913. In 1920–21 he undertook an extensive pastoral tour, visiting the Jewish communities in South Africa, Australia, New Zealand and Canada. In 1925 he was made a governor of the University of Jerusalem. His *A Book of Jewish Thoughts* went through numerous editions, and his commentaries in English on the Pentateuch and the Standard Prayer Book are widely accepted and used by orthodox and conservative Jews. Hertz died in London on Jan. 14, 1946.

HERTZBERG, EWALD FRIEDRICH, GRAF VON (1725–1795), the last foreign minister under Frederick the Great of Prussia and the leading statesman at the beginning of Frederick William II's reign, was born on Sept. 2, 1725, at Lottin in Hinterpommern of an ancient noble family. He studied constitutional law and history at Halle and in 1745 entered the Prussian civil service. At Frederick the Great's command he served simultaneously in the state record office and in the department of foreign affairs; and as early as 1750 he was entrusted with the direction of the secret cabinet record office. In a short time he became fully conversant with the constitutional law, the genealogies and the hereditary claims of Brandenburg-Prussia—dates and facts of great

importance for foreign policy in those days. In 1752 he became a member of the Berlin Academy of Sciences, where he was later to give annual accounts of the Prussian administration and to argue strongly for the emancipation from feudal tenure.

From 1754 Hertzberg attended the secret meetings of the cabinet; and at the beginning of the Seven Years' War (*q.v.*) he was asked by the king to draw up the notorious *Mémoire raisonné sur la conduite des cours de Vienne et de Saxe et leurs desseins dangereux contre Sa Majesté le roi de Prusse.* This memorial, containing documents from the Saxon archives published verbatim, was designed to exonerate Prussia from responsibility for the war. When he wrote it Hertzberg was honestly persuaded of the necessity of a preventive war, but later he came to question this. In 1757 he was appointed by Frederick II "privy councillor in the department of foreign affairs"; *i.e.* a kind of undersecretary of state to the two cabinet ministers Heinrich von Podewils and Karl Wilhelm Finck von Finckenstein. As such, he drew up the peace treaties between Prussia and Russia and between Prussia and Sweden (1762) and signed the peace of Hubertusburg with Austria and Saxony (1763). In 1763 he was made the second cabinet minister for foreign affairs, as Podewils had died in 1760. Hertzberg however won no appreciable influence over Frederick II either then or later: in the 1770s, indeed, there arose strong and increasing tension between king and minister. Hertzberg was rather a scholar and political writer than a practical statesman, and he had his share of doctrinaire vanity. He believed Austria's inclusion in the first partition of Poland (1772) to be both unnecessary and impolitic; and he thought the same, only more so, of Frederick's refusal to acquire territory after the War of the Bavarian Succession (1778–79). Frederick accused Hertzberg of planning annexations irresponsibly. In the end, Hertzberg joined the party of the heir to the throne, as did other discontented politicians.

When Frederick William II succeeded to the throne in 1786, Hertzberg came to exert a predominant influence. Appointed secretary of the Academy of Sciences, he helped to counteract the French spirit which had prevailed there under Frederick II; but he failed in the long run to attract a sufficient number of able men, so that the academy declined in importance instead of gaining European recognition for the German spirit that he sought to promote. In foreign affairs he aimed at a Northern league allying Prussia with Great Britain, the United Provinces of the Netherlands, Sweden and also, if possible, Russia. This league was to checkmate diplomatically the "Southern" powers—France, Austria and Spain—and to strengthen Prussia's position in Germany and in Europe. In pursuit of this aim, Hertzberg sent Prussian troops to suppress the revolt of the Patriot party in Holland (1787–88) and concluded an alliance with the reinstated stadholder William V of Orange. Great Britain acceded to the alliance in Aug. 1788. Hertzberg moreover thought that Russia's and Austria's war against the Turks (begun in 1787) should bring Prussia the chance of benefiting by a great exchange of territories: Turkey should cede Bessarabia to Russia and Moldavia and Walachia to Austria; Austria should return Galicia to Poland; and Poland should cede West Prussia, Gdansk and Torun to Prussia. However, it soon became clear that Russia did not favour Hertzberg's "Great Plan," and Great Britain was unwilling to take risks for Prussia's sake. Even with regard to Austria, Frederick William II, after long hesitations which almost led to war, eventually disavowed Hertzberg's policy and let himself be satisfied with having made Austria renounce any territorial accessions arising from the Turkish war (convention of Reichenbach, July 1790). This wrecked Hertzberg's plan, which in any event was based on a false estimate of the European balance of power and of Prussia's ability to exert pressure on other nations.

Thereafter Hertzberg lost the direction of foreign policy. Dismissed from the ministry in 1791, he kept only his offices as secretary of the academy and as supervisor of the silk industry—in which he was especially interested. In his last years the fallen minister continued to justify his policy, writing state papers that nobody wanted and criticizing aloud his successors—who were indeed even less able than he had been. Thus he acquired the reputation of a sulky faultfinder and died, full of bitterness, on May 27, 1795, in Berlin.

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HERTZOG, JAMES BARRY MUNNIK (1866–1942), prime minister of South Africa from 1924 to 1939, was born on April 3, 1866, on a farm near Wellington, Cape Colony. The family moved to the Kimberley diamond fields in 1872 and to Jagersfontein, Orange Free State, in 1879. After graduating at Victoria college, Stellenbosch, and Amsterdam university, Hertzog practised as an attorney in Pretoria from 1892 to 1895, when he became a judge in the high court of the Orange Free State. During the South African War he was assistant chief commandant of the Orange Free State and led a successful raid into the Cape Colony. At the Vereeniging conference in May 1902 he was loath to abandon the struggle, but he signed the peace treaty.

Hertzog was a severe critic of the crown colony regime in the Orange River Colony. He opposed Lord Milner's anglicization policy and was a founder of the Orangia Unie party. When self-government came into effect in the colony in Nov. 1907, he became a member of Abraham Fischer's cabinet. Regarding it as his duty to do everything possible to preserve the identity of the Afrikaner people (who are mainly of Dutch descent) he made sure in the national convention that the South African constitution made Dutch as well as English an official language of the Union. He was also responsible for an Orange River Colony education act which provided that in the government schools children should be taught in their home language, Dutch or English, in the junior standards, and that in the senior standards half the subjects should be taught in Dutch and half in English. This act went much farther than J. C. Smuts' education act for the Transvaal, and Hertzog's attempt to enforce it landed him in serious difficulties. By 1910 he was the centre of a nationwide controversy: the hero of Afrikaner nationalists, the bogy of British South Africans.

Louis Botha was embarrassed by this controversy, which weakened the hold of his own conciliation policy, and it was with reluctance that he gave Hertzog a place in his Union cabinet in May 1910. From the first the cabinet was divided, and in 1912, after fiery speeches by Hertzog, Botha resigned and formed a new government without him. In 1913 Hertzog founded the Afrikaner Nationalist party, which gained strength from Botha's decision that South Africa should take an active part in World War I, and from the postwar reaction. In 1924, in alliance with the Labour party, Hertzog won a majority of the seats in the house of assembly and formed a government.

As prime minister, Hertzog played a leading part in the imperial conferences which produced the Balfour Declaration (1926) and prepared the way for the Statute of Westminster (1931). Furthermore, Afrikaans (a language that developed from 17th-century Dutch) was made an official language of the Union, a national flag was created, poor whites were given sheltered employment, Africans and Indians were excluded from skilled trades, agriculture and industry were given increased protection, imperial preferences were reduced and the franchise was extended to all white men and women. Hertzog considered that these achievements secured the independence of South Africa and the position of the Afrikaner people. Consequently in 1933, after his government had lost prestige through its ill-judged attempt to remain on the gold standard, he formed a coalition with Smuts; and in 1934 the Nationalist and South African parties merged into the United party with Hertzog as prime minister and Smuts as deputy prime minister.

After consolidating the autonomy of the Union with the Status act of 1934, parliament gave further effect to Hertzog's segregation policy. The Cape Province voters were removed from the common roll and given three white representatives in the house of assembly; the Africans throughout the Union were given the right to elect four white senators; an advisory Natives Representative council was established; provision was made for an increase in the size of the African reserves; and the government was empowered to restrict the entry of Africans into the towns and to order municipalities to segregate their African residents. Although the

United party had the support of an overwhelming majority of the electorate, in 1934 a small group of Afrikaner nationalists led by D. F. Malan formed a Purified Nationalist party; and by 1939 it was claiming to be the sole heir to the *voortrekker* tradition and demanding that still further restrictions should be placed on the Africans and that the Coloured people, also, should be segregated.

The outbreak of World War II caused Hertzog's downfall. The cabinet had been agreed on questions of internal policy, but it split into two groups on the war issue. Hertzog regarded the war as no concern of South Africa. In parliament on Sept. 4, 1939, he proposed that South Africa should remain neutral and Smuts proposed that it should declare war against Germany. Smuts's amendment was carried by 80 votes to 67, and on Sept. 5, having been refused a dissolution by the governor general, Hertzog resigned and Smuts formed a ministry to prosecute the war. Hertzog then joined Malan in a Reunited Nationalist party, but he left it in Nov. 1940, when a majority at a Free State party congress refused to guarantee British South Africans equality of status and political rights. Next month he resigned from parliament, doubly disappointed that Smuts and a parliamentary majority had defeated his neutrality motion and that the Nationalists had rejected his principle of equal rights for Afrikaners and British South Africans. He died at Pretoria, a lonely and embittered man, on Nov. 21, 1942.

Hertzog was consistent in his belief in a two-stream white South African nation, comprising an Afrikaner and a British element, each assured against domination by the other, and both protected against the numerically superior African. But by the time of his death the Afrikaner nationalist movement which he had assisted so greatly had developed a dynamic and radical character and passed beyond his control. *See* also SOUTH AFRICA, REPUBLIC OF: *History*.

See L. E. Neame, *General Hertzog* (1930); C. M. van den Heever, *General J. B. M. Hertzog* (1946). (L. M. T.)

HERTZSPRUNG, EJNAR (1873–), Danish astronomer, was born at Frederiksberg, near Copenhagen, on Oct. 8, 1873. He was educated in technological colleges in Denmark and became a chemical engineer. After several years in this profession he was called to Göttingen, Ger., in 1909 as professor of astronomy and later moved to Potsdam, Ger. He was appointed assistant director of the university observatory at Leiden, Neth., in 1919 and became director in 1935; he resigned in 1945.

There is hardly a phase of modern stellar astronomy not affected by Hertzsprung's work. In papers published in 1905 and 1907, he showed that there is a relationship between the colours of the stars and their true or absolute brightness. The great majority lie along a sequence ranging from the blue and white stars (the Orion group, Sirius, and Vega) through the yellow (Procyon, α Centauri, and the sun) to the orange (61 Cygni) and red. Along this sequence the true brightness decreases smoothly and rapidly; the blue and white stars are larger and much more luminous than the sun; the orange and red stars are smaller and fainter. In addition to this main sequence, Hertzsprung called attention to a number of yellow, orange and red giants (Arcturus, Pollux, Aldebaran and Betelgeuse); these are far less numerous in space than the main sequence stars of the same colour, and they were described as "whales among the fishes."

This description of stellar types was refined by the later work of Hertzsprung and H. N. Russell, and culminated in the "Hertzsprung-Russell diagram"—perhaps the fundamental diagram of stellar astronomy.

Later work indicated that there are faint white stars (the so-called white dwarfs), but the over-all picture suggested by Hertzsprung was completely confirmed. He also noted that the great majority of stars in our region of space are smaller and absolutely fainter than the sun.

One of the most important fields in contemporary astronomy originated in Hertzsprung's discovery that there is a relationship between the strength of certain features in the spectrum of a star and its true brightness. This furnishes a means of estimating the true brightness—that is, the absolute magnitude—simply from the appearance of a stellar spectrum. (W. W. M.)

HERULI, a Germanic people, are said by Jordanes, the 6th-century historian of the Goths, to have been expelled from Scandinavia by the Danes. This may have happened in or before the middle of the 3rd century A.D., as Heruls are found in the Black sea region in 267 and on the lower Rhine in 286. The western Heruls were of little importance historically, though some appear as mercenaries in the Roman army throughout the 4th and 5th centuries and others often raided the western provinces by land and sea. Nothing is heard of them after the early 6th century.

The eastern Heruls lived near the Sea of Azov in the mid-3rd century and along with the Goths undertook mass raids on the Roman empire in that period. In 267, the year in which they are first mentioned, they scored their greatest success: they captured Byzantium, sailed down into the Aegean sea and sacked Athens, Corinth, Sparta and Argos. But their great raid of 269 ended in disaster: the emperor Claudius II heavily defeated them near Naissus (Nis in Yugoslavia), and only a few of them escaped. In the mid-4th century they were incorporated into the empire of Ermanaric (*see* GOTHS) and were thereafter subjugated by the Huns. Late in the 5th century they formed a powerful kingdom on the middle Danube, but they were severely defeated by the Lombards early in the following century. Many of them were settled in Illyricum by the Romans in 512; others returned to Scandinavia. No more is heard of them after the middle of the 6th century.

They were one of the most primitive of the Germanic peoples of that period. Kingship was but little developed among them. Their slaves fought side by side with them in battle. Human sacrifice is still mentioned among them in the 6th century. (E. A. T.)

HERVEY OF ICKWORTH, JOHN HERVEY, BARON (1696–1743), English politician and wit best remembered for his outspoken *Memoirs* (published 1848), was born on Oct. 15, 1696, and was the eldest surviving son of John Hervey, 1st earl of Bristol (d. 1751). He was educated at Westminster school and at Clare hall, Cambridge. When he was 20 he went on the customary continental tour and at Hanover laid the foundations of his friendship with Frederick, the eldest son of George II, who in 1727 became prince of Wales. In 1720 he married Mary (Molly) Lepell, a spirited member of the intellectual aristocracy and a close friend of the prince and princess of Wales (from 1727 King George II and Queen Caroline). Hervey was Whig member of parliament for Bury St. Edmunds, Suffolk, from 1725 to 1733. His wit and sense were admired by the queen, and he was vice-chamberlain of the royal household from 1730 to 1740. He was created Lord Hervey of Ickworth in 1733 and sat in the house of lords to improve the debating strength of Sir Robert Walpole's government. After a ferocious exchange of pamphlets he fought a duel with William Pulteney in 1731. In public life Hervey was disappointed, though he was made lord privy seal in 1740, falling with Walpole two years later. He died at Ickworth on Aug. 5, 1743.

Hervey's claim to renown, however, did not so much lie in the world of politics as in that of fashion and the court. His character was curious and fascinating. He suffered all his life from a feeble constitution, though a visit to Italy, where he formed a warm friendship with Stephen Fox (later Lord Ilchester), did much to revivify him. He incurred the wrath of Alexander Pope (*q.v.*) who made scandalous allusions to his friendship with Fox in his "Epistle to Dr. Arbuthnot," in which Hervey figured as "Sporus." His *Memoirs of the Reign of George the Second* are of the first importance and, with the writings of Horace Walpole, are largely responsible for posterity's impressions of the 18th century. He said of his *Memoirs* that he wrote for those who prefer to see the great "dressing and undressing rather than when they are playing their part on the public stage." They were first published in 1848 by J. W. Croker (*q.v.*) but the definitive edition is by R. Sedgwick (1931).

See the Earl of Ilchester, *Lord Hervey and His Friends, 1726–1738* (1950), which contains his correspondence with Fox and others. (R. T. B. F.)

HERVIEU, PAUL ERNEST (1857–1915), French dramatist and short-story writer, whose plays are characterized by strong didactic or moral purpose, was born at Neuilly-sur-Seine, Sept. 2,

1857. A trained lawyer, he used his legal knowledge in a series of plays including *Les Tenailles* (1895), *La Loi de l'homme* (1897) and *Le Dédale* (1903), which were directed against the divorce laws. *La Course du flambeau* (1901) preached the sacrifice of the older generation for the sake of the younger. In *Connais-toi* (1909) and *Le Destin est maitre* (1914) he aimed at creating "modern middle-class tragedy." His one historical play, *Théroigne de Méricourt* (1902), performed by Sarah Bernhardt, attempted a dramatic synthesis of the French Revolution. He died in Paris on Oct. 25, 1915.

See E. Estève, *Paul Hervieu* (1917). (D. Ks.)

HERWEGH, GEORG (1817–1875), German revolutionary poet, was born at Stuttgart on May 31, 1817. Expelled from the theological college at Tübingen, he became a journalist. He was called up for military service, but committed an act of insubordination and fled to Switzerland. There he published *Gedichte eines Lebendigen* (1841), political poems expressing the aspirations of German youth. Although the book was confiscated, it ran through several editions. Herwegh returned to Germany in 1842, greeted by demonstrations showing popular sympathy; Frederick William IV received him in Berlin with the memorable words: *"Ich liebe eine gesinnungsvolle Opposition"* ("I admire an opposition, when dictated by principle"). In 1844 the second volume of *Gedichte eines Lebendigen* was published in Paris, where Herwegh was living, and was also confiscated. At the head of a column of German workingmen, recruited in Paris, Herwegh took part in a south German rising in 1848 but was defeated on April 27 at Schopfheim, Baden. He escaped to Switzerland, but was permitted (1866) to return to Germany, and died at Lichtental, Baden, on April 7, 1875. *Neue Gedichte* appeared in 1877. Herwegh also translated the works of Alphonse de Lamartine.

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HERZEN (Russian Gertsen), **ALEKSANDR IVANOVICH** (1812–1870), Russian author, editor of the influential radical newspaper *Kolokol* (1857–65; "The Bell"), was born in Moscow on April 6 (new style; March 25, old style), 1812, the illegitimate son of Ivan Yakovlev, a wealthy Russian nobleman, and a German girl of humble origin. Under his father's guidance, Herzen tasted in boyhood the chief literatures of Europe and started the study of his own country's important role in recent European history. In 1825, at the age of 14, together with his life-long friend, Nikolai Ogarëv, he took a solemn oath to devote all his strength to upholding the ideals for which the Decembrist rebels had suffered.

Soon after leaving Moscow university, Herzen and some of his friends were arrested and he was exiled to Perm and Vyatka in 1835. In fact, a roving interest in French political ideas, together with a few disrespectful remarks about the Emperor Nicholas I, were the blackest crimes that could be proved against him. But seven years in Vyatka as a minor civil servant provided him with a wholesome instruction course in Russian local government. He began to prize the sturdy qualities of inconspicuous townspeople and peasants, rescued by sheer geographical distance from the paralyzing grip of huge administrative centres. In 1840 he was sentenced to service in Novgorod till 1842. Two brilliant early essays date from this period, "Dilettantism in Science" and "Buddhism in Science" (1841–1843).

In 1846 Herzen inherited a substantial fortune from his father and in 1847 he left Russia, never to return. His novel *Kto Vinovat?* ("Who is to Blame?") was published in the same year. In his striking *Briefe aus Italien und Frankreich* (1850; "Letters from France and Italy") and *Vom anderen Ufer* (1850; "From the Other Shore"; both translated from the Russian manuscripts), written under the overwhelming impression of the abortive 1848 revolutions, Herzen summed up the main lessons he had learned from his odyssey in Europe. The sordid anticlimax of mid-19th-century reforms, the misfire of revolutionary efforts, seemed to him symptoms of a widespread decline in the moral standards and ideals of western European society. "On one side the property-owning bourgeoisie, obstinately refusing to part with its monopolies, on the other side, the bourgeoisie without property, or with less, who want to seize it from those who have more, but lack the strength to do so. In a word, on one side, avarice, on the other, envy."

In 1852 Herzen left France for England, where he spent the next 11 years. The death of Nicholas I in 1855 filled him with hope. He immediately wrote a letter of admonition to the new tsar; "Your reign begins under an auspicious star. The Russian autocracy can be revolutionary. It is all-powerful for good or evil." His journal *Polyarnaya Zvezda* ("The Polar Star") started in the same year. Its success encouraged him to embark on his free Russian newspaper *The Bell*. The latter exerted great influence and was soon passing from hand to hand throughout Russia, defying the tsar's security police. But, in addition to its compromising entanglement with the anarchist, Mikhail Bakunin (*q.v.*), *The Bell*, by taking the side of the Polish rebels in 1863, forfeited the support which it had hitherto received from Russian liberals. It also began to lose its grip on the second generation of radical intellectuals, dominated by the harsher Nikolai Chernyshevski. Herzen settled in Geneva in 1868 and started to publish *The Bell* in French, with an occasional Russian supplement. But within a year public indifference brought it to an end. He died in Paris on Jan. 21 (N.S.; 9, O.S.), 1870.

Herzen resembled Bakunin in maintaining that the masses would derive little benefit when the latest stick with which they were beaten was called a popular stick. He felt sure that formerly decent peasants and artisans, after they had seized political power and degenerated into government officials, would become at least as bourgeois and nationally arrogant in their behaviour as the class which they had driven out. The mutually antagonistic types of *de facto* national socialism, which, after Herzen's death, emerged to threaten each other throughout the world, proved the essential accuracy of his political warnings. A federalist, a convinced though gradualist republican, a believer in regional self-government and the multiplication of small co-operative landowners (keeping the commune only as charitable institution for hopelessly backward peasants), Herzen conceived Russia as a loosely knit, slowly developing country, whose physical and mental health depended on a preponderance of agrarian over industrial concerns.

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HERZL, THEODOR (1860–1904), founder of modern political Zionism (*q.v.*), was born in Budapest, Hung., on May 2, 1860. He received a legal education at the University of Vienna (doctor of laws, 1884) but, deciding to devote himself to literature, joined the staff of the leading Viennese newspaper, *Neue Freie Presse*. He was its foreign correspondent in Paris from 1891 to 1896, in which year he returned to Vienna to become the literary editor of the paper, a position he held until his death.

Herzl's experiences in Paris during the Dreyfus affair changed his whole outlook on life. He was deeply hurt by the anti-Semitism in the homeland of the great Revolution and from it drew the conclusion that only the establishment of a Jewish state could solve the Jewish problem. It was his conviction that anti-Semitism was not a temporary reaction but the expression of ingrained, ineradicable feeling. He regarded assimilation of the Jews to the people among whom they lived as desirable but believed that anti-Semitism prevented it, thus leaving to the majority of Jews no other course but organized emigration to a state of their own. To propagate these ideas he published in 1896 his famous pamphlet *Der Judenstaat* (Eng. trans., *The Jewish State*, 4th ed. rev., 1946).

Herzl envisaged the Jewish state as progressive and modern, one that would realize the advanced ideas of the time. Devoid of any cultural Jewish tradition, he did not at first select Palestine as the Jewish home, nor did he ever envisage Hebrew as a national language to be revived in the new homeland. Rather, he expected

the Jews of the *Judenstaat* to speak the native tongues of their various countries, with the belief that finally the most practical one would emerge as the national language. Under the influence of the existing Love of Zion movement in eastern Europe, however, Herzl soon came to regard Palestine as the desirable homeland. Believing that it was practically "a land without people," he urged that the nations of the world arrange for it to be given to the "people without land."

From this time Herzl devoted the remaining years of his life to the Zionist movement. He gave it a world-wide organization; created its official organ, characteristically called *Die Welt* ("The World"), published as a weekly in the German language in Vienna; and established the Jewish Colonial trust as a financial instrument of the movement. From the time of the first Zionist congress, which Herzl assembled in Basel, Switz., at the end of Aug. 1897, he was the recognized leader of the movement. Through the strength of his imposing personality he aroused the enthusiasm and love of the Jewish masses and gained the respect of many statesmen of his time, in spite of the opposition of leading rabbis and laymen to his plans. On behalf of the Zionist movement he negotiated unsuccessfully with the sultan of Turkey for the grant of a charter that would allow Jewish mass settlement in the then Turkish Palestine on an autonomous basis.

Herzl's vision of the future was contained in his novel *Altneuland* (1902; Eng. trans., *Old-New Land*, 1941), which he left as his testament to the movement. In it the New Society, as he called the new Palestine, would be realized in harmony with the Muslim Palestinian population, who would prosper greatly as a result of Jewish immigration. Meanwhile Herzl had gained the ear of British statesmen who in 1903 offered him a charter for Jewish settlement in Uganda. This offer, which he and many other of the delegates were willing to accept, aroused violent opposition at the Zionist congress of 1903. This embittered controversy within the movement undermined Herzl's already failing health, and he died of a heart ailment at Edlach, near Vienna, on July 3, 1904, at the age of 44. He was buried in Vienna but, in accordance with his wish, his remains were removed to Jerusalem in 1949, after the creation of the Jewish state.

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HERZOG, JOHANN JAKOB (1805–1882), German Protestant theologian and editor of the *Realencyklopädie für protestantische Theologie und Kirche*, was born in Basel, Sept. 12, 1805. He studied at the universities of Basel and Berlin, being taught at the latter by F. Schleiermacher and August Neander. In 1831 he became lecturer at Basel and in 1838 lecturer in church history at Lausanne. From 1847 he was professor of church history and New Testament exegesis at Halle, and from 1858 to 1877 was professor of Reformed theology at Erlangen, where he died on Sept. 30, 1882.

Herzog contributed 529 articles to the *Encyklopädie*, the first part of which appeared in 1853. By 1868 there were 22 volumes. In 1908–14 it appeared in English as the *New Schaff-Herzog Encyclopedia of Religious Knowledge*. Herzog also carried out important research into the history of the Waldensians, publishing *De origine et pristino statu Waldensium* (1848) and *Die Romanischen Waldenser* (1853). (C. L. A. R. H.)

HERZOGENBERG, HEINRICH VON (1843–1900), Austrian composer who wrote in the style of Brahms, was born on June 10, 1843, at Graz. He studied under F. O. Dessoff at Vienna, and in 1874 helped to found the Bach-Verein in Leipzig. In 1885 he went to Berlin where he was later appointed director of the department of composition at the Hochschule für Musik. Herzogenberg wrote many chamber works, including variations on a theme of Brahms, some orchestral pieces and several large-scale religious works. His wife, Elisabeth von Stockhausen (1847–1892), was a pianist and a pupil of Brahms. He died at Wiesbaden, Oct. 9, 1900.

See J. Brahms, *The Herzogenberg Correspondence*, ed. by M. Kalbeck, trans. by H. Bryant (1909).

HESILRIGE (HASELRIG), **SIR ARTHUR,** BART. (d. 1661), English parliamentarian, was the eldest son of Sir Thomas Hesilrige, 1st baronet, of Noseley, Leicestershire. He sat for Leicestershire in the Short and Long parliaments in 1640, and took a principal part in the earl of Strafford's attainder, the root and branch bill and the militia bill of Dec. 7, 1641, and was one of the five members impeached by King Charles I on Jan. 4, 1642. He raised a troop of horse for the earl of Essex, fought at Edgehill, commanded in the west under Sir William Waller, and distinguished himself at the head of his cuirassiers, "The Lobsters," at Lansdown on July 5, 1643, at Roundway Down on July 13, at both of which battles he was wounded, and at Cheriton, March 29, 1644. On the occasion of the breach between the army and the parliament, Hesilrige supported the army, took Cromwell's part in his dispute with the generals, the earls of Manchester and Essex, and on the passing of the Self-denying ordinance gave up his commission and became one of the leaders of the Independent party in parliament. On Dec. 30, 1647, he was appointed governor of Newcastle, which he successfully defended; he defeated the royalists on July 2, 1648, and regained Tynemouth. He accompanied Cromwell to Scotland in Oct. 1648 and gave him valuable support in the Scottish expedition in 1650. Hesilrige, though he approved of the king's execution, had declined to act as judge on his trial. Cromwell's expulsion of the Long parliament threw him into antagonism, and he opposed the protectorate and refused to pay taxes. He was returned for Leicester to the parliaments of 1654, 1656 and 1659, but was excluded from the first, and also from the second until Jan. 1658. On Oliver Cromwell's death Hesilrige refused support to Richard Cromwell; after Richard's downfall he attempted to maintain a republican parliamentary administration, "to keep the sword subservient to the civil magistrate," and when John Lambert expelled the parliament, Hesilrige turned to General Monck for support, and helped him by securing Portsmouth on Dec. 3, 1659. He marched to London, was appointed one of the council of state, and on Feb. 11 became a commissioner for the army. He was completely outwitted by Monck, and trusting to his assurance of fidelity to "the good old cause" agreed to withdraw his regiment from London. At the Restoration his life was saved by Monck's intervention, but he died in the Tower of London on Jan. 7, 1661.

HESIOD (fl. *c.* 800 B.C.) Greek poet who created didactic poetry in the western world, was a Boeotian. His father had migrated from Cyme in Asia Minor to Boeotia; and he himself spent most or all of his life in Ascra, near Mt. Helicon. He may at first have been a rhapsode, learning the technique and vocabulary of the epic by memorizing and reciting heroic songs. He himself attributes his poetic gifts to the inspiration of the Muses, who appeared to him while he was tending his sheep; giving him a poet's staff and endowing him with a poet's voice they bade him "sing of the race of the blessed gods immortal." That his epics won him renown during his life is shown by his participation in the contest of songs at the funeral games of Amphidamas in Chalcis (Euboea). This, as he himself says, was the only occasion on which he crossed the sea, but it is not likely to have been the only invitation which he received from places other than his home town.

Genuine Works.—Of Hesiod's two extant epics the *Theogony* is clearly the earlier. As the Muses had bidden him, Hesiod here recounts the history of the gods, beginning with the emergence of Chaos, Earth and Eros (the power of procreation). Earth gives birth to Uranus (heaven), the mountains and Pontus (sea), and later, after uniting herself to Uranus, bears many other deities. One of these is Cronus who rebels against Uranus, emasculates him and after this rules himself until he in turn is overpowered by Zeus. This story of crime and revolt in the ruling divine family, which is the central subject of the *Theogony*, is interrupted by many additional pedigrees of gods, including the progeny of Night, a deity sprung directly from the original Chaos; here Hesiod has brought together the forces of evil (death, strife, hunger, woe, etc.) which beset the life of man. Elsewhere too Hesiod presents in addition to mythical family relations new ones that are the product of his own speculation. Thus the names of the 50 sea-maidens in the progeny of Nereus indicate various qualities of the sea. In a different way the story describing the origin of woman, whom Zeus in his wrath at Prometheus' attempted deception sent to man

as his baneful companion, brings out Hesiod's firm belief in the supreme and irresistible power of Zeus. This power, stressed also in other sections of the *Theogony,* finds its most majestic display in the so-called Titanomachia, the battle between the Olympian gods led by Zeus and the Titans on the side of Cronus. After his victory in this battle Zeus organizes his kingdom.

Hesiod's authorship of the *Theogony* has been questioned but is probably no longer subject to doubt. However, the work includes various sections that were inserted by poets and rhapsodes before the text became fixed in approximately its present form perhaps *c.* 600 B.C. The story of Typhoeus' rebellion against Zeus (820–880) is almost certainly an interpolation, while the somewhat overlapping accounts of Tartarus (720–819), the hymn on Hecate (411–452) and the progeny of the sea monster Keto (295–336) are under grave suspicion. The discovery of a Hittite (or more precisely, Hurrian) theogony which offers close parallels to Hesiod's has led to the realization that the main line of Hesiod's divine history owes significant episodes to near-eastern—Mesopotamian, Anatolian, and perhaps also Phoenician—models. As told by Hesiod the succession Uranus-Cronus-Zeus approximates the pattern of a tragic trilogy. The Erinyes are born when Uranus is overthrown by Cronus and their time for action comes when Cronus himself is about to be overthrown by Zeus. Such and similar features are likely to represent Hesiod's own contributions to the inherited story.

Hesiod's other epic poem, the *Works and Days,* has a much more personal character. It is addressed to his brother Perses who by guile and bribery has secured for himself an excessive share of their inheritance and is once again seeking to get a similar advantage over Hesiod. Trying to dissuade him from such practices Hesiod recounts in the first part of the poem two myths designed to account for the necessity of honest and hard work in the prevailing sad conditions of man's life. One of them is the story of Pandora who from her jar sends forth the plagues of human life; the other traces man's decline through the sequence of the five ages, beginning with the race of gold and ending with the present iron generation whose sins and sorrows Hesiod describes with passionate eloquence. Against the brutality and injustice of his contemporaries Hesiod affirms his unshakeable belief in the power of justice. For him Justice is a deity and indeed the favourite daughter of Zeus and the happiness or ruin of individuals as well as of communities depends on their treatment of her.

This part of Hesiod's message which exalts justice and deprecates *hybris* is addressed to the leaders of his community who seem inclined to abet Perses in his unjust plans. Speaking to Perses directly, Hesiod urges him to abandon these schemes and to gain his livelihood henceforth through strenuous and persistent work. "Before success the immortal gods have placed the sweat of our brows." Hard work is for Hesiod the only way to prosperity and distinction. This is a new conception of human life which Hesiod here develops in conscious opposition to the more glorious ideals of the heroic epic of Homer.

As work in a community of peasants follows the course of the seasons Hesiod in the second half of this poem describes with much practical detail the kind of work appropriate to each part of the year and how to set about it. His advice is seasoned by bits of shrewd and dry humour, while the description of the rural year is enlivened by a vivid feeling for the rhythm of human life and for the forces of nature, such as the overpowering winter storm which drives man back into his home, and the parching heat of summer during which he must give himself a respite from his hard work.

The poem ends with a series of primitive taboos and superstitions (724–759) followed by a section explaining which parts of the month are auspicious for sowing, threshing, shearing, begetting of children, etc. It is difficult to believe that either of these sections could have been composed by Hesiod.

Spurious Works.—Such was the power of Hesiod's name that epics written by other poets were soon attributed to him, and these are often included in editions of his works. The *Precepts of Chiron,* the *Astronomy,* the *Ornithomanteia* ("Divination by Birds"), the *Melampodeia,* which described a contest between two seers, and the *Aigimios* are barely more than names for us. Considerable fragments are extant of the *Catalogues of Women* which dealt primarily with women who through union with gods became mothers of heroes and ancestresses of noble families. There is no evidence for the theory that the oldest parts of this poem are by Hesiod. The story of Alcmene, Heracles' mother, in an expanded form is extant as the *Shield of Heracles,* probably dating before the middle of the 6th century. The *Contest between Homer and Hesiod,* ending in Hesiod's victory, is later in its present form than the emperor Hadrian (2nd century A.D.), whom it mentions.

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(F. So.)

HESPERIDES, "daughters of evening," in Greek mythology, clear-voiced maidens who guarded the tree bearing golden apples which Earth gave Hera on the occasion of her marriage to Zeus. According to Hesiod (*Theogony,* 215) they were the daughters of Erebus and Night; in later accounts, their parents were Atlas, the scene of whose toil was nearby (*Theogony,* 517), and Hesperis, or Phorcys and Ceto. They were usually supposed to be three in number—Aegle, Erytheia, Hesperis (or Hesperethusa)—but according to some there were four, or even seven. They lived far away in the west beyond the Ocean stream, where the sun sets. Hence the sun sails in the golden bowl made by Hephaestus from the abode of the Hesperides to the land where he rises again. According to other accounts their home was among the Hyperboreans. The golden apples were guarded by Ladon, the ever-watchful dragon, offspring of Phorcys and Ceto. As Ladon is the name of an Arcadian river, Arcadia is possibly the original site of the garden. Heracles (*see* HERCULES) slew the dragon or put it to sleep and stole the apples, or else had Atlas get them for him. The golden apples, the gift of Aphrodite to Hippomenes before his race with Atalanta, were plucked from the garden of the Hesperides.

See H. J. Rose, *A Handbook of Greek Mythology* (1928).

(G. E. DK.)

HESPERORNIS, a genus of extinct birds known from the upper Cretaceous deposits of the Great Plains area of the United States (Kansas, South Dakota and Montana), classified in the order Hesperornithiformes. The first specimen, part of a tibiotarsus, was found by Othniel C. Marsh in Dec. 1870, in fossil beds near the Smoky Hill river in western Kansas. Bitterly cold weather and the presence nearby of hostile Indians prevented further work at the time, but the following June Marsh's party, under strong military escort, excavated a nearly complete skeleton, the type of *Hesperornis regalis.* This was a highly specialized aquatic bird, a diver in habit, about 5 ft. in length.

The head was long, with 14 teeth on the maxilla and 33 on the mandible on either side, placed in a continuous groove. The bare premaxilla seems to point to the beginning of the toothless condition of living birds. The brain appears to have been similar to that of modern birds. The body was elongate and compressed, with the wings functionless and reduced so that the humerus, the only wing bone known, was slender and curved, with so slight an articulation with the scapular arch as to indicate that it had little power. The remaining wing elements, the forearm and hand, were either missing or so rudimentary that they have not been preserved in the specimens found. The sternum was flat and without a keel, another indication that the wing had no function. The pelvis on the other hand was long and strong, the legs were heavy boned, and the toes strong. The first attempts to reconstruct the skeleton placed the bird in an upright attitude like an auk. But further study revealed that the head of the femur was articulated with the pelvis at such an angle that the leg stood out at the side, and on land the bird must have remained prostrate on the breast. That the leg muscles were extraordinarily strong is indicated by the conformation of the processes for muscular attachment. The patella in particular was especially long and well developed.

Because of the primitive condition of the skull and the flat sternum, Marsh was led to believe that *Hesperornis* was ancestral to the Struthioniformes (an order of flightless ratite birds including the ostrich) so that he referred to it as a "carnivorous, swimming ostrich." On further investigation it developed that characters of the fossil which seemed to ally it with the ratites are rather those marking it as a primitive type, as these fossil species belong in a group apart.

Parts of more than 60 individuals of the *Hesperornis* group had been found, including two additional species of the type genus, *Hesperornis crassipes* of Kansas, larger than *H. regalis*, and *H. montana* named by Robert W. Shufeldt from a vertebra found in Montana. *Hesperornis gracilis* and *Coniornis altus* are additional species of the family Hesperornithidae, which with the family Baptornithidae (for *Baptornis advenus*) form the order Hesperornithiformes.

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(A. WT.)

HESPERUS, the evening star, son or brother of Atlas (Gr. Esperos; Lat. Vesper). Although as a mythological personality he is regarded as distinct from Phosphoros or Heosphoros (Lat. Lucifer), the morning star or bringer of light, the son of Astraeus (or Cephalus) and Eos, the two stars were early identified by the Greeks.

HESS, DAME MYRA (1890–), British pianist known for her interpretations of Bach, Mozart, Beethoven and Schumann, was born in London, Feb. 25, 1890. She studied at the Guildhall School of Music, and from 1902 to 1907 at the Royal Academy of Music under Tobias Matthay, whose theories of touch, related to the weight of the arm and muscular relaxation, she illustrated in her playing. She first appeared in London in 1907 and in the U.S. in 1922. From 1939 to 1946 she organized a series of daily midday concerts at the National gallery, London, which were of great service to both music and the public during World War II and for which, in 1941, she was made a dame commander of the British empire. In her earlier years she cultivated an intimate chamber music style, and it was in this sensitive manner that she gave her memorable performances of the concerto of Schumann. The more powerful style of her later years became evident in her performances of the concertos of Beethoven and Brahms.

HESS, RUDOLF (1894–), German National Socialist, at one time one of Hitler's appointed successors, was born at Alexandria, Egypt, on April 26, 1894, the son of a German merchant. He served for part of World War I in the same regiment as Hitler before transferring to the air force. After the war he enrolled at Munich university and engaged in nationalist and anti-Semitic agitation. He wrote a prize essay on "How Must the Man Be Constituted Who Will Lead Germany Back to Her Old Heights?" and brought Hitler into touch with Karl Haushofer, the propounder of geopolitics. He assisted Hitler in the *Putsch* of Nov. 1923, escaped to Austria, then returned to join Hitler in prison at Landsberg. He took down much of Hitler's dictation of *Mein Kampf*, acted as Hitler's private secretary, became deputy party leader in April 1933 and entered Hitler's cabinet in Dec. 1933. In 1939 Hitler declared him second to Hermann Göring in the line of succession. With a reputation for absolute loyalty to Hitler, he had little intelligence or personality of his own. In the first year of World War II his relationship with the *Führer* began to be undermined by his nominal subordinate, Martin Bormann.

In the spring of 1941, encouraged by astrology and hoping to restore his prestige by a great coup for Germany, he made a dramatic attempt to obtain peace with Great Britain. After consulting Haushofer, he believed the duke of Hamilton (Douglas Douglas-Hamilton, the 14th duke) to be the most appropriate intermediary. On May 10 he flew alone from Augsburg, landed by parachute in Scotland near Glasgow and asked to be taken to the duke. After some delay in establishing his identity he was able to lay his proposals for peace before Ivone Kirkpatrick, of the foreign office, and Sir John Simon, but met with no response and was treated as a prisoner of war. Later he was brought to trial with the other Nazis at Nürnberg. His sanity was by this time seriously in doubt, but he stood trial, was found guilty of conspiracy to wage aggressive war and crimes against peace and, on Oct. 1, 1946, was sentenced to life imprisonment in Spandau jail. (W. KP.)

HESS, VICTOR FRANCIS (1883–1964), Austrian physicist, shared the 1936 Nobel prize for physics with C. D. Anderson (*q.v.*) for his discovery of cosmic radiation, was born at Schloss Waldstein on June 24, 1883. He was educated at Graz and Vienna. From 1910 to 1920 he was assistant at the Institute for Radium Research of the Vienna Academy of Sciences and lectured on physics at the Vienna Veterinary college. Appointed associate professor at Graz in 1920, in 1921 he became director of the research laboratory of the U.S. Radium corporation and consulting physicist to the U.S. department of the interior (bureau of mines). He returned to Graz in 1923 and became professor of physics in 1925 and professor and head of the new Institute for Radiation Research at Innsbruck in 1931. In 1938 he became professor of physics at Fordham university, New York, and was naturalized in 1944. Hess died on Dec. 17, 1964, at Mount Vernon, N.Y.

Hess's researches dealt mainly with radioactivity and atmospheric electricity. As early as 1911 he studied the electrical conductivity of the atmosphere during balloon ascents and on high mountains, and found that ionization increased rapidly with altitude. His experiments proved what had long been suspected; *i.e.*, that an extremely penetrating radiation enters the earth's atmosphere from outer space. Further investigation of the radiation, which was given the name of cosmic rays by R. A. Millikan in 1925, led to discovery of the positron, or positively charged electron, by Anderson, and opened up new fields of research in modern physics. (W. J. BR.)

HESS, WALTER RUDOLF (1881–), Swiss physiologist, shared with Antonio Egas Moniz (*q.v.*) the 1949 Nobel prize for medicine "for his discovery of the functional organization of the interbrain as a coordinator of the activities of the internal organs." Hess was born at Frauenfeld, Switz., on March 17, 1881. After studying medicine at several Swiss and German universities he obtained his M.D. at Zürich in 1906 and practised for six years as an ophthalmologist. In 1911 he devised the Hess screen which is widely used in the investigation of squint. From 1912 he devoted himself to the study of physiology and in 1917 was appointed director of the physiological institute in Zürich. During advanced study in England he came under the influence of J. N. Langley, Sir C. S. Sherrington and other pioneer neurophysiologists. His own researches dealt with the viscosity of the blood, the dynamics of blood pressure, the physiology of respiration and finally with the central control of the internal organs in general

through the vegetative or autonomic nervous system. He studied cerebral localization by the application of fine electrodes which permitted of strictly local stimulation or destruction of brain tissue. By these means he was able to prove that the cerebral centre for the control of blood pressure lies in a group of cells in the medulla and diencephalon. His work is complementary to that of C. Heymans (*q.v.*) on the peripheral mechanisms involved in the regulation of blood pressure. (W. J. Br.)

HESSE, HERMANN (1877–1962), German-born novelist and poet, winner of the Nobel prize in literature in 1946, was born in Calw, Württemberg, on July 2, 1877. Intended to follow his father's career as a Protestant pastor and missionary, he rebelled against traditional academic education and for a time became a bookseller. From 1904 he was able to live as a professional writer.

During World War I he lived in Switzerland, advocating policies of peace and reconciliation, and became a Swiss citizen in 1923. His political essays were collected in *Krieg und Frieden* (1946). He died on Aug. 9, 1962, at Montagnola, Switz.

Hesse's poetry is gently lyrical, being based on 19th-century German romantic traditions, while his early collections of stories (*Diesseits*, 1907; *Nachbarn*, 1908; *Umwege*, 1912) depict small-town life with ironical humour and melancholy that recall the German regional fiction of the mid-19th century. *Peter Camenzind* (1904) is the novel of a failed artist who finds consolation in nature. The psychological difficulties experienced by creative artists are also the theme of the novels *Gertrud* (1910; Eng. trans. 1955) and *Rosshalde* (1914).

During the 1920s, the period of his productive maturity, Hesse's writings were deepened by his increased interest in new psychological developments, in particular those of C. G. Jung. *Klein und Wagner* (1919), a *Novelle*, portrays the disastrous conclusion to a man's attempt to escape from domesticity and bourgeois life. *Demian* (1919; Eng. trans. 1923), a novel about adolescence influenced by his interest in psychoanalysis, aroused much discussion, and a comparable experimental approach may be discerned in *Der Steppenwolf* (1927; Eng. trans. 1929). *Narziss und Goldmund* (1930; Eng. trans., *Death and the Lover*, 1932), set in a medieval background, develops the contrast between an ascetic intellectual and an artistic sensualist. *Das Glasperlenspiel* (1943; Eng. trans., *Magister Ludi*, 1949), a novel set in the future, again shows his concern to achieve a balance between the contemplative and active life. The book links up with the aspirations of Goethe and the German Romantics, but it is also influenced by the eastern thought which Hesse met first through his missionary parents and which made a still deeper mark after a journey to India in 1911; this influence is reflected also in the earlier lyrical novel *Siddharta* (1922).

Hesse's prose style, with its fluent mastery of German and its development from classical-romantic forebears, is smooth and mellifluous; in construction, his shorter tales are often more satisfying than his longer novels, though it is in these that he expresses his ideas and portrays his characters more fully.

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HESSE (Hessen) a *Land* (state) of Germany, which following partition of the nation after World War II became part of the Federal Republic of Germany, has an area of 8,150 sq.mi. and a population (1961) of 4,814,383. The state lies between the Rhine plateau and the Thüringer Wald and was formed in 1945 through the amalgamation of the former Prussian province of Hesse-Nassau (excluding Montabaur) and the former *Land* of Hesse (excluding the left bank Rhenish Hesse) (see *History* below). It consists mainly of richly wooded hill land cut by two fault troughs, the west and east Hesse depressions, which have been since earliest times important corridors and along which most of the main towns were founded in the middle ages. To the south the Vogelsberg, a great basaltic mass, and the Rhön, rising to the Wasserkuppe (3,117 ft.), Hesse's highest mountain, dominate the area. The Spessart and the Odenwald (*q.v.*) both belong in part to Hessian territory. Hesse is drained by the Rhine and its tributaries the Main and the Lahn, by the Weser and by the Werra and Fulda. The greater part of the *Land* lies in the country of hills and lowlands that is drained north by the Fulda and Eder rivers above their confluence to form the Weser river. Beechwoods and conifers cover the highlands, and cultivated land lies on the limestone uplands and on the loess soils of the lowlands proper. This is a predominantly unspoiled agricultural countryside with small historic towns.

In 1959, 18.7% of the population were refugees from the former east German lands, Czechoslovakia, etc.; a further 5% came from the German Democratic Republic and East Berlin. Towns of more than 50,000 people (1961) are: Frankfurt am Main (683,081); Wiesbaden, the state capital (253,280); Kassel, capital of the former Prussian province of Hesse-Nassau (207,507); Darmstadt (133,412); Offenbach (116,195); and Giessen (66,291) (*qq.v.*). About 64% of the population are Protestants and 32% Roman Catholics. The constitution was adopted by popular referendum in Dec. 1946. Hesse is divided administratively into three districts (*Regierungsbezirke*)—Wiesbaden, Kassel and Darmstadt —which are subdivided into urban and rural districts (*Stadtkreise* and *Landkreise*). There are two universities, Frankfurt and Marburg, a technical college at Darmstadt, an agricultural and veterinary college at Giessen, two colleges for art and one for music.

The southwest of Hesse is primarily industrial, but it is also an area of intensive agriculture (which occupies about one-fifth of its workers). The plains of the Rhine and the Main are a mosaic of vineyards, orchards and fields of grain, potatoes and tobacco. This lowland has an early spring and a long hot summer and the total rainfall is only about 20 in. a year. Market gardening is especially important near the cities. The surrounding hills have a three-year rotation of rye, oats and potatoes, and livestock farming concentrated on the production of butter and cheese.

Natural resources are small, including some low-grade iron ores in the Taunus which are of little economic significance, salt mines near Fulda and small brown coal deposits near Frankfurt and Kassel. The industries depend on the Rhine waterway and its extensions up the Main and the Neckar. The Rhine-Main area, centred on Frankfurt and Mainz-Wiesbaden, is one of the great industrial regions of Germany. Kassel, Offenbach, Wiesbaden and Darmstadt are other big manufacturing centres. Vehicles, machinery, chemicals (especially at Höchst, west of Frankfurt), electrical goods, scientific instruments and textiles are among the products of these and other towns. New industries developed after World War II, stimulated by the arrival of refugees; these manufactures include the making of glass, toys and musical instruments.

(R. E. Di.)

History.—In the course of history Hesse has been the name for different territories. Generally supposed to be the descendants of the Frankish tribe of the Chatti (*q.v.*) who had their seats north of the Main river (originally in the district between the Eder, Fulda and Lahn rivers), the Hessians began to receive Christianity from St. Boniface and his disciples. From the end of the 8th century the greater part of their country was included in the bishopric of Mainz, and the Benedictine abbeys of Fulda and of Hersfeld played an important role. The German king Conrad I was a member of the family of the Conradines, who had originally been the counts of the Lahngau and then of the Hessengau or Hesse district. After the Conradines' successors, the counts of Maden and of Gudensberg, had died out in 1121–22, the Ludowings or Ludovingians, from 1130 landgraves of Thuringia, acquired their possessions in Lower and Upper Hesse through marriage, so that Hesse was made part of the Thuringian landgraviate. The death of Henry Raspe, however, in 1247 (*see* Henry, German kings) was followed by a long war of succession till 1264; then his niece Sophia, wife of Henry II of Brabant, acquired Hesse for her son Henry the Child. Henry the Child (d. 1308), ruling an independent landgraviate, with Kassel and Marburg as its chief seats, founded the Brabant dynasty of Hesse; and in 1292 he was raised to the rank of a prince of the empire. For two centuries the landgraves of Hesse were at variance with the archbishop-electors of Mainz, who had possessions within their frontiers. Hesse inherited the counties of Ziegenhain and Nidda in 1450 and the county of Katzenelnbogen, with Sankt Goar and Darmstadt, in 1479, but was twice

partitioned in the 15th century. Philip (*q.v.*), landgrave from 1509 to 1567, the greatest of all the Hessian rulers, reunited the territory. It was he, moreover, who in 1526 introduced the Lutheran Reformation: the monasteries were dissolved to provide for the instruction of Lutheran clergy, for the relief of the poor and the sick and for the University of Marburg, founded in 1527; and Martin Bucer (*q.v.*) was especially influential. By his last will Philip divided Hesse among his four sons into Hesse-Kassel, Hesse-Marburg, Hesse-Rheinfels and Hesse-Darmstadt.

Hesse-Kassel (*Later Electoral Hesse*).—Hesse-Kassel consisted of about half the former country and was assigned in 1567 to Philip's eldest son William IV the Wise (1532–92). In 1605 Calvinism was introduced. In the Thirty Years' War the country sided with the Swedes. Charles (1654–1730), landgrave from 1670, an outstanding ruler, improved the prosperity of Hesse-Kassel despite continual wars; *e.g.*, by bringing in the Huguenots. In 1720 Charles's son Frederick (d. 1751) became king of Sweden as consort of Queen Ulrika Eleonora. Kassel was embellished by magnificent buildings, and its picture gallery and Wilhelmshöhe palace were founded in the 18th century. Hesse-Kassel inherited the county of Hanau-Münzenberg in 1736. From the Thirty Years' War, Hessian troops fought in nearly every European and Turkish campaign; and in 1776–83 as many as 17,000 Hessian mercenaries fought for the British in the American Revolution.

In 1803 Hesse-Kassel was raised to an electorate; and it was to remain the only territory so styled after the end of the Holy Roman empire. The elector William I (1743–1821; landgrave, as William IX, from 1785) pursued a policy of neutrality toward Napoleon who, however, occupied Hesse-Kassel after the battle of Jena (1806) and in 1807 united it with the kingdom of Westphalia, while Hanau was allotted to the grand duchy of Frankfurt from 1810 to 1815. In 1809 a rising of Hessian patriots under Col. Wilhelm von Dörnberg against the French failed. Hessian troops suffered heavy losses during Napoleon's campaigns in Spain and Russia.

In 1816 Hesse-Kassel received the old lands of Fulda as a grand duchy in compensation for Lower Katzenelnbogen. Fierce disputes between the electors and the estates followed during the next two decades. After riots had broken out at Hanau, at Fulda and at Kassel, William II (1777–1847), elector from 1821, signed the extremely liberal constitution of 1831 and made his son Frederick William (1802–75) regent. The latter, counseled by H. D. Hassenpflug (*q.v.*), continuously quarreled with the diet. After he had succeeded his father in 1847, the revolutionary government (1848–49) introduced liberal reforms, sided with the national assembly at Frankfurt and joined the Prussian-sponsored Erfurt union (*see* GERMANY: *History*). In 1850, however, Frederick William returned to the Austrian side, recalled Hassenpflug and dissolved parliament. Judges, officials and officers resisted with open disobedience. At Hassenpflug's appeal, Austrian and Bavarian troops intervened while at the same time the Prussians marched against them. Then Prussia was compelled to retire by the Olomouc agreement, and Frederick William resumed his reactionary policy.

The struggle over the constitution went on, even after the constitution of 1831 was largely restored in 1862. In the Seven Weeks' War (1866) the elector sided with Austria, against the majority of the diet. The country was then annexed by Prussia and the elector exiled. In 1867 Hesse-Kassel, with Nassau, some former Hesse-Darmstadt districts and Frankfurt, was made part of the province of Hesse-Nassau. This in 1944 was split into Nassau and Electoral Hesse (Kurhessen); but on Sept. 19, 1945, these provinces were united with the part of Hesse-Darmstadt east of the Rhine to form Greater Hesse, later called simply Hesse.

Hesse-Marburg.—Hesse-Marburg was formed in 1567 for the landgrave Philip's second son, Louis IV (d. 1604). After disputes up to 1648 it was divided between Hesse-Kassel and Hesse-Darmstadt.

Hesse-Rheinfels.—Formed in 1567 for Philip's third son, Philip, Hesse-Rheinfels passed to the other lines on his death in 1583.

Hesse-Darmstadt (*Later Grand Ducal Hesse*).—Philip's fourth son, George I (1547–97) received in 1567 only the small territory of Upper Katzenelnbogen with Darmstadt. The first important addition was made at the end of the Thirty Years' War, during which George II (1605–61), landgrave from 1626, had sided with the Holy Roman emperor; the southern part of Hesse-Marburg with Giessen (where a Lutheran university had been founded in 1607) was then given to Hesse-Darmstadt. The same policy of loyalty to the imperial house was followed later on.

Hesse-Darmstadt inherited the county of Hanau-Lichtenberg in 1736. In this new territory Louis IX (1719–90), landgrave from 1768, made Pirmasens his capital, where he drilled his soldiers on Prussian lines. His wife, Henrietta Caroline, "the great landgravine," counted Goethe, Herder and Wieland among her friends, and Frederick the Great had her gravestone inscribed *Femina sexu, ingenio vir* ("a woman in sex, in wisdom a man").

After ceding Hanau-Lichtenberg to France in 1801, Hesse-Darmstadt in 1803 received in compensation parts of the former electorate of Mainz and of the Palatinate, the duchy of Westphalia (with Arnsberg) and the free city of Friedberg. In 1806 the mediatized counties of Erbach and the territories of Solms were added and the landgrave Louis X (1753–1830) became grand duke of Hesse, as Louis I, on Hesse-Darmstadt's entry into the Confederation of the Rhine. Compelled to support Napoleon with troops, Louis I did not join the allies till Nov. 1813. The congress of Vienna transferred Westphalia to Prussia and some frontier districts of Hesse-Darmstadt to Bavaria, but Louis received part of the principality of Isenburg-Birstein (with the industrial city of Offenbach) and, above all, a district on the left bank of the Rhine including the cities of Mainz and Worms. Hesse-Homburg (*see* below) had, however, to be recognized as independent. The grand duchy entered the German confederation.

Louis I, who was moreover a notable patron of the opera, granted Hesse-Darmstadt a constitution in 1820. Some reforms were carried through, and in 1828 the grand duchy was the first of the southern German states to join the Prussian customs union. Under Louis III (1806–77), grand duke from 1848, many concessions were made to the liberal doctrines during the short-lived ministry of Heinrich von Gagern and that of his successor Heinrich Karl Jaup, but during the subsequent period of reaction these were withdrawn. The responsible statesman between 1850 and 1871 was Reinhard, Freiherr von Dalwigk, who in foreign policy relied on Austria and on France and in domestic policy oppressed the liberals. Having sided with the Austrians in the Seven Weeks' War (1866), the grand duchy had to cede to Prussia the so-called Hinterland and also the newly recovered part of Hesse-Homburg; and in 1867 Hesse-Darmstadt and Prussia signed a military convention. When the new German empire was founded in 1871, the grand duchy's government became liberal. The house of Battenberg (*q.v.*) descends from Louis III's brother Alexander.

Ernest Louis (1868–1937), grand duke from 1892 to 1918, was a great patron of the theatre, the arts and architecture and the founder of the *Künstlerkolonie* (artists' colony) at Darmstadt. It was also in his reign that the railway union with Prussia was contracted (1896). On his abdication in 1918, Hesse became a republic. In 1945 the territory east of the right of the Rhine was in the U.S. occupation zone, and became part of the *Land* of Greater Hesse (*see* above, *Hesse-Kassel*), while the rest became part of the *Land* of Rhineland-Palatinate.

Hesse-Homburg.—Formed in 1622 for Frederick, a younger son of George I of Hesse-Darmstadt, the landgraviate of Hesse-Homburg at first had only limited sovereignty. Frederick II (1633–1708), who was a general in the service of Brandenburg and famous as "the Prince of Homburg" (hence Heinrich von Kleist's play of that name) before becoming landgrave in 1681, settled French refugees in his country. Separated from Hesse-Darmstadt in 1768, Hesse-Homburg was again included in the larger state from 1806 to 1815, but its independence was restored by the congress of Vienna, and Meisenheim was then added to it. When Ferdinand (1783–1866), landgrave from 1848, died childless, Meisenheim passed to Prussia and the rest of the country to Hesse-Darmstadt; but this latter part was also ceded to Prussia later in 1866 and became part of Hesse-Nassau (*see* above, *Hesse-Kassel*).

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HESSIAN: *see* BURLAP.

HESSIAN FLY (*Phytophaga destructor*), a small pest fly native to Asia, transported into Europe and later into North America in hay or straw. It is especially destructive to wheat crops, particularly in the United States and Canada. It is dark in colour and lays its eggs on the upper surface leaves of young wheat, barley and rye, the whitish larvae feeding on the stem. Eggs laid by adults in early spring hatch in a few days; the larvae feed for about one month, then develop into flaxseedlike capsules (puparia) in the axils of leaves. In late summer these "flaxseeds" give rise to another generation of flies, which then lay eggs; these latter develop into "flaxseeds" that overwinter on crop stubble. When conditions are particularly favourable additional generations may be interspersed between the spring and autumn ones. Late spring seeding, after the spring generation of flies has died (several days after emergence from the "flaxseeds"), aids in control. Some varieties of wheat are resistant. Deep plowing of stubble prevents emergence of the flies. The common name is derived from the fact that the fly is supposed to have been introduced into America in straw bedding by Hessian troops during the American Revolution. *See* FLY; WHEAT: *Insects.* (C. H. CN.; X.)

HESSUS, HELIUS EOBANUS (1488–1540), German scholar, considered the foremost Latin poet of his age, was born at Halgehausen in Hesse-Cassel, on Jan. 6, 1488. His family name is said to have been Koch. He entered the University of Erfurt in 1504 and became professor of Latin there in 1517. He took part in the political, religious and literary quarrels of the period, finally declaring in favour of Luther and the Reformation. Through the influence of Camerarius and Melanchthon, he obtained a post at Nürnberg (1526). He again went back to Erfurt (1533), but found the university deserted. In 1536 the landgrave of Hesse made him professor of poetry and history at Marburg, where he died on Oct. 5, 1540. Described as "brilliant but bibulous," Hessus was a facile versemaker but not a true poet. He wrote local, historical and military poems, idylls, epigrams and occasional pieces, collected under the title of *Sylvae* (1539). His most popular works were translations of the Psalms into Latin distichs (1538), which reached 40 editions, and of the *Iliad* into hexameters (1540). His most original poem was the *Heroïdes Christianae* (1514–1532) in imitation of Ovid, consisting of letters from holy women.

BIBLIOGRAPHY.—His *Epistolae* were edited by his friend Camerarius, who also wrote his life (1553). There are later accounts of him by M. Hertz (1860), G. Schwertzell (1874) and C. Krause (1879).

HESTIA, in Greek mythology the hearth goddess (*see* VESTA), daughter of Cronus and Rhea. She is not mentioned as a goddess in Homer, but the hearth is recognized as a place of refuge for suppliants. In post-Homeric religion she is one of the 12 Olympian deities. When Apollo and Poseidon became suitors for her hand she swore to remain a maiden forever, whereupon Zeus bestowed upon her the honour of presiding over all sacrifices. She was worshiped chiefly as goddess of the family hearth; but, as the city union was only the family union on a large scale, she had also, at least in some states, a public cult at the civic hearth in the *prytaneion* or town hall, where the common hearthfire round which the magistrates met was ever burning. From this fire, as the representative of the life of the city, intending colonists took the fire that was to be kindled on the hearth of the new colony. In later philosophy Hestia became the hearth goddess of the universe—the personification of the earth as the centre of the universe, identified with Cybele and Demeter (*q.v.*). She is seldom represented in works of art and plays no important part in legend.

HESTON AND ISLEWORTH, a municipal borough of Middlesex, Eng., which under the London Government Act 1963 was to be amalgamated on April 1, 1965, with Brentford and Chiswick and with Feltham to form the new London borough of Hounslow (*see* LONDON). Heston and Isleworth and Feltham return two members to parliament. The municipal borough (1932) is on the north bank of the Thames, 11 mi. W.S.W. of Charing Cross. Pop. (1961) 102,897. Area 11.3 sq.mi. A residential and industrial area, it contains Hounslow (*q.v.*) and Cranford. Syon monastery (1415) was pulled down by the duke of Somerset who there built Syon house (1547), a seat of the duke of Northumberland. Syon was remodeled by Robert Adam who also rebuilt the Elizabethan Osterley house, given to the National trust by the earl of Jersey in 1949.

HESYCHASM, a type of Eastern Christian monastic life, whose purpose is to achieve divine quietness (Gr. *hesychia*) through the contemplation of God in uninterrupted prayer. Such prayer, involving the entire human being, soul, mind and body, is often called "pure" or "intellectual" prayer, or the "Jesus prayer." St. John Climacus, one of the greatest writers of the hesychast tradition, writes, "Let the remembrance of Jesus be present with each breath, and then you will know the value of the *hesychia.*" In the late 13th century, St. Nicephorus the Hesychast produced an even more precise "method of prayer," advising novices to fix their eyes during prayer on the "middle of the body," in order to achieve a more total attention, and to "attach the prayer to their breathing." This practice was violently attacked in the first half of the 14th century by Barlaam the Calabrian, who called the hesychasts *omphalopsychoi* (*i.e.,* people having their souls in their navels).

St. Gregory Palamas (*q.v.*), a monk of Mount Athos and later archbishop of Thessalonica, defended the hesychast monks. In his view, the human body, sanctified by the sacraments of the church, is able to participate in the prayer, and human eyes may become able to see the uncreated light which once appeared on Mt. Tabor on the day of Transfiguration. The teachings of Palamas were confirmed by the Orthodox Church in a series of councils held in Constantinople. Hesychast spirituality is still practised by Eastern Christians and gained wide popularity in Russia.

BIBLIOGRAPHY.—The main collection of hesychast spiritual texts is the *Philocalia* (1782); partial English trans. by E. Kadloubovsky and G. E. H. Palmer (1951–53). The main work of Palamas is *For the Defense of the Holy Hesychasts* (Gr. text and Fr. trans.), 2 vol. (1959). *See* also J. Meyendorff, *St. Grégoire Palamas et la mystique orthodoxe* (1959), *A Study on Gregory Palamas* (1963). (J. ME.)

HESYCHIUS (5th or 6th century A.D.), Alexandrian scholar who compiled a lexicon important for the study of Greek dialects and the restoration of the text of Greek poets. The work, entitled *Synagoge pason lexeon kata stoicheion,* is also valuable for its information about Greek religion and customs and for the many words, forms and expressions it contains which are found nowhere else. It often preserves the original rare words for which commoner synonyms have been substituted in the manuscripts of Greek poetic texts. It is based primarily on an abridged version of the lost lexicon of Diogenianus, a compilation widely used at the time, to which Hesychius has added words from Homeric *lexica* and entries from collections of proverbs. It survives in a single manuscript (Marcianus 622, of the 15th century, at Venice) in an abridged form (many references to author and work have been dropped) and with substantial accretions of alien material. Nothing is known of Hesychius' life.

See the editions by M. Schmidt, 5 vol. (1858–68) and K. Latte, vol. i, A–Δ(1953). (D. M. J.)

HESYCHIUS OF MILETUS (by rank ILLUSTRIS) (fl. 5th/6th century), was a Byzantine historian and literary biographer. According to Photius his world history in six books extended from the Assyrian ruler Belus, the reputed founder of the Assyrian empire, to the emperor Anastasius I (d. 518). The longest surviving fragment is the account of Constantinople from book vi (*Patria Konstantinoupoleos*). He also wrote a history of Justin I (518–527) and the early years of Justinian I which has not survived. His biographical dictionary of famous writers (*Onomatologos e pinax ton en paideia onomaston*) was used in the Suda lexicon, probably from an epitome compiled between 829 and 857 which substituted alphabetical order for arrangement by chronology and

classes and added articles on Christian and later writers. Both this version and Hesychius' original are lost and are known only from excerpts in the Suda lexicon and in Photius. A smaller work with a similar title (*Peri ton en paideia dialampsanton sophon*), usually known as pseudo-Hesychius, is now considered to be a compilation made from Diogenes Laërtius and the Suda lexicon between the 10th and the 13th centuries. The absence of Christian writers from Hesychius' dictionary suggests that he was a pagan.

BIBLIOGRAPHY.—*Patria Konstantinoupoleos,* ed. by T. Preger in *Scriptores originis Constantinopolitanae,* vol. 1 (1901) in the "Teubner Series." A reconstructed text of the biographical dictionary is ed. by J. Flack (1882), and the pseudo-Hesychius is ed. by J. Flack in the "Teubner Series" (1880). *See* also K. Krumbacher, *Geschichte der byzantinischen Litteratur,* 2nd ed., pp. 323–325 (1897). (J. M. Hy.)

HETEROGAMY, in biology a condition in which the sex cells (gametes) are unlike, as opposed to isogamy (*q.v.*), in which they are alike. The term is commonly used to designate differences of both size and structure, implying a differentiation into male and female sex cells, often called microgametes and macrogametes, respectively.

Usage has tended, however, toward a separation of heterogamy into two categories: namely, anisogamy, in which the uniting gametes appear to differ only in size; and oögamy, in which they differ in both size and structure. In all cases of gametic union it is probable that the pairing gametes are differentiated physiologically whether they appear alike or unlike.

In zoology, heterogamy is used for a type of alternation of parthenogenetic generations with a sexual generation, as in certain aphids.

In botany, the term is also used for the bearing of two different kinds of flowers on the same plant, as in certain sedges, or in many Compositae (*q.v.*) where the discoid florets are perfect and the radiate florets are neutral or pistillate.

See also REPRODUCTION. (J. M. Bl.; X.)

HETMAN, a military title formerly in use in Poland; the *hetman wielki,* or great hetman, was the chief of the armed forces of the nation, and commanded in the field unless the king was present in person. The office was abolished in 1792. From Poland the word was introduced into the Ukraine in the form *ataman* and was adopted by the Cossacks as a title for their head, who was practically an indpendent prince, when under the suzerainty of Poland. After the acceptance of Russian rule by the Cossacks in 1654, the post was shorn of its power.

Ataman was also the name of the elected commander of the Cossack *voiska* in Russia. From 1723, after the rebellion led by Kondrati A. Bulavin had been crushed, only the atamans of the *stanitsas* (villages) were elected. *See* COSSACKS.

HETZER (HAETZER or HATZA), **LUDWIG** (*c.* 1500–1529), marginal Anabaptist, was born at Bischofzell, Switz., and studied at Freiburg im Breisgau. He published *Judicium Dei* (1523) against images; *Ein Beweis* on the conversion of the Jews (1524), and a German version of John Bugenhagen's exposition of Paul's epistles (1524). In the autumn of 1525 he was expelled from Augsburg, for leading the "apostolic brethren" against the Lutheran leaders, and made his way to Basel, where John Oecolampadius received him kindly, and then to Zürich. His relations with Huldreich Zwingli were difficult. He went to Strasbourg, where, in 1526, he fell in with Hans Denck, who collaborated with him in the production of his *opus magnum,* the translation of the Hebrew prophets (Worms, 1527), preceding Luther by five years. Hetzer was arrested in Constance on the charge of adultery, but more probably for his secret antitrinitarianism, and was beheaded on Feb. 4, 1529.

BIBLIOGRAPHY.—F. Weis, *The Life, Teachings and Works of Ludwig Haetzer* (1930); G. Goeters, *Ludwig Haetzer: Eine Randfigur der frühen Täuferbewegung* (1955); *Mennonite Encyclopedia,* vol. ii, pp. 621–626. (G. H. Ws.)

HEULANDITE, mineral of the zeolite family consisting of hydrous calcium and aluminum silicate, and the name of a group of zeolites including brewsterite and epistilbite. Crystals are monoclinic, and have a characteristic coffin-shaped habit. They have a perfect cleavage parallel to the plane of symmetry on which the lustre is markedly pearly; on other faces the lustre is vitreous. The mineral is usually colourless or white, sometimes brick-red. The hardness is 3.5–4, and the specific gravity 2.2. It closely resembles stilbite (*q.v.*) in appearance, and differs from it chemically only in containing rather less water of crystallization.

Heulandite occurs with stilbite and other zeolites in cavities of basaltic volcanic rocks, and occasionally in gneiss and metalliferous veins. The best specimens are from the basalts of Berufjord in Iceland and the Faeroe Islands, and the Deccan traps near Bombay, India. Crystals of a brick-red colour are from Campsie Fells in Stirlingshire, Scot., and the Fassathal in the Tirol. Heulandite also is found near Paterson, N.J., and in Nova Scotia.

For discussion of composition, origin and characteristics *see* ZEOLITE.

HEUREAUX, ULISES (1845–1899), president of the Dominican Republic, whose regime was a military despotism marked by corruption and gross cruelty to opponents, was a mestizo born in 1845, the illegitimate son of a Haitian father and mother from Saint Thomas. Heureaux grew up at Puerto Plata and early distinguished himself in the revolt against Spain and the frequent civil wars that followed. He had almost no education. He was president 1882–84 and from 1887 until his death. Relative peace during his regime encouraged agriculture and trade and especially the growing of sugar, which became the country's chief export. His improvident dealings, however, with the San Domingo Improvement Company of New York, which floated loans, built railways and took over the collection of the customs, left the country bankrupt and later led to interference in the country's affairs by the United States. Heureaux was murdered by political enemies in 1899. (D. G. Mo.)

HEUSS, THEODOR (1884–1963), first president of the Federal Republic of Germany (1949–59), was born at Brackenheim in Württemberg on Jan. 31, 1884. He studied at the universities of Munich and Berlin and obtained his doctor's degree in political science at Munich in 1905. He then joined the editorial board of Friedrich Naumann's Liberal weekly, *Die Hilfe.* From 1912 to 1918 he was the editor of the daily *Neckar-Zeitung,* at Heilbronn. Appointed a lecturer at the newly founded Deutsche Hochschule für Politik in Berlin in 1920, he held this position until 1933.

Having joined the German Democratic party, Heuss was in 1924 elected a member of the *Reichstag.* He failed at the election of 1928 but was re-elected in 1930, twice in 1932 and on March 5, 1933. With all other members of the *Reichstag* except the Social Democrats, he voted in favour of giving Hitler full powers on March 23, 1933. Even so, on May 10, his 20 books were among those "un-German" writings which were publicly burned in Berlin. After the dissolution of the *Reichstag* in Oct. 1933, Heuss went to Heidelberg to edit *Die Hilfe* until its suppression in 1936.

After World War II and the capitulation of Germany in 1945, Heuss obtained from the U.S. military government the licence to publish the *Rhein-Neckar-Zeitung* in Heidelberg. Elected chairman of the Freie Demokratische Partei in 1948, he was also a member of the parliamentary council in Bonn (Sept. 1948–May 1949) that drew up a constitution for the Federal Republic of Germany. He was elected president of the republic on Sept. 12, 1949, and re-elected on July 17, 1954. He died on Dec. 12, 1963.

Among the books that Heuss wrote, *Hitlers Weg* (3rd ed., 1932), *Friedrich Naumann* (1937) and *Die deutsche Nationalidee im Wandel der Geschichte* (2nd ed., 1950) were the most important. His early memoirs, *Vorspiele des Lebens* (1954), appeared in English as *Preludes to Life* (1955).

See M. Boveri and W. Prinzing, *Theodor Heuss* (1954).

HEVELIUS (HEWEL or HÖWELCKE), **JOHANNES** (1611–1687), German astronomer whose careful charting of the lunar surface entitles him to be called the founder of lunar topography, was born at Danzig on Jan. 28, 1611. In 1641 he built an observatory in his house, provided with excellent equipment. Besides composing his *Selenographia* (1647), he catalogued 1,564 stars, made observations of sunspots, discovered four comets, and suggested the revolution of such bodies in parabolic paths about the sun. He published two books on comets, *Prodromus cometicus* (1665) and *Cometographia* (1668). Hevelius died at

Danzig on Jan. 28, 1687. His wife, Elizabeth, had collaborated in his study of the surface of the moon, his catalogue of the stars and his work on comets. After his death she edited and published his *Prodromus Astronomiae* (1690). (O. J. E.)

HEVESY, GEORGE CHARLES DE (1885–), Hungarian chemist who became a Swedish subject, codiscoverer of the element hafnium and pioneer in the use of radioactive isotopes, received the Nobel prize for chemistry in 1943. He was born on Aug. 1, 1885, in Budapest, Hung., and educated there and in the Technische Hochschule at Berlin and at Freiburg. He was elected professor in Budapest in 1918, left there to work in the institute of theoretical physics in Copenhagen, where he became professor in 1920, and then returned to Freiburg as professor of physical chemistry in 1926. In 1943, a refugee from Germany, he became professor in the institute of organic chemistry in Stockholm university. In Copenhagen in 1923 he discovered, with D. Coster, a new element, named hafnium; on his return to Freiburg he applied a method based on the fluorescent radiations excited by X-rays to calculate the relative abundance of the different chemical elements. In 1934, after the preparation of a radioactive isotope of phosphorus, he used this discovery to study various physiological processes by means of such "labeled" radioactive isotopes to trace the course of particular substances in the body. Thence he showed the dynamic state of the constituents of the body; for this and similar work he received the Nobel prize. (D. McK.)

HEWART, GORDON HEWART, 1ST VISCOUNT, OF BURY (1870–1943), British lord chief justice remembered for the independence of his views, was born on Jan. 7, 1870, at Bury, Lancashire. A scholar of University college, Oxford, he was called to the bar at the Inner Temple in 1902 and practised on the northern circuit. After an unsuccessful contest in northwest Manchester in 1912, in which year he took silk, he was elected as a liberal for Leicester in 1913, and later represented the eastern division of that city. In Dec. 1916 he was appointed solicitor general in Lloyd George's coalition government. He was made attorney general in Jan. 1919, and was admitted to the cabinet in 1921. He played, as law officer, a leading part in a great deal of litigation arising under the Defence of the Realm acts; while in the house of commons he proved himself a powerful debater. He took an active part in the final phase of the negotiations with Sinn Feiners. He acted as president of the War Compensation court from 1922. Hewart was knighted in 1916; on Jan. 16, 1918, he was sworn in as a member of the privy council, and on March 24, 1922, was appointed lord chief justice; at the same time he was created Baron Hewart of Bury. He resigned as chief justice in 1940 and in that year was created Viscount Hewart of Bury. As a judge, Hewart was prone to reach a decision too soon and on insufficient material, and so seemed to take sides. His book *The New Despotism* (1929) was a powerful but not always temperate or just indictment of the quasijudicial powers granted to the executive and of the use made of them. He died on May 5, 1943, in Totteridge, Hertfordshire. (W. T. Ws.)

HEWITT, ABRAM STEVENS (1822–1903), U.S. manufacturer and political leader, was born in Haverstraw, N.Y., July 31, 1822. His father was one of a party of four mechanics who were sent from England to Philadelphia about 1790 to set up a steam engine for the city waterworks and who in 1793–94 built at Belleville, N.J., the first steam engine constructed wholly in America. Abram Hewitt graduated from Columbia college in 1842 and then taught mathematics there for a time. He also studied law and was admitted to the bar but did not practise. With Edward Cooper, son of Peter Cooper who built the first steam locomotive in the United States, he began the manufacture of iron girders and beams under the firm name of Cooper, Hewitt and Co. His study of the making of gun-barrel iron in England enabled him to be of great assistance to the U.S. government during the Civil War, when he refused any profit on such orders. In 1862 he introduced the first American open-hearth furnace at Trenton, N.J., and later produced the first American-made steel. Hewitt maintained excellent relations with his employees and during the depression years from 1873 to 1878 ran his plant at a loss in order to provide employment. In 1871 he was prominent in the reorganization of Tammany Hall after the fall of the "Tweed ring." From 1875 until the end of 1886 (except in 1879–81) he was a representative in congress. In 1886 he was elected mayor of New York city over Henry George and Theodore Roosevelt. He broke with Tammany, was not renominated, ran independently for re-election and was defeated. He died on Jan. 18, 1903. He gave liberally to Cooper Union, of which he was trustee and secretary.

PETER COOPER HEWITT (1861–1921), his son, was a scientist and inventor. Among his discoveries or inventions were the mercury vapour lamp, an electrical interrupter and a radio receiver.

HEWITT, HENRY KENT (1887–), U.S. naval officer, was born at Hackensack, N.J., Feb. 11, 1887, and graduated from the United States Naval academy, Annapolis, Md., in 1906. Hewitt commanded amphibious forces in a series of successful landings during World War II: in Morocco, Nov. 1942; the U.S. forces in Sicily, July 1943; the Allied forces at Salerno, Sept. 1943; and in southern France, Aug. 1944. He became commander of the U.S. naval forces in Europe on Aug. 16, 1945, retaining this post until Sept. 1946. He subsequently served as U.S. naval representative on the military staff committee of the United Nations from 1947 until his retirement as admiral in 1949. (J. B. Hn.)

HEWLETT, MAURICE HENRY (1861–1923), English novelist, essayist and poet, best known for his historical tales with medieval settings and *The Song of the Plow*, was born at Oatland's park, Weybridge, Surrey, on Jan. 22, 1861, son of Henry Gay Hewlett, the amateur critic and poet. He attended, among other establishments, the London International college, Isleworth, and was in 1891 called to the bar at the Inner Temple: during 1897–1900 he was keeper of land revenue records, succeeding his father in that position. After publishing *Earthworks out of Tuscany* (1895) and the poems *A Masque of Dead Florentines* (1895) and lecturing on medieval art in London, he achieved popular fame with a highly coloured medieval tale *The Forest Lovers* (1898). He recognized the spurious romanticism of this work and avoided it in the excellent *Little Novels of Italy* (1899), *The Life of Richard Yea-and-Nea* (1900), about Richard Coeur-de-Lion, and *The Queen's Quair* (1904), on Mary, queen of Scots—works which show Hewlett's scholarship and vigorous if somewhat bookish historical imagination at its best; however, the public continued to prefer his earlier work. Other historical works set in England and Italy by Hewlett at this time include *The New Canterbury Tales* (1901) and *The Fool Errant* (1905). He turned to the contemporary period in England with three novels centred on an imaginary scholar gypsy, John Maxwell Senhouse—*Halfway House* (1908), *Open Country* (1909) and *Rest Harrow* (1910). However, the best work of his later period is undoubtedly *The Song of the Plow* (1916), inspired by his first-hand contact with country people. This poem portrays on an epic scale the fortunes of the English agricultural labourer—personified by one Hodge—in his struggles with his environment, moneyed interest and his rulers, from the Norman conquest to the 20th century. Hewlett's vigorous and independent mind is seen here and throughout six books of essays, including *In a Green Shade* (1920), *Wiltshire Essays* (1921) and *Extemporary Essays* (1922).

Hewlett died at his home at Broade-Chalke, near Salisbury, Wiltshire, on June 15, 1923.

See *The Letters of Maurice Hewlett*, ed. by L. Binyon (1926). (W. L. G. Ja.)

HEXACHORD, a series of six diatonic notes as organized in the musical theory and teaching practice of the later middle ages and Renaissance. The names of the degrees of the hexachord are *ut, re, mi, fa, sol, la.*

The essence of the hexachordal system is that each hexachord includes only one semitone, always in the same position: between *mi* and *fa*. In the hard hexachord starting on G, *mi* is B and *fa* is C. In the natural hexachord starting on C, *mi* is E and *fa* is F. In the soft hexachord starting on F, *mi* is A, but *fa* cannot be B since that would be a tone and not a semitone above A; *fa* is therefore B♭.

The pupil learned his gamut (*q.v.*) by training himself to sing

Table of Hexachords

Pitch in Helmholtz' notation	Hard hexachord*	Natural hexachord†	Soft hexachord‡	Hard hexachord*	Natural hexachord†	Soft hexachord‡	Hard hexachord*	The basic gamut
e′							E *la*	E *la*
d′						D *la*	D *sol*	D *la sol*
Treble c′						C *sol*	C *fa*	C *sol fa*
b						b *fa* B	B *mi* B	b *fa* B
								mi B
a′					A *la*	A *mi*	A *re*	A *la mi re*
g′					G *sol*	G *re*	G *ut*	G *sol re ut*
f′					F *fa*	F *ut*		F *fa ut*
e′				E *la*	E *mi*			E *la mi*
d′			D *la*	D *sol*	D *re*			D *la sol re*
Middle c′			C *sol*	C *fa*	C *ut*			C *sol fa ut*
b♭ b ♮♯			b *fa* B	B *mi* B				b *fa* B
								mi B
a		A *la*	A *mi*	A *re*				A *la mi re*
g		G *sol*	G *re*	G *ut*				G *sol re ut*
f		F *fa*	F *ut*					F *fa ut*
e	E *la*	E *mi*						E *la mi*
d	D *sol*	D *re*						D *sol re*
Tenor C	C *fa*	C *ut*						C *fa ut*
B	B *mi*							B *mi*
A	A *re*							A *re*
G	Γ *ut*							Γ *ut (gamma ut)*

**Hexachordum durum*, because it includes b *durum* or *quadration; i.e.*, B *mi* (B ♮). †*Hexachordum naturale*, including no B. ‡*Hexachordum molle*, because it includes B *molle* or *rotundum; i.e.*, b *fa* (B♭).

the hexachordal names and positions so that he always knew where to make the semitone interval *mi* to *fa*. Ascending the hard hexachord to its fourth note, C *fa*, he finds himself on a level with the first note, C *ut*, of the natural hexachord. The full name of this note is therefore C *fa ut*. He can then think himself over into the overlapping hexachord by taking this C as *ut* and continuing from there. This is called mutation. (But the best note on which to mutate depends on the context.)

This system had the advantage of helping the learner to keep his tonal bearings; modifications of it to an octave system are still in use. *See* SOLMIZATION; TONIC SOL-FA. (R. Do.)

HEXAMETER, metrical term for a line of six feet or metra, commonly used to mean dactylic hexameter, the characteristic metre of narrative and didactic poetry in Greek and Latin. The sixth metron of the hexameter is always a spondee (– –), the fifth is usually a dactyl (– ∪ ∪). A line with spondaic fifth metron is called *versus spondaicus:*

– ∪ ∪ | – –|– ‖|– ∪ ∪ | – – | – –

flavit ab Epiro lenissimus Onchesmites (Cicero).

The hexameter has caesura either after the third long (penthemimeral), as in the line quoted above, or between the shorts of the third metron (after the third trochee):

– –| – ∪ ∪|–∪‖ ∪|– ∪ ∪|–∪ ∪|– –

formosam resonare doces Amaryllida silvas (Virgil).

or after the fourth long (hephthemimeral):

– ∪∪| – ∪ ∪ | – –| – ‖ –| – ∪ ∪|– –

obruit Auster aqu(a) involvens navemque virosque (Virgil).

Word-end after the fourth metron, although not obligatory, is common, and is called bucolic diaeresis from its frequent use in pastoral poetry (*e.g.*, Theocritus):

– ∪∪|– –|– –| – ∪∪‖– ∪ ∪| – –

nos patriae fines et dulcia linquimus arva (Virgil).

The metron preceding bucolic diaeresis is almost always a dactyl. From Homer to Virgil the dactylic hexameter underwent certain variations and refinements. In Greek hexameters caesura after the third trochee is most common. The hephthemimeral caesura is usually preceded by caesura after the third trochee or penthemimeral caesura. Word-end between the shorts of the fourth metron is avoided (Hermann's law). Callimachus (3rd century B.C.) introduced frequent *versus spondaici*, observed Hermann's law without exception and evolved other rhythmic refinements peculiar to himself.

In Latin hexameters the penthemimeral caesura is most common. The hephthemimeral caesura need not be preceded by caesura in the third metron. Hermann's law is not observed:

– ∪ ∪ | – –|– ∪∪| – ∪||∪| – ∪ ∪| – –

nudus in ignota, Palinure, iacebis harena (Virgil).

Catullus (lxiv) imitates Callimachus in using frequent *versus spondaici*, and, alone among Latin poets, observes Hermann's law.

A hexameter followed by a so-called pentameter forms the elegiac distich (*see* ELEGY).

Attempts have been made to compose hexameters in English, but the verse has never been successfully naturalized. The most ambitious and successful poems in English hexameters are those of Arthur Hugh Clough (*The Bothie of Tober-na-Vuolich, Amours de Voyage*). Clough preserves a recognizable hexameter rhythm by commencing each foot with a stressed syllable:

Went, in his life and the sunshine rejoicing, to

Nuneham and Godstowe

He admits numerous *versus spondaici:*

Be it recorded in song who was first, who last in

dressing

But his spondees are usually, by stress scansion, trochees

(*first, who last in dressing*). Clough's lines may be contrasted with Tennyson's deliberately grotesque

Hexameters no worse than daring Germany gave us.

Longfellow, in *Evangeline*, does not admit *versus spondaici*, and the invariable line-end – ∪ ∪ – – becomes monotonous. Robert Bridges (in *Ibant Obscuri*, etc.) experimented in composing hexameters more or less according to the classical rules of quantitative scansion. For the principles he followed, *see* W. J. Stone, *Classical Metres in English Verse*, appended to Bridges' *Milton's Prosody*, 2nd ed. (1901).

The alexandrine, a line of twelve syllables, sometimes called a hexameter, is not to be confused with the dactylic hexameter. (L. P. E. P.)

HEXAPLA ("sixfold"), an edition of the Old Testament in six versions, compiled by Origen. *See* ORIGEN.

HEXAPODA, an alternative scientific name for insects (class Insecta), referring to their six-legged condition. *See* INSECT.

HEXATEUCH, in biblical criticism, is the name given to the group of Old Testament books Genesis, Exodus, Leviticus, Numbers, Deuteronomy and Joshua (Gr. *hexateuchos*, "book of six volumes"). The name indicates a belief that the documentary sources of the Pentateuch (*q.v.*) appear also in Joshua. Other scholars have included Judges and Samuel and spoken of an Octateuch. The opinion that these sources can be detected outside the Pentateuch has been generally abandoned, and Martin Noth proposed that Deuteronomy did not belong originally to the Pentateuch. It was, he says, originally a preface to the "Deuteronomic history" of Israel from its entrance into Canaan to the fall of the Judahite monarchy and was detached from this context and put in its present position. Noth therefore prefers the term Tetrateuch ("book of four volumes") to designate the history of early Israel.

For bibliography, *see* PENTATEUCH. (J. L. McK.)

HEXHAM, a market town and urban district in the Hexham parliamentary division of Northumberland, Eng., 20 mi. W. of Newcastle upon Tyne by road and on the Tyne river. Pop. (1961) 9,897. Its great abbey church of St. Andrew, standing by the market place, is a fine monument of Early English work. It was largely built of stone from Roman Corstopitum near Corbridge, 4 mi. E. of Hexham, and was reconstructed about 1112; the nave was rebuilt in 1907–08. There are also fragments of the monastic buildings remaining, and west of the churchyard is the monks' park, known as the Seal. In the town are two castellated 14th-century towers known as the Moot hall (*c.* 1100–1178), which now houses the Brough library, and the Manor office, which was built as a prison in the 14th century. Aydon castle near Corbridge is a fortified house of the 14th century; and Dilston or Dyvilston is a typical border fortress dating from Norman times. There is an Elizabethan grammar school.

Hexham (in 685 Hagustaldes ham, "the estate of the hagustealed," or squire) and its abbey were the victims of many raids from Danes, Scots and English. In 1464 at the battle of Hexham the Lancastrians under the duke of Somerset were defeated. In 1536 the last prior was hanged for being concerned in the Pilgrimage of Grace. In 1761 many people were killed in a riot over enlistment. The church and monastery were founded about 673 by Wilfrid, archbishop of York. The church in 678 became the head of the new see of Bernicia, united to that of Lindisfarne about 821 and restored to the archbishop of York by Henry II. In 1545 the archbishop exchanged Hexhamshire with the king for other property. Hexham was a borough by prescription from 1276 until 1853. Many fairs and markets were granted from the 13th century onward. In the neighbourhood are market gardens, especially on the rich alluvium near Haugh lane. The chief industries are agricultural, including the marketing of cattle and other livestock, the making of agricultural implements and the buying and sorting of wool.

HEYDEN, JAN VAN DER (1637–1712), Dutch painter of town views, was born at Gorinchem, Neth. In 1650 his family moved to Amsterdam, where he lived for the rest of his life. Recurrent subjects in his paintings afford evidence of a journey to Brussels, Cologne and perhaps even farther, undertaken probably before his marriage in 1661. Later in life he may possibly also have visited London. Although he painted a few landscapes and still-life pictures, van der Heyden's reputation rightly rests upon his architectural subjects—the town views which he painted in early maturity. In these he was unrivaled, for he succeeded in combining breadth and truth of general effect with remarkable attention to the minutest details. His manner of separately realizing each brick of his houses has never ceased to amaze as a technical feat. His pictures are well composed and harmoniously coloured, exploiting contrasts of foliage and mellow brickwork. Although they carry the conviction of factual record, they are by no means all topographically truthful, for he often took liberties with actuality in the interests of design, sometimes fusing recognizable details of different towns in one composition. His *Brandspuiten-boek* ("fire-engine book"), published in 1690, contains etched illustrations of high quality. He died in Amsterdam on March 28, 1712.

See Hofstede de Groot, *Catalogue of Dutch Painters*, vol. viii (1927); W. Martin, *De Hollandsche Schilderkunst in de zeventiende Eeuw*, vol. ii (1936). (R. E. W. J.)

HEYMANS, CORNEILLE (JEAN FRANÇOIS) (1892–), Belgian physiologist, was awarded the 1938 Nobel prize for medicine and physiology for his discovery of the role played by carotid and aortic structures in the regulation of respiration. He was born at Ghent on March 28, 1892. After taking his M.D. degree at Ghent in 1920 he studied physiology in Paris, Lausanne, Vienna, London and the United States. In 1930 he succeeded his father, J. F. Heymans (1859–1932), as professor of pharmacology in the University of Ghent. His researches, which were begun in collaboration with his father, were mainly concerned with the physiology of the respiratory and circulatory systems.

The work for which he received the Nobel prize dealt with the part played by the carotid sinus, the carotid body and the aortic bodies situated in the neck in regulating blood pressure and respiration by their response to pressure stimuli and to changes in the oxygen tension of the blood. (W. J. Bp.)

HEYNE, CHRISTIAN GOTTLOB (1729–1812), German classical scholar and early scientific exponent of the significance of myth. He was born on Sept. 25, 1729, at Chemnitz, Saxony. His early life and his studies at Leipzig were made difficult by extreme poverty. In 1752 he went to Dresden at the invitation of Count von Brühl, prime minister of Saxony; but after long delay Brühl offered him only the wretchedly paid post of clerk in his library. In 1755 Heyne published his first edition of Tibullus and a year later his Epictetus and after an interval as private tutor looked forward to a better post in Dresden, but the bombardment of the city in 1760 ruined his hopes and destroyed his possessions, which included an almost finished edition of Lucian. In 1763, however, he became a professor at Göttingen, where he remained until his death there on July 14, 1812. Though Heyne edited the *Iliad* and Pindar his devotion was primarily to the Romans and among them especially to Virgil, Horace and Tibullus, of whom he published various editions. He made his name by his commentaries, but in later life he somewhat neglected textual criticism. He attempted to enter imaginatively into the life of the ancient world and perhaps thus came to formulate his view of mythology as an expression of the inexpressible religious idea (*see* his *Sermonis mythici seu symbolici interpretatio* in *Commentationes societatis regiae scientiarum Gottingensis* vol. xvi, 1808).

Bibliography.—T. Carlyle, *Miscellanies*, vol. ii (1839; later entitled *Critical and Miscellaneous Essays*), based on Latin biography by A. H. Heeren (1813); F. Leo, *Heyne* (1901); A. Hessel, *Heyne als Bibliothekar* (1928).

HEYROVSKY, JAROSLAV (1890–), Czech chemist awarded the 1959 Nobel prize for chemistry "for his discovery and development of polarography" (*q.v.*), was born in Prague on Dec. 14, 1890.

He was educated at the Charles University of Prague and at University college, London, where he worked under Sir William Ramsay and F. G. Donnan and, in 1913, held the post of demonstrator in the chemistry department. Returning to the University of Prague he was in turn assistant in the chemistry department (1920), lecturer (1922), assistant professor (1924) and professor of physical chemistry and director of the Institute of Physical Chemistry (1926–54). Heyrovsky then became director of the institute of polarography of the Czechoslovak Academy of Sciences. The work which led eventually to the discovery of polarography was begun during his student days in London, when he investigated the electrode potential of aluminum at the suggestion of Donnan.

The polarograph is an instrument for measuring the current which flows when a predetermined potential is applied to two electrodes immersed in the solution being analyzed. The first polarographic apparatus was made and described in 1925, but the method did not come into common use until some ten years later. Polarography permits of some determinations which are difficult or impossible to carry out by other means and the method finds increasing applications in both qualitative and quantitative chemical analysis. Heyrovsky's monograph *Polarographie* appeared in 1941.

In Nov. 1955 he revisited London to deliver his presidential address to the Polarographic society.

See J. Heyrovsky, "The Development of Polarography," *Nature*, 177:266–267 (1956); G. W. C. Milner, *Principles and Applications of Polarography and Other Electroanalytical Processes* (1957). (W. J. Bp.)

HEYSE, PAUL JOHANN LUDWIG VON (1830–1914), German writer, a prominent member of the traditionalist Munich school, was born in Berlin on March 15, 1830, the son of the philologist K. W. L. Heyse (1797–1855). He studied classics and romance languages and then spent a year in Italy. In 1854 he was summoned to Munich by Maximilian II of Bavaria and soon found himself, with the poet Emanuel Geibel (*q.v.*) at the centre of a flourishing circle of men of letters, who attempted to keep alive a respect for artistic values in what they held to be an age of increasing philistinism. His many-sided talent made him a

worthy representative of the old classical-romantic culture, particularly in the short story. He soon showed his mastery in a collection published in 1855 which contained "L'Arrabbiata" (Eng. trans. 1867). This is one of his best stories and is still widely read. He subsequently published many collections of stories, all of them marked by a strong emphasis on subtle and delicate psychological problems and a most carefully balanced and highly wrought style. Many of them are set in Italy and reveal his taste for the highly coloured and sculptural qualities he found there. His novels (*Kinder der Welt*, 1873, Eng. trans. *Children of the World*, 1882; *Im Paradiese*, 1875) were less successful, and he wrote a number of plays which are no longer read. For 30 years he was acknowledged as one of the important writers of the day, but in the 1880s he found himself opposed to the growing fashion of naturalism and his reputation waned. Nevertheless he was awarded the Nobel prize for literature in 1910. His *Novellen* are still considered to be among the masterpieces in the genre, and his translations from Leopardi and other Italian poets (*Italienische Dichter seit der Mitte des 18, Jahrhunderts*, 5 vol., 1889–1905) are among his best works. He produced also a considerable body of lyric poetry. He died at Munich on April 2, 1914.

BIBLIOGRAPHY.—*Gesammelte Werke*, 15 vol., new ed. (1924). Correspondence with J. Burckhardt (1916), T. Storm (1917–18), G. Keller (1919), E. Geibel (1922), T. Fontane (1928), J. V. von Scheffel (1932). *See* his autobiography, *Jugenderinnerungen und Bekenntnisse* (1912); also P. Zincke, *Paul Heyses Novellentechnik* (1928); G. Kemmerich, *Paul Heyse als Romanschriftsteller* (1928). (W. D. WI.)

HEYWARD, (EDWIN) DUBOSE (1885–1940), U.S. novelist, dramatist and poet, whose first novel, *Porgy*, was also a highly successful play, opera and motion picture. Born in Charleston, S.C., on Aug. 31, 1885, he was educated in private and public schools there. At the age of 17 he worked on the waterfront, where he observed the Negro life that was to bulk large in his work. The novel *Porgy* (1925) was set in Catfish Row, a Charleston tenement. Heyward and his wife Dorothy dramatized it (1927) and in 1935 the opera *Porgy and Bess* was produced, the libretto and words being by Heyward and Ira Gershwin and the music by George Gershwin. A motion picture version appeared in 1959. Other plays include *Brass Ankle* (1931), about miscegenation, and *Mamba's Daughters*, also dramatized by him and his wife from the novel (1929).

Heyward's first published work was poetry, *Carolina Chansons* (1922) being a joint publication with Hervey Allen; other volumes include *Skylines and Horizons* (1924) and *Jasbo Brown and Selected Poems* (1931). Other novels include *Angel* (1926), about mountain people in North Carolina; *Peter Ashley* (1932), concerning pre-Civil War Charleston; and *Star Spangled Virgin* (1939), about the Virgin Islands during the New Deal. He died at Tryon, N.C., on June 16, 1940.

See Frank Durham, *DuBose Heyward* (1954).

HEYWOOD, JASPER (1535–1598), English priest and poet whose translations of Seneca had some importance in the development of English drama, was born in London in 1535, the son of John Heywood (*q.v.*). Educated at Merton college, Oxford, he entered the Jesuit society in Rome (1562) and became professor in 1564 at the Jesuit college at Dillingen, Ger. In 1581 Heywood replaced Robert Parsons as head of the Jesuit mission to England, and was imprisoned from Dec. 1583 to Jan. 1585, when he was exiled. Heywood died in Naples on Jan. 9, 1598.

His English translations of the *Troas* (1559), the *Thyestes* (1560) and the *Hercules Furens* (1561) of Seneca were issued, with other translations, as *Seneca his tenne Tragedies, translated* (1581).

HEYWOOD, JOHN (b. 1497), English dramatist, one of the first professional writers of interludes, was probably the son of William Heywood, coroner of Coventry in 1505–06. In 1519 Heywood received a quarterly payment from the crown as "singer" and later he appeared as "player of the virginals." From time to time he received grants which show that he was in favour at court under Edward VI and Mary. He may have owed his introduction to the court to Sir Thomas More to whose circle he belonged. His wife Joan was a daughter of the printer, John Rastell, who was More's brother-in-law. He was attached to the old religion, and in 1564 when a commission was appointed to enforce the Act of Uniformity he went into exile at Malines in Belgium. From there he wrote in 1575 to Lord Burghley saying that he was an old man of 78, and asking that his daughter might collect his rents. The date of his death is unknown.

Heywood's name was attached to four interludes. *The playe called the foure P.P. . . . A palmer. A pardoner. A potycary. A pedler* (not dated, but printed *c.* 1544), is a contest in lying, easily won by the palmer, who said he had never known a woman out of patience. *The play of the wether* (printed 1533) describes the chaotic results of Jupiter's attempts to suit the weather to different people's desires. *A play of love* (printed 1533) is an extreme instance of the author's love of wire-drawn argument. *Wytty and Wytless* is more of an academic dispute than a play. Two pieces usually assigned to Heywood, though printed by Rastell without any author's name, are *A mery play between the pardoner, the frere, the curate and neybour Pratte* (printed 1533, probably written much earlier), and *A mery play Betwene Johan Johan the Husbande, Tyb his Wyfe, and Syr Jhān the Preest* (printed 1533). These two pieces show the strong influence of More, but there seems no reason to deny them to Heywood. Heywood's other works are *A Dialogue conteining . . . all the proverbes in the English tongue* (1546) and collections of epigrams, published together as *John Heywoodes woorkes* in 1562; ballads, one of them "The Willow Garland," sung by Shakespeare's Desdemona; and a long verse allegory entitled *The Spider and the Flie* (1556).

BIBLIOGRAPHY.—The 1562 *Works* and *The Spider and the Flie*, reprinted by the Spenser society (1867 and 1894); *The Dramatic Writings of John Heywood*, ed. by J. S. Farmer (1905); *"Works" and Miscellaneous Short Poems*, ed. by B. A. Milligan (1956). *See* also A. W. Reed, *Early Tudor Drama* (1926); S. A. and D. R. Tannenbaum, *John Heywood: a Concise Bibliography* (1946); C. S. Lewis, *English Literature in the Sixteenth Century Excluding Drama* (1954). (X.; N. D.)

HEYWOOD, THOMAS (1574?–1641), English playwright and miscellanist who excelled in dramas of domestic sentiment, was born in Lincolnshire, probably in 1574. Cambridge was apparently his university and Emmanuel his college. Though his stay from 1591 may have been cut short, he left with some classical scholarship, acquiring later several modern languages. Philip Henslowe first mentioned a "bocke" by him in Oct. 1596. Thereafter he was active as playwright and player until the late 1630s, claiming in 1633 to have had "either an entire hand, or at the least a maine finger" in 220 plays. Twenty-four surviving plays are generally accepted as by Heywood in whole or in part; and cases have been made out for shares in about 12 more.

His voluminousness, facility in collaboration and readiness to throw any material into a play made him, along with Thomas Dekker, the best representative of the journeymen-playwrights who wrote primarily for immediate effect. He took more care in his middle and later years, as the appeal of the theatre to the *bourgeoisie* diminished. But "the prose Shakespeare," as Charles Lamb called him, remained a practical purveyor of theatrical fare, making no high claims for his plays as literature and explaining that he was not anxious to usher them, "into the world in Volumes, to beare the title of Workes," like Ben Jonson. If he was sometimes complacent, it was at his stage successes; as when *If you know not me, You know nobody* (1605) so filled the cockpit that the printers pirated the play from shorthand notes; or when the *Ages* were acted by two companies concurrently; or when Charles I and his queen saw *Love's Mistress* three times in eight days. Heywood's plays are theatrical mélanges, his recipe being two or more contrasted plots with little integration and a lacing of clowning.

In one prologue he boasts of the variety of plots on the English stage. He dabbled in every field; but he made that of domestic sentiment his own. It is the chief ingredient of his masterpiece, *A Woman killed with Kindness* (1607), with its main plot of the erring wife and the forgiving husband. *The English Traveller* (1633) is a variant on the same theme; and so are the Jane Shore episodes of *Edward IV*, pts. 1 and 2 (1599), and the "Generous" story in *The late Lancashire Witches* (1634, with Richard Brome). Other plays with a domestic emphasis are *How a man may choose a good Wife from a bad* (1602), *The Rape of Lucrece* (1608),

The Wise-woman Of Hogsdon (1638) and *If you know not me*, pt. 2 (1606).

Part 1 of the last-named play, with some scenes in part 2, is a chronicle-history of Elizabeth as princess and queen. Other chronicles, based on pseudo-history, are *Nobody and Somebody* (1606) and *The Royall King, and The Loyall Subject* (1637). Adventure plays include the naïve *Foure Prentises of London* (1615), *The Fair Maid of the West* (1631) and *Fortune by Land and Sea* (with William Rowley, 1655). The five *Ages* (*Golden, Silver, Brazen* and, in two pts., *Iron*) are a mythological cycle dramatizing much of Heywood's *Troia Britanica*, Lucian, Homer, Virgil and Ovid. *Love's Mistress* (1636) is a charming masque play also based on mythology. Still another group of plays are essays in Fletcherian romance: *The Captives, A Maidenhead well lost* (1635) and *A Challenge for Beauty* (1636).

Heywood also wrote many books and pamphlets in prose, verse, or a mixture of both. The verse is mostly included in *Troia Britannica* (1609), an engaging version of William Caxton's *Recuyel of the Histories of Troy* with two further cantos of universal history; *The Hierarchy of the Blessed Angels* (1635), a folio of angelology and diabolology with copious notes; *Pleasant Dialogues and Dramas* (1637), consisting of dialogues and miscellanea; and seven lord mayor's pageants between 1631 and 1639. His celebrity as a symbolist in the pageants probably secured him his commission to devise the carving for the "Sovereign of the Seas," launched in 1637. He published *A True Description of His Majesties Royal Ship* in the same year. Other prose works are a translation of Sallust (1608) from the French; *An Apology for Actors* (1612); *Gynaikeion: or, Nine Books of Various History; Concerning Women* (1624); *Englands Elizabeth* (1631); *The Exemplary Lives . . . of nine of the most worthy Women of the World* (1640); and *The Life of Merlin* (1641). From 1635 on Heywood turned out 12 or more pamphlets coming down, not altogether surprisingly, on the anti-Laudian and Parliamentary side.

Heywood was married, perhaps twice, and had several children. He was buried in Clerkenwell, London, where he had lived for many years, on Aug. 16, 1641.

BIBLIOGRAPHY.—A. M. Clark, "Bibliography of Thomas Heywood," *Proc. Oxford Biblio. Soc.*, I (1925). *See* also P. Aronstein, "Thomas Heywood," *Anglia*, XXXVII (1913); O. Cromwell, *Thomas Heywood: a Study in the Elizabethan Drama of Everyday Life* (1928); A. M. Clark, *Thomas Heywood: Playwright and Miscellanist* (1931); F. S. Boas, *Thomas Heywood* (1950); and M. Grivelet, *Thomas Heywood et le drame domestique élizabéthain* (1957). (A. M. CK.)

HEYWOOD, a municipal borough (1881) in the Heywood and Royton parliamentary division of Lancashire, Eng., 9 mi. (14 km.) N. of Manchester by road. Pop. (1961) 24,090. It owes its rise to the father of the statesman Sir Robert Peel, who introduced cotton manufacturing. Spinning concerns now produce a wide range of yarns. Other industries include tanning, engineering, papermaking and towel weaving. There is a Royal Air Force maintenance unit on the outskirts. Queen's park covers 43 ac. and has an open-air theatre; attractive countryside lies not far from the town.

(W. R. P.)

HEZEKIAH (Heb. HIZQIYA; Gr. EZEKIAS), son of Ahaz, descendant and 13th successor of David upon the throne of Judah at Jerusalem. Though there are chronological difficulties in the biblical accounts, Hezekiah was on the throne from about 715 B.C. until about 686 B.C., a period when the Assyrian empire was consolidating its control of Palestine and Syria. Hezekiah's father had placed Judah under the Assyrian suzerainty in 735 B.C., in order to protect his land from the attacks of Syria, Israel, Edom and the Philistine cities of the coastal plain. The rule of Hezekiah was marked by a consistent policy of religious reform and political independence, so far as it was possible in view of the Assyrian military supremacy.

Hezekiah began his reign as a vassal of King Sargon II of Assyria (722–705 B.C.), probably in 715 B.C., and shortly afterward the city-state of Ashdod led a rebellion, attempting to obtain the support of Judah, Edom, Moab and Egypt. Whether Hezekiah actually took part in this rebellion is not known for certain, though Sargon called himself the "subduer" of the land of Judah, probably referring to some event of the year 710 when he crushed the rebellion. At the accession of Sennacherib (705–681 B.C.), further rebellions broke out all over the empire. The Babylonian vassal Merodach-baladan (Marduk-apal-iddina) allied himself with Elam, and even sent emissaries to Hezekiah (II Kings xx, 12–19) to organize a concerted resistance to Assyria. Hezekiah may have been the leader of the resistance in Palestine, which included the city-states of Ascalon and Ekron, and obtained the support of Egypt. In preparing for the inevitable battle, Hezekiah strengthened the defenses of the city, and dug out the famous Siloam tunnel (II Kings xx, 20; II Chron. xxxii, 30) which brought the water of Gihon spring to a reservoir inside the city wall. The tunnel's completion was commemorated by an inscription, discovered in 1880.

Sennacherib put down the rebellion in 701 B.C., capturing in rapid succession Sidon (which had also offered resistance), Ascalon and Ekron; Jerusalem was spared only on payment of a heavy tribute. An Egyptian army led by Shabaka of the 25th (Ethiopian) dynasty, which came to the help of the rebels, was defeated near Eltekeh in the coastal plain. Hezekiah had to capitulate after a siege of undetermined duration, during which 46 of his walled cities were taken and much of the territory of Judah placed under the control of Ashdod, Ekron and Gaza. The biblical account in II Kings xviii, 13–16 agrees very well with the information given in the annals of Sennacherib, though there are minor differences in detail. The event was thoroughly disastrous to Hezekiah.

The narrative in II Kings xviii, 17–xix, 37, which tells of a miraculous deliverance of Jerusalem by a plague that struck the Assyrian army, can hardly be based upon the events of 701 B.C. On the other hand, numerous authentic historical events are referred to, and the narrative cannot be dismissed as unhistorical. Since the mid-19th century it has been suggested by various scholars that Sennacherib actually did invade Palestine a second time, besieged Jerusalem and defeated an Egyptian army led by Shabaka's successor, Taharqa, who came to the throne in 689 B.C. This "two-campaign theory" makes it possible to account for the ancient Judaean doctrine of the "inviolability of Zion" and the prophecies of Isaiah that supported Hezekiah's policy of resistance (II Kings xix, 20–34), which can hardly be assigned to 701 B.C.

To the biblical narrator, Hezekiah's religious reform was of greatest interest. Since the cult of the Assyrian gods was a part of a vassal's obligation, any rejection of foreign gods was equivalent to rebellion. Hezekiah's religious and political policy was thus unitary, based upon the conviction that the welfare of Judah depended upon a firm adherence to its own inherited religious traditions and practices. The age of David, the Judaean golden age, was the model, and there are indications that Hezekiah had some hope of reuniting under a single rule the two parts of the Israelite people, Israel and Judah. The inspiration of past ages found expression not only in religious and political reform; especially in contrast to the sad picture of the realities of the political situation after the catastrophe of 701 B.C. there was a yearning for an ideal king who would bring about a rule of justice, peace and freedom (Isa. xi, 1–9; ix, 2–7).

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HIALEAH, a city of Florida, U.S., in Dade county and part of greater Miami, is widely known for the Hialeah racecourse, maintained as a public park, which annually attracts many visitors, exclusive of the racing season, to the exquisitely landscaped grounds. Hundreds of flamingos live on islands in the enclosed lake of the course, and are "paraded" annually on Flamingo day around a part of the infield turf. The birds were originally imported from Cuba, but most of the present flock was raised at Hialeah, where they were successfully propagated outside their native habitat. Their wings are clipped to keep them in the park.

Founded as a suburb of Miami in 1922 by James Bright, pioneer stockman, and Glenn Curtiss, aviation promoter, the city was incorporated in 1925. Hialeah developed as a distribution and

manufacturing centre for processed foods, bricks, glass fibre, steel and concrete products, furniture and fabricated homes. With a navigable canal, two railroads, several federal and state highways, the city has solicited commercial enterprises for its industrial parks. More than 10,000 residents of Hialeah are employed in the airline shops and offices at the nearby Miami International airport.

Points of interest include the Fire Engine museum with its collection of fire fighting equipment, two automobile race tracks, the nearby *jai alai frontón* and Miami-Battle Creek sanitarium.

Hialeah grew slowly with a population of 3,958 by 1940 and participated in the phenomenal growth of the city of Miami and of Dade county after World War II. By 1950 the population had reached 19,676; in the special census of 1955, 43,135; and 66,972 in 1960. For comparative population figures *see* table in FLORIDA: *Population.* (J. E. D.)

HIAWATHA ("he makes rivers"), a legendary chief (*c.* 1450) of the Onondaga tribe of North American Indians. The formation of the League of Five Nations, known as the Iroquois, is attributed to him by Indian tradition. In his miraculous character, Hiawatha is the incarnation of human progress and civilization. He teaches agriculture, navigation, medicine and the arts, conquering by his magic all the powers of nature which war against man. He was adopted as the hero of the well-known poem by Longfellow.

HIBBING, a village of St. Louis county, Minn., U.S., 76 mi. (122 km.) N.W. of Duluth, centrally located on the Mesabi range 1,527 ft. (465 m.) above sea level. Organized as a lumbering centre and named after Frank Hibbing, a timber cruiser, it was platted and incorporated in 1893. Digging a well to secure drinking water resulted in the discovery of iron ore. The finding of rich deposits under the village streets in 1919 caused the entire village to be moved one mile south. Old Hibbing became the site of one of the world's largest open-pit mines, 400 ft. (122 m.) deep and covering 1,300 ac. (526 ha.). Wealth derived from the mines is evidenced by a combined high school-junior college erected in 1921 costing $3,800,000. Mining over 121,000,000 tons of ore during World War II exhausted the rich deposits and the village, again relocated by 1950, turned to the processing of nonmagnetic taconite and the promotion of a strong retail trade. The original Northland-Greyhound bus line was established near Hibbing in 1926 by Carl E. Wickman and Andrew G. Anderson. For comparative population figures *see* table in MINNESOTA: *Population.* (E. F. GR.)

HIBERNATION AND ESTIVATION, broadly speaking, are states of dormancy in which bodily functions and activities of certain animals are greatly reduced. During hibernation, commonly known as winter sleep, certain animals endure prolonged periods of cold. Estivation, or summer torpidity, is a comparable state of suspended animation entered into by some animals in periods of heat or drought. Both hibernation and estivation permit survival during periods when food supply is short. While cold is usually considered as the most important stimulus for hibernation, other environmental factors as well as internal seasonal rhythms must be recognized as playing some part in bringing on the sleep.

There is a fascination for man in those warm-blooded animals that can hibernate, partly because man cannot do it and partly because of the hope that man might prolong his own life if he learned how to survive near-freezing body temperatures. By mid-20th century lowered body temperature (generalized hypothermia), induced during general anesthesia, had been used in surgery of the heart and brain.

Many living cells, such as sperm for artificial insemination and red blood cells for transfusion, can be stored frozen, and some very small organisms can be repeatedly rapidly frozen and thawed without apparent damage. The harm of freezing comes from the slow formation of ice crystals. Some living tissues can be cooled rapidly in liquid air to a solid state and later rewarmed rapidly without harm. In slow freezing there are changes in the distribution of water and salts that kill cells. For living cells to endure storage in a frozen state, they must undergo preliminary dehydration and salt dilution by some nonaqueous solvent.

Probably no animal can withstand freezing of all its body water and still recover afterward, but a few mammals have been frozen experimentally to the extent of becoming rigid for a few minutes and have recovered. Although the outer tissues of fish can be frozen, reports of complete freezing of fish appear fallacious.

Many insects are frozen for long winter periods. In these insects there is some dehydration during gradual winter-hardening and their body fluids become supercooled by many degrees; *i.e.,* the temperature falls below the freezing point, yet the body fluids remain liquid; but if an ice crystal forms, the temperature rises rapidly to the freezing point. Some animals can remain in a supercooled condition for long periods; certain fish in deep fjords live in this state permanently.

Hibernation by Mammals and Birds.—So-called warm-blooded (homoiothermic) animals are distinguished from so-called cold-blooded (poikilothermic) ones in having higher metabolism, hence greater heat production; in being protected against heat loss by insulation of fur, feathers and subcutaneous fat; by being able to divert warm blood away from the body surface; but most of all by having a temperature-regulating centre ("thermoregulator") in the brain. When the temperature centre of a homoiothermic animal is stimulated, either by nerve impulses from skin cold receptors or by direct cooling of the blood, various protective mechanisms are called into action and body heat is conserved. The first protective responses against cold are the diversion of blood from the skin to the interior of the body, the improvement of insulation by erection of fur or feathers and then the increase of heat by shivering. A set of responses in the opposite direction serves to increase heat dissipation when the temperature centre is activated by high temperatures. Hormonal responses occur to each temperature stress.

All mammals and birds show fluctuations in body temperature characteristic of the time of day or night. Night prowlers or fliers have their sleep period of low body temperature in the daytime. In some bats heat regulation lapses during rest and they enter a torpid state: during each day's sleep they go into a condition similar to winter dormancy, with their body temperature dropping to near air temperature. Similar cessation of activity, slowdown of heart and breathing and fall in body temperature, occurs in sleeping hummingbirds, some swifts and poorwills. This cooling during sleep conserves body reserves but it delays the animal's becoming active on awakening. Primitive mammals such as the monotremes (platypus, spiny anteater), marsupials (kangaroo, opossum) and edentates (sloth, armadillo) tend to have lower temperatures normally than other mammals. Seasonal hibernators are found among the monotremes, insectivores (shrews, hedgehogs) and insect-eating bats. Best-known hibernators are rodents of temperate and arctic latitudes; *e.g.,* ground squirrels, woodchucks, marmots, hamsters, dormice.

The warm-blooded animals that can hibernate are able to turn down the setting of their thermoregulators, so to speak, so that over a wide range of environmental temperature they are essentially cold-blooded. They then enter a sleep in which their body temperature fluctuates with the temperature of the air around them. Some animals pass abruptly into the hibernation state; others require much preparation. Some, such as ground squirrels, gain much fat prior to hibernation and all body fats change to a less saturated form. Others, for example hamsters, store up much food and delay entrance into hibernation.

Most hibernating mammals seek a sheltered hiding place, or burrow into the ground. The temperature in the den is usually several degrees warmer than outside, 59°–63° F. when it is 46°–50° F. outdoors. (The temperature measurements in this article are given in the Fahrenheit scale [32° F. = 0° C.; 59°–63° F. = 15°–17° C.].) The burrow usually extends below the frost line; the alpine marmot burrows 9 ft. into the ground, the steppe marmot as much as 30 ft. and closes the entrance with stones and hay.

Hibernation is normally initiated by cold temperatures, but it may be hastened by lack of food, shortened days and other factors. As an animal enters hibernation, its temperature regulation becomes poor; when its body temperature falls, it fails to respond in the usual manner by fluffing fur, shivering and increasing metabolism. The body temperature falls to conform with that of the

air and may go down to a few degrees above freezing (39°–41° F.). Breathing becomes slow and irregular, the heart beats very slowly (7 to 10 times per minute, compared with the 300 per minute normal in the ground squirrel) and metabolism is reduced by 30 to 100 times. Various nervous reflexes cease to function when the body temperature falls to 64°–77° F.; and electrical activity of the brain is no longer detected at below 52°–66° F. (The exact limiting temperature may vary for each animal species.) Throughout hibernation the breathing centre remains sensitive to carbon dioxide. During the sleep, body fats are slowly used up; a brown bat may lose 35% of its weight and a fattened ground squirrel 80% during a winter.

If the air temperature drops to freezing (32° F.), many hibernators begin to breathe faster; they raise their heat production and maintain their body temperature at about 39° F.; some awaken. Those that fail to respond to the freezing air die as a result of the extreme cold. Many hibernators awaken periodically during the winter, some of them to feed and drink. Bats apparently are not stimulated to awaken by extreme cold but they usually hibernate in comparatively warm moist caves and move about occasionally. The energy expended by a ground squirrel in awakening every 11th day has been calculated to be more than that used during the entire 10 intervening days of dormancy.

Arousal from hibernation is a dramatic process. It can be elicited experimentally by a rise in temperature, by mechanical, sound and other stimulation. The body temperature may rise by as much as 86° F. during three or four hours. The warming process of a hibernating mammal uses self-produced heat in contrast to the warming of a cold-blooded animal, which absorbs heat from outside. The heart begins to beat regularly, breaths come more frequently, heat is produced by heart and chest muscles and the anterior half of the body warms before the hind part. The region of the brain concerned with autonomic function is active before higher centres. As the animal warms, its oxygen consumption overshoots the normal level, and muscular activity begins irregularly.

Many body functions in hibernators are different from those in nonhibernators, but the most important seems to be the setting down of the thermoregulator to a little above freezing temperature. The net effect is to permit the animal to remain alive without additional food during the period when temperatures are low and food is scarce.

Many mammals sleep a great deal during the winter but do not hibernate; that is, their body temperature remains high. Bears, skunks, pocket gophers, chipmunks and opossums take long winter sleeps. Brown and black bears enter protected dens; the anus becomes plugged with a tappen composed partly of pine needles, and they do not defecate until spring. However, the young are born during the winter.

Reports of hibernation among birds have been made for certain nightjars or goatsuckers (Caprimulgidae). Some birds are able to withstand the vicissitudes of cold weather; but many others, which lack sufficient insulation to survive long, cold winter nights without eating, migrate to warmer climates. (*See* also BIRD; MIGRATION, BIRD.)

Hibernation and Estivation by Cold-Blooded Vertebrates.—In winter many amphibians become inactive in a protected niche. At low temperatures aquatic amphibians such as frogs burrow into bottom mud. Reptiles also spend the winter in a torpid state. A few fish spend long periods resting on the lake or river bottom or in mud when their activity is limited by temperature. Most fish, however, continue to be active in winter.

Many reptiles, amphibians and fish undergo estivation brought on not so much by heat as by drought. Crocodiles, alligators and water turtles may remain buried in mud until water reappears. Frogs have frequently been dug out of clay near the edges of dried-up ponds and streams. The bladder may retain water; Australian aborigines are said to use such frogs as a source of water. The best-known of estivating fish are the dipnoans or lungfish (*q.v.*). The African lungfish *Protopterus* burrows deep into the mud when its swamp stream starts to dry. The gills become useless, but it breathes by means of its gas bladder and in its torpid state uses fat reserves slowly. Its bladder accumulates quantities of urea, but when the fish is released by the rains it reverts to the excretion of ammonia.

Invertebrates.—Many fresh-water protozoans form cysts under such adverse conditions as cold, heat, drying or fouling of the water in which they live. Encystment is entered by some protozoans in the normal process of reproduction and dispersal. The protozoan secretes a protective cyst wall, which may be either carbohydrate or keratinous in nature, and a transparent inner membrane. Reorganization of cell contents occurs. Encysted protozoans may survive high heat, subfreezing (liquid air) temperatures and drying. There are reports of revival of soil flagellates and amoebae from cysts that had been dried for more than 40 years. Cysts of ciliates attached to grass survive long periods of drought. In suitable surroundings and temperature excystment occurs in a few minutes.

Fresh-water sponges (*q.v.*) form resistant gemmules, and bryozoans (*see* BRYOZOA) form statoblasts as part of their normal life cycles. Both gemmules and statoblasts are surrounded by a hardened, resistant double membrane and may survive repeated freezing and drying. Some of the fresh-water Copepoda and Tardigrada (*qq.v.*) form resistant cysts in unfavourable conditions, either winter or summer. Land snails protect themselves for either hibernation or estivation by closing the shell mouth with a resistant, sometimes calcareous, membrane. Slugs burrow into the soil and protect themselves with a mucous mantle. Desert snails may survive several years without food or water in a state of estivation.

Insects winter in several ways, many as nymphs or pupae in a state of diapause or rest. Diapause can be brought on by cold or lack of food and water; some species, such as meal moths and blowflies, breed continuously in favourable conditions, but enter diapause in unfavorable conditions. In other species, particularly certain moths and butterflies, pupal diapause is a necessary stage of the life cycle, and the butterfly or moth cannot emerge until diapause is broken by exposure to cold. Other insects, for example mosquitoes, spend the winter as resistant eggs, and many spend it as larvae or adults. These may seek locations protected from freezing, or a place where only their outer layers may freeze. In preparation for wintering they become somewhat dehydrated, and may contain more bound and less free water than previously. They may become supercooled by about 41°–68° F., and thus they do not freeze. Experiments indicate that when invertebrates do freeze, only slightly more than half their body water is frozen.

Various animals suspend vital activities in different ways during periods of prolonged cold and drought. Cold, especially gradually decreasing temperatures, is only one stimulus, perhaps the most important, for hibernation. And drought is only one of the stimuli for estivation. Investigations of the processes of hibernation and estivation may aid in bringing about an understanding not only of the limits of vital function but also of the preservation of tissues in a state of suspended animation. *See* also ANIMAL HEAT; and references under "Hibernation and Estivation" in the Index volume.

See C. P. Lyman and P. O. Chatfield, "Physiology of Hibernation in Mammals," *Physiol. Rev.*, 35:403 (1955); C. Kayser, *The Physiology of Natural Hibernation* (1961). (C. L. PR.; X.)

HIBERNIA, in ancient geography, one of the names by which Ireland was known to Greek and Roman writers. Other names were Ierne, Iouernia and (H)iberio. All these are adaptations of a stem from which Erin and Eire are also derived. The island was known to the Romans through the reports of traders, so far at least as its coasts, but never became part of the Roman empire. Agricola (*c.* A.D. 80) planned its conquest from Britain, which he judged easy, but the Roman government forbade it. *See* IRELAND: *History.*

HIBISCUS, a genus of plants of the mallow family (Malvaceae), comprising about 150 or more species of herbs, shrubs and trees, native to temperate and tropical regions but most abundant in the latter. They bear palmately veined, lobed or parted leaves and mostly bell-shaped, frequently very large, scarlet, pink, yellow or white flowers, with the parts, except the numerous stamens,

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ROSE MALLOW (HIBISCUS MOSCHEUTOS)

usually in fives. A few species yield food and fibre products, but in Great Britain they are grown chiefly, and in the U.S. frequently, for ornament. Representative economic species are *H. esculentus* (okra or gumbo); *H. tiliaceus*, the mahoe, a tropical plant that yields a fibre; and *H. sabdariffa*, the roselle, the cooked calyx of which has a cranberrylike flavour and is used in the southern United States. Among the best-known ornamental species are *H. syriacus* (rose of Sharon or shrubby althea); *H. rosa-sinensis* (rose of China or shoeblack plant, widely cultivated in many handsome varieties); and *H. trionum* (flower of an hour). The North American rose mallow, swamp mallow or sea hollyhock (*H. moscheutos*) is native to salt or brackish marshes near the coast from Massachusetts to Florida and occurs sparingly, westward to Indiana and Missouri, in fresh marshes. It is the source of many fine garden forms cultivated for ornament. These varieties, which are treated as annuals or perennials, require deep, rich, moist soil. They may be grown from seed or roots; hardy late summer and fall bloomers in temperate regions, they may benefit from a mulch during the winter. *See* MALVACEAE; OKRA. (N. TR.; X.)

HICKES, GEORGE (1642–1715), English clergyman and scholar, one of the most thoroughgoing nonjurors (*q.v.*) and Jacobites, was born in Yorkshire on June 20, 1642. Educated at Cambridge, he was appointed rector of St. Ebbe's, Oxford (1675); vicar of All Hallows, Barking, Essex (1680); chaplain to the king (1681); and dean of Worcester (1683). He opposed both James II's Declaration of Indulgence and Monmouth's rising, though he tried in vain to save from death his nonconformist brother John, who had joined Monmouth. At the revolution Hickes, as a nonjuror, was suspended and in 1691 deprived of his deanery. After a period of concealment in London, he was sent by the other nonjurors to James II in France to discuss episcopal succession; on his return he was secretly consecrated suffragan bishop of Thetford. He died on Dec. 15, 1715. Posthumous publication of his *The Constitution of the Catholic Church and the Nature and Consequences of Schism* (1716) gave rise to the celebrated Bangorian controversy (*see* HOADLY, BENJAMIN).

Hickes was a profound scholar in Hebrew, Anglo-Saxon and theology. While a Jacobite fugitive he published in 1705 his study in the comparative philosophy and the history of England, *Linguarum veterum septentrionalium thesaurus grammatico-criticus et archaeologicus*, which won him a European reputation. Among his other works are his two treatises of 1707, *Of the Christian Priesthood* and *Of the Dignity of the Episcopal Order*.

See J. H. Overton, *The Nonjurors* (1902); S. C. Carpenter, *Eighteenth Century Church and People* (1959).

HICKOK, JAMES BUTLER ("WILD BILL") (1837–1876), U.S. marshal, soldier and scout, was born May 27, 1837, at Troy Grove, Ill. Early in life he became recognized as an excellent pistol shot. In 1855 he went west where for a time he drove a stage over the Santa Fe and Oregon trails. He had many violent encounters. Once he was almost fatally injured from an attack by a cinnamon bear which he killed with a knife. In 1861 he fought singlehandedly the McCanles outlaw gang at Rock Creek Station in Jefferson county, Neb., killing McCanles and two of his men. During the American Civil War he served as a scout in the Union army. His career as an Indian fighter and as a U.S. marshal at Hays City and Abilene, Kan., led to numerous combats with thieves and outlaws. For a brief period of time he was an unsuccessful member of one of William ("Buffalo Bill") Cody's tamed Wild West shows. When not otherwise employed, Hickok liked to gamble at cards, and it was while playing in a poker game at Deadwood city, Dakota Territory, that he was fatally shot from behind by Jack McCall, Aug. 2, 1876.

See William E. Connelley, *Wild Bill and His Era* (1933); Richard O'Connor, *Wild Bill Hickok* (1959). (O. O. W.)

HICKORY, the common name for the genus *Carya*, of the walnut family (Juglandaceae), and one of the most valuable timber and nut-producing groups of hardy trees indigenous to eastern North America. They are all fast-growing tall trees, often reaching 100 ft., whose pinnately compound leaves turn yellow before dropping in autumn. The most important of the genus is the pecan (*q.v.*; *C. illinoensis*). The other *Carya* species are the hickories proper.

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FRUIT AND LEAVES OF THE SHAGBARK HICKORY (CARYA OVATA)

The recognized American species are native to the eastern U.S., westward to Texas and Nebraska, with a few species extending into southeastern Canada and northern Mexico. These are the bitternut, *C. cordiformis*; black, *C. texana*; Carolina, *C. carolinae-septentrionalis*; Fernow, *C. fernowiana*; hammock, *C. ashei*; mockernut, *C. tomentosa*; nutmeg, *C. myristicaeformis*; pignut, *C. glabra*; red, *C. ovalis*; sand, *C. pallida*; scrub, *C. floridana*; shagbark, *C. ovata*; shellbark, *C. laciniosa*; swamp, *C. leiodermis*; and water, *C. aquatica*. A few hickory species, including *C. cathayensis*, *C. poileana* and *C. tonkinensis*, are found in southeast Asia, along with the closely related trees of the genera *Annamocarya* and *Rhamphocarya*. Fossil forms referred to *Carya* have been found over wider regions, including western U.S. (including Alaska), Greenland, Iceland, Europe and a considerable part of China.

All hickories are nut bearers; the shagbark, shellbark and Carolina hickories and their hybrids are of particular value on this account. Bitternut and water hickory are inedible because of tannin in the skin covering their convoluted kernels, but a few pecan-bitternut and shagbark-bitternut hybrids are cultivated for their nuts and are among the most vigorous trees of the genus. Many hickories have special ornamental value, since the foliage is rich green in summer and may become bright yellow in fall. The wood of all hickories is valuable as fuel, and that of shagbark, shellbark, Carolina, mockernut, pignut and red is much prized as material in making tool handles.

JOHN H. GERARD

TRUNK OF THE SHAGBARK HICKORY (CARYA OVATA)

Although cultivated to a limited extent, the shagbark, shellbark and hybrid hickories are propagated in numerous varieties that yield high-quality nuts farther northward than the pecan. Among the pomological varieties are the shagbarks Harold, Etter No. 54, Anthony, Bernath, Davis, Fox, Grainger, Neilson, Schinnerling, Shaul, Weschcke and Wilcox; the shellbarks Scholl, Ross Etter No. 9 and Wagner; and the hybrids De Acers, Fairbanks and Stratford. The first two shagbarks and the last three hybrids are among the few that appear permanently compatible when grafted on stock of the bitternut species. Shagbark, shellbark, pecan and hybrids between them make more useful stocks in nurseries. Grafting is by bark, modified cleft or plate budding methods.

Pleas is the only pecan-bitternut hybrid with good-flavoured nuts. *See* also NUT. (J. C. MCD.; X.)

HICKS, ELIAS (1748–1830), U.S. Quaker liberal, influential in the early days of the abolition movement, was born on the

Hempstead plains, Long Island, N.Y., on March 19, 1748. A carpenter's apprentice, he married Jemima Seaman in 1771 and settled on the Seaman farm at Jericho, L.I. Recorded a minister in 1778, he repeatedly passed through the British and American lines during the Revolutionary War. On horseback or by gig he journeyed 40,000 mi. in the ministry, from Canada to North Carolina and as far west as Richmond, Ind. Walt Whitman wrote of the "pleading, tender, nearly agonizing conviction" of Hicks's speech. Hicks urged the Society of Friends to establish local schools and helped found an important boarding school. After assisting in freeing the Society of Friends of slavery, he worked for general abolition. He urged a boycott on the products of slave labour and advocated the establishment of an area in the southwest as a home for freed slaves. Several editions of his *Observations on the Slavery of the Africans and Their Descendants* (1811) were published. He helped secure legislation bringing slavery to an end in New York state. Hicks's sermons dwelt much on simplicity, temperance and peace. He combined the Quaker teaching of God's individual guidance with the use of human reason, and was one of the first teachers of the doctrine of progressive revelation. He successfully opposed the adoption by the Baltimore yearly meeting in 1817 of a set creed. Called a heretic for opposing the rising evangelical movement among Friends, he was unjustly held responsible for the Quaker schism in America of 1827–28. His followers, who called themselves the Liberal branch, were termed Hicksites by the orthodox party, which in the beginning they outnumbered. (*See* FRIENDS, SOCIETY OF: *History*.) Hicks died at Jericho on Feb. 27, 1830.

Hicks's *A Series of Extemporaneous Discourses* was published in 1825, his *Journal* in 1832 and his *Letters* in 1834.

See B. Forbush, *Elias Hicks: Quaker Liberal* (1956). (B. FH.)

HICKS, THOMAS HOLLIDAY (1798–1865), U.S. politician, governor of Maryland at the outbreak of the Civil War and largely responsible for Maryland's remaining in the Union, was born on a farm in Dorchester county, Md., Sept. 2, 1798. He became a constable when 21 years old and was elected sheriff when 26. In 1830 he was elected to the state legislature; in 1836 he was made a member of the electoral college; in 1838 was appointed register of wills in his home county, a position he held for almost 17 years. He was elected governor of Maryland in 1857.

The state was divided on the question of secession. The southern and eastern parts generally favoured the cause of the seceding states; the northern and western counties did not. In 1860–61 Hicks resisted great political pressure to call a special session of the state legislature, avoiding any official action on secession. This and the fact that the state lay north of Washington and quickly came under control of the federal government at the outbreak of the war kept Maryland from joining the Confederacy. Hicks represented the state in the U.S. senate from 1862 to 1865. He died at Washington, D.C., on Feb. 13, 1865.

HIDALGO (a contraction of *hijo de algo*, literally "son of something"), a Spanish term formerly denoting a person enjoying the status of knight, either by direct grant from the crown or by inherited privilege. The term appears during the 12th century as *fijodalgo* and *fidalgus* (*filius de algo*); *hijodalgo* and then *hidalgo* are later forms. The term could be applied to the nobility as a whole (*cf.* gentleman) but in general was used to distinguish the lesser nobility from the magnates (*ricos hombres*) and the ordinary gentry (*caballeros villanos*). The hidalgo enjoyed exemption from most taxation but could not practise a craft or trade without losing his caste status. Because of the severe demands on the knightly class in medieval Spanish wars, the status had continuously to be extended, and hidalgos finally formed a sizable minority of the total population.

HIDALGO, an inland central plateau state of Mexico. Pop. (1960) 994,598. Area 8,103 sq.mi. It is bounded on the north by San Luis Potosí and Veracruz, on the east by Puebla, on the south by the states of México and Tlaxcala and on the west by Querétaro. Hidalgo was part of the state of México until 1869 when it was established as a separate state in honour of the revolutionary patriot Miguel Hidalgo y Costilla (*q.v.*), the priest who began the struggle which ended in Mexico's independence from Spain in the early 19th century. Its northern and eastern parts are among the most mountainous in Mexico. The peak at Navajas reaches 10,538 ft. and is near the spot where the Aztecs obtained obsidian for their knives. The south and west of the state is relatively flat and semiarid elevated tableland, sloping off into tropical lowlands. In the plains area is Lake Metztitlán and the valley of Tulancingo, centre of textile industries.

Hidalgo has a number of natural thermal baths, such as those at Ixmiquilpan. With cool to temperate climates and considerable ranges of moisture, a variety of agricultural products are cultivated including rice, cereals, coffee, maguey (American aloe) for pulque, peppers, tobacco, fibres and woods. Hidalgo is one of the most highly mineralized states of Mexico. The first mines were founded in 1534 in Pachuca, and the government-owned Cía. del Real del Monte y Pachuca is one of the most extensive properties in the world. Much of the silver carried to Spain by the famous "silver fleet" came from the rich mines of Hidalgo. Silver, gold, mercury, copper, iron, lead, zinc and antimony as well as sulfur, jasper, opals and a little coal are produced. Although fairly well urbanized, Hidalgo still has numerous indigenous groups, such as the Otomi, living in primitive but picturesque agricultural villages and settlements such as Tenango de Doria and Metepec. Tula, 40 mi. W. of Pachuca (*q.v.*), the state capital, was once the capital of the Toltecs and is an archaeological site. Tulancingo (pop. [1960] 26,839) and Huejutla de Reyes (3,849) are important commercial centres. (H. R. HY.)

HIDALGO Y COSTILLA, MIGUEL (1753–1811), "father of Mexican independence," was born May 8, 1753, at Corralejo, a farm near Guanajuato. He was educated for the priesthood at Valladolid (now Morelia, Michoacán) and was ordained in 1789. His early career was uneventful, though his interest in the economic advancement of his parishioners in Dolores, through the introduction of newer methods of agriculture, made him suspect by the Spanish authorities. He was thought to be too much under the influence of the Enlightenment.

In 1808 Spain was invaded by French troops and Napoleon forced the abdication of Ferdinand VII in favour of his brother Joseph Bonaparte. Though Spanish officials in Mexico were loath to oppose the new king, many Mexicans formed secret societies, some in support of Ferdinand, others of independence from Spain. Father Hidalgo belonged to such a group in San Miguel, near Dolores. When the plot was betrayed to the Spanish, several members were arrested. Warned to flee, Hidalgo decided instead to act promptly. On Sept. 16, 1810, he rang the church bell in Dolores to call his parishioners, announcing a revolution against the Spanish. But what had begun in San Miguel as a movement for independence became a social and economic war of the masses against the upper classes. Thousands of Indians and mestizos flocked to Hidalgo's banner of the Virgin of Guadalupe. The hosts rolled over Guanajuato and other major cities west of Mexico City. Soon Hidalgo was at the gates of the capital. Yet he tarried, and the opportunity was lost. His followers melted away. The responsible elements in Mexico were frightened by the prospect of social upheaval. In the end Hidalgo fled north, hoping to escape into the United States. He was captured, degraded from the priesthood and shot as a rebel in Chihuahua on July 31, 1811. Though he accomplished little, Father Hidalgo's name became the symbol of the independence movement for most Mexicans and Sept. 16, the anniversary of *grito de Dolores* ("cry of Dolores"), is celebrated as Mexico's Independence day. *See* also MEXICO; DOLORES, GRITO DE. (R. E. Q.)

HIDATSA, an American Indian people of Siouan family, one of three "village tribes" on the upper Missouri river in the state of North Dakota, the others being the Mandan and Arikara (*qq.v.*). The Hidatsa are also known as the Minitari and Gros Ventre of the Missouri. They were a sedentary people who engaged in corn, bean and squash horticulture in the fertile river valleys and who hunted bison and other large game on the grasslands. The women did the farming, while the men hunted and engaged in warfare. Circular earth lodges were occupied by matrilocally extended families, and their social organization included matrilineal clans and an age-graded society system. The

Sun dance (*q.v.*), which involved considerable self-torture, was their major ceremony.

The language of the Hidatsa is most closely related to that of the Crow (*q.v.*), with whom they were united before the historic period. Culturally they resemble the Mandan, a result of more than 200 years of continuous and peaceful association. In the latter part of the 18th century there were over 2,000 Hidatsa located in three separate villages. With their neighbours, the Mandan, they occupied a central position in the extensive trading network on the northern plains. Horses, dressed hides and buffalo robes, obtained from the nomadic warrior peoples to the west, were exchanged with European traders for guns, knives and other manufactured goods.

The power of the Hidatsa was broken in 1837, the result of a terrible smallpox epidemic which reduced the population so severely that the survivors consolidated into one village. Continual harassment by their enemies, the Dakota, forced them to band together with the Mandan in 1845 and with the Arikara in 1862 for purposes of defense. Since the establishment of a permanent Indian bureau in 1868, the Hidatsa, Mandan and Arikara, collectively known as the Three Affiliated Tribes, have lived together on the Fort Berthold reservation, N.D. The combined reservation population was approximately 2,500 in the early 1960s. *See* also PLAINS INDIANS.

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HIDDENITE: *see* SPODUMENE.

HIDE, in English history, a word that can most accurately be rendered by the phrase "family land"; originally it denoted the amount of land necessary for the support of a free peasant family. The actual amount of land covered by this term is still and is long likely to be a matter under discussion.

In the 12th and 13th centuries, the hide commonly appears as 120 ac. of arable land with the meadow and the pasture-rights locally considered appurtenant to such a tenement. But the scanty evidence which comes from an earlier time suggests that, at least in Wessex, the hide had once been much smaller than this, and there are facts which point to a pre-Conquest southern hide of 48 ac. The large hide of 120 ac. is best recorded in the eastern midlands, and its appearance there may in part be due to the influence of the large Scandinavian tenements introduced into the neighbouring country by the Danish settlements of the 9th century. In any case, throughout England, the hide underlay the whole local organization of early English society. It was the basis of the earliest taxation, the contributions made by different districts to the support of kings and ealdermen, and it seems to have formed also the basis according to which the primitive English militia, the *fyrd*, was raised. By the end of the old English period it had become unusual for a single peasant to hold an entire hide. The quarter hide, or yardland (Lat. *virgata*), had become, and long continued to be, the normal peasant tenement. Long after the Norman Conquest, however, the hide was the unit according to which assessment to national taxation, such as danegeld (*q.v.*), was expressed. The Norman administration maintained the old English system by which most villages in the midlands and the south and west of England were assessed at some round number of hides, such as 5, 10 or 25, an arrangement which undoubtedly descends from the time when the hide was the essential unit of agrarian economy. (F. M. S.)

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HIDE. This term is generally used to describe the pelts taken from cows, steers and bulls of the bovine species and also the pelts from horses. The pelts of other animals are commonly called skins, viz., sheepskins, goatskins, calfskins, etc. Hides are almost entirely a by-product of the meat industry, the supply being determined by the demand for beef. For the preservation and tanning of hides *see* LEATHER. (E. L. D.; X.)

HIERAPOLIS, the name of two ancient cities, one in Syria, the other in Asia Minor.

Syrian Hierapolis.—This is now a ruin, the site of which is partly occupied by modern Membij (Manbij), about 50 mi. N.E. of Aleppo in the Aleppo *mohafazet* (district) of Syria. The place first appears in Greek as Bambyce, but Pliny (*Natural History*, v, 23) states that its Syrian name was Mabog. It was doubtless an ancient Commagenian sanctuary. The Seleucids made it the chief station on their main road between Antioch and Seleucia-on-Tigris. As a centre of the worship of the Syrian nature-goddess Atargatis (*q.v.*), it became known to the Greeks as the Holy City (Hierapolis). Lucian (or some anonymous writer) in the tract *De Dea Syria* has described the orgiastic luxury of the shrine. The worship was of a phallic character, votaries offering little male figures of wood and bronze. Huge phalli were also set up before the temple and were climbed once a year, with certain ceremonies, and decorated. For the rest the temple was Ionic.

The temple was sacked by Crassus on his way to meet the Parthians (53 B.C.). In the 3rd century of the empire Hierapolis was the capital of the Euphratensian province and one of the great cities of Syria. It was in ruins, however, when Julian collected his troops there, and Khosrau I held it to ransom after Justinian had failed to put it in a state of defense. Harun al-Rashid restored it at the end of the 8th century and it became a subject of dispute among Byzantines, Arabs and Turks. The crusaders captured it from the Seljuks in the 12th century, but Saladin retook it (1175) and later it became the headquarters of Hulagu and his Mongols, who completed its ruin. A colony of Circassians was settled there in 1879 after the Russo-Turkish War.

The remains are extensive, but almost wholly of late date, as is to be expected in the case of a city that survived into Muslim times. A sacred lake is there.

Phrygian Hierapolis.—This is an ancient city in the Denizli *il* (province) of Turkey, situated, at a height of 1,200 ft., on the Coruh Su, a tributary of the Buyuk Menderes (Maeander) river, about 6 mi. N. of the ruins of Laodicea (*q.v.*). There, at an early date, a religious establishment (hieron) existed, and the town that grew round it became one of the greatest centres of Phrygian native life but of nonpolitical importance. The chief religious festival was the Letoia, named after the goddess Leto, a local variant of the Great Mother of the Gods, who was honoured with orgiastic rites. There was also a worship of Apollo Lairbenos.

Hierapolis was the seat of an early Christian church (Col. iv, 13), with which tradition closely connects the apostle Philip.

The ruins of Hierapolis are remarkable particularly for a long avenue of tombs in the west of the city and for a very perfect, partly excavated theatre.

HIEROCLES (fl. *c.* A.D. 535), Byzantine grammarian, whose *Synekdemos* (a list of eparchies and cities under Justinian I) is fundamental for the study of the political geography of the Byzantine empire. It was a source for George of Cyprus and for Constantine VII Porphyrogenitus' book on the themes.

See edition by E. Honigman with introduction and notes (1939).

HIEROCLES OF ALEXANDRIA (fl. *c.* A.D. 430), Alexandrian Neoplatonist who, after studying under Plutarch of Athens and visiting Constantinople, spent the rest of his life in Alexandria, where he won a reputation as a teacher of philosophy. His commentary on the *Chrysa Epe* ("Golden Words," 71 hexameters ascribed to Pythagoras) is written with sincerity in a clear and simple style. His other work, *Peri Pronoias* ("On Providence"), is known only from the summary and fragments in Photius' *Bibliotheca*, 214, 251.

He rejected the multiplicity of entities introduced by the Athenian school of Neoplatonism. His teaching on morals and psychology is a mixture of Platonic, Aristotelian and Stoic elements. His theory of creation seems to show Christian influence.

This Hierocles should not be confused with the Stoic Hierocles of Alexandria who lived in the 1st/2nd century A.D.

BIBLIOGRAPHY.—The commentary is ed. by F. W. Mullach, *Fragmenta philosophorum Graecorum*, vol. I, pp. 416–484 (1860); word index by R. Robinson (1772); Eng. trans. by N. Rowe (1756). *See* bibliography to NEOPLATONISM. *See* also K. Praechter in Pauly-Wissowa, *Real-Encyclopädie der classischen Altertumswissenschaft*, vol. 8, col. 1479–87 (1913); K. Praechter, "Christlich-neoplatonische Beziehungen," *Byzantinische Zeitschrift*, 21:1–27 (1921).

HIEROGLYPHS, a term broadly used to denote any system of writing (*q.v.*) composed of pictures. Hieroglyph, "sacred carving," is a Greek translation of the Egyptian "the god's words," which was used at the time of the early Greek contacts with Egypt to distinguish the older hieroglyphs from the handwriting of the day (demotic). Modern usage has extended the term to other writing systems, such as Hieroglyphic Hittite, Mayan hieroglyphs and early Cretan. There is no connection between Egyptian hieroglyphs and these other scripts, the only certain derivative from the Egyptian writing being that used for Meroitic.

Egyptian hieroglyphic writing was composed entirely of pictures, though the object depicted cannot be identified in every instance. The earliest examples which can be read show the hieroglyphs used as actual writing, that is, with phonetic values, and not as picture writing such as that of the Eskimos or American Indians. The origins of the script are not known. It apparently arose in the late predynastic period (just before 3100 B.C.). There were contacts between Egypt and Mesopotamia at this time, and it has been thought that the concept of writing was borrowed from the Sumerians. This is certainly possible, but even if this was the case, the two systems were so different in their use of signs that it is clear that they developed independently.

Except for names and a few titles, the oldest inscriptions cannot be read. In many cases individual hieroglyphs were used which are familiar from later periods, but the meaning of the inscription as a whole is obscure. It is apparent that this writing did not represent the sounds as completely as was the case later. This fact may be illustrated by personal names of this period and by formulas from later times which still reflected the usage of this period. The royal name Wedymuw was written simply , that is, with (later read *d*) for *wdy* and for "water," read *mw* (the vowels were not written). Later writing was fuller, indicating the *w* and perhaps also the *y* of *wdy*, and used three wavy lines for *mw*, reserving the single one for the consonant *n*. The formula "(may he) live, be prosperous and healthy!" constantly used throughout later times after royal names, was written with the sign for "live" , which represented all the consonants in the word (*ʿnx*—the ʿ was the equivalent of Arabic *ayin*) at all periods, the sign for *ǧ*ʾ (ʾ was a glottal stop), which stood for *wǧ*ʾ "prosper," and the sign for *s* , which stood for the word *snb* "be healthy." The abbreviated nature of these writings shows that early hieroglyphic had not developed a consistent representation of the sounds. It was as much an aid to memory as it was a system of writing.

Nevertheless, even in the oldest period the basic principles of hieroglyphic writing were in operation.

1. A hieroglyph could be used to represent the original object or action pictured. might be "sun"; a man with his hand to his mouth might be "eat."

2. A hieroglyph might be used to represent another word suggested by the picture. might be "day" or the sun-god Re (Ra); might be used for "be silent," as if the man were putting his hand on his mouth to keep himself from saying anything.

3. A hieroglyph might be used phonetically to represent a word or part of a word having the same (or nearly the same) consonants. The consonants must be in the same order. "mace," which had the consonants *ḫǧ*, could also be used for *ḫg* "be bright"; *pr* "house" might represent *pry* "go out."

By the 3rd dynasty (about 2700 B.C.) these principles had been elaborated into a more regular representation of the language, and a system of writing was established which remained in use for approximately 3,000 years. While there must have been some conscious direction of the process, there was no absolutely consistent, logical system introduced into the spelling. Usage brought about general agreement on how signs might be used. Middle Egyptian spelling was the most consistent, and the following description is based primarily on this period. In general it also reflects Old Egyptian. (*See* EGYPTIAN LANGUAGE.)

Egyptian, like Semitic, was a language in which the roots were usually composed of consonants, which might combine with any number of different vowel patterns, as well as suffixes and prefixes. The word for "face" was something like * *ḥar* but "his face" more like * *ḥrif*. Since only the consonants remained the same in different usages of the same root, the hieroglyph for that root came to be associated with just the consonants. "face" represented only the two consonants *ḥr*. When the sign was used for a similar sounding word, only the consonants were taken into consideration. The sign for house could be used for *par, pur, pir, pra, pru, pri* or for *pr* with no vowel. The result was that Egyptian hieroglyphic writing did not have any way of indicating vowels. (Modern scholars have a conventional way of pronouncing Egyptian which has nothing to do with ancient Egyptian pronunciation.)

In any example of Egyptian writing most of the signs represented consonants, not ideas. A small number of signs came to represent single consonants. A horned viper was *ḥ*, a hand was *d*, a loaf of bread *t*, an owl *m*, and so on. In a few cases there were several signs for the same consonant, as or for *w*. As there was at least one sign for each of the 24 consonants, the Egyptians had in these signs a potential alphabet (*q.v.*), equal to that later developed by the Canaanites. They never took advantage of this fact but continued to write in the complex manner outlined here as long as hieroglyphs were used. Within the system, however, many words were written out with these signs and so spelled alphabetically (as far as the consonants were concerned).

The use of signs representing single consonants arose in several ways. In some cases the first letter of the word was taken, as *ḥ* from *ḥt* "horned viper," *r* from *rʾ* "mouth." On the other hand the cobra , originally *ʾǧyt*, was used for *ǧ*. In this, as in many other things, there was no absolute consistency. Some scribe used for *ǧ*, and others followed suit. The phonetic principle of hieroglyphic writing did not demand complete identity of consonants in this early period. This is further illustrated by some of the signs which came to represent two or three consonants. There does seem to be a pattern, however, in what consonants might be ignored. Only the glottal stop (ʾ), *y*, *w* and the suffix-*t* (a feminine ending) might be dropped.

About 78 hieroglyphs came into general use as representing two consonants each. The house stood for *pr*, an eye for *yr* (from *yrt* "eye," with the *-t* dropped). In a few cases a sign stood for more than one combination, as for both *bḥ* and *ḫw*, or several signs for the same sounds, as both and for *mr*. In all about 76 different combinations, out of a possible 576, could be written with commonly used phonetic signs.

A hieroglyph representing all the consonants in a word might stand for up to three or even more consonants. "Head" was *tp* or *ǧ*ʾ*ǧ*ʾ (*tp* was more frequent in Middle Egyptian); "day" was *hrw;* "build" was *qd*. Only a few signs came to be used as general phonetic signs for three consonants. The most common of these was *tyw* (used only as a phonetic sign); another was *xpr* (from *xprw* "dung beetle"), used in *xpr* "become" and other words.

Egyptian spelling combined all of the above elements in a manner which was usually clear but was often clumsy. Words were ordinarily written with a combination of signs, some representing the general idea or even picturing the object or action, others giving the sound. Since a given sign might have several different sound values, other signs were added to make sure that the reader knew which was meant. For example, an animal ear might be *msḏr* "ear" or *sḏm* "hear." *Msḏr* might be written or . In the single stroke was added to show that the hieroglyph was to be read as the object pictured, that is as *msḏr* "ear." This was not a foolproof system, however, and it was usually considered better to add at least some phonetic signs. In the word was written out in phonetic signs in addition to the ear. is *ms;* is *ḏr*. Each of these had another consonant added, which repeated the last consonant of the preceding sign (*s* and *r*). There could have been no ambiguity here, as the signs and regularly stood for *ms* and *ḏr,* but the addition of the other two signs was typical of Egyptian writing. The word was actually spelled *ms-s-ḏr-r* (ear). Such multiple writing has been of considerable help to scholars in determining the sounds of each word. The other value of the ear noted above, *sḏm* "hear," was usually written , the ear being followed by an *m* ( ) to show that it was to be read *sḏm,* not *msḏr* or some other word.

Just as a limited number of hieroglyphs came to have regular phonetic value, others came to be regularly used to designate words belonging to a certain type or class. These are known as determinatives. The seated man (originally *z* "man") came to be used after many words designating persons, often as engaged in a profession or trade: *smr* "courtier," *smḏt* "subordinates, staff." The seated man with hand to mouth was used as a determinative in large numbers of words suggested by this gesture, such as those for "call," "lamentation," "complaint," "thirst," "message," "mourn," "interpreter," "boasting," "swallow," "bite," "answer," "denounce." The sparrow never represented the bird itself. It rather became a symbol of that which was restricting, bad or defective and was used as a determinative in words such as *šw* "empty," *mr* "sick," *ʾq* "to perish." The papyrus roll tied with a string came to be associated not only with writing but also with abstract concepts, so that it was used as a determinative in *rx* "know," hrt "contentment" and many others. Very frequently several determinatives were used in the same word: *nmḥ* "waif, orphan" (written *n-nm-m-ḥ* [child with hand to mouth] [sparrow]).

There were a number of ways of writing noun plurals. One of these was to repeat the word or the word sign three times: *rnw* "names" (rn "name"), *prw* "houses." Another way was to add three strokes: *prw* "houses" (the stroke beside showed that it was to be read as what it pictured, not as *pry* "go out" or some other word). The ending could also be written out phonetically, but it was customary to add the plural strokes to such a spelling. Since the plural ending was *w*, the plural strokes were often added to a word ending in *w*, even though no plural was intended, as *nfrw* "shortage" (note the use of the "bad bird"). The triple writing might be used in the same way: *nfrw* "beauty." (These two words had the same consonants. They undoubtedly had different vowel patterns, but these are unknown. They illustrate the fact that Egyptian writing was clearer than purely alphabetic writing of only the consonants would have been.) The plural strokes might also be used as a determinative in words indicating quantity, as *šʾ* "many," or mass, as *ʿḏ* "fat."

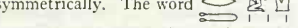
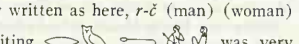
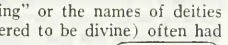
Many other examples of this type of derived value, based on the associations of a hieroglyph in the spelling system, might be given. For example, the exclamation "oh!" was written , with the appropriate determinative. This group of signs was then used to represent the same consonant (a glottal stop) elsewhere, in words in which the determinative has no bearing, as in , a late Middle Egyptian writing for *ʾnn* "we" (note plural strokes).

On the basis of the uses noted here, hieroglyphs have been classified into logograms (also called ideograms or word signs; more accurately described as representing morphemes), determinatives and phonograms (phonetic signs). This classification is convenient, but it is often impossible to determine which classification fits a hieroglyph in a particular word. The inexactness is due to the nature of Egyptian writing, which does not lend itself to modern analysis into set categories.

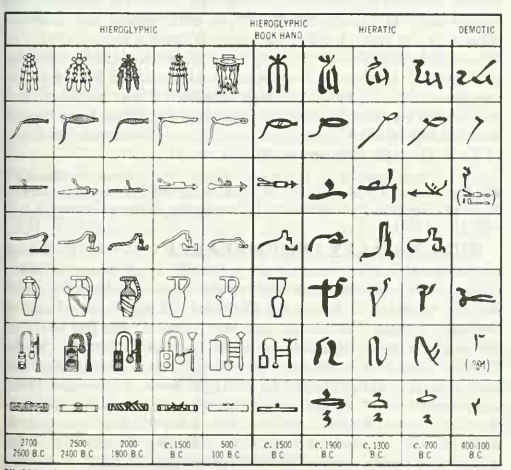
The Egyptian often looked upon the writing of a word as a unit, and the old phonetic spelling was usually kept even after sound change had altered the consonants. When the word *swr* "drink" (written *s-wr-r* [water] [man with hand to mouth]) became *swy* through the change of *r* to *y*, the *y* ( ) was simply added to the spelling: . There was a minimum of this kind of writing in Old and Middle Egyptian, but Late Egyptian spelling abounded in signs added, sometimes erroneously, to try to compensate for linguistic change. For example, in Late Egyptian "his beginning" was written , that is, *ḥʾt-t* (stroke) *t-w-f*, where Middle Egyptian wrote only *ḥʾt-t* (stroke) *f*. The word *hʾt* "beginning" had become something like **ha* by Late Egyptian times, so that the writing represented a word which, standing alone, had in current pronunciation no *t* at the end. The word still had the *t* before suffixes such as *f* "his," and the signs (*t-w*, to be read simply *t*) were added to show this. The whole spelling represented only the consonants *ḥ t f*.

It is readily seen from these examples that while there was a basic core of uniformity, there was also a large area of permissible variation in hieroglyphic spelling. In addition to the regular system, several special types of spelling arose. The most important of these was "group writing," in which each consonant was written with a sign or group of signs which normally indicated two consonants. No texts were written in this spelling, but it was used occasionally for individual words from Old Egyptian times onward. In Late Egyptian it was primarily used to write foreign names and other loan words. The word "chariot," borrowed from Semitic (probably Canaanite **markabtu*), was written . This would normally have been transcribed *m-y-t k-ʾ-b-w-ty-y-t* ("wood"), but in group writing it represented only *m-r-k-b-t*. Attempts have been made to demonstrate that

such writing was syllabic and so indicated the vowels. This has not been proved. It is possible that it was an Egyptian way of spelling out words using the names of hieroglyphs, like the English pronunciation of abbreviations such as NBC, some of the names having different vowel associates. There would, then, be a partial correspondence of the signs to the vowels of the word. There were also cryptographic scripts, such as the secret writing used for certain religious inscriptions in the 19th and 20th dynasties.

Order of Signs.—Hieroglyphs could be written either right to left or left to right, the lines being either vertical (reading down) or horizontal (reading across). The hieroglyphic figures always faced the beginning of the line. In an inscription which read right to left the signs faced the right. They were reversed for one reading left to right. Hieroglyphs were chosen and arranged so as to fill the space neatly and symmetrically. The word  *rmč* "people" was regularly written as here, *r-č* (man) (woman) (plural strokes). The writing  was very rare, as the *m* (the owl) made the group untidy. In other instances neatness caused the order of the consonants to be changed in the writing; for example, may be *t-w* as it is written, or *w-t*. Signs were transposed for honorific reasons also. Phrases containing words such as "god," "king" or the names of deities (including the king, who was considered to be divine) often had these words first, out of deference. The name  "Menkheperre" ("enduring is the becoming of the sun-god Re") was written *r'-mn-xpr*, though it must be read *mn-xpr-r'*. *Ḥm nčr* "servant of god" (a type of priest) was written *nčr-ḥm:* .

Hieroglyphs and Religious Beliefs.—A number of hieroglyphs were used as amulets. The signs for "life" , "stability" and "protection" were among those frequently reproduced as charms or included in dress or jewelry designs. The sacred eye of the god Horus , according to legend scratched from its socket and torn into pieces by the wicked god Seth and later restored by the good god Thoth, was a talisman signifying wholeness and soundness. (The individual parts of the eye also served to indicate the fractions of a standard grain measure, the eyebrow being one-eighth, the pupil and iris one-fourth, etc.) As used in the tombs, hieroglyphs were not considered as mere writing. The portrayal of a person, animal or object, either as a picture on the wall or as a hieroglyph, was believed to be as effective as the original. The drawings of food in an offering list were therefore not just pictures; they were symbols which could become real food for the deceased. Since hieroglyphs also depicted persons and animals which could harm the occupant of the tomb or deprive him of his food by eating it themselves, measures were sometimes taken to prevent this. In the Pyramid texts hieroglyphs representing human beings or animals who might eat the food needed by the deceased were usually incompletely drawn. The head, shoulders and arms (enough to show which sign was meant) would be used instead of a seated or standing man. An animal, such as a lion, would be shown cut in two pieces. A snake, on the other hand, was left whole, since it would not be interested in man's food. In funerary texts of the Middle Kingdom fear is also shown of snakes, as well as other animals, by such incomplete drawing.



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EGYPTIAN HIEROGLYPHS AND THEIR CURSIVE EQUIVALENTS

The hieroglyphs depict: (1) three foxskins tied together; (2) a whip; (3) a single-barbed harpoon; (4) an adz at work on a block of wood; (5) a stone jug with handle; (6) a scribe's outfit; (7) a roll of papyrus tied with a cord

Hieroglyphs as Art.—At all periods the hieroglyphs were part of the artistic expression of ancient Egypt. As noted above, the very choice and order of signs was influenced by considerations of symmetry. The actual execution of the signs was the business of sculptors and painters. Nina M. Davies has listed seven ways in which the hieroglyphs were made on walls and like surfaces: (1) carved in low relief; (2) carved and then touched up with different colours; (3) modeled on plaster which had been applied to the surface and then painted; (4) carved into the surface (incised) and the interior of the sign painted a solid blue or green; (5) incised deeply and the details carved on the sunken surface (a feature of the New Kingdom and later); (6) in silhouette (painted solid in blue or black); (7) painted directly on the surface in different colours. Although most inscriptions were done as a matter of routine and many were quite poorly executed, there were also many of fine artistic quality with exquisite detail. The colours applied sometimes corresponded to those in nature but as often did not. The pastel shades of many painted hieroglyphs as seen today are the result of fading. The original colours were bright and contrastive.

Handwriting.—The scribes wrote with fine reed pens, using red ink for rubrics and black ink elsewhere. The hieroglyph for "scribe" shows the palette, with the two depressions for red and black ink, a bag to hold the powdered pigments and a holder for the reed pens: . Examples of handwriting are known from very early times, though they are rare from the first few dynasties. The signs were written with thick strokes, giving the characteristic features of the hieroglyph in broad outline. This cursive script is known as hieratic, three types of which came into use: a book hand, used for literary works and official documents; a business hand, also used for private letters; and a religious book hand, which was a closer approximation to hieroglyphic than the other two. Some hieratic forms reflect hieroglyphs which were not used in contemporary inscriptions, such as , which goes back to a hieroglyph of a falcon on a standard There were also spelling conventions for hieratic which were slightly different from those used for hieroglyphic.

Hieratic became more and more cursive in the course of time. The changes were gradual but distinct enough to afford a good basis for dating manuscripts on paleographic grounds alone. Late Egyptian hieratic was considerably different from the older stages, as a result not only of the changes in the shape of the characters but also of the new spellings introduced. About 650 B.C. a new cursive, demotic, replaced hieratic. Demotic was a development from hieratic and retained all the features of the hieroglyphic system, including word signs, determinatives and phonetic signs. However, the script became so cursive that it is far more difficult to read. Seven demotic signs were borrowed to supplement the Greek letters used to write Coptic when the ancient Egyptian

hieroglyphic system was finally abandoned.

The latest known use of hieroglyphs was at Philae about A.D. 394. The latest use of demotic was about A.D. 470. After this, knowledge of hieroglyphs was completely lost until they were deciphered in the early 19th century (*see* also EGYPTIAN LANGUAGE).

Decipherment.—Attempts made before 1800 to decipher the hieroglyphic inscriptions were completely unsuccessful, as the picture was believed to be composed of mystic symbols. This medieval concept was slow to die out even after the discovery, in 1799, of an inscription, the Rosetta stone (*q.v.*), in three languages, hieroglyphic Egyptian, demotic and Greek. In 1802 the French scholar A. I. Silvestre de Sacy and the Swedish diplomat Jean David Akerblad identified a number of proper names in the demotic text by comparing it with the Greek. Akerblad also correctly assigned phonetic values to a few of the demotic signs.

Several 18th-century scholars had believed that the ovals, or cartouches, found in the inscriptions contained proper names. There were six cartouches on the Rosetta stone, but they all contained the same name, which was quickly identified as Ptolemy. The English physicist Thomas Young made a study of this and cartouches found on other inscriptions. Five of the phonetic values he assigned to hieroglyphs were correct (*p, t, i, n* and *f*). He completed his paper in 1819 and it was published by the *Encyclopædia Britannica* in 1824.

The first person who was actually able to read not merely proper names and a few isolated words but longer passages and connected texts was the French scholar Jean François Champollion. He made an exhaustive study of the Rosetta stone, comparing the different versions sign by sign and preparing lists of equivalents. He recognized that demotic writing was developed from hieratic (which he knew from other documents) and hieratic from hieroglyphic. On identifying the name Cleopatra in demotic, he transcribed it back into hieratic and then into hieroglyphs. He later obtained a copy of an obelisk inscription written in both Greek and hieroglyphs in which he found Cleopatra written almost as he had reconstructed it. Comparing the names Ptolemy and Cleopatra, which had the sounds *p, t, o, l* and *e* in common, he was able to identify not only the hieroglyphs for these letters (including two for *t*) but also the others used in these two cartouches. Not all of the values he assigned to the hieroglyphs were exact from the point of view of present knowledge, but they were close enough to provide a firm basis for further work.

Champollion was still not convinced that hieroglyphs were regularly used in a phonetic way to write the ancient Egyptian language, since the names which had been deciphered were foreign (Greek and Roman). In Sept. 1822 he received copies of inscriptions from older periods, which included cartouches with the names Rameses and Tuthmosis. Working from his meagre alphabet and skillfully applying his knowledge of Coptic and of the Rosetta stone, he successfully deciphered them. He then knew that he had the key to the ancient language itself. The phonetic values found in the proper names could now be used to read the Egyptian texts. He announced this in his letter to M. Dacier of Sept. 22, 1822.

See also PALEOGRAPHY; PICTOGRAPHY; and references under "Hieroglyphs" in the Index.

See Alan Gardiner, *Egyptian Grammar*, 3rd ed. rev. (1957); Nina M Davies, *Picture Writing in Ancient Egypt* (1958). (C. T. HE.)

HIERON I, brother of Gelon (*q.v.*) and tyrant of Syracuse from 478 to 467/466 B.C. During his reign he greatly increased the power of Syracuse. He removed the inhabitants of Naxos and Catana (Catania) to Leontini, peopled Catana (which he renamed Etna) with Dorians, concluded an alliance with Acragas (Agrigentum, modern Agrigento) and espoused the cause of the Locrians against Anaxilas, tyrant of Rhegium (Reggio di Calabria). His most important achievement was the defeat of the Etruscans at Cumae (474), by which he saved the Greeks of Campania. A bronze helmet (now in the British museum, London) with an inscription commemorating the event was dedicated at Olympia. Though despotic in his rule, Hieron was a liberal patron of literature; the poets Aeschylus, Pindar and Bacchylides were among those who repaid his hospitality with elegant flattery. He died at Catana in 467/466.

See T. J. Dunbabin, *The Western Greeks*, pp. 428 ff. (1948).

HIERON II, tyrant of Syracuse from *c.* 270 to 216/215 B.C., was the illegitimate son of a Syracusan noble, Hierocles, who claimed descent from Gelon. On the departure of Pyrrhus (*q.v.*) from Sicily (276), the Syracusan army and citizens appointed Hieron commander of the troops. He materially strengthened his position by marrying the daughter of Leptines, the leading citizen. In the meantime the Mamertini, a body of Campanian mercenaries who had been employed by Agathocles (*q.v.*), had seized the stronghold of Messana (Messina), whence they harassed the Syracusans. They were finally defeated in a pitched battle near Mylae by Hieron, who was prevented from capturing Messana only by Carthaginian interference. His grateful countrymen then chose him king (*c.* 270). In 264 he again returned to the attack, and the Mamertini called in the aid of Rome. Hieron at once joined the Carthaginian leader Hanno, who had recently landed in Sicily; but being defeated by the consul Appius Claudius, he withdrew to Syracuse. Pressed by the Roman forces, in 263 he was compelled to conclude a treaty with Rome, by which he was to rule over the southeast of Sicily and the eastern coast as far as Tauromenium (Taormina). From this time till his death in 216/215 he remained loyal to the Romans and frequently assisted them with men and provisions during the Punic Wars. He kept up a powerful fleet for defensive purposes and employed his famous kinsman Archimedes in the construction of those engines that, at a later date, played so important a part during the siege of Syracuse by the Romans.

BIBLIOGRAPHY.—Theocritus, *Idyll* xvi; Diodorus Siculus, xxii, 13; Polybius, i, 8–16; vii, 8; Livy, xxi, 49–51; xxii, 37; xxiii, 21; A. G. Woodhead, *The Greeks in the West*, pp. 107 ff. (1962).

HIGDEN (HIGDON), **RANULF** (d. 1364), Benedictine monk and chronicler, famous as the author of the *Polychronicon*, a universal history, entered the monastery of St. Werburgh at Chester in 1299. The *Polychronicon* was written in Latin but translated into English by John de Trevisa in 1387 and again in the 15th century. It enjoyed very great popularity, and well over 100 manuscripts survive. Beginning with the creation and ending originally in 1327, the chronicle was continued in a later recension to 1352, and Higden's autograph manuscript is in the Huntington library, San Marino, Calif. The *Polychronicon* is of less value for English history than its numerous continuations, the best known of which is that of John of Malvern. It belongs rather to literature and throws light on the general historical, geographical and scientific culture of the age. It was printed by William Caxton (1482), by Wynkyn de Worde (1495) and Peter Treveris (1527). Higden also wrote a number of theological works, such as his *Speculum curatorum* (1340), some of which survive. It has been believed, but is unlikely, that he was the author or translator from French into English of the Chester mystery plays. He died at the abbey of St. Werburgh, Chester, on March 12, 1364.

See C. Babington and J. Lumby (eds.), *Polychronicon Ranulphi Higden*, 9 vol. (1865–86); V. H. Galbraith, "An Autograph MS of Ranulph Higden's *Polychronicon*," *Huntington Library Quarterly*, vol. xxiii (i) (1959). (V. H. G.)

HIGGINS, ALEXANDER PEARCE (1865–1935), British international lawyer remembered primarily as an expert in maritime international law, was born at Worcester on April 24, 1865. He was educated at Worcester Cathedral (King's) school and at Downing college, Cambridge, and was called to the bar in 1908. He taught international law for many years at Cambridge, at the London School of Economics and at the Royal Naval War and Staff colleges. He published his principal work, *The Hague Peace Conferences*, in 1909, containing the texts of the Hague conventions of 1899 and 1907, together with some kindred instruments and valuable detailed commentaries. During World War I his special knowledge enabled him to render great service as adviser in international law and prize law to the procurator-general and treasury solicitor. In 1920 he succeeded L. F. L. Oppenheim as Whewell professor of international law at Cambridge. Pearce Higgins was a member of the Permanent Court of Arbitration at

The Hague (1930) and president of the Institut de Droit International (1929–31). He died on April 2, 1935. His published work includes contributions to basic textbooks on international and maritime law, as well as studies in international law and in history. (McN.)

HIGGINSON, THOMAS WENTWORTH STORROW (1823–1911), U.S. reformer, soldier and author, active in the cause of abolition, was born at Cambridge, Mass., on Dec. 22, 1823. He graduated from Harvard college in 1841, spent two years teaching, thought for a time that he might become a poet, and then entered the Harvard divinity school, where he graduated in 1847. Although still a bit uncertain as to his calling he was ordained in Sept. 1847, married his cousin Mary Channing a few weeks later and accepted the pastorate of the Religious Society of Newburyport. During the next two years he set the pattern he was to follow for the remainder of his life. He preached a social gospel that was too liberal even for Unitarians. He organized an evening school for workers; wrote editorials for newspapers; ran for congress on the Free Soil ticket; and took such extreme positions on temperance, women's rights, labour and slavery that, as he said, he literally "preached himself out of his pulpit."

The loss of his pulpit intensified his reforming zeal. On the passage of the Fugitive Slave act in 1850, he joined the Boston Vigilance committee to aid escaping slaves, advocated breaking up the Union and denounced those who refused to use force against slavery. In May 1854 he took a leading part in the liberation of the fugitive slave Anthony Burns in Boston. It was Higginson who purchased the axes and helped break down the door of the courthouse. For his part in the affair, he was arrested but never brought to trial. Next he turned his efforts to sending settlers and supplies to Kansas. He visited the territory twice and supported John Brown both in Kansas and in the raid on Harpers Ferry. With the outbreak of the Civil War in 1861 Higginson helped to raise and drill troops in his own community. In 1862 he resigned his commission as captain in a newly organized Massachusetts company to accept appointment as colonel of the first Negro regiment in the Union army.

After the war, Higginson spent his time writing and gained ready access to the *Atlantic*, *Scribner's*, *Harper's* and the *North American Review*. Many of his articles were later gathered into books. He wrote a *Young Folks' History of the United States* (1875), a *Larger History of the United States* (1885) and the lives of Margaret Fuller Ossoli, Henry Wadsworth Longfellow, John Greenleaf Whittier and Francis Higginson, first minister of the Massachusetts Bay Colony, for a popular biographical series of the day. His only novel, *Malbone*, never won the recognition given his magazine articles. He died in Cambridge on May 9, 1911.

(Ay. Cn.)

HIGHAM FERRERS, an ancient market town and municipal borough in the Wellingborough parliamentary division of Northamptonshire, Eng., 15 mi. E.N.E. of Northampton by road. Pop. (1961) 3,756. It stands high above the river Nene. The fine church of St. Mary is mainly Early English and Decorated; close by stand the remarkable Perpendicular schoolhouse and the bedehouse, both founded by Archbishop Henry Chichele; in the town are remains of Chichele's college. The local industries are leather dressing and shoemaking.

Higham (Hecham, Heccam, Hegham Ferrers) was evidently a large village before the Domesday survey, when it was held by William Peverel for the king. It was granted in 1199 to William Ferrers, earl of Derby, who gave the first charter (confirmed 1251); after passing through various hands it went to Henry, earl of Lancaster; it subsequently formed part of the duchy of Lancaster and so remains. The castle, mentioned in 1322, no longer existed by 1540. A mayor was elected from about 1343; a town hall is mentioned in 1395. The borough, incorporated in 1556, returned one member until 1832.

HIGH COMMISSION, COURT OF. The Act of Supremacy (1534) recognized Henry VIII as "Supreme Head in earth of the Church of England" and assigned to the crown the power of ecclesiastical visitation. This was given practical effect in 1535 when Thomas Cromwell was appointed vice-gerent, invested with the plenitude of royal authority in ecclesiastical affairs and directed to delegate part of it from time to time to such persons as he thought fit. The first general commission to a number of men was issued by Edward VI in 1549. The royal powers were confirmed by the Elizabethan Act of Supremacy (1559), which declared the queen to be "Supreme Governor of this realm . . . as well in all spiritual or ecclesiastical things or causes as temporal" and authorized the crown to nominate by letters patent persons to exercise on its behalf "all manner of jurisdictions . . . touching . . . any spiritual or ecclesiastical jurisdiction . . . and to visit, reform, redress, order, correct and amend all . . . errors, heresies, schisms, abuses, offences, contempts and enormities whatsoever."

The device of an ecclesiastical commission was thus adopted in the first place as a means whereby the crown could effectively enforce the laws of the Reformation settlement and exercise control over the church. The existing archiepiscopal and subordinate church courts were inadequate for this purpose. The men in charge of them were often unreliable; their organization was incapable of dealing with the increased business consequent upon the Reformation; and their coercive powers were insufficient to ensure obedience to orders given, secularism breeding increasing disrespect for ecclesiastical censures. By the high commission the authority of the church was to be at once controlled and supplemented by that of the state.

Until 1565 the work performed by the commissioners was mainly visitatorial, and their authority was regarded as temporary. But the continued difficulties experienced in enforcing the settlement, the development of additional administrative functions by the commission itself and the increasing delegation to it of ecclesiastical or semiecclesiastical business from the privy council gave the commissioners a sufficiently permanent tenure to enable them to establish traditions and judicial forms which, in time, transformed a temporary device into a permanent, regularized prerogative court. These developments were reflected in the appearance of the term "high commission" by 1570 and the title of "court" about ten years later.

That these developments took place in the 1570s was due to the fact that during that decade the position of the established church became most critical in face of growing opposition by Romanists and Puritans alike. The crown was forced to adopt firmer measures to protect the settlement. The intrinsic authority of the bishops and their courts was still declining, and in consequence an increasing burden was thrust upon the commissioners. It was also found necessary in the early 1570s to set up local ecclesiastical commissions, offshoots of the parent body in London, to deal with particularly disordered parts of the country.

Composition and Jurisdiction.—The total membership of the commission varied between 24 in 1549 and 108 in 1633; but of these any three were normally empowered to act, provided one of them was "of the quorum" (which numbered 11 in 1549, 68 in 1633). The effective nucleus of the commission appears to have consisted of a group of canon lawyers, who were joined by bishops or other men of superior standing as the importance of the business or quality of the offenders before the court might determine. The commission (as its visitatorial duties demanded) originally sat anywhere in the province of Canterbury, but came later, as its form and procedure hardened, to sit only in London on certain fixed days and to keep the law terms. Its jurisdiction, best summarized in connection with the other ecclesiastical courts as concurrent, appellate and equitable, though vague, was by no means unlimited. It could assume jurisdiction only *in personam* in criminal matters (though here the interpretation was rather loose); and it could not initiate cases of party and party. In matters of discipline its procedure was normally based upon the administration of the oath ex officio; *i.e.*, an oath imposed by the judge in virtue of his office. This device was borrowed from the procedure of the ordinary church courts, being naturally employed by canon lawyers on the commission as the form most familiar to them. On the other hand, the penalties inflicted were generally secular in character: fine and imprisonment. The commission did not employ torture or inflict the death penalty.

That the commission's appellate jurisdiction in cases of party and party was popular is evident from the numbers who applied to it even in its last years. As an instrument for the maintenance of ecclesiastical discipline it seems to have been generally successful except in cases where it was concerned to coerce those whose opposition to the church settlement was dictated by sincere religious conviction. Secular penalties were of no more avail in such circumstances than the excommunication of a despised church: rather, indeed, they served to strengthen the sects by providing them with a martyrology.

Opposition and Suppression.—The opposition which eventually destroyed the commission derived principally from the Puritans, the common lawyers and the common-law judges. The Puritans resented the commission's enforcement of orders relating to the conduct of services which they regarded as idolatrous; and they complained that the use of the ex officio oath compelled a man to convict himself. The common lawyers' opposition to the commission stemmed from the traditional hostility between the lay and ecclesiastical courts. Though in part actuated by jealousy and self-interest, by a desire to extend their jurisdiction and hence enlarge their income from fees, they could also claim with some justification that the commission's activities bred jurisdictional confusion. Recusancy, for instance, was a secular as well as an ecclesiastical offense.

Under James I the common-law judges first attempted, by prohibitions and pronouncements, to limit the commission's activities; and then, encouraged by the support of the parliamentary opponents of the royal prerogative, they embarked upon a vigorous attack upon its jurisdiction and procedure in general. The Supremacy act of 1559 had purported merely to restore to the crown the "ancient jurisdictions" allegedly "usurped" by the bishop of Rome; and the crown claimed accordingly that its power to exercise ecclesiastical jurisdiction through commissioners rested on its own inherent, ancient rights, not on any authority specifically conferred by parliament. The common-law judges had accepted this point of view as late as 1591 (Cawdrey's case); but now, under the Stuarts, they began to insist that the commissioners' jurisdiction was based on statutory permission, not prerogative right, and to interpret the terms of the act of 1559 in an indefensibly narrow fashion. They took exception to the use of fine and imprisonment because these were not strictly ecclesiastical penalties; and they challenged the legality of the ex officio oath as being contrary to common-law practice.

As the constitutional struggle developed between the Stuart kings and their parliaments the legal opposition to the commission became merged into the general political conflict. Abortive bills on the subject of the commission were introduced in the parliaments of 1607 and 1609–10; and in 1610 a petition of the commons denounced the act of 1559 as "inconvenient and of dangerous extent."

In 1641, when Charles I had to give way to parliament, the clause of the act of 1559 that gave the crown power to exercise its supremacy through commissioners was repealed, the court was abolished and it was provided that no similar court should again be set up. The commissioners were accused of having, "to the great and insufferable wrong and oppression of the King's subjects, used to fine and imprison them, and to exercise other authority not belonging to ecclesiastical jurisdiction restored by that Act." At the Restoration, when the other ecclesiastical courts were revived, the prohibition upon the use of a high commission was retained. It was nevertheless re-established by James II in 1686, only to be condemned finally by the Bill of Rights in 1689 as "illegal and pernicious."

See R. G. Usher, *The Rise and Fall of the High Commission* (1913); W. S. Holdsworth, *History of English Law*, vol. i and vi, rev. ed. (1922–24). (F. D. Pe.)

HIGH COURT OF JUSTICE, one of the two major divisions of the English supreme court of judicature (*q.v.*), the other being the court of appeal (*see* COURT OF APPEAL [BRITISH]), was created by the Judicature act, 1873. This measure, among other changes, abolished the historic courts with their separate jurisdictions, such as the courts of chancery, queen's (or king's) bench, common pleas, admiralty and so on, and substituted a high court of justice sitting in three divisions: the chancery division; the queen's (or king's) bench division; and the probate, divorce and admiralty division. Each division has certain classes of work assigned exclusively to it, but apart from these any division may deal with any matter and the remedies available in one division are available in another, so that, *e.g.*, the chancery division may award damages and the queen's bench grant an injunction. *See* COURT: *England;* JUDICIARY AND COURT OFFICERS: *English System.* (W. T. Ws.)

HIGHER EDUCATION. During most of the 19th century higher education was understood as referring to the training provided in established colleges and universities, and this was essentially a nontechnical and nonprofessional liberal arts education. In the 20th century the term has come to be applied to a great variety of postsecondary institutions of learning, including not only universities and colleges, but also large numbers of professional schools, separate from the universities, which provide preparation in such fields as law, theology, music and art and, in addition, separately organized teacher-training schools, junior colleges (a peculiarly American institution) and various kinds of institutes of technology.

This article reviews the growth in curriculum offerings in the traditional institutions and the development of new institutions of higher education accompanying the increasing specialization of knowledge and of technology and the expanding number of students seeking higher education. For details on traditional educational institutions *see* COLLEGE; UNIVERSITIES; UNIVERSITY COLLEGES; LAND-GRANT COLLEGES AND UNIVERSITIES. *See* also EDUCATION, HISTORY OF. For institutions of higher education in particular countries, *see* education sections of separate articles on those countries.

EXPANSION OF THE CURRICULUM

Historical Background.—In spite of the fact that the 19th century witnessed a steady expansion of scientific knowledge, the curriculum of the established higher educational institutions was virtually untouched. Higher education followed a single dimension. This was the century of Faraday, Von Helmholtz, Joule, Darwin, Lister, Wundt, Pasteur and Koch. Yet, until the end of the century, most of the significant research was done outside the walls of higher educational institutions. In Great Britain it was the Royal society and other such societies that fostered advanced studies and encouraged research. In 1828 Yale college issued what was, in effect, a manifesto, proclaiming that a single prescribed course of study, nontechnical and nonprofessional, was the only proper course for a higher educational institution. When, in 1847, Abbott Lawrence notified the president and fellows of Harvard college that he was prepared to give $50,000 for the support of scientific education, the college organized a separate school, the Lawrence scientific school. The basic curriculum of Harvard college remained intact. Cardinal Newman, lecturing in Dublin on "The Idea of a University" in 1852, stated that the task of the university was to prepare young men "to fill any post with credit, and to master any subject with facility." Higher education was for the gentleman.

The German University.—While Newman's words epitomized the views held in most colleges and universities in the United States, Great Britain and continental Europe, the end of the 19th century saw the beginnings of the expansion of the entire enterprise. Earlier, in 1807, J. G. Fichte (*q.v.*) drew up a plan for the proposed new university of Berlin, of which he became rector (1810–12) and which was dedicated to the scientific approach to knowledge. By the third quarter of the 19th century the influence of German *Lernfreiheit* (freedom of the student to choose his own program) and *Lehrfreiheit* (freedom of the professor to develop the subject and to engage in research) was being felt throughout the academic world. When Charles W. Eliot was named president of Harvard in 1869, he advocated greater flexibility in the college curriculum. By 1900 Eliot's free elective system had been widely adopted by U.S. colleges and universities.

The German conviction that investigation and research were the

primary functions and responsibilities of institutions of higher education was embodied in the new Johns Hopkins university, founded in 1876, the first U.S. institution of higher education organized along modern university lines. It was followed by Clark university, Worcester, Mass., in 1887 and The University of Chicago in 1891. The polytechnic idea caught on in Great Britain in the 1890s. The first civic universities in England came into existence at the turn of the century—Birmingham was chartered March 24, 1900.

20th-Century Expansions.—In the 20th century the unfolding scientific revolution, the growth of a technological society, the expansion of the cities, the changes in the intellectual and social climate brought new demands upon the formal educational program. The whole world of organized knowledge exploded as new areas of study emerged and old areas expanded beyond recognition. Auguste Comte (1798–1857) is called the father of the "social sciences"—sociology, anthropology, economics and political science—but it is the 20th century that has seen their development. Psychology as a field of study is essentially a 20th-century phenomenon. The pioneers, Wilhelm Wundt (1832–1920), William James (1842–1910), G. Stanley Hall (1846–1924), Sigmund Freud (1856–1939), bridged the 19th and 20th centuries. The physical sciences began the exploration of the atom, and the biological sciences expanded in new directions.

At the beginning of the second half of the 20th century higher educational institutions still accepted as their proper role the transmission of the cultural heritage; but they also stood at the forefront of research—much of the original work on the use of atomic energy was done in the laboratories of the universities of Chicago and California. The curriculum had expanded, and at some of the large state universities in the United States it was possible to study everything from atomic physics to television repairing and driver training.

Teacher Training.—This expansion of the functions of institutions of higher education is illustrated by the developments in teacher training and technical education in the United States and Great Britain. During the first part of the 20th century U.S. teacher training was a limited type of postsecondary training carried on in normal schools. It was not until the second and third decades that there was a move toward collegiate-level programs. By the 1960s, however, a national program of accreditation had been set up and many of the normal schools had extended their offerings to include functions other than teacher training—though this remained their primary role—and had dropped the word "normal" or "teachers" from their titles. (*See* also TEACHERS, TRAINING OF.)

The United States had established a system of tax-supported secondary education much earlier than had Great Britain, and it was only after the British Education act of 1944 completely revised secondary schooling in England and Wales that British teacher training was thoroughly reorganized. Prior to the act of 1944 teacher training was carried on in schools having little status and operating under great diversity of form and sponsorship. By 1949, however, the responsibility for training teachers, as had been proposed in the McNair report of 1943, had been taken over by 16 area training organizations, for 13 of which the universities and university colleges had accepted administrative responsibility.

Thus, by the middle of the 20th century, the training of elementary- and secondary-school teachers, training for specific vocations, had come to be considered an integral part of higher education in Great Britain and the United States. Debate continued about the nature of the training, the courses to be included and the locus of administrative responsibility for the programs in the university, but teacher training had become "higher education."

Technical Education.—Technical education had not proceeded as far in gaining status as had teacher training, but it too was more frequently being included under the general category of "higher" education. As an applied science, engineering in all of its branches had gained acceptance into the university curriculum during the first part of the 20th century, largely because of the strong emphasis engineering programs placed upon theory and general principles. The expanding technology, however, demanded for every graduate engineer a score of persons with less training in theory but with basic insights into technical applications. In the United States two- and three-year technical institutes experienced a spectacular growth in enrollment following World War II. During the 1950s some of these technical programs found their way into the curriculums of established higher educational institutions, and regional accrediting agencies adopted new policies for the recognition of qualified, separately organized technical institutes as higher educational institutions.

In Great Britain the universities strongly opposed the offering of degrees by technical colleges, a prerogative the technical colleges sought with equal fervour. The Percy committee in 1945 recommended the establishment of regional advisory councils on which the universities and technical colleges would be represented with industrial and local authorities. In 1948 the ministry of education established a national advisory council on education for industry and commerce to co-ordinate the work of the regional councils and advise on matters of national policy. Various national technical schools were established, such as the National College of Rubber Technology (Northern Polytechnic, London, 1948). Technical colleges strengthened their programs and increased their emphasis on research. (*See* also TECHNICAL EDUCATION.)

Advanced programs in separately organized art and music schools also gained status, and in the United States many were classified by the office of education as higher educational institutions.

(A. O. P.)

Points of View.—Though welcomed by many, and accepted by most, the horizontal expansion of higher education was not without opponents. Dissenters insisted that, whatever else they might be, courses in beauty culture, manipulation of the adding machine and preparation of an evening meal were not valid parts of higher education. They damned the uncontrolled impetus toward specialized fragmentation and the introduction of triviality into the college curriculum and called for a re-examination and reorientation of educational theory. Advanced training in academic areas and preparation for "successful" careers, these people asserted, are not proper objectives of undergraduate college curriculums.

From the debate which followed, a debate largely forced on the educational world by the articulate voices of the dissenters, emerged the concept of general education. As used in its most common currency, the term was understood to embrace the broad views of those who sought to preserve certain common elements of liberal education in the college curriculum and to restore the unity of purpose that had characterized the best colleges of the 18th and 19th centuries. Despite a number of specific successes, the supporters of general education would be the last to assert the victory of their position and many of them would, indeed, insist that the situation may have become worse than when the debate began; that, like a large cafeteria, the college program seems designed to offer the largest number of students the widest variety of insubstantial snacks to be eaten with the least amount of effort.

Most hopeful—and, perhaps, most enduring—of the many experiments sponsored by the supporters of general education were various efforts to plan education around a standardized program of reading in what came generally to be called Great Books. The idea that true education begins best with the reading of great works by great minds, rather than in the analysis of what later textbook authors have written about those works, was not new. It may have been implicit in the *Bibliotheca curiosa*, a formal eclectic reading list prepared by Johann Hallervord of Königsberg in 1676, or in the reading-discussion program of Benjamin Franklin's Junto association of the 18th century, in Sir John Lubbock's list of the *Hundred Best Books* (1891) or in any of the many bound home-library collections of "classics" published throughout the late 19th and early 20th centuries.

In 1916 John Erskine at Columbia university made what is believed to have been the first attempt to persuade a major U.S. college to offer a credit course based on the reading and discussion of great books. He was not to succeed in his plan until the end of World War I, when he first offered his general honours course in great writings from Homer to William James. Fifteen students were enrolled in the initial course; they read a book a

week and met once a week in the evening for a two- or three-hour discussion of the material covered. Unlike later offerings of the same type, the Erskine course did not constitute the entire curriculum followed by the students enrolled in it, and the 53 works on the reading list were drawn entirely from the humanities. The goal of Erskine and his assistant instructor, Mark Van Doren, was relatively modest—to repair the failure of contemporary scholarship to reward effort with "either pleasure or wisdom."

The general honours course continued in existence at Columbia until 1932, when it was replaced by a colloquium, or seminar, limited to selected members of the junior and senior classes.

Early in the 1930s Robert M. Hutchins, then president of The University of Chicago, with Mortimer Adler, who had been an Erskine student in the first year of the course at Columbia, offered a great books class for 25–30 selected freshmen at the university. Convinced that the great books approach offered a sound corrective to the educational trends of his day, trends which "confused science with information, ideas with facts and knowledge with miscellaneous data," and determined that the primary obligation of the college student was "to think," Hutchins in 1936 established at Chicago a committee on the liberal arts. The committee, whose members included Stringfellow Barr and Scott Buchanan, was directed to study the whole concept of a liberal education. Hutchins in 1937 dropped high school credits as a basis for admission to the college and instituted a four-year liberal arts program starting in what would have been the junior year of high school. In 1942 the university decided to award the bachelor's degree for the program. Three years earlier, in 1939, the university college had begun a great books curriculum, which by 1944 had become firmly established.

Meanwhile, in 1937, St. John's college in Annapolis, Md., reinstituted the liberal arts program that it had earlier abandoned. Under the direction of Barr as president and Buchanan as dean, it became the first U.S. college to offer a full four-year liberal arts program consisting of the study of great books. Like The University of Chicago list before it, the St. John's course was based on a modified version of the Erskine reading list with science as a notable addition. Seventy-five authors were represented on the list which formed the nucleus of a program consisting of four years of seminars on the books, one lecture each week on the great ideas, special tutorials in Greek, Latin, French, German and mathematics, and laboratory work in science. The course has remained without substantial revision.

Significantly, the great books program has perhaps been more influential in the field of adult, nonformal education than it has in academic collegiate studies. In New York, under the influence of the Columbia program, Adler, Buchanan and Everett Dean Martin in 1927 began a series of adult courses with the support of the Carnegie Corporation of New York. Similar courses had been offered two years earlier by the New York Public library and the Peoples' institute and were to be offered later by Alexander Meiklejohn's School of Social Studies in San Francisco, Calif. (1933); the Chicago Public library (1945) and the District of Columbia Public library (1945); and by adult education programs in Annapolis, Washington, D.C., and Baltimore, Md., beginning in 1938 and 1939. In 1945–46 The University of Chicago accepted an invitation to conduct what is believed to have been the first course in classical readings for industrial employees in the United States, and in the same period offered a similar program for supervisory personnel of the Marshall Field department store in Chicago.

By 1947 the movement had resulted in the creation of the Great Books foundation to promote "reading and discussion of Great Books as a program of free, universal adult liberal education." The foundation assisted in the organization of groups, the training of group leaders and the publication of editions of the works to be read. Discussion groups were conducted in the manner of Platonic dialogues. Growth of the movement was spectacular. In 1948 there were 38,000 enrollees in groups in 222 cities throughout the United States; in 1949 the number had grown to 60,000 and by the beginning of the 1960s, organized groups were active in well over 1,000 communities.

Perhaps the most spectacular manifestation of the movement was recorded in 1952 when, after seven years of preparation, a 54-volume set of the "Great Books of the Western World" was published by Encyclopædia Britannica, Inc., under the direction of William Benton and the editorship of Hutchins. Included in the 54 volumes were 32,000 pages and 25,000,000 words comprising 443 full works by 74 authors. A feature of the set was the *Syntopicon*, edited by Adler, which indexed the entire set in relation to 102 great ideas and 3,000 subordinate ones. Within a decade, the set had become, despite the early skepticism of many, a publishing success which attested to the vigour of the great books idea as a method of liberal education. (W. E. Pr.)

GROWTH IN ENROLLMENTS

Not only was the curriculum of higher education expanding, but enrollments also increased. Following World War II the "G.I. Bill of Rights" (public law 346, 78th congress) in the United States and the Further Education and Training scheme in Great Britain released a flood of students upon the educational institutions in both countries. The effect was not only to fill the gaps created by the war years but also to give new impetus to the demand for higher education on the part of persons who otherwise would not have considered applying for work beyond the secondary-school level. What happened can be illustrated by the experience in the United States. In 1946, when higher education first felt the full impact of World War II veterans, the enrollment climbed to 2,078,000. The highest enrollment ever before reached was in 1939, when 1,365,000 students were registered. By the late 1950s enrollments exceeded 3,000,000. In 1930 just over 21% of U.S. youth aged 18 to 21 attended higher educational institutions. By the second half of the 20th century the ratio between persons aged 18 to 21 years and persons enrolled in higher educational institutions had climbed beyond 32%. Similar advances were recorded in Great Britain.

Calibre of Students.—In the midst of these exploding enrollments, questions were raised about the intellectual calibre of the young people entering colleges. Some persons were convinced that opening the doors to more and more students could only result in the progressive deterioration of higher education. On the other hand, the United States president's commission on higher education in 1946 argued that only a portion of those qualified for higher education were actually enrolled. The commission said that 49% of the population had the mental ability to complete 14 years of schooling with a curriculum of general and vocational studies and that 32% had the ability to complete advanced liberal or specialized professional education.

In Great Britain the Barlow committee earlier concluded, on the basis of an analysis of test experiments, that only about one in five of the boys and girls with intelligence equal to that of the best half of the university students actually reached the university. The committee stated that it would be possible to double enrollments in British higher educational institutions while still raising standards. In both the U.S. and Great Britain the respective reports met with mixed reactions. They were as roundly condemned as they were loudly applauded, but conclusive evidence either substantiating or repudiating their conclusions was lacking.

Faculties.—Increased enrollments were accompanied by problems in staffing and financing. Among U.S. colleges and universities one of the most persistent concerns was how to obtain and hold competent teachers in the numbers needed to serve the steadily expanding enrollment. A study conducted by the research division of the National Education association showed that over a four-year span holders of the doctor's degree comprised a steadily decreasing per cent of the successive groups of newly employed full-time college teachers. The decrease appeared to be only in small part due to the short supply of qualified personnel. To fill the gaps institutions were turning to new instructional methods and, among other things, some introduced closed-circuit television in various ways.

Among British institutions, the expanding enrollments also brought significant changes. The traditional residential college pattern was disrupted by the tremendous growth in enrollments

in the nonresidential "red-brick" or civic universities.

Finance.—The financing of higher education in the United States represents a complex balance of eight different sources of income: student fees, government grants (federal, state, local), endowment earnings, private gifts, sales and services, auxiliary enterprises, scholarships and a general catchall category labeled "other." The proportion of income from each of these sources varies with the institution and with the type of institution. The most striking variation is between public and private institutions. Private institutions in the second half of the 20th century derived over 30% of total income from student fees, while public institutions received about 10% from the same source. (In the United States "public" institutions are tax-supported institutions.) Private institutions received about 15%–17% of their total income from government sources, while public institutions received over 60% of their income from these sources.

Private colleges and universities earlier depended heavily upon endowment income. In the 1960s endowment funds produced less than 10% of the income. These institutions became more dependent upon student fees and private gifts. The most significant development in the financing of private higher education was the growth in contributions from industry. In 1960 business and industry gave an estimated $100,000,000 to higher education in the United States. This was an increase of $60,000,000 over 1950. In large part the funds went to private institutions. Public higher educational institutions, enrolling almost 60% of the resident students, depended for their major income upon tax monies from state governments. State governments contributed more than 40% of the total income for these institutions. Education had become one of the major items in state budgets.

In Great Britain, except for the University of London, none of the institutions had an endowment comparable with Oxford or Cambridge; but even those relatively wealthy universities were becoming more and more dependent upon government grants. Endowment was unable to carry the burdens imposed by postwar expansion, rising costs and new facilities. In the 1950s government grants constituted 70% of the total income for British higher educational institutions. *See* also ADULT EDUCATION; TECHNICAL EDUCATION; UNIVERSITY EXTENSION.

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HIGH-FIDELITY SOUND SYSTEMS. The reproduction of music in the home has been of sufficient importance that two large industries are built upon it—recording and radio broadcasting. With the popularization of alternating-current-operated amplifiers in the late 1920s, it became possible to provide enough power to approximate the acoustic volume of the original performance with loud-speakers, which have been improved continuously ever since. High fidelity became a hobby of thousands of music lovers, and many developments in the art appeared during the succeeding years. The introduction of the long-playing phonograph record in 1948 made it possible to widen the over-all frequency range of recorded music so that a reasonable facsimile of the original could finally be attained. Improvements in broadcasting equipment and the introduction of frequency-modulation (FM) broadcasting provided still higher quality, and by the early 1950s the general public began to develop an interest in high fidelity.

The term high fidelity, in its original meaning, referred to an assembly of equipment—more often than not built by the hobbyist himself—designed for reproduction of music with as great a faithfulness to the original as possible. In general, a high-fidelity or "hi-fi" system contains a source of music, an amplifier and a loud-speaker. The source may be any means for reproducing phonograph records, a radio tuner or a tape recorder; the sound signals from a television set may also be used. The signals produced by any of these devices are fed into the amplifier where they are increased in strength so that they have enough energy to actuate one or more loud-speakers, a combination of several mounted in an enclosure commonly being known as a loud-speaker system. Early systems usually consisted of loud-speakers originally intended for use in motion-picture theatres, since speakers of good quality were rarely used in conventional radio receivers. Amplifiers designed for public-address systems were adapted for home use, but in many ways early systems were makeshift. Sufficient demand was recognized by 1950 to warrant the production of amplifiers, record-playing equipment and high-quality loud-speakers intended for home use. Within five years the industry had some 200 manufacturers engaged in building components.

With no industry standards of quality and no restrictions on what could be called high fidelity, it was not long before the term was applied to any and all equipment that would reproduce a sound. While the original concept of high fidelity referred exclusively to an assembly of individual components—each being produced by a specialist in that particular equipment—by 1954 many complete systems, already housed in a cabinet by the manufacturer, appeared on the market. Economies of manufacture resulted in more impressive equipment at lower cost, but complete packaged hi-fi systems seldom compared in reproduction quality with those assembled from components, even though the latter might have been assembled by a dealer and sold as a complete unit. In general, sound quality is better when the loud-speaker is in a separate cabinet, particularly if a record player or turntable is part of the system.

Sound Sources.—The source of sound for the usual hi-fi system is the phonograph record, although many listeners find adequate programming from radio broadcasts. Record-playing equipment chosen for such a system is most often of highest quality, especially in the case of the serious music lover, who is likely to use a transcription turntable, a less-expensive modification of the extremely fine machines used in broadcasting stations and recording studios. This type of turntable produces a minimum of flutter and wow, and the lowest possible rumble. "Wow" is the name given to low-frequency variation in rotational speed of the record which causes a sound well described by the name. "Flutter" refers to speed variations of higher frequency, and while not so readily detected by the untrained ear, it is usually manifested by a roughness in violin and soprano voice tones. "Rumble" is a continuous low frequency which is fairly constant and which interferes with good reproduction of bass tones; intentional reduction of low-frequency response of the amplifier and loud-speaker equipment reduces the effect of rumble but sacrifices bass.

The phonograph pickup is the device which converts the mechanical vibrations caused by variations in the record groove into an electrical signal. Two general types are in use, with the magnetic group—including variable-reluctance, moving-coil and moving-magnet constructions—favoured for best quality. Piezoelectric types, which include crystal and ceramic pickups, are less expensive and require less critical amplifier circuits, but their output is not as uniform for all frequencies nor do they cover as wide a frequency range. Output signals from the magnetic types range from 1 or 2 mv. up to about 50 mv. for average recorded volume; ceramic and crystal types have outputs in the vicinity of 0.5 v. Stereophonic pickups of either type are actuated simultaneously by variations in both walls of the record groove and provide the two separate signals necessary for stereophonic reproduction. (*See* also PHONOGRAPH.)

Another source of program material is the tape recorder, which

came into common use in the early 1950s. These machines record on narrow bands of thin plastic upon which a coating of magnetic oxide has been deposited. The recording process is simple and necessitates little skill, reproduction quality being dependent almost entirely on the quality of the recorder itself. Program material may be recorded from broadcasts or from live performances, and prerecorded tapes have been introduced that offer a wide selection of music. (*See* TAPE RECORDING, MAGNETIC.)

For reception of radio broadcasts, the tuner is employed. The hi-fi tuner is simply a refined version of a radio receiver, but without audio amplifier or loud-speaker. Best reproduction comes from frequency-modulation stations, but since the range of FM signals is limited to about 50 mi. for reliable reception, amplitude-modulated (AM) stations can provide a usable signal for greater distances. The usual tuner for hi-fi use combines both AM and FM in the same unit, with circuitry often being arranged to permit reception of both types of signal at the same time for stereophonic reproduction. Frequency response of FM tuners meets highest broadcasting standards, and reception is almost entirely free from atmospheric or man-made static or noise.

FM stations are inherently capable of transmitting two or more programs over one channel at the same time by a process known as multiplexing, and thus can transmit both portions of a stereo program at once. FM stations also can provide additional program services by multiplex without the knowledge of listeners who are receiving the main channel only; such transmissions are usually subscribed for by hotels, restaurants and the like for background music entertainment.

The sound portion of TV programs is often fed into a high-fidelity system for improved reproduction. In most TV sets, the amplifier and speaker offer minimal sound quality, although the transmitted sound is almost equal to the best of FM quality. In built-in hi-fi systems, careful placement of TV picture tube and loud-speaker can give increased realism and greater enjoyment.

Amplifiers.—Since the output signals from phonograph pick-ups may be as low as 0.000001 v. during quiet passages, amplifiers are required to build these minute signals up to the volt or so necessary to actuate a loud-speaker. Controls are necessary to adjust frequency response to suit the listener's desires, the acoustic environment in the home and deficiencies in equipment or recordings. Phonograph records are not cut with a uniform frequency response because at low frequencies a loud signal would require a wide groove spacing which would reduce playing time. Noise and "needle scratch" can be reduced by accenting the high frequencies during recording and attenuating them during playback. Beginning at 500 cycles per second (c.p.s.), about one octave above middle C, the recording level is reduced progressively as frequency is lowered, decreasing in strength by one-half for each octave. High frequencies are increased or pre-emphasized beginning at 2,120 c.p.s., doubling in strength with each octave. To play back properly, a complementary correction must be introduced in the amplifier so that the resultant output is uniform over the entire frequency range. The frequency at which the lows begin to be reduced is known as the turnover, and was standardized in 1954 by the Record Industry Association of America (R.I.A.A.) at 500 c.p.s. for long-playing records. Prior to that time various other turnover points were used, resulting in lack of uniformity of records and necessitating greater complication in the amplifier. Similarly, the amount of pre-emphasis was standardized at 13.75 decibels (db.) at 10,000 c.p.s., which requires the complementary "roll-off" in the amplifier. For records made after 1954, only the one compensating characteristic, known as the R.I.A.A. curve, is required, but for records made prior to that date a number of compensations must be provided in the amplifier. These compensations, along with bass and treble tone controls, volume and loudness controls and source selector switches, form the preamplifier section, which may or may not be a separate unit. Tone controls must be arranged to provide boosts and attenuations of approximately 15 db. at both the bass and treble ends of the sound spectrum, with the reference frequencies usually specified as 50 c.p.s. in the bass and 10,000 c.p.s. in the treble. Loudness controls (sometimes designated "contour") are intended to compensate for reduced sensitivity of the human ear to low tones at volumes lower than the original performance. As the loudness control is turned so as to reduce volume, it reduces middle and high frequencies more rapidly than it reduces lows, giving the effect of increasing bass. Preamplifiers for stereophonic reproduction are equipped with two complete sets of controls, usually arranged so that one knob will control the same function in both amplifiers simultaneously.

The preamplifier may be combined with the basic or power amplifier, which furnishes sufficient electrical energy to drive the loud-speaker to room volume, although separate units for both give greater flexibility in use as well as in physical placement. When each component of a system is a separate unit, improvements in any one do not make the entire system obsolete, since the outdated unit may be replaced independently of the remainder of the equipment.

Amplifiers for home use should be capable of furnishing at least 10 w. of power to the speaker. Two separate amplifiers are required for stereophonic reproduction, and each should be rated at not less than 10 w. Distortion in high-fidelity amplifiers should not exceed 2% at rated output, and many amplifiers are even better. Certain types of loud-speakers are of low efficiency and consequently require 30 w. of power or more to perform satisfactorily, and it is not unusual for home systems to employ 60-, 70- or 80-w. amplifiers. Because of their greater physical size, it is not usual for these high-power amplifiers to be built on the same chassis with the preamplifiers. Lower-powered amplifiers are usually combined with the preamplifier sections, and in many instances with a radio tuner, making a complete system in one unit. (*See* also AMPLIFIER, ELECTRONIC.)

Loud-speakers and Speaker Systems.—For use in the home, loud-speakers must be housed in cabinets which combine proper acoustic design with aesthetically compatible appearance. By the late 1930s, the dynamic or moving-coil loud-speaker was established as the most efficient form of reproducer, and more powerful magnets and design improvements subsequently brought it to a high degree of performance. The typical high-fidelity loud-speaker is basically a modification of heavy-duty theatre types, and different sizes—each intended for optimum performance over a limited range of frequencies—are often combined into a loud-speaker system. The larger models of direct-radiator cone speakers are generally employed for low frequencies because of the need to move large volumes of air for good performance. Middle frequencies may be reproduced well by eight-inch cones, but some designers prefer small driver units coupled to horns for the intermediate range. Still smaller cones or horn-type loud-speakers are preferred for the very high frequencies. Reasonably uniform sound pressures may be created by such complete systems from as low as 25 or 30 c.p.s. up to about 18,000 c.p.s.

Electrostatic loud-speakers met with some acceptance, particularly for handling the upper frequency range, and some even were offered as "full-range" models. Most types have exceptionally good tone quality, but for acceptable reproduction down to 50 c.p.s. or below, the electrostatic speaker must be made excessively large, usually with an area of at least 12 sq.ft. Smaller units designed especially for high frequencies were favoured by some listeners, but not universally.

The performance of a loud-speaker depends more upon the enclosure than upon the mechanism itself, and a wide variety of enclosure designs appeared, each with its own claims to superior performance. Since all loud-speakers are presumed to possess the best sound-reproducing characteristics their designers can build into them, and since all do not sound alike by any means, the potential buyer should listen to the products of several reputable manufacturers and then choose the one that sounds best to him. (*See* also LOUD-SPEAKER.)

Public-Address Systems.—Sound coverage of large groups of people comprises two classifications: public-address systems, in which the principal requirement is to provide intelligible speech over large areas, usually outdoors; and sound reinforcement systems, which must reproduce both speech and music with sufficient faithfulness that the sound system is unobtrusive. The latter are

generally employed indoors, and aim for greatest realism. Equipment differs considerably between the two types, and the acoustic problems are entirely dissimilar.

For large outdoor gatherings, directional horns are usually employed to concentrate the sound over the occupied areas, thus utilizing the available power most efficiently. Since low frequencies contribute little to intelligibility of speech, response is decreased below about 300 c.p.s., and the upper limit is around 5,000 c.p.s. This permits the use of sturdy driver units and horns of reasonable sizes.

These units, used with directional horns, have high efficiencies—of the order of 40%–50%—and about 2 w. of electrical power will be required for each 1,000 sq.ft. of floor or seating area for a suitable sound level of 20 dynes per square centimetre, which is 100 db. above the threshold of audibility. Reflections from adjacent structures, such as buildings, grandstands and high fences, may reduce the required power, but such reflections may result in echoes which decrease rather than increase intelligibility, and their effect must be considered carefully. Amplifiers must be duplicated sufficiently so that failure of any one will not put the entire system out of commission, and output lines should feed the loud-speakers alternately so that partial coverage will be possible even in the event of some equipment failure.

Because of the high powers required, loud-speaker lines should be fed from a 70.7-ohm distribution system to reduce losses in the wiring, rather than at the lower impedances of the speaker units. This also permits ease of adjustment of the power consumed by each speaker to equalize sound distribution over the affected area. Switching of loud-speakers and sound sources and control of volume should be concentrated at one point so that a single operator can control the system.

Sound reinforcement systems for indoor use require less acoustic power because of reflections from walls and ceiling, but since wide-range loud-speakers are less efficient than directional horn units, a minimum of 50 w. should be provided for seating capacities up to 500, with an additional 50 w. being necessary for each additional 500 seats. The entire system must be capable of a wide frequency range for high-fidelity reproduction of music. It is important that the operator be stationed not in a separate control studio but where he can hear the sound in the auditorium if he is to maintain levels that are not too loud for realism, yet still adequate to override audience noises.

Theatrical performances are best reinforced by groups of loud-speakers at the sides and above the proscenium, but in many other applications the use of a "low-level" system which employs numerous small speakers at low volume is more satisfactory. Acoustic treatment to avoid undesirable echoes or reflections is likely to be required in most auditoriums, and the use of nonparallel surfaces often simplifies the sound reinforcement problem. *See* also ACOUSTICS OF BUILDINGS.

See J. H. Newitt, *High Fidelity Techniques* (1953); H. Pender and K. McIlwain, *Electrical Engineers' Handbook,* vol. 2 (1950).

(C. G. McP.)

HIGH-FREQUENCY HEATING is that form of industrial heating which derives its energy source from an alternating electric field. The field may be magnetic, as in induction heating, or electric, as in dielectric heating. In both cases, the energy transfer as heat into the material being processed increases with the frequency of the alternating polarity. Therefore, frequencies greater than those normally encountered in electrical energy supplies are generally used. These heating methods are sometimes misleadingly referred to as "r-f" (radio-frequency) heating or "electronic" heating.

Induction heating is applicable to materials that are nominally electrical conductors, usually metals. The required magnetic field is produced by circulating high-frequency current through a work coil, or inductor, that acts as the primary winding of a simple transformer in which the work to be heated may be thought of as a single-turn secondary or susceptor. By shaping the coil properly, the heat can be localized or spread throughout the work as required, and heat distribution patterns can be obtained which are not possible using conventional forms of heating. The work coil may consist of a single turn or of many turns, depending upon the desired heat pattern.

Appreciable heat losses occur in the work coil from the relatively high currents and the high effective resistance due to the increased frequency. Because of these losses, the work coil is generally water-cooled.

Induction heating has a number of salient features. For example, it is possible to localize the heat at the surface of the work, resulting in surface hardening, such as is required for bearings. This phenomenon becomes more pronounced at higher frequencies.

With induction heating it also is practical to localize the heat longitudinally on the work within the confines of the work coil. Many desirable heat-treating and metal-joining applications are made possible by this feature.

No electrical connections are made to the work to accomplish the heating, and the surrounding atmosphere remains cool. Induction heating has no temperature limitations, since the heat energy is generated within the work itself, and as long as the energy input is in excess of the heat losses, the work temperature will increase. With proper thermal insulation, extremely high temperatures can be attained, an especially important factor in the metallurgy of the refractory metals. In addition, heat energy can be introduced into the work at extremely rapid rates, many times those possible by conventional means.

Combination of one or more of these features makes induction heating a widely accepted metal-working tool. It is used for metal melting and refining, sintering, surface hardening, annealing, soldering, brazing, welding, and in vacuum furnace operations. In broad terms, induction heating finds application in practically any metal-working process requiring heat. It has been utilized in the processing of nuclear fuels and components, and also has been used in specialized heating applications for materials that are electrically conducting though nonmetallic; ionized solutions, glass at elevated temperature and molten salts are examples.

Three types of frequency conversion equipment are used as energy sources for induction heating. The motor-generator set is the most common, and standard units of this type supply frequencies of 960, 1,920, 3,000 and 9,600 cycles per second (c.p.s.) at power ratings of 7.5 to 1,500 kw.

Spark-gap convertors are also used for induction heating, employing both the mercury-vapour gap and the air gap principle. These units are inherently of low output, not exceeding 40 kw., and their frequency is limited to the 40 kc. to 300 kc. range. Vacuum-tube oscillators are employed where the higher frequencies at higher output power ratings are desired, and equipment of this type is available at frequencies of 300 kc. and higher at power outputs of 200 kw. or greater in single units.

The choice of frequency in induction heating depends upon the particular application. In many cases, it is not critical, and any frequency may suffice. The degree to which the induced current, and in turn the heat losses, penetrate the work is an inverse function of the frequency. Therefore, for deep-heating applications, such as forging, melting, brazing and through-hardening, the lower frequency range of 1,000 to 10,000 c.p.s. finds application. For case hardening, or any other surface heating application, the higher frequencies of 10,000 to 500,000 c.p.s. are used. Diameter of the work being heated also affects the choice of frequency, since the smaller diameters require higher frequencies for a given rate of energy transfer. As a rule, it can be said that the range of frequencies for induction heating is from 1,000 to 500,000 c.p.s., with very few applications requiring higher frequencies. Large melting installations and low-temperature heating of large masses employ 60-cycle energy for induction heating, and the principles of operation are the same as those which apply to high-frequency induction heating.

The induction heating effect also is dependent upon the magnetic properties of the material being heated, and in general magnetic materials heat more readily than nonmagnetic. However, all magnetic materials lose their magnetic properties at the Curie point (1,330° F. for iron). Since most metallurgical operations on steel require temperatures in excess of this value, the problems of heating must be considered as those of nonmagnetic materials. Since

induction heating can be considered as resistance heating, the resistivity of the material directly affects its reaction to the induction-heating field. Hence, good electrical conductors, such as copper, silver and aluminum, heat less readily than poorer conductors such as nickel, iron, steel and the refractory metals.

Dielectric heating is the counterpart in the field of industrial heating of electrical nonconductors to induction heating in the metal-working field. Materials that are poor electrical conductors because of their molecular behaviour are also poor thermal conductors, and when they are heated by conventional means the transfer of heat through the surface to the inner sections of the mass is difficult and time-consuming. Since a large proportion of these materials are subject to damage at elevated temperatures, the rate of heating conventionally is slowed considerably by the damage temperature, which cannot be exceeded.

Dielectric heating is achieved by placing the material to be processed in the influence of a high-frequency electric field. It is a voltage phenomenon, whereas induction heating is a current phenomenon, but it is also directly affected by the frequency of the alternating field. The electrodes which produce the heating field are, in industrial practice, flat plates separated so that the work can be placed between them. Since one side of the output circuit can be operated at ground potential, the electrode assembly reduces itself to a single high-voltage electrode, suspended on electrical insulators above the grounded platen of the work-handling equipment. Other electrode configurations are employed, such as cylindrical, finger and cuff shapes.

If a mass of material relatively uniform and homogeneous in cross section is placed in a high-frequency electric field, each unit mass of that material absorbs energy. The rate of energy absorption is proportional to (1) the square of the voltage gradient across the unit mass; (2) the frequency of the alternating field; (3) the dielectric constant of the material at the operating frequency and (4) the power factor of the material at the operating frequency. The latter two factors are often combined and their product referred to as the loss factor of the material. Consequently, for maximum heating rate, the frequency and voltage should be as high as can be practically attained. In general, dielectric-heating electrodes are energized at potentials of the order of 5,000 to 15,000 v., and the frequency ranges from 5 to 50 mc. For many materials, the specific frequency is relatively unimportant, and effective heating can be accomplished anywhere within the above limits. Other materials show radical change in their loss factor at different frequencies, and the frequency for such materials must be chosen to give the maximum loss factor.

Since dielectric heating is a voltage phenomenon, the currents involved in the electrode circuit are relatively small and no water cooling is required. On the other hand, the high voltages encountered impose a severe electrical insulation problem.

Dielectric heating finds application in practically all fields where heat must be introduced uniformly throughout electrically nonconducting materials. Moisture removal is one of its most important functions, since much of the industrial heating done on such materials is for this purpose. Water heats much more rapidly than any other material when exposed to the dielectric-heating field, since it has a dielectric constant of 80 over practically the entire frequency range, whereas other materials have dielectric constants from 1.0 to 8.0. Typical examples of dielectric heating as applied to moisture removal are the heating of packages of yarn, the baking of foundry cores and the curing of wood and tobacco. Other curing operations do not involve the removal of moisture but are truly molecular transformations brought about by heat. Thermosetting plastics are typical examples and dielectric heating is used extensively in processing them. The heat may be applied to a thermosetting glue in the woodworking field or to plastic for heating prior to molding. Foundry cores, already mentioned as an application for moisture removal, are also an example of plastic processing, since a thermosetting binder is used in aqueous solution. Other fields of application of dielectric heating include the production of pharmaceuticals, food processing and sterilization.

The great advantage of dielectric heating is speed. For example, foundry cores that previously required 8 to 12 hr. in an oven can be baked in 90 sec., and textile packages that formerly required 72 hr. in heated, circulated air for proper drying can be dried dielectrically in 15 min. The vacuum-tube oscillator provides the high-frequency electrical energy source for dielectric heating, since it is the only type of apparatus which will provide sizable amounts of electrical energy in the high-frequency ranges. Terminal output voltages range from 5,000 v. on small equipment to 15,000 and even 20,000 v. on large units. Power output ratings range from a fraction of a kilowatt to 200 kw. Although the large majority of units operate in the frequency range from 1 to 50 mc., some equipment is built which has an output frequency of the order of 2,500 mc. These units are self-contained equipment of the resonant cavity type, with the oscillator and heating section mounted adjacent to each other in the same cabinet. They have found application in cooking and defrosting foods.

See J. Wesley Cable, *Induction and Dielectric Heating* (1954).

(J. Wy. Ce.)

HIGHGATE, a district in north London, Eng., lies within the three boroughs of St. Pancras, Islington and Hornsey (*qq.v.*). Highgate hill, a road made by the hermit Lichfield in the 14th century, was formerly part of the Great North road. Near the summit of the hill (426 ft.) stood a tollgate (whence Highgate) erected in 1356 by the bishop of London. On the site of Lichfield's hermitage Highgate school was founded by Sir Roger Cholmeley in 1565: in the crypt of the school's Victorian chapel was the tomb of Samuel Taylor Coleridge, later removed to St. Michael's church. The poet lived at No. 3 The Grove for 18 years until his death in 1834. Nearby in Arundel house (now Old hall) Francis Bacon died in 1626. A. E. Housman lodged at Byron cottage, North hill, during the time *A Shropshire Lad* was written. Running up the hill is Waterlow park, with Lauderdale house, associated with Nell Gwynn and the seat of John Maitland, the 2nd earl of Lauderdale, a member of the cabal ministry of Charles II. Nearby stood the cottage and garden belonging to the poet Andrew Marvell (1621–78). Adjacent to the park is Highgate cemetery, where many famous people lie buried, including Karl Marx, Michael Faraday, George Eliot and her husband George Henry Lewes, Mrs. Henry Wood the novelist, Herbert Spencer the philosopher, Tom Sayers the pugilist champion. The "Whittington stone" associated with Richard Whittington, lord mayor of London, was placed near the foot of Highgate hill in 1821, replacing an earlier 17th century stone.

Parliament Hill fields and Ken wood (*see* St. Pancras) lie west of Highgate, and to the north are Highgate and Queen's woods.

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(W. B. St.)

HIGHLAND GAMES, originally athletic meetings carried out in the Scottish Highlands, now include similar meetings in any part of the world conducted usually under the auspices of a local Caledonian society and more or less according to what are believed to be traditional customs. The meetings originated in impromptu competitions at the clan assemblies summoned by the chiefs for hunting, military exercises and the conduct of clan business generally. The complete breakup of the clan organization after the Jacobite rising of 1745 put an end to these gatherings. The first of the modern meetings was instituted about 90 years later at Braemar and Strathdon (the Lonach gathering). Other meetings, notably at Ballater and Aboyne in Aberdeenshire, at Oban (the Argyll gathering) and Dunoon (the Cowal gathering) followed between 1864 and 1871. There are now about 40 major meetings and gatherings in Scotland and numerous ones elsewhere.

The local chief, if there is one, usually acts as president and at some gatherings is received with ceremony and escorted to his place to the music of the bagpipes. At the Lonach gathering the clansmen, armed with pikes, follow their chief to the arena. The meetings include the usual flat and hurdle races, long and high jumps and pole vault, and throwing the hammer and putting the weight. In these last two there are links with the past in the wooden shaft of the hammer (though the original hammer head

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is replaced by an iron ball) and in the round stone ball used for putting at many games. An exclusively highland event is "tossing the caber," a fir pole about 17 ft. long and about 90 lb. in weight (*see* CABER TOSSING).

At all gatherings and meetings competitions in bagpipe music and highland dancing form an important part. Competitions are usually for individual pipers, but at the Cowal gathering there are also competitions for pipe bands. The standard highland dances are the reel, fling, sword dance and Seann Triubhas. These dances were always regarded as male dances, and it was only at the beginning of the 20th century that women were allowed to compete. The ban on women dancers is still in force at Braemar and Oban. At Aboyne women compete but have to wear a feminine highland costume instead of the kilt, which is an exclusively male dress. (C. V. S. J.)

HIGHLAND PARK, a residential city of Lake county, Ill., U.S., 23 mi. N.N.W. of Chicago, situated on a bluff 100 ft. above Lake Michigan. Two Potawatomi villages originally stood at the site. White settlement began in 1834 with a tavern, Green Bay house, on the Chicago-Milwaukee post road. For a short time it served as a small lake port (Port Clinton), and was named Highland Park by the Chicago and North Western railroad in 1854 when it became a station. The town was incorporated in 1867, became a popular wealthy residential and health resort area in the late 19th century, and owes its growth to its proximity to Chicago. It adopted a city-manager form of government in 1955. Ravinia park within the city is one of the oldest outdoor summer music and cultural centres in the United States; the U.S. army's Ft. Sheridan adjoins Highland Park on the north. For comparative population figures *see* table in ILLINOIS: *Population*. (RI. S. H.)

HIGHLAND PARK, a city in Wayne county, Mich., U.S., is a residential and industrial suburb surrounded by the city of Detroit (*q.v.*). The site, originally the English settlement of Nabors, was renamed Whitewood after the American Civil War.

Judge Augustus B. Woodward in 1824 purchased 320 ac. in what is now the centre of the city and laid plans for developing a village which he named Woodwardville. Three years later the judge died and his property was sold.

In the early 1880s Capt. William Stevens settled in Whitewood, which by 1889 was incorporated as a village. A ridge or highland (at Highland and Woodward avenues) leveled to make way for the electric railway became the namesake of the community. City status was attained in 1918.

Henry Ford purchased the old race track along Woodward avenue and opened his automobile plant Jan. 1, 1910. Three years later he introduced the system of mass production. After the Model T was discontinued in 1927, the Ford assembly operations moved to Dearborn. In 1959 the famous Ford stacks were torn down to make way for a modernization program, completed the following year. Paints, chemicals, interior trim sets for cars and tractors are manufactured in the Highland Park Ford plant. Another major industrial establishment is the Chrysler corporation plant with its institute of engineering.

The school district of Highland Park, established in 1889, offers an educational program from kindergarten through junior college to all residents. For comparative population figures *see* table in MICHIGAN: *Population*. (E. C. HA.)

HIGHLAND PARK, an independent town within the city of Dallas, Tex., U.S., was one of the first planned residential towns in the southwestern United States. In 1889 a Philadelphia syndicate acquired the wooded, creekside site north of Dallas for an exclusive residential section, but the panic of 1893 killed the project. In 1906 John S. Armstrong, a retired packer, bought the land. The town was incorporated in 1913. He and his son-in-law, Hugh E. Prather, went to California to see the town of Beverly Hills, laid out by a planning expert, and brought the planner to Texas to design Highland Park. With its sister suburb, University Park (*q.v.*), at its north boundary, Highland Park shares one of the better public school systems of the nation. Of its high school graduates 98% go to college. For comparative population figures *see* table in TEXAS: *Population*. (E. P. CR.)

HIGHLANDS, THE (SCOTTISH HIGHLANDS), that part of Scotland northwest of a line drawn from Dumbarton to Stonehaven, sometimes including the Inner and Outer Hebrides and the county of Bute, but excluding the Orkneys and Shetlands, Caithness, the flat coastal land of the shires of Nairn, Elgin and Banff, and all east Aberdeenshire (*see* SCOTLAND). In this area Gaelic customs (highland games [*q.v.*], dancing, music) and language have lingered on. The town of Inverness is usually regarded as the capital of the Highlands.

HIGHMORE, JOSEPH (1692–1780), English portrait painter, was born in London, June 13, 1692. About 1714 he entered Sir Godfrey Kneller's academy where he was influenced, according to George Vertue, by the French painter Louis Cheron. In Highmore's early work he adapted Kneller's style to a more unvarnished if less masterful rendering. Observation of individual resemblance and a discreet grace are evident in later portraits.

Although Highmore visited France and the Low Countries in 1732 and again in 1734, his style was perhaps affected more by French rococo artists such as Philippe Mercier and Hubert Gravelot, who were established in London during the 1730s and 1740s. But their influence is traceable less in Highmore's portraits than in his genre illustrations. In 1744 he painted a series of 12 illustrations for Richardson's *Pamela,* which suggest comparison with William Hogarth's "Marriage à la Mode." Highmore is less boisterous, less satirical and more refined, although his juxtaposition of characters is quite vivacious, as in the British museum drawing called "The Enraged Husband." But Highmore's genre belongs to a larger context that includes John Vanderbank's illustrations for *Don Quixote* and Francis Hayman's compositions for Vauxhall. Highmore retired from practice in 1761 and moved in 1762 to Canterbury, where he spent the remainder of his life. He died in March 1780. (F. H. D.)

HIGH PLACE is the term used in the standard English versions of the Old Testament to designate a shrine built on a hilltop. The Israelites found many such shrines in existence when they settled in Canaan and apparently adopted them, or some of them, for their own worship. They were of Canaanite origin, as indeed is the Hebrew word *bamah* which is translated "high place." They are associated with high hills and spreading trees (Ezek. xx, 28 ff.) and were doubtless at times the scene of fertility rites. The name *bamah,* meaning "hill" or "high place," was transferred to the shrine built on it. There were high places in Moab (Num. xxi, 28), and Solomon even built one for Chemosh, the god of Moab (1 Kings xi, 7). Their furniture may have varied from place to place and depended upon local custom and belief, but there would be an altar for sacrifice and a room or hall for a com-

munal meal (I Sam. ix. 12–14, 22). Beside the altar, in Canaanite times, were a stone pillar (mazzebah) and a wooden pole (asherah) sacred to and symbolizing the god and goddess respectively (*see* BAAL; ASTARTE). The Hebrews looked askance at these two objects and eventually came to condemn their existence and use in the strongest terms (Deut. xvi. 21 f.; I Kings xiv, 23; etc.). The use of the shrines themselves, especially the altars, seems to have continued well into the period of the Israelite monarchy. According to tradition Solomon went on using the shrine at Gibeon even after the Temple was built and the ark housed there, for Gibeon "was the great high place" (I Kings iii. 4). The religious reformers of the 8th century, represented in writing by the Book of Deuteronomy and in practice by the reform of Josiah, so strongly condemned the worship at these shrines as to demand their complete destruction. Against this background *bamah* came to be a contemptuous term: it was used to describe Bethel, where Jeroboam worshiped the calf (II Kings xxiii. 15), and Topheth, where human sacrifice was practised (Jer. vii, 31). (L. H. BR.)

HIGH POINT, an industrial city of Guilford county, in north central North Carolina, U.S., in the Piedmont region, 18 mi. S.W. of Greensboro and 99 mi. N.W. of Raleigh.

The area was originally settled by Quakers about 1750, but the town was not laid out until 1853 when it was so named because it was the highest point between Goldsboro and Charlotte on the state-built North Carolina railroad. Incorporated in 1859, it developed from a small trading centre in the 1880s into a modern, sprawling industrial city. Furniture manufacturers, attracted by the abundance of hardwood timber, caused it to become "the Grand Rapids" of the south. The Southern Furniture exposition is held every January and July in a block-size building where national manufacturers bring their new lines for inspection and sale. More recently the hosiery industry outstripped the furniture business in volume. Other manufactures include paint, chemicals and machinery. High Point college, a Methodist coeducational institution, chartered in 1920 and opened in 1924, has about 1,000 students, one-half of whom are day students.

The city adopted a commission-manager form of government in 1916. Pop. (1960) 62,063; Greensboro-High Point standard metropolitan statistical area (Guilford county), 246,520. For comparative population figures *see* table in NORTH CAROLINA: *Population*. (B. P. R.)

HIGH SCHOOL (UNITED STATES), the secondary level of the U.S. common school system. The high school is distinctive in that it is a graduated extension (grades 9 through 12) of the elementary school system, open to all, and not a distinct type of school. Generally it offers either terminal education or preparation for college. It is roughly comparable to the British grammar, technical and modern secondary schools, and the various forms of postprimary schools in Germany, France and other countries. *See* SECONDARY EDUCATION; EDUCATION, HISTORY OF.

HIGH SEAS consist of all parts of the mass of salt water surrounding the globe which are not part of the territorial sea or internal waters of a state. For several centuries beginning in the middle ages a number of maritime states asserted sovereignty over large portions of the high seas. Well-known examples were the claims of Genoa in the Adriatic and of Great Britain in the North sea and elsewhere.

The doctrine that the high seas in time of peace are open to all nations and may not be subjected to national sovereignty (freedom of the high seas) was proposed by Grotius as early as 1609 in his famous *Mare liberum*, but did not become an accepted principle of international law until the 19th century. Ideologically connected with other 19th-century freedoms, and particularly *laissez faire* economic theory, freedom of the high seas was vigorously pressed by the great maritime and commercial powers, especially Great Britain, and is presently recognized to include freedom of navigation, fishing, the laying of submarine cables and pipelines, and overflight by aircraft.

At mid-20th century demands by some coastal states for increased security and customs zones, for exclusive offshore fishing rights, for conservation of maritime resources, and for exploitation of resources, especially oil, found in continental shelves, caused serious conflicts. A United Nations conference of 86 nations at Geneva in 1958 sought to codify the law of the high seas but was unable to resolve many outstanding issues, notably the maximum permissible breadth of the territorial sea subject to national sovereignty. *See* also WATERS, TERRITORIAL; RULE OF THE ROAD AT SEA.

BIBLIOGRAPHY.—C. J. Colombos, *International Law of the Sea*, 4th ed. (1959); United Nations Legislative Series, *Laws and Regulations on the Regime of the High Seas* (1951); H. Reiff, *The United States and the Treaty Law of the Sea* (1959). (N. DEB. K.)

HIGH-SPEED STEEL, a tungsten-chromium-vanadium tool steel, so called because of its ability to machine metals at speeds many times those possible with carbon tool steels.

It was developed almost simultaneously by European and U.S. metallurgists during the latter years of the 19th century. The research of F. W. Taylor and Maunsel White on proper heat-treating methods led to the full realization of the unusual qualities of these high-alloy steels. The Taylor-White heat treatment, which applies substantially to all high-speed steels, consists of two essential parts: heating the tool to a temperature just below its melting point, usually in the range of 2,200°–2,350° F. (1,204°–1,288° C.), the exact temperature depending upon the type of high-speed steel, and quenching in oil, molten salt or a blast of air; reheating to approximately 1,050° F. (565° C.) and cooling in air. Subsequent research showed that a second reheating (tempering treatment) at 1,050° F. develops the optimum in hardness, resistance to wear and toughness, which are essential for good cutting tools. Such a treatment induces the quality of red-hardness in these alloys, whereby the tool retains its useful hardness even when cutting so fast that the tip is heated red-hot by friction with the chip. The presence of numerous small particles of tungsten and vanadium carbides in the steel plays a significant role in attaining these properties. The most important feature of the Taylor-White treatment is the unusually high quenching temperature to which the steel is heated. Ordinarily carbon or low-alloy steels would be seriously damaged by heat treating at such temperatures.

Up to 5% cobalt has been usefully added to high-speed steel to improve its hardness and wear resistance for special machining requirements. Other innovations include an increase in the vanadium content to 2%–3%, which permits higher carbon contents and provides greater wear resistance without decreasing the toughness. A more important innovation consists of replacing half or more of the tungsten with molybdenum, an element analogous chemically but cheaper and much more readily available. However, the molybdenum-type steels are more prone to suffer a loss of carbon from their surface because of reaction with oxygen of the air at the high heating temperatures, thus decreasing the cutting efficiency of the tools. Coating the tools with borax or copper paint or using neutral molten salt baths for a heating medium successfully combats this problem.

Approximate Analysis of High-Speed Steel

Metal	High tungsten	Molybdenum	Tungsten-molybdenum
Carbon . . . . per cent	0.50–0.80	0.75	0.80–1.20
Tungsten . . . . per cent	18.0	1.5	5.75
Chromium . . . . per cent	4.0	4.0	4.0
Vanadium . . . . per cent	1.0	1.0	1.0–4.0
Molybdenum . . . . per cent	—	8.5	4.5

The varieties of high-speed steel can be reduced to the three important classes indicated in the table. Three additional classes are made possible by the addition of cobalt to each of these types.

BIBLIOGRAPHY.—M. A. Grossmann and E. C. Bain, *High Speed Steel* (1931); J. P. Gill and others, *Tool Steels*, American Society for Metals, 3rd ed., ed. by G. A. Roberts (1962); American Society for Metals, *Transactions*. (J. P. S.)

HIGH WYCOMBE, a municipal borough in the Wycombe parliamentary division of Buckinghamshire, Eng., 29 mi. N.W. of London by road, on the edge of the Chiltern hills. Pop. (1961) 50,301. The town stretches for more than 4 mi. along the narrow valley of the Wye stream and it also spreads over the steep hills on either side. The valley is one of the main passes of the Chilterns and through it run the railway and the London-Oxford road. High

Wycombe has long been noted for furniture, especially Windsor chairs, manufactured from the beeches that grow on the Chiltern hills; to the sheer woodwork have been added ancillary industries in metal and the manufacture of precision instruments. During World War II a number of clothing factories were opened. There are also paper mills and printing works. Wycombe appears to have been settled from early times. There are various ancient British remains, including an encampment, and many indications of an important Roman settlement. In Domesday the manor only is mentioned, but the borough existed in the time of Henry II and was granted a charter in 1237 by Henry III.

All Saints' church replaced in 1273 a church dedicated in 1070 to All Hallows. It was in great part rebuilt in the 16th century. Wycombe abbey, now a public school for girls, is a modern rebuilding. In and around the main street are other interesting buildings, including the 18th-century Market house and guildhall and the Red Lion hotel associated with Benjamin Disraeli, who fought several elections in the town. Hughenden manor, where Disraeli lived and where he lies buried, is on the northern outskirts of the borough. Since 1947 it has been national property—a rebuilt Tudor house in a fine park and a rebuilt church incorporating 14th-century features.

West Wycombe is a picturesque 15th- to 18th-century village lining the main road west of High Wycombe. Threatened with destruction, it was bought by the Royal Society of Arts in 1929 and transferred to the National trust in 1934. The trust also owns West Wycombe park (300 ac. and an 18th-century mansion) and the hill above the village. This is crowned by an extraordinary church and mausoleum erected in 1763 by the eccentric Sir Francis Dashwood, who also built West Wycombe park and founded the so-called "Hell Fire club."

HIKING: *see* WALKING.

HILARIUS (HILARUS, HILARY), **SAINT** (d. 468), pope from 461 to 468, succeeded Leo I. He was of Sardinian origin. As legate to the "robber" synod of Ephesus in 449 he opposed the condemnation of Flavian, patriarch of Constantinople, whose dying appeal to Rome he brought to Leo. His letters as pope show him as a wise and zealous administrator, correcting abuses and solving disputes submitted to him from southern Gaul and Spain. His synod of 465 is the oldest Roman synod of which the acts survive. He died on Feb. 29, 468, and his feast day is Feb. 28.

See his letters in A. Thiel, *Epistolae Romanorum pontificum genuinae*, vol. i (1868); *see* also E. Caspar, *Geschichte des Papsttums*, vol. ii (1933). (ME. BT.)

HILARIUS (fl. A.D. 1125), medieval poet and wandering scholar, was a pupil of Abelard and seems to have been associated with Angers, France. He wrote light verse of great charm in Latin, including a poem addressed to Abelard and several dedicated to English persons—which has led to the otherwise unsupported theory that he was English himself. His fame rests on his three Latin religious plays, two of which, like two of his poems, have French refrains. Those on the raising of Lazarus and on Daniel were written to be performed at matins or vespers. Both follow the biblical narrative fairly closely. In the latter, surprising elaboration of décor is required for a performance within the liturgy. The third play, which bears no trace of liturgical performance, is on a non-biblical subject: the legend of the image of St. Nicholas. All three plays show variety of metre, great liveliness and dramatic power. The French refrains (lacking in the play on Daniel), which are a lyrical addition, not an interpretation of the Latin, give an impression of directness and freshness.

See editions of his works by J.-J. Champollion-Figeac (1838) and J. B. Fuller (1929). The plays are quoted in full in K. Young, *The Drama of the Medieval Church*, vol. i (1933).

HILARY (HILARIUS), **SAINT,** OF ARLES (*c.* 400–449), is often regarded as having provided the occasion for an extension of papal authority in Gaul. Born probably in northern Gaul, in early youth he entered the abbey of Lérins, presided over by his kinsman Honoratus, who became bishop of Arles in 426. In 429 Hilary succeeded him and vigorously promoted reforms through several local councils. But his zeal led him to interfere with provinces outside his metropolitan jurisdiction and to overstep even the personal privileges bestowed on Patroclus, one of his predecessors, by Pope Zosimus in 417. He deposed Chelidonius, bishop of Besançon, and replaced another bishop (Projectus) regardless of canonical procedure. An appeal was made to Rome (444), and Pope Leo I quashed Hilary's irregular appointments, but while depriving him of all metropolitan rights he did not remove him from his see. These measures, to which Hilary submitted, were endorsed by an imperial decree of Valentinian III reinforcing Gratian's recognition of papal authority in 378. Besides minor works, Hilary wrote a memorial sermon on St. Honoratus. His feast day is May 5.

BIBLIOGRAPHY.—Works in J. P. Migne, *Patrologia Latina*, vol. i (1846). *See* also O. Bardenhewer, *Geschichte der altkirchlichen Literatur*, vol. iv, pp. 571–572 (1924); T. G. Jalland, *Life and Times of St. Leo the Great*, pp. 113–136, 159–164 (1941) (ME. BT.)

HILARY (HILARIUS), **SAINT,** OF POITIERS (*c.* 315–367), a convert from Neoplatonism, was elected bishop of Poitiers, his native city, *c.* 353. A champion of orthodoxy, after the Arianizing councils of Ariminum (Rimini) and Seleucia (359) he resisted almost alone both imperial pressure and the maneuvers of his fellow bishops and then consolidated the faith of his colleagues in Gaul, thus earning the title of "Athanasius of the west." He was exiled from his see by the emperor Constantius to Phrygia (356–360), where his contact with the Greek mind enabled him to discern the real issues of the Trinitarian controversies. There he wrote *De trinitate*, the first work in Latin to deal with them comprehensively. In *De synodis seu de fide orientalium* he explained the history of the controversy to his Gallic colleagues and convincingly showed the easterns that those who held the Son to be like the Father in substance and those who held him to be consubstantial should rally against those who called him unlike the Father. His appeals to the emperor were in vain, and he was turned out of the east as a troublemaker. Returning to Poitiers, he spent his last years in confirming the faith in Gaul and in writing his commentary on the Psalms and *Tractatus mysteriorum* on typology. In these, too, he served as a channel for Greek thought to the west, writing in a very personal style, which is difficult but free from ambiguity or uncertainty of thought. Besides minor works he also wrote hymns and (before his exile) a commentary on St. Matthew. His feast day is Jan. 14. He was declared a doctor of the church in 1851.

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HILBERSEIMER, LUDWIG (1885–), German-American city planner, was born at Karlsruhe, Ger., on Sept. 14, 1885. In Germany he devoted as much time to architecture as to planning and in 1930 founded the department of city planning at the Bauhaus, Dessau. An original and logical thinker, his first project for a new city was, to some extent, two cities on top of one another, dwelling houses for workers being vertically above the offices and workshops. Later he developed a linear form of city with housing and industrial units related horizontally.

In 1938 Hilberseimer came to the United States as professor of city planning at the Illinois Institute of Technology, Chicago, and there demonstrated further the implications of the decentralization of cities with a plan for Chicago and in regional planning studies showing the possibilities for integrating agriculture, industry and transportation. His writings include *The New City* (1944); *The New Regional Pattern* (1952); *The Nature of Cities* (1956). (R. F. MN.)

HILBERT, DAVID (1862–1943), German mathematician who exerted a great influence on modern mathematics. He was born on Jan. 23, 1862, in Königsberg, where he studied under H. Weber and F. von Lindemann, receiving his Ph.D. in 1885. During this period began the close personal and scientific ties with H. Minkowski and A. Hurwitz that had a lasting effect on his mathe-

matical interests. He taught in Königsberg as *Privatdozent* (1886–92) and professor (1893) until he became professor at Göttingen (1895), a post he held to his retirement in 1930. He died in Göttingen on Feb. 14, 1943.

Hilbert became a member of the academy at Göttingen in 1895, editor of the *Mathematische Annalen* in 1902, and later received many honours. His lectures were rich in ideas and stimulated his students, who came from all parts of the world.

His main achievements, all of great importance, included work on the theory of algebraic invariants (1885–92); the theory of algebraic numbers (1893–99); the foundations of geometry, initiating his work in axiomatics (1898–99); a new approach to Dirichlet's problem and other contributions to the calculus of variations (1900–05); integral equations and the theory of infinitely many variables including spectral theory and the concept of Hilbert space (1901–12). Then followed his work in mathematical physics with contributions in such fields as the kinetic theory of gases, the theory of relativity, etc., and, finally, his critical studies on the foundations of mathematical logic.

He helped establish many modern trends with his famous "mathematical problems" formulated at the International Mathematical congress in Paris (1900). Noteworthy among his extensive accomplishments is his proof, in 1909, of the famous conjecture of E. Waring (1782) on the representation of integers as sums of powers.

Hilbert's work, and in particular his collaboration with H. Minkowski and F. Klein, was most fruitful and led to a new vigour within the field of mathematics in Göttingen and all over Germany, interrupted only by the unhappy political developments of the 1930s. *See* also MATHEMATICS, HISTORY OF: *19th and 20th Centuries*. (G. Sö.)

HILDA (HILD), **SAINT** (614–680), abbess of Whitby and foremost among the abbesses of Anglo-Saxon times, belonged to the royal house of Northumbria and was baptized by Paulinus, with King Edwin, her great-uncle, *c.* 627. At the age of 33 she wished to become a nun at Chelles, in France, like her sister Hereswith, but Aidan, bishop of Lindisfarne, prevailed upon her to stay in England. She lived first in a small nunnery on the river Wear, and then presided over the abbey of Hartlepool, until, *c.* 657, she founded a new monastery at Streaneshalch (now Whitby, as renamed by the Danes), on land given her by King Oswiu. The establishment, with both monks and nuns under the authority of Hilda, became an important training ground for churchmen; five of its inmates under the first abbess became bishops, and the poet Caedmon was a brother there. Hilda's influence was felt all over England, even in the north and east, among the missionaries of Celtic origin, whose rites and customs she favoured. Oswiu entrusted to her his daughter Elfled. At the synod of Whitby, in 664, Hilda submitted to the king's decision in favour of the Wilfridian party on the question of adopting the Roman Easter usage (*see* EASTER), though she sided later with Archbishop Theodore of Canterbury against Wilfrid. She died on Nov. 17 (her feast day), 680.

See Bede, *Historia ecclesiastica*, iii, 24–25; iv, 23; v, 24, ed. by C. Plummer with notes (1896); Eddi's life of Wilfrid ed. by B. Colgrave with Eng. trans. (1927). (PL. GN.)

HILDEBRAND, ADOLF VON (1847–1921), German sculptor, who was a powerful exponent of classical Greek principles in modern sculpture, was born in Marburg on Oct. 6, 1847. He studied in Nürnberg, Munich, Berlin and Rome, and in 1874 settled in the neighbourhood of Florence. In 1897 he built himself a house in Munich, where he died on Jan. 1, 1921.

Hildebrand's work combined lifelike realism with classic conception of form. He modeled many portrait busts, among which may be mentioned those of Clara Schumann, Hermann von Helmholtz, Max von Pettenkofer, Wilhelm von Bode and Henriette Hertz. For the market place in Jena he designed the Bismarck fountain (1894); for Munich the Wittelsbach fountain (1895) and the Hubertus fountain (1907); for Strasbourg a fountain with the bronze figure of Father Rhine (1903), the architectural part of which was destroyed in 1919 and the figure placed in a park; for Meiningen a monument of Brahms (1898) and one of the poet Otto Ludwig (1898); for Bremen a monument of Bismarck (1910); and for Nürnberg a monument of Schiller (1911). His small book entitled *Das Problem der Form* (1893), in which he analyzed the optical laws underlying the artistic representation of form, exercised a revolutionary influence on art criticism. It was widely read, and many theorists in art founded their writings on it.

HILDEGARD, SAINT (1098–1179), German abbess and mystic, called the "Sibyl of the Rhine," was born of noble parents at Böckelheim, near Spanheim, and was educated at the Benedictine cloister of Disibodenberg by Jutta, sister of the count of Spanheim, whom she succeeded as prioress in 1136. From childhood she experienced visions, and in her 43rd year she consulted her confessor, who in turn consulted the abbot and the archbishop of Mainz, who gave a favourable verdict. He appointed a monk, Volmar, to aid in preparing a manuscript record of Hildegard's visions, and the principal writing, *Scivias*, was taken down in the years 1141–50. This consists of 26 visions, prophetic, apocalyptic, symbolic in form. About 1147 she went with 18 of her nuns to a new convent on the Rupertsberg near Bingen, where she continued to exercise the gift of prophecy and to record her visions in writing. She died on Sept. 17, 1179, and though she has never been canonized, her name is in the Roman martyrology. Her feast day, Sept. 17, is observed in a number of German dioceses.

In addition to the *Scivias* there is an extensive correspondence, in which are to be found further prophecies and allegorical treatises. Those addressed range from popes and emperors to simple nuns and laymen. There are also two treatises dealing with medicine and science, reflecting a quality of scientific observation rare at that period.

See H. Thurston and D. Attwater (eds.), *Butler's Lives of the Saints*, vol. iii, pp. 580–585 (1956). (Fs. P. C.)

HILDEN, a town of Germany which after partition of the nation following World War II was in the *Land* (state) of North Rhine-Westphalia, Federal Republic of Germany, lies to the east of the Rhine river 9 mi. S.E. of Düsseldorf. Pop. (1961) 37,595. Notable buildings are the late Romanesque church (12–13th century) and the house called "Auf der Bech" dating from 1589. Industries include iron founding, tube drawing, tanning and the manufacture of textiles, machinery, instruments, umbrellas and varnishes. Hilden, first mentioned in documents in 1074 and whose municipal charter dates from 1861, is a railway junction and lies just west of the Cologne-Frankfurt *Autobahn*. (H. SR.)

HILDESHEIM, a town of Germany and capital of the Hildesheim *Regierungsbezirk* (administrative division) in the *Land* (state) of Lower Saxony, which after partition of the nation following World War II was part of the Federal Republic of Germany, lies between wooded hills where the Innerste river enters the North German plain from the Harz mountains, 38 km. (24 mi.) S.S.E. of Hanover. Pop. (1961) 96,341.

The main business streets are the Almsstrasse and Hoher Weg (north-south) and the Schuhstrasse (east-west). The oldest church is the cathedral of the Roman Catholic diocese of Hildesheim (10th–11th century), whose magnificent bronzes include the Bernward's door, the *Christussäule* (Christ's pillar) and baptismal fonts; it has a rich treasury. St. Michael's church, a former Benedictine abbey (11th century) now in Protestant hands, has a painted ceiling of the 12th century depicting the Root of Jesse. Other churches include the Roman Catholic St. Godehard's (the only one in the town nearly intact at the end of World War II) and Holy Cross and St. Andreas', the principal parish church of a community that has been two-thirds Protestant since the Reformation. The town hall, whose oldest parts date from 1268, is on the old market place facing the Late Gothic Tempelhaus, built 1484–90 on the site of a former Jewish temple. The noted wooden Knochenhauer-Amtshaus, formerly the butchers' guildhouse, was destroyed in 1945.

Hildesheim contains trade schools with courses in art, building, commerce, joinery, domestic science and agriculture. Parks and open spaces include the Ehrlicherpark, the Steinberg (518 ft.) and the Galgenberg (498 ft.), where in 1868 a hoard of Roman table silver dating from about the time of Christ was found. Near the cathedral the Roemer-Pelizaeus museum contains an important Egyptian collection.

The town lies on the railway Cologne-Brunswick-Berlin and on the *Autobahn* between Hamburg and Basel, Switz., and is connected with the inland-waterway network. Industries include the manufacture of large cooking stoves, agricultural and dairy machinery, carpets, rubber articles, textiles, cosmetics, sweetmeats (candies), precision tools and radio and television apparatus.

Hildesheim originated in the 8th century as a fort sheltering merchants using the trade route between Cologne and Magdeburg, with a single street market which is now the Alter Markt north of the cathedral. In 815 the emperor Louis I (*q.v.*; "the pious") transferred the bishopric, founded at Elze on the Leine river by his father Charlemagne, to a hill south of Hildesheim, an event commemorated by the legend of the "rose staff" and linked with the "1,000-year-old rose" that still blooms above the east choir of the cathedral (but whose probable age is only 300–500 yr.). Great prelates such as St. Bernward (bishop 993–1022) and his successor St. Godehard (bishop 1022–38) fostered the development of the settlement that arose around the market; the former is buried in St. Michael's church and the latter gave his name to the St. Gotthard pass. The town was a member of the Hanseatic league and throve under the protection of the cathedral citadel. Its charter dates from 1300. The territory of the Roman Catholic bishop was reduced by the religious feuds of 1519–23 and lost at the Reformation in 1542, and although part of it was later regained the major part remained Protestant under Guelph rule. Hildesheim fell to Prussia in 1802 and in 1815 to the kingdom of Hanover; with the latter it reverted to Prussia in 1866. It was severely damaged by bombing (March 22, 1945) in World War II and in 1946 was included in the new *Land* of Lower Saxony.

Hildesheim *Regierungsberzirk* (pop. [1961] 943,442) has an area of 2,014 sq.mi. (R. Z.)

HILFERDING, RUDOLF (1877–1941), German Socialist, a leading representative of Austro-Marxism, that is to say of the Viennese development of Marxist theories, was born in Vienna on Aug. 10, 1877. Having turned to socialism already as a medical student, he wrote several politico-economic works, among which *Das Finanzkapital* (1910; 2nd ed. 1920, reprint 1947) made him famous. In 1906 he became a teacher at the Social Democratic party's training school in Berlin; and from 1907 to 1915 he was political editor of *Vorwärts*. He opposed the approval of war-credits by the Majority Socialists at the outbreak of World War I in 1914 and became chief editor of *Freiheit*, the principal newspaper of the Independent Social Democrats, at the end of 1918, but rejoined the Majority party with the remaining Independents in 1922. He was twice minister of finance for the Reich (Aug.–Oct. 1923 and 1928–29) and from 1924 was a deputy in the *Reichstag*. His party's chief theorist and financial expert, he was also editor of the periodical *Die Gesellschaft*. Hilferding fled to Denmark in March 1933, going later to Switzerland and, in 1938, to France. He drafted the Prague program of Jan. 1934 for the exiled German Socialists and continued writing on political questions. After the outbreak of World War II, he was arrested in unoccupied southern France in Feb. 1941 and handed over to the Germans. A few days later he died in a Parisian jail. *See* also MARXISM: *Neo-Marxism*.

See Alexander Stein, *Rudolf Hilferding und die deutsche Arbeiterbewegung* (1946); L. J. Edinger, *German Exile Politics* (1956). (G. Sz.)

HILIGAYNON, the third largest ethnolinguistic group in the Philippines, inhabiting most of Panay and western Negros, as well as parts of Mindanao, Mindoro, Romblon and the adjacent smaller islands. In 1948, the Hiligaynon numbered 2,373,566, including many living in Manila. They speak a Bisayan language (*q.v.*), usually called Hiligaynon or Ilongo, which is closely related to Cebuano (*q.v.*) and Samaran and to other central Philippine languages such as Tagalog. Geographically and culturally, the "heartland" of the Hiligaynon area lies along both sides of the broken straits separating Panay and Negros. The coastal cities of Iloilo, on the former, and Bacolod on the latter, serve as economic and administrative centres for the region. Each has a population of over 100,000. Most Hiligaynon, however, live in small rural barrios where the main economic activity is farming or, occasionally, fishing. The major agricultural products include the dominant food staples of rice and corn (maize) and the important commercial crops of sugar cane and coconuts. There are a number of large sugar-cane plantations, especially on Negros, but most of the farms are small, and extensive intercropping is practised. For the area as a whole, most of which consists of hilly and broken terrain, the size of the average farm is less than four acres. Like many lowland Filipinos, most Hiligaynon live in rectangular pile dwellings constructed ideally for each nuclear family household; they affiliate socially with a wide range of bilaterally reckoned kinsmen and *compadrazgo* relations, and are predominantly Roman Catholic. A number of Hiligaynon communities are famous for their hand-woven fabrics of cotton and other local fibres. Hiligaynon have long been prominent in the Philippine maritime and shipping trades. At the time of first European contact, Hiligaynon documents contained not only the earliest evidence of a Philippine legal code (that of the ruler *Kalantiyaw*) but also the earliest records of pre-Spanish Philippine contact with Borneo. *See* also BISAYAN. (H. C. Co.)

HILL, AARON (1685–1750), English miscellaneous writer, whose adaptations of Voltaire's plays *Zaïre* (*Zara*) (1736) and *Mérope* (1749) enjoyed considerable success, was born in London on Feb. 10, 1685. On leaving Westminster school he traveled in the near east, and published *A Full Account of the Present State of the Ottoman Empire* (1709). He was an optimistic speculator and, though kindly, bored his friends and irritated them with gratuitous advice. He married an heiress, produced Handel's *Rinaldo* at the Haymarket theatre (having himself translated the Italian libretto) and engaged in various ambitious commercial ventures, all without success. Peter the Great acknowledged his poem *The Northern Star* (1718) by ordering a gold medal for him which, however, never arrived. In 1730 he wrote *The Progress of Wit* as a retort to Pope who had satirized him in *The Dunciad*. He also published periodical essays, and his letters to Pope and others were published in 1751. Hill died in London on Feb. 8, 1750, and was buried in Westminster abbey.

See H. Ludwig, *The Life and Works of Aaron Hill* (1911); D. Brewster, *Aaron Hill: Poet, Dramatist, Projector* (1913).

HILL, AMBROSE POWELL (1825–1865), Confederate general in the American Civil War, was born on Nov. 9, 1825, in Culpeper, Va. He graduated from West Point in 1847, saw service in the Mexican War and against the Seminole Indians and was engaged from 1855 to 1860 in U.S. coast survey work. Hill served as a colonel in the Confederate army at the first battle of Bull Run, and fought at Williamsburg and Fair Oaks on the peninsula. He was named major general on May 26, 1862. His "Light Division," so called because of the speed with which it moved, was rated one of the best in the army. It was in the thick of the fighting during the Seven Days' battle at Mechanicsville, Gaines's Mill and Glendale. At the second battle of Bull Run (Aug. 1862) Hill's troops assisted in repelling the Federal attacks and they helped capture Harpers Ferry in Sept. 1862. Hill arrived at Antietam just in time to check decisively the Union assault against Lee's right wing. After participating in the battle of Fredericksburg, Hill was wounded at Chancellorsville. Promoted to lieutenant general in command of the III corps, Hill took a prominent part in the battle of Gettysburg (July 1–3, 1863). Although his command, after suffering severe casualties, was victorious in the first day of the battle, it was unsuccessful in the fighting on the next two days. He was engaged in the Wilderness campaign in 1864, and at Petersburg, Va., where he was killed at the front lines on April 2, 1865.

See W. W. Hassler, *A. P. Hill: Lee's Forgotten General* (1957). (W. W. Ha.)

HILL, ARCHIBALD VIVIAN (1886–), British physiologist, was awarded the 1922 Nobel prize for medicine and physiology jointly with Otto Meyerhof "for his discovery relating to the production of heat in muscles." Born at Bristol on Sept. 26, 1886, he was educated at Blundell's school and at Trinity college, Cambridge, where he distinguished himself as a mathematician, being third wrangler in 1907 and a fellow of his college from 1910 to 1916. He became a physiologist at the suggestion of Sir Walter Fletcher, one of his teachers, and his researches on the physiology

of muscular activity were undertaken at the suggestion of J. N. Langley. After study in Germany in 1910–11, he continued to work at Cambridge until the outbreak of World War I, in which he served from 1914 to 1919. In 1920 he was appointed Brackenbury professor of physiology at Manchester university, and from 1923 to 1925 he was Jodrell professor of physiology at University college, London. Hill was elected fellow of the Royal society in 1918 and he was the society's Foulerton research professor (1926–51), secretary (1935–45), foreign secretary (1945–46) and Copley medalist (1948). As an Independent Conservative he represented Cambridge university in parliament from 1940 to 1945. During World War II he served on many commissions and committees concerned with defense problems and with scientific research. He was awarded the Order of the British Empire in 1918 and was made a Companion of Honour in 1946.

In addition to his work on muscular activity, Hill studied heat production in nerves following their stimulation. These researches involved the use of apparatus capable of measuring rises of temperature of not more than 0.003° C. during only a few hundredths of a second. Hill's principal researches are summarized in his books *Muscular Activity* (1926) and *Muscular Movement in Man* (1927). (W. J. Bp.)

HILL, DANIEL HARVEY (1821–1889), Confederate general in the American Civil War, was born on July 12, 1821, in York district, S.C. He graduated from West Point in 1842, and served in the Mexican War. After resigning from the U.S. army in 1849 he served successively as professor of mathematics at Washington college (now Washington and Lee university) at Lexington, Va., as professor of civil engineering and mathematics at Davidson college in North Carolina, and as superintendent of the North Carolina Military institute. Accepting a colonelcy in the Confederate army at the start of the Civil War, Hill was successful in the engagement at Big Bethel, June 10, 1861, and served with distinction as a major general commanding a division on the peninsula. During the Maryland campaign, while in command at South Mountain, he was unable to prevent McClellan from carrying the heights but did delay the Federals sufficiently to enable Lee to concentrate at Sharpsburg. He fought well at Antietam and Fredericksburg, and commanded a corps under Bragg at Chickamauga in 1863. Hill disliked to make important decisions off the field, and showed some shortcomings when fully responsible as an independent commander in charge of a sizable battle. Moody, critical of others, and bored with routine administrative duties in camp, he excelled as a hard-fighting combat officer in the field. After the war, he edited journals and wrote Civil War articles. He was president of the University of Arkansas from 1877 to 1884, and directed the Georgia Military and Agricultural college from 1885 until 1889. He died at Charlotte, N.C., on Sept. 24, 1889.

See L. H. Bridges, *Lee's Maverick General* (1961). (W. W. Ha.)

HILL, DAVID JAYNE (1850–1932), U.S. educator, author and ambassador to Germany, was born in Plainfield, N.J., on June 10, 1850. After attending Suffield academy in Connecticut he studied at the University of Lewisburg (later Bucknell university) in Pennsylvania graduating in 1874 as valedictorian. In the same year he became librarian and tutor in rhetoric. Three years later he took a M.A. degree and in 1879 was elected president of the university. In 1888, he became the second president of the University of Rochester in New York.

Upon leaving Rochester in 1896 he went to Europe to study public law. Returning 1898, he was appointed an assistant secretary of state by President McKinley. The remainder of his active life he devoted to public service. He served in the department of state for five years, at the same time occupying a chair of European diplomacy at the School for Comparative Jurisprudence and Diplomacy in Washington, then two years as U.S. minister to Switzerland, and three years in the same capacity in the Netherlands. In 1907 he was a delegate to the second Hague conference. The following year he was appointed ambassador to Germany, where he remained until his retirement in 1911. He died at Washington, D.C., on March 2, 1932.

Hill was a prolific writer who published 24 books on a variety of subjects. His most notable work was the three-volume series, *History of Diplomacy in the International Development of Europe* (1905–14). (Ar. R.)

HILL, JAMES JEROME (1838–1916), U.S. capitalist and one of the great U.S. railroad magnates, was born near Guelph, Ont., Can., Sept. 16, 1838. After settling in St. Paul, Minn., about 1870 he established transportation lines on the Mississippi and Red rivers and effected a traffic arrangement with the St. Paul and Pacific railroad. When the railway failed in 1873 Hill interested Canadian capitalists in the road, reorganized it as the St. Paul, Minneapolis and Manitoba Railway Co., and in 1882 became its president, becoming president of the Great Northern railway, which absorbed the St. Paul line in 1890 (1893–1907), and board chairman (1907–1912). The Hill interests obtained control of the Northern Pacific and the Chicago, Burlington and Quincy railroads. Hill was president of the Northern Securities Co., which in 1904 was declared to be in conflict with the Sherman Anti-Trust law. In 1912, he secured control of and merged the First and Second National banks of St. Paul. He wrote *Highways of Progress* (1910). Hill died in St. Paul, May 29, 1916. (W. H. D.)

HILL, JOHN (*c.* 1716–1775), English miscellaneous writer and botanist who compiled from his wide firsthand knowledge the earliest British flora to use Linnaean nomenclature. Born, possibly in Peterborough, about 1716, he opened an apothecary's shop in Westminster. He studied botany and was employed by the Duke of Richmond and Lord Petre to arrange their botanical specimens, traveling all over the country to collect rare plants for them. A versatile man, of pugnacious temperament and extravagant tastes, he attempted to make money in a variety of ways: writing plays, novels and treatises on acting, natural history, medicine, astronomy and geology; editing the monthly *British Magazine* (1746–50) and contributing a daily letter of society gossip to the *London Advertiser and Literary Gazette* (1751–53); selling herbal medicines and practising medicine, in which he had a diploma from St. Andrews. He was involved in many literary quarrels; his scurrilous attack on Christopher Smart provoked Smart's mock epic, *The Hilliad* (1752), and his failure to persuade John Rich and David Garrick to produce his plays led to fierce denunciation of them, and to Garrick's epigram.

> For physic and farces, his equal there scarce is,
> His farces are physic, his physic a farce is.

Hill's most lasting work was as a botanist. Although critical of Linnaeus' work on classification, he accepted and used his system of binomial nomenclature and thus made it more widely known. In 1756 he published a *British Herbal* and between 1759 and 1775, under the patronage of Lord Bute, produced *The Vegetable System*, in 26 folio volumes with 1,600 copperplate engravings of 26,000 plants. For this, his most important work, he received the order of Vasa from the king of Sweden and thereafter called himself "Sir" John Hill. He died on Nov. 21, 1775, in London.

HILL, MATTHEW DAVENPORT (1792–1872), English lawyer and penologist and the originator of the *Penny Magazine*, was born on Aug. 6, 1792, at Birmingham. He was a brother of Sir Rowland Hill. In 1819 he was called to the bar by Lincoln's Inn. In 1832 he was elected one of the Liberal members for Hull, but he lost his seat at the next election in 1835. He took silk in 1834, and was recorder of Birmingham from its incorporation in 1839 until 1865. He was also commissioner in bankruptcy for the Bristol district from 1851 until 1869. In his charges to the grand juries, as well as in special pamphlets, he advocated many important reforms in the methods of dealing with crime. He was supported by his brother Frederic Hill (1803–96), whose *Crime: Its Amount, Causes, and Remedies*, the result of his experience as inspector of prisons for Scotland, marked an era in the methods of prison discipline. Hill was a promoter of the Society for the Diffusion of Useful Knowledge. He died at Stapleton, near Bristol, on June 7, 1872.

His principal works are *Practical Suggestions to the Founders of Reformatory Schools* (1855); *Suggestions for the Repression of Crime* (1857), consisting of charges addressed to the grand juries of Birmingham; *Mettray* (1855); *Papers on the Penal Servitude Acts* (1864); *Journal of a Third Visit to the Convict Gaols, Refuges and Reformatories of Dublin* (1865). See *The Recorder of Birmingham: Memoir of M. D. H.* by his daughters R. and F. Hill (1878).

HILL, OCTAVIA (1838–1912), English housing reformer, whose work led to the founding of the Society of Women Housing Managers in England and of similar societies in Europe and in the United States, was also a pioneer of the open space movement, one of the principal founders of the National Trust and organizer of the first cadet corps for lads. Eighth daughter of James Hill, a merchant and banker, and maternal granddaughter of Thomas Southwood Smith (1788–1861), pioneer of sanitary reform, she was born at Wisbech, Cambridgeshire, on Dec. 3, 1838. John Ruskin greatly influenced her. He offered to teach her drawing, and out of her visits to his home grew the first of her housing projects in a slum court in Marylebone, London (1864). Ruskin lent the money; Octavia managed the property. The novelty of her system was the substitution of a personal visitor for a slum rent collector; its success depended on the property's paying its way. The experiment succeeded and the scope of her work spread widely. In 1884 she was entrusted by the Ecclesiastical Commissioners with the management of their property in Southwark, London; she trained other women managers and her work became known abroad.

Knowledge of the life of the town poor led her to a crusade for open spaces, which resulted in the foundation of the National Trust (1895), and the preservation of such open spaces as Parliament hill in London. She died in London on Aug. 13, 1912.

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HILL, SIR ROWLAND (1795–1879), English administrator and educator, originator of the penny postage system, was principally known for his development of the modern postal service subsequently adopted throughout the world (*see* Postal Services; *Great Britain: General History*). Born Dec. 3, 1795, at Kidderminster, the son of an English schoolmaster, he early turned his attention to problems of teaching, developing the Hazelwood system of instruction with emphasis on student democracy, rigid self-discipline and intensive teaching methods. Hill possessed wide-ranging interests, exploring the fields of printing, astronomy, mathematics and transportation. An analysis of taxation led him to the conclusion that the best levies were those whose productiveness kept pace with the growing prosperity of the nation. The postal revenues of his time were, he felt, an example of the failure to meet that requirement. His proposals for reform were based on the following: a lower rate would increase the revenues of the state by increasing the volume of mail; all postage rates should be the same without regard to distance; and all mail should be prepaid. In connection with the last principle he suggested a device which subsequently became known as a postage stamp. He managed to put his program into effect in 1840 in spite of the opposition of an entrenched bureaucracy. He died at Hampstead on Aug. 27, 1879, and was buried in Westminster abbey.

See G. Birkbeck Hill, *Life of Sir Rowland Hill* (1880). (L. N.)

HILL, ROWLAND (1744–1833), English popular preacher and founder of the Surrey chapel, was born on Aug. 23, 1744, sixth son of Sir Rowland Hill of Hawkstone, Shropshire. He was educated at Shrewsbury and Eton, and at St. John's college, Cambridge, where he was influenced by Methodism and gave open-air sermons despite opposition from the authorities. He was ordained curate of Kingston, Somerset, in 1773, but was refused priest's orders. Having inherited property, he built for his own use Surrey chapel, in Blackfriars road, London, in 1783. Hill conducted his services in accordance with the forms of the Church of England, in whose communion he remained. Thirteen Sunday schools were attached to the chapel, and both there and on his tours of the countryside he attracted immense audiences. Hill helped to found the Religious Tract society, the British and Foreign Bible society and the London Missionary society, and was a stout advocate of vaccination. He died in London on April 11, 1833. His best-known work is the *Village Dialogues* (1801), which reached a 34th edition in 1839.

See W. Jones and J. Sherman, *Memoir of the Reverend Rowland Hill, M.A.*, 5th ed. (1853).

HILL, ROWLAND HILL, 1st Viscount (1772–1842), British general, one of the best of the duke of Wellington's officers, was born on Aug. 11, 1772, the second son of Sir John Hill, of Hawkstone, Shropshire. Entering the army in 1790, he took a course at Strasbourg military school, did well at the siege of Toulon (1793) and was secured by Thomas Graham (his future colleague in Spain, later Baron Lynedoch) as major of the 90th foot. Wounded in the first fight in Egypt (1801), he was promoted brigadier in 1803 and won credit in Ireland. A brigade command in Portugal (1808) brought him to Vimeiro, Corunna and Oporto; he led a division at Talavera. In 1810 Hill covered the southern flank with a corps and stood out as Wellington's ablest general, entirely trustworthy in a wing command and respected by his men. His absence on sick leave in 1811 was deeply felt at La Albuera; he came back a week later and faced J. B. Drouet d'Erlon in Estremadura; in October a well-calculated march and surprise broke J. B. Girard's division near Arroyomolinos de Montánchez. He was along the Tagus during the siege of Badajoz and led Wellington's right wing with prudence, enterprise and success for the rest of the war. He stormed the works of Almaraz at the Tagus bridge May 19, 1812, advanced to Madrid after Salamanca, was the pivot at Vitoria, invested Pamplona, drove Drouet d'Erlon from the Pyrenees, broke the lines on the Nive river and, at Bayonne on Dec. 13, 1813, defeated Marshal Soult before Wellington could join him. Orthez and Toulouse added to his renown. (*See* Peninsular War.)

Knight of the Bath and member of parliament for Shrewsbury in 1812, he was created Baron Hill of Almaraz and Hawkstone Salop, May 17, 1814. In 1815 he commanded one of Wellington's two corps. On the right at Waterloo he led the charge of Sir Frederick Adam's brigade against the imperial guard; his horse was shot down and for a time he was lost in the confusion. When Wellington became prime minister in 1828, Hill replaced him as general commander in chief.

Hill resigned in 1842 and was created a viscount, but died on Dec. 10, 1842.

See E. Sidney, *Life of Lord Hill, G.C.B.* (1845). (I. D. E.)

HILLAH (Al Hillah), a town of Iraq and capital of a *liwa* (province) of the same name, lies on the eastern (Hillah) branch of the Euphrates river 60 mi. (97 km.) S. of Baghdad by road. Pop. (1957) 54,095. In Abbasid times the Hillah channel was in process of developing into the mainstream of the Euphrates, and Hillah became the principal river-crossing point. The earliest settlement, of a religious character, was on the left bank, but following the establishment of a bridge of boats in about 1100 a larger commercial settlement (Hillah = settlement) developed on the opposite bank, and is the main part of the modern town.

Hillah is a river port, and the principal grain market of the middle Euphrates area; it is surrounded by date groves. The remains of the ancient Babylon lie four miles away and the sites of Borsippa and Kish are also nearby. Many of the older houses in Hillah are built of brick removed from the ruins. During the 19th century there was a gradual diminution of river flow into the Hillah channel, and local agriculture greatly declined until the construction of the Hindiyah barrage in 1913. Since then Hillah has steadily developed as an agricultural region producing wheat, barley, rice, dates and vegetables; and there is an extensive bazaar trade, with locally made leather goods and woolen rugs as specialities; the covered bazaar is one of the largest in Iraq.

Hillah *liwa* (area 2,660 sq.km.; pop. [1962 est.] 380,362) is small in extent and despite agricultural richness is lightly populated as compared with the neighbouring Baghdad and Karbala' *liwas*. It was formed along with Karbala' and Diwaniyah from part of the Ottoman *il* of Baghdad, and this division may be said to reflect a characteristic social feature: the existence of several medium-sized towns of roughly equal importance in the zone of the middle Euphrates, rather than domination by one large city.

(W. B. Fr.)

HILLARY, SIR EDMUND PERCIVAL (1919–), New Zealand mountaineer and explorer, was the first man, with Tenzing Norgay, to reach the summit of Mt. Everest (*q.v.*) (29,028 ft.). He was also the first man after Capt. R. F. Scott to reach

the south pole overland. Born on July 20, 1919, at Auckland, and by occupation an apiarist, Hillary started climbing in the New Zealand Alps. In 1951 he joined a New Zealand party to the central Himalaya, and went on to take part in Eric Shipton's successful reconnaissance of a route up the southern flank of Everest. During the British Everest expedition of 1953 he and Tenzing Norgay (*q.v.*) reached the summit of Mt. Everest at 11:30 A.M. on May 29, 1953. This and his earlier journeys he described in *High Adventure* (1955).

He was appointed leader of the New Zealand section of the British Commonwealth Transantarctic expedition. With the "Theron" party he reconnoitred the Weddell sea base (Nov. 1955–March 1956). During the main crossing by Vivian (later Sir Vivian) Fuchs's party (Nov. 1957–March 1958), his job was to support from the Ross sea and establish Depot 700. He reached the pole himself in a tractor on Jan. 4, 1958, and was flown out from the American South Pole station.

In 1960–61 he led a scientific expedition to Nepal. This attempted Makalu (27,790 ft.) without oxygen but failed to reach the summit. (C. W. F. N.)

HILLEGOM, a town of the Netherlands, lies on the Ringvaart, 10 km. (6 mi.) S.S.W. of Haarlem. Pop. (1960) 14,910 (mun.). Partly situated on sandy soil along the foot of the dunes, it is the centre of the Dutch bulb-growing district, and large quantities of bulbs are exported. The bulb exchange, called "Treslong," has a well-known demonstration flower garden. There is also some agriculture, market gardening and cattle raising, while industries include a very large sand-lime brickworks and factories producing concrete and other building materials, wires, cables, plastics and central heating equipment. (A. V. D. L.)

HILLEL (*c.* 70 B.C.–*c.* A.D. 10), Jewish rabbi, who lives in the memory of posterity as the great teacher who enjoined and practised the virtues of charity, humility, patience and true piety, was of Babylonian origin and descended from the family of David. At about the age of 40, he went to study at Jerusalem. There he became numbered among the leaders of the Pharisaic scribes, and tradition assigns him the highest dignity of the Sanhedrin (*q.v.*), under the title of nasi, about 30 B.C. Hillel is said to have laid down seven rules for the interpretation of the scriptures, which became the foundation of rabbinical hermeneutics. He founded a more lenient school in opposition to that of his colleague Shammai (*q.v.*), and introduced the well-known institution of the *prosbul,* which was intended to avert the evil consequences of the scriptural law of release in the seventh year (*see* TALMUD: *Oral Law: Shammaites and Hillelites*).

Of the sayings ascribed to him, to which many of the teachings of Jesus bear a remarkable resemblance, the following are typical: "My abasement is my exaltation"; "What is unpleasant to thyself that do not to thy neighbour; this is the whole Law, all else is but its exposition"; "If I am not for myself, who is for me? And if I am for myself alone, what then am I? And if not now, then when?" "Separate not thyself from the congregation"; "Judge not thy neighbour until thou art in his place"; "He who wishes to make a name for himself loses his name; he who does not increase [his knowledge] decreases it; he who does not learn is worthy of death; he who works for the sake of a crown is lost"; "He who has acquired the words of doctrine has acquired the life of the world to come."

It is noteworthy that no miraculous legends are connected with Hillel's life. A scholastic tradition, however, tells of a voice from heaven which made itself heard when the wise men had assembled in Jericho, saying: "Among those here present is one who would have deserved the Holy Spirit to rest upon him, if his time had been worthy of it." And all eyes turned toward Hillel. He was lamented after his death as "the humble, the pious, the disciple of Ezra."

The university student clubs established by the B'nai B'rith (*q.v.*) order were named after Hillel, the ideal student and sage.

HILLEL II, one of the patriarchs belonging to the family of Hillel I, lived in Tiberias about the middle of the 4th century, and according to tradition introduced the arrangement of the calendar through which the Jews of the Diaspora became independent of Palestine in the uniform fixation of the new moons and feasts (*see* CALENDAR: *Jewish Calendar: Origin*).

The RABBI HILLEL, who in the 4th century made the remarkable declaration that Israel need not expect a Messiah, because the promise of a Messiah had already been fulfilled in the days of King Hezekiah, is probably Hillel, the son of Samuel ben Nahman, a well-known expounder of the scriptures.

See N. Glatzer, *Hillel the Elder* (1956).

HILLER, FERDINAND (1811–1885), German composer and conductor known for his operas and instrumental music, was born on Oct. 24, 1811, at Frankfurt am Main. In 1825 he was a pupil in Weimar of J. N. Hummel, with whom, in 1827, he visited Beethoven in Vienna shortly before the great composer died. In 1828 he went to Paris, where he spent seven years perfecting his piano and composition technique, giving the first performance there of Beethoven's "Emperor" Concerto. He traveled in Italy and Germany from 1839 to 1842 and in 1843–44 conducted the Gewandhaus concerts at Leipzig. In 1845 he founded the subscription concerts in Dresden, his opera *Traum in der Christnacht* being produced there in the same year. Two years later he was *Kapellmeister* at Düsseldorf. In 1850 he was conductor at Cologne, where he organized the conservatory and became its first director. He died at Cologne on May 10, 1885. His rather impersonal style hardly allowed his works to survive him. He was an interesting writer on music; his memoirs, *Aus dem Tonleben unserer Zeit* (1867–76), contain revealing side lights on many famous contemporaries.

HILLER, JOHANN ADAM (1728–1804), German composer who played a prominent part in the development of the Singspiel and the lied, was born at Wendisch-Ossig, near Görlitz, on Dec. 25, 1728. He went to Leipzig in 1751, earning his living by playing the harpsichord and the flute, singing and composing. He promoted public concerts in Leipzig, leading in 1781 to the establishment of the Gewandhaus concerts. From 1776 he was associated with the Leipzig theatre. For production there he wrote a number of light German operas in the style of the future Singspiel, deriving from the Italian *opera buffa* and the French *opéra comique. Die Liebe auf dem Lande* (1768) and *Die Jagd* (1770) were among his successes in this form. Among the first to popularize Handel's music in Germany, Hiller conducted several of his oratorios, including *Messiah,* which he gave in Berlin in 1786. In 1766 he published *Wöchentliche Nachrichten,* the first German musical review to be concerned with current musical affairs. In 1789 he became cantor of the Thomasschule in Leipzig, where he died on June 16, 1804. His autobiography (1784) was republished in Alfred Einstein's *Lebensläufe deutscher Musiker* (1915).

(Cs. CH.)

HILLIARD, LAWRENCE (1582?–1640), English miniaturist, was baptized on March 5, 1582, in St. Vedast's, Foster Lane, London. He was a pupil of his father, Nicholas Hilliard (*q.v.*), whose profession he followed. In 1606 he was working for James I and the queen, in limning and medals; in 1608 he was granted a patent as king's limner, to take effect at his father's death. He succeeded his father in 1619, and in 1624 was paid for five pictures, presumably painted for the king. Lawrence Hilliard is reputed to have had three sons, and one daughter named Laurence. His portraits, signed L. H. in roman capitals, are rare. His style is stiffer than his father's; two examples in the Beauchamp collection, signed and dated 1636 and 1638, bear florid inscriptions, like those found in Nicholas' work. The colour scheme adopted by Lawrence is fuller and more varied than his father's, and to some extent his light and shade and modeling were influenced by the oil painters of the early Stuart period. (C. H. C. B.)

HILLIARD, NICHOLAS (1547–1619), English painter of portrait miniatures, was born at Exeter, Devon, in 1547, the son of a goldsmith. His earliest known attempts at miniature painting were made in 1560. He became miniature painter to Queen Elizabeth I about 1570 and made many portraits of her and of the leading members of her court. His first wife, Alice Brandon, was the daughter of a London goldsmith. Hilliard paid a short visit to France in the service of the duc d'Alençon, but was forced to return early in 1578, because his wife was expecting a child.

Throughout his life Hilliard practised as goldsmith and jeweler as well as miniaturist and in 1584 he designed Queen Elizabeth's second great seal. On the accession of James I in 1603 his appointment as limner to the crown was continued, but he seems to have found the atmosphere of the new court less congenial to his art. In his treatise on the *Arte of Limning* he gives an account of his method and many side lights on his own mercurial and engaging temperament. Throughout his life he had financial difficulties and was imprisoned for debt for a short period in 1617. He died in London on Jan. 7, 1619.

Nicholas Hilliard's son Lawrence (*c.* 1582–1640) also practised miniature painting, but a much more eminent pupil was Isaac Oliver (*q.v.*). The Victoria and Albert museum, London, contains 27 examples of Hilliard's work.

Bibliography.—N. Hilliard, *A Treatise Concerning the Arte of Limning*, ed. by P. Norman, Walpole Society, vol. 1 (1912); Carl Winter, *Elizabethan Miniatures* (1943); Graham Reynolds, *Nicholas Hilliard and Isaac Oliver*, Victoria and Albert museum handbook (1947); John Pope-Hennessy, *A Lecture on Nicholas Hilliard* (1949); E. Auerbach, *Nicholas Hilliard* (1961). (G. Rs.)

HILLINGDON, one of the 32 London boroughs that came into existence on April 1, 1965, under the provisions of the London Government Act 1963 which reorganized local government in the metropolis and the area around it. These 32 London boroughs constitute Greater London (*see* London). Hillingdon, in the west, is composed of areas that were previously in Middlesex: the former municipal borough of Uxbridge and the former urban districts of Hayes and Harlington, Ruislip-Northwood, and Yiewsley and West Drayton.

See Hayes And Harlington; Ruislip-Northwood; Uxbridge; Yiewsley And West Drayton.

HILLMAN, SIDNEY (1887–1946), U.S. labour leader noted for his aggressive organization of industrial workers and extension of union functions to include social services and political action. He was born March 23, 1887, at Zagare, Lithuania, and received a rabbinical education. At the age of 19, while employed in a chemical laboratory in Kovno (Kaunas), he was jailed by the government for advocating labour reforms. Released, he went to England and then in 1907 to the United States where he soon became active in labour unions.

In 1914 he became president of the Amalgamated Clothing Workers of America, a position he held for the rest of his life. Under his leadership the union increased its membership and provided two banks, a housing development and unemployment insurance for its members. With John L. Lewis (*q.v.*) and others, Hillman formed the Congress of Industrial Organizations in the 1935–38 period and broke away from the American Federation of Labor. (*See* American Federation of Labor–Congress of Industrial Organizations.)

Pres. Franklin D. Roosevelt appointed him to several labour advisory posts and in 1941 made him associate director-general of the Office of Production Management and in 1942 director of the labour division of the War Production board. Hillman left his government positions in 1943 to become chairman of the C.I.O. political action committee, which played an active role in the election of 1944. After World War II he attended labour union meetings in Europe and served as vice-president of the World Federation of Trade Unions. He died at Point Lookout, N.Y., July 10, 1946.

See Matthew Josephson, *Sidney Hillman: Statesman of American Labor* (1952). (B. Mi.)

HILTON, WALTER (*c.* 1340–1396), English devotional writer and mystic, studied at Cambridge before becoming a hermit; later he joined the Augustinian Canons at Thurgarton priory (Nottingham), where he died. Both as hermit and as canon Hilton wrote a number of letters and treatises in Latin and English, some of which remain unprinted. His masterpiece is *The Scale* (or *Ladder*) *of Perfection* in two books composed separately at a considerable interval of time. The first, written for an anchoress, teaches the means by which a soul may advance toward perfection by destroying the image of sin and forming the image of Christ by practising virtue. The second distinguishes between the active, ascetic life ("reformation in faith") and the contemplative, mystical life ("reformation in feeling"), and describes the early stages of mystical contemplation, seemingly from the author's own experience. The close resemblance between passages in Hilton and parts of *The Cloud of Unknowing* probably implies that Hilton followed *The Cloud;* the opinion that he was the author of that work has found little support. Taken together, the works of Hilton and the author of *The Cloud* stand apart from other English medieval spiritual writings in their careful theological basis, which resembles that of the Dominican spirituality of the Rhineland, with Dionysian affinities. They also anticipate much of the teaching of St. John of the Cross. Despite the mystical character of parts of the book, Hilton's *Scale,* by reason of its sober and methodical character, became and remained a popular devotional classic in the 15th and early 16th centuries (first printed 1494). It was repeatedly reprinted, and among its readers was Lady Margaret Beaufort, mother of Henry VII.

Bibliography.—Modernized versions of *The Scale* are by E. Underhill (1923) and G. Sitwell (1953). *See* also E. Colledge, *The Medieval Mystics of England,* with bibliography (1961); D. Knowles, *The English Mystical Tradition* (1961). (M. D. K.)

HILVERSUM, a town in the province of North Holland, Neth., lies 29 km. (18 mi.) S.E. of Amsterdam by road and rail. Pop. (1960) 101,299 (mun.). It is in the middle of the Gooi, a stretch of hilly country extending from the IJsselmeer to about 5 mi. S. of the town. Hilversum is known for its modern architecture, including that of the town hall (1931, designed by W. M. Dudok), schools and broadcasting buildings. A village depending on agriculture and weaving until the coming of the railway in 1874, Hilversum now has industries producing electrical machinery, telephone installations, dyestuffs and pharmaceutical products, metal goods and carpets. It is also the centre of all Dutch radio and television activities, has film studios and is a summer resort. (C. D.)

HILWAN: *see* Hulwan.

HIMACHAL PRADESH, a union territory of India, lies north and north-northeast of the state of Punjab. Area 10,885 sq.mi. It comprises a main tract and a detached area (3,135 sq.mi.) to the northwest, the two being separated by the Kangra district of Punjab. The main tract is bordered on the east by Tibet, north by Jammu and Kashmir state and south by Tehri-Garhwal and Dehra Dun districts of Uttar Pradesh.

The territory is entirely mountainous with elevations reaching about 22,000 ft. Magnificent Himalayan ranges, including the Dhaula Dhar, Hathi Dhar and the Pir Panjab, pass through it and contain many beautiful valleys known locally as *duns*, such as the Kiarada *dun* in the Sirmoor district. The drainage in the main tract is controlled by tributaries of the Jumna in the east; the Sutlej, which enters the territory from Tibet about 20 mi. E. of Shipki pass and flows southwest in a zigzag manner through Mahasu, Mandi and Bilaspur districts before crossing into Punjab; and the Beas, which enters the Mandi district near the village of Largi and flows northwestward for a short distance before entering the Kangra district of Punjab. The detached area of Chamba (*q.v.*) district is drained by the upper waters of the Ravi and the Chenab, there known as Chandrabhaga. The slopes are covered with dense evergreen forests abounding in pine, oak, cedar and silver fir.

Himachal Pradesh was constituted on April 15, 1948, by a consolidation of 21 former princely Punjab hill states—Baghal, Baghat, Balsan, Bushahr, Bhaji, Bija, Chamba, Darkoti, Dhami, Jubbal, Keonthal, Kumarsain, Kunihar, Kuthar, Mahlog, Mandi, Mangal, Sangri, Sirmoor, Suket and Tharoch—along with their 9 tributaries—Delath, Dhadi, Ghund, Khanet, Koti, Madhan, Ratesh, Rawingarh and Theog. The former princely state of Bilaspur (*q.v.*) was merged in the territory on July 1, 1954. The territory was divided into the five administrative districts of Bilaspur (pop. [1961] 158,806; area 448 sq.mi.), Chamba (210,579; 3,131 sq.mi.), Mahasu (358,969; 2,171 sq.mi.), Mandi (384,259; 1,523 sq.mi.) and Sirmoor (197,551; 1,095 sq.mi.). A new district, Kinnaur, carved from the Mahasu district, was constituted on May 1, 1960, and comprises a small portion of the Rampur *tehsil* and the entire Chini *tehsil* on the Tibetan border (40,980; 2,517 sq.mi.).

Himachal Pradesh is administered under part C of the first schedule of the Indian constitution of 1950; *i.e.*, it is the direct responsibility of the central government, which controls it through an administrator. The territorial council (43 members) is elected directly from the territorial constituencies on the basis of adult suffrage, and the chief executive officer is appointed by the administrator.

In spite of the mountainous character of the terrain, the territory is well populated. In 1961 the figure was 1,351,144, mostly rural. The towns are few and small: Bilaspur (7,424), Chamba (8,609), Jogindernagar (2,719), Mandi (13,034), Nahan (12,439), Simla (42,597), Solan (6,564) and Sundernagar (5,782). Simla (*q.v.*) is the state capital and a popular hill station in summer for the residents of Punjab and Delhi. The climate of Himachal Pradesh is hot and dry in summer, cold in winter.

There is a degree-granting college at Mandi and many schools, but the area is generally backward. Means of communication are lacking and hard to develop because of the nature of the country.

The dense coniferous forests of the territory are a rich source of timber supply in northern India and account for more than half of the annual revenue of the state. They also ensure the safety of the catchment areas of the rivers. For the purpose of forest utilization, the territory has been divided into 12 forest divisions. The chief crops are wheat, maize (corn), barley, rice and potatoes, besides a variety of fruits. The territory is a source of supply of potatoes, particularly seed potatoes, which form an important cash crop. Large areas in Himachal Pradesh possess suitable climatic conditions for growing apples, pears, pomegranates, almonds and other fruits. High-quality apples are exported in large quantities to various parts of the country. Considerable attention is being paid to the development of fruit cultivation on modern lines.

In Mandi district, the Uhl river, a tributary of the Beas, has been utilized for generating electric power. The Uhl waters are diverted from the headworks at Brot into a three-mile-long tunnel and then through a pipe line to Jogindernagar, where the hydroelectric plant is located. The Bhakra dam (across the Sutlej) reservoir, begun in 1955, would form a large lake in Bilaspur district and partly submerge the town of Bilaspur.

There is a rosin and turpentine factory at Nahan and a brewery at Solan. A foundry, established in 1872 at Nahan and taken over in 1952 by the government of India, manufactures agricultural implements. Large quantities of wool and pashmina are exported, and in the early 1960s handlooms and small machines were installed to produce knitted, spun and woven materials. The quality and the yield of wool are being improved by the import of Australian, Russian and Spanish sheep for local breeders.

(S. S. Bh.)

HIMALAYAS (anglicized from Himalaya, "abode of snow"), that portion of the mountain region between India and Tibet stretching from the Indus in the west to the Brahmaputra in the east and having a length of 1,500 mi. and a width from 100 to 150 mi. Northwest of the Indus the region of mountain ranges which stretches to a junction with the Hindu Kush (*q.v.*), south of the Pamirs, is known as Trans-Himalayas.

Thus the Himalayas represent the southern face of the great central elevated region—the plateau of Tibet—the northern face of which is buttressed by the Kunlun.

For expeditions *see* the articles Everest, Mount; and Mountaineering.

PHYSIOGRAPHY

Geographical Classification.—For this purpose the Himalayan mountain system is divided into three parallel longitudinal zones:

(1) *The Great Himalayas.*—The main ranges, which lie in the north, rise above the snow line and have an average elevation of 20,000 ft. above sea level. They include the highest peaks; *e.g.*, Everest, K2 (Godwin Austen) and Kangchenjunga.

(2) *The Lesser Himalayas.*—The middle ranges, which are closely related to and lie south of the Great Himalayas, form an intricate mountain system with an average height of 12,000 to 15,000 ft. above sea level.

(3) *The Outer Himalayas.*—These comprise the Siwalik and other ranges which lie between the Lesser Himalayas and the plains, and have an average height of 3,000 to 4,000 ft. above sea level.

Although this division into three zones is a useful generalization, it should not be allowed to obscure the fact that the whole mountain chain is very complex, especially in the northwest.

The Great Northern Watershed.—On the north and northwest of Kashmir the great water divide which separates the Indus drainage area from that of the Yarkand and other rivers of Chinese Turkistan (Sinkiang) is not the Great Himalayas but the Muztagh range which, with the Karakoram, trends southeastward, forming a continuous mountain barrier and the true water divide west of the Tibetan plateau. Shutting off the sources of the Indus affluents from those of the central Asian system of hydrography, this great water parting is distinguished by a group of peaks of which the altitude is hardly less than that of the eastern Himalayas. K2, which is 28,250 ft. high and only 778 ft. lower than Everest, affords an excellent example of a dominating, peak-crowned water parting or divide. From Kailas on the far west to the extreme northeastern sources of the Brahmaputra, little is known of the great northern water parting of the Indo-Tibetan highlands. For some 500 or 600 mi. east of Kailas it appears to be lost in the mazes of the minor ranges and ridges of the Tibetan plateau. Nor can it be said to be well defined to the east of Lhasa.

Eastern Tibet.—The Tibetan plateau, or Chang, breaks up at about the meridian of latitude 92° E., to the east of which the affluents of the Tsangpo (the Dihang and subsequently the Brahmaputra) drain from wild, rugged mountain slopes. In this region are the sources of all the major rivers of Burma and China.

The northern limits of the Tsangpo basin do not coincide with any marked mountain barrier. In the neighbourhood of Everest the Tibeto-Nepalese boundary follows the main crestline of the Great Himalayas, which is there a main water parting, but farther east Nepalese rivers rise beyond the crestline.

Height of Himalayan Peaks.—It is now proved that Mt. Everest (*q.v.*), which appears from the Tibetan plateau as a single dominating peak, has no rival among Himalayan altitudes and is definitely the world's highest mountain. Much controversy has been aroused on the subject of Himalayan altitudes. The heights of peaks determined by exact processes of trigonometrical observation are bound to be more or less in error for at least three reasons: (1) the extraordinary geoidal deformation of the level surface at the observing stations in submontane regions; (2) ignorance of the laws of refraction when light rays traverse rarefied air in snow-covered regions; (3) ignorance of the variations in the actual height of peaks due to the increase, or decrease, of snow. For long, the height of Everest appeared on atlas maps as 29,002 ft.; it is given in this encyclopaedia and in *The Times Atlas of the World*, vol. ii (Mid-Century ed.), as 29,028 ft. (8,848 m.). Everest was climbed by Sir Edmund Hillary and Tenzing Norgay (*qq.v.*) in 1953. In Asia there are 94 peaks exceeding 24,000 ft.; all but two are in the Himalayas or Karakoram.

GEOLOGY

Evolution and Structure.—Much of the Himalayan area is still very imperfectly known geologically. The general structure resembles that of the Alps (*q.v.*), with huge overfolds and nappes; all the main horizons from Pre-Cambrian to Recent (*see* Geologic Time Chart) appear to be represented. A very large number of rock groups have been distinguished, described and given local names; in due course correlation will establish main series. It is certain that during Mesozoic times the Himalayan area was occupied by the great geosyncline which coincided with the Tethys sea or ocean basin. The sediments laid down in the Tibetan section of this great basin constitute the Tibetan zone in which fossiliferous beds of Palaeozoic and Mesozoic ages differ entirely in facies from those farther south. The second or Himalayan zone which comprises the Great and Lesser Himalayas is composed chiefly of metamorphic rocks and sediments that are generally unfossiliferous. It is believed that the elevation of this central axis took place mainly in Eocene-Oligocene times and that during this

HIMALAYAN MOUNTAIN REGION IN THE NORTHERN PORTION OF THE INDIAN SUBCONTINENT

great reversed fault (the "Main Boundary Fault"). The hade, or angle of inclination from the vertical, of the fault is constantly inward, toward the centre of the chain, and the older rocks, which form the Himalayas proper, have come to rest over the younger beds of the sub-Himalayas which have been pushed under them.

Moreover, nearly everywhere the fault formed the northern boundary of deposition of the Siwalik beds, and only in few instances do any of these deposits extend even to a short distance beyond it. It may even be that the fault was being formed during the deposition of the Siwalik beds, and as they were laid down the Himalayas were pushed forward over them, so that they were folded and upturned during the process. The Siwaliks are fluviatile and torrential deposits similar to those which are now being formed at the foot of the mountains in the Indo-Gangetic plain. The "Main Boundary Fault" is really one of a series of approximately parallel faults, all of which at one time formed the northern boundary of deposition. One view is that the Himalayas grew southward in a series of stages. A reversed fault was formed at the foot of the chain, and upon this fault the mountains were pushed forward over the beds deposited at their base, crumpling and folding them in the process, and forming a sub-Himalayan ridge in front of the main chain. This process was repeated several times and the earthquakes today in this region can be traced to the fault lines and show that crustal equilibrium has not yet been reached. Studies there suggest a hitherto unsuspected importance of tear faults.

phase the important Nummulitic limestones were deposited in a series of basins, notably in Ladakh. The main orogeny would seem to have resulted from the northward movement of the ancient block now seen in peninsular India and which underlies the Indo-Gangetic plain. Continued movement in Miocene times folded the Nummulitic limestones; the final phase of the mountain building came in post-Pliocene times and has scarcely yet ceased—as the Assam earthquakes bear witness—and folded intensely the Pliocene Siwalik sediments of the southern flanks of the Outer Himalayas (sub-Himalayan zone).

In one part or another of the Himalayan area fossiliferous marine beds have been found of almost every age from Cambrian to Recent. Of areas that have been the subject of detailed study, the Spiti valley is of particular interest. The oldest fossiliferous beds belong to the Cambrian system (the "Haimanta" system). These are underlain by Archean gneisses. There appears to be no break in the Lower Paleozoic beds in the Spiti region but in other parts of the central Himalayas the conglomerate at the base of the Permian rests unconformably upon older formations. This conglomerate forms an important datum line. From the Permian to the Lias (Early Jurassic) the sequence in the central Himalayas shows no sign of a break. The Spiti shales follow, and although they contain Middle and Upper Jurassic fossils no break has been proved at their base. The Spiti shales are succeeded conformably by Cretaceous beds (Giumal sandstone below and Chikkim limestones above), and these are followed without a break by Nummulitic beds of Eocene age. The beginning of the Tertiary period was marked by violent igneous activity in which intrusion and extrusion occurred. The next succeeding deposit is a sandstone, often highly inclined, which rests unconformably upon the Nummulitic beds and resembles the Lower Siwaliks of the sub-Himalayas (Pliocene) but which has yielded no fossils of any kind. The whole is overlaid unconformably by the younger Tertiaries of Hundes, which are perfectly horizontal and have been quite unaffected by folding.

It is evident that in the northern part of the Himalayan belt, at least in the Spiti area, there can have been no post-Archean folding of any magnitude until after the deposition of the Nummulitic beds, and that the folding was completed before the later Tertiaries of Hundes were laid down. It was, therefore, during the Miocene period that the elevation of this part of the chain began, while the disturbance of the Siwalik-like sandstone indicates that the folding continued into the Pliocene period. Along the southern flanks of the Himalayas the history of the chain is still more clearly shown. The sub-Himalayas are formed of Tertiary beds, chiefly Siwalik or Upper Tertiary, while the lower Himalayas proper consist mainly of pre-Tertiary rocks without fossils. Throughout the whole length of the chain, wherever the junction of the Siwaliks with the pre-Tertiary rocks has been seen, it is a

Topographical Results of Evolution.—The uplift of the Himalayas was a gradual process protracted over a very long period and had a very marked effect upon the scenery, the topography and the river system. The latter is not consequent upon the structure, but the principal rivers were of an age anterior to the Tertiary earth movements and the drainage is spoken of as antecedent. During the slow process of uplift, folding and faulting, the rivers were able to keep, for the most part, to their original courses, although their erosive power was increased because of increased gradients. Thus the rivers cut through the main chains in deep transverse gorges after flowing for long distances parallel to the trend of the chain; *e.g.*, the Indus and the Brahmaputra.

In the outer valleys of the Himalayas the sides are generally steep, so steep that landslides frequently occur, while the streams are still cutting down the river beds and have not yet reached their base level. Here and there a valley has become filled with alluvium, due to some local obstruction, and when this occurs there is usually to be found a fertile and productive field for agriculture. The straits of the Jhelum, below Baramulla, for example, probably account for the lovely vale of Kashmir.

Other rivers besides the Indus and the Brahmaputra begin by draining a considerable area north of the snowy range—the Sutlej, the Kosi, the Gandak and the Subansiri, for example. All these rivers break through the main snowy range before they wind their way through the southern hills to the plains of India. Some geomorphologists consider that there is insufficient catchment area north of the snows to support the view that they are antecedent streams. Their formation is explained by a process of "cutting back," or headward erosion by which the heads of the streams are gradually eating their way northward because of the greater rainfall on the southern than on the northern slopes. The result of this process is well exhibited in the relative steepness of slope on the Indian and Tibetan sides of the passes to the Indus plateau. On the southern or Indian side the routes to Tibet and Ladakh

follow the levels of Himalayan valleys with no remarkably steep gradients till they near the approach to the water divide. The slope then steepens with the ascending curve to the summit of the pass, from which point it falls with a comparatively gentle gradient to the general level of the plateau. The Zoji La, the Kashmir water divide between the Jhelum and the Indus, is a prominent case in point, and all the passes from the Kumaon and Garhwal hills into Tibet exhibit this form. Taking the average elevation of the central axial line of snowy peaks as 19,000 ft., the average height of the passes is not more than 10,000 ft. because of this process of cutting down by erosion and gradual encroachment into the northern basin.

CLIMATE

Independently of the enormous variety of relief, the altitude of the mountains alone is sufficient to cause very great modifications of climate. One-half of the total mass of the atmosphere and three-fourths of the water suspended in it in the form of vapour lie below the average altitude of the Himalayas; and of the balance, one-half of the air and almost all the vapour come within the influence of the highest peaks. The mean winter temperature at 7,000 ft. is 44° F. (7° C.) and the summer mean about 65° F. (about 18° C.), but in the valleys a temperature of 90° to 100° F. (32° to 37° C.) may be felt during the day in May and June. At 9,000 ft. the mean temperature of the coldest month is 32° F. (0° C.). At 12,000 ft. the thermometer remains above the freezing point from the end of May to the middle of October, but at 15,000 ft. is seldom above that point even in the height of summer. It should be noted that the temperatures in Tibet vary considerably from those of the Himalayas. At 12,000 ft. in Tibet the mean of the hottest month is about 60° F. (15° C.) and of the coldest about 10° F. (−12° C.) while at 15,000 ft. the frost is only permanent from Nov. 1 to May 1. In Tibet the daily range may be 60° F. (15° C.) and often reaches 50° F. (10° C.). The temperature of the sandy surface varies even more and records of 2° and 96° F. (−16° and 35° C.) have been taken within 24 hours by Everest expeditions. The soil beneath the surface is far more constant in temperature. The difference of temperature between forest-clad ranges and the Indian plains is twice as much in April and May as in December or January; and the difference between the temperature of a well-wooded hilltop and the open valley below may vary from 9° to 24° F. (−12° to −4° C.) within 24 hours. The general relations of temperature to altitude in the Himalayas are: (1) the decrease of temperature with altitude is most rapid in summer; (2) the annual range diminishes with the elevation; (3) the diurnal range diminishes with the elevation.

Rainfall is related to the monsoonal rainfall of India, of which the Himalayas catch a large portion. There is more rain, and rain for a longer season, in the east than in the west. The east may have 50 to 80 in. of rain against southward hill slopes and in certain spots even higher totals are reached; *e.g.*, Darjeeling gets 120 in. Rainfall diminishes westward to 40 in., near where the Ganges leaves the mountains and falls to 30 in. toward the emergence of the Indus from the mountains, while in places in a rain shadow the fall may be only 15 in. though they are in a zone that on the whole averages 30 in. or more. In the arid zone protected from the rainy winds the rainfall decreases to below 15 in. and in Tibet for the most part well below 10 in.

In Tibet the rapid heating of the plains by the morning sun brings a fierce wind down daily from the perpetual snows and some air may thus drift through such partial gaps as there are in the great range from India to the Tibetan tableland.

In the eastern Himalayas the ordinary winter limit of snow is 6,000 ft. and it never lies for many days even at 7,000 ft. In Kumaon, on the west, it usually reaches down to the 5,000 ft. level and occasionally to 2,500 ft. Snow has been known to fall at Peshawar. Snowfall on the western passes between 17,000 and 19,000 ft. is not generally more than three feet, but on the Himalayan passes farther east the falls are much heavier. Even in September these passes may be quite blocked and they are not usually open till the middle of June. The snow line, or the level to which snow recedes in the course of the year, ranges from 15,000 to 16,000 ft. on the southern exposures of the Himalayas that carry perpetual snow, along all that part of the system that lies between Sikkim and the Indus. Although after September light falls occur which cover the mountain sides down to 12,000 ft. these soon disappear, and it is not till December that the snow begins to fall for the winter. On the snowy range the snow line is not lower than 18,500 ft. and on the summit of the tableland it reaches to 20,000 ft. On all the passes into Tibet vegetation reaches to about 17,500 ft., and in August the passes may be crossed in ordinary years up to 18,400 ft. without finding any snow upon them; it is as impossible to find snow in the summer in Tibet at 15,500 ft. as on the plains of India.

The glaciers of the Himalayas seem to be in retreat. On the north side of Everest the Rongbuk glacier ends at about 16,500 ft. and the Kyetrak glacier at 15,400 ft. In the Kangchenjunga group the glaciers may come down to 13,000 ft. while in Kumaon they reach 12,000 ft. and in Kashmir, in special situations, they may come as low as 8,000 ft. The level reached is, as in Europe, 3,000–5,000 ft. below the limit of perpetual snow. The air temperatures at the ends of the glaciers are about as in Europe; namely, nearly 60° F. (15° C.) in July and diminishing slowly until the end of September. Several glaciers are 11–16 mi. long, the higher figure being attained in the Kangchenjunga series. Italian geologists have investigated the moraines of the Karakoram mountains which give evidence of the great ice sheets of the Pleistocene glaciation, ice sheets which may have been one continuous mass over the whole of central Asia. They have further shown that there is evidence of phases of variation during the Pleistocene Ice Age which seem to correspond with those observed in Europe.

(X.; L. D. S.)

PLANT AND ANIMAL LIFE

Plant Life.—Because of its geographical position between the plains of India and the highlands of central Asia, the Himalayan system provides an enormous variety of habitats, the extent of which is illustrated by the fact that the foothills in the east (Assam) are covered with tropical rain forest, whereas in the west the hills rise out of the arid plains of the Punjab; furthermore, the remarkable heights attained give wide range for vertical succession. As the type of vegetation developed in this part of the world is mainly based on precipitation, derived in the first place from the monsoon approaching from the Bay of Bengal, the vegetation is most luxuriant where the mountains are fully exposed to it; *i.e.*, in Sikkim. From there the air masses divide. One branch runs along the mountain ranges to the west with decreasing precipitation and the vegetation changes from tropical rain forest to wet, moist and dry deciduous forests of sal (*Shorea robusta*) until this is replaced by thorn steppe (*Acacia, Prosopis, Zizyphus*) and finally desert (*Capparis, Calotropis, Ephedra*) in the valleys of Indus and Kunar. In the east the monsoon clouds seem to be trapped in the valley of Assam, creating very wet conditions, and as a result rain forest (*Dipterocarpus, Beilschmiedia, Mesua*) has developed along the foothills. Each of these foothill types changes with altitude. In the northwest Tirich Mir rises out of the desert valley of the Kunar, its slopes dotted with steppe of *Artemisia*, and only near the glaciers small clusters of trees (*Betula*) or some wet alpine vegetation appear. Nanga Parbat towers above the desert valley of the Indus; there steppe gives way to steppe forest at 2,000 m. or 6,560 ft. (*Pinus gerardiana, Quercus ilex*) and this is replaced by moist coniferous forest (*Abies, Picea, Pinus*) higher up; a birch belt (*Betula utilis*) signifies the upper limit of tree growth (12,800 ft.), alpine vegetation—scrub and meadow—follows. The central parts of the Himalayas are marked, above the deciduous forest, by an extensive development of forests of *Pinus roxburghii*, which merges at 4,900 ft. into forests of oaks and conifers (*Quercus incana, dilatata, Q. semecarpifolia; Cedrus deodara, Pinus, Picea, Abies*), which in turn give way at their upper limit to the *Betula* belt. In the east, Namcha Barwa rises steeply out of the jungle-filled gorge of the Tsangpo-Brahmaputra; at 3,300 ft. the rain forest is succeeded by a montane forest (*Quercus, Castanopsis, Schima*), which at 6,600 ft. gives way to an even more dis-

tinct upper montane forest, of which the lower belt is known for its magnolia and rhododendron trees, whereas in the upper belt conifers (*Abies*, *Tsuga*) and rhododendron predominate; the highest belt of trees in the east consists of small rhododendron trees. Above the tree line, scrub and alpine vegetation cover the slopes until conditions become unsuitable for plant life. Against this variety the Tibetan plateau behind the main Himalayan range is uniformly covered or rather sprinkled with alpine steppe (*Astragalus, Caragana, Artemisia*).

This already complex, though only roughly outlined, picture of the vegetation of the Himalayas is further complicated by the fact that the mountain system consists of more than one range; there are valleys and intermontane basins, which can, being sheltered from the rain-bearing winds, produce strikingly different conditions; but most extraordinary are dry valleys, *i.e.*, dry types of vegetation occurring along the valley bottom within the wet parts of the mountains (Karnali, Bhutan, Lohit, etc.)—a phenomenon which seems to find its explanation in the daily occurrence of certain wind systems. Another phenomenon is the great contrast between opposite slopes of certain valleys: the north-facing slope may be thickly covered with forest, whereas the south-facing slope is devoid of tree growth and carries grass or may even be bare; although pronounced in the less humid parts of the mountains (Nanga Parbat, Sutlej, upper Tibetan gorge country), this contrast is accentuated in the more populated areas by the action of man. The main reason for this difference is that only the south-facing slopes are exposed to a high intensity of insolation. The upper limit of tree growth in the Himalayas varies. It is reached on Nanga Parbat at 12,800 ft. (*Betula utilis*) and in Sikkim at about the same height by rhododendron, but there are variations: in the drier parts of the mountain system a lower tree line can be found; *e.g.*, on the slopes of Nanga Parbat at about 6,600 ft. (*Pinus gerardiana, Quercus ilex*). There are still areas in the Himalayas about which very little is known. (C. T. T.; U. Sc.)

Animal Life.—On the surrounding fringes the Himalayan fauna grades into that of the surrounding regions. Toward the subcontinent of India and Pakistan, for example, are found the langur (a monkey), elephant, rhinoceros, tiger, leopard, civet, mongoose, palm civet (*Paradoxurus*), red panda (*Ailurus*), melogale (an aberrant badger), linsang (an aberrant civet), the last two of Malayan affinities, and the bamboo rat (*Rhizomys*) of the base of the eastern Himalayas. The Himalayan fauna in the stricter sense, especially on the Tibetan side is mainly northern in its affinities. The fossils of the Siwalik beds include remains of 84 species of mammals akin to those of Miocene and Pliocene Europe. The langur reaches as high as the 12,000 ft. level and bears, martens and related forms and several cats are features of the forests, while moles abound, though they are unknown in India; foxes and wolves are unknown in the forest area, but both, and also the lynx, ounce, marten, ermine and wild ass occur on the Tibetan side, as do deer, antelope (two species) and sheep. The wild dog (*Cuon*) is found in the forest area, as also is wild pig, a form of which reaches very high levels, but the gaur or wild ox is confined to the lower lands; two species of the scaly anteater (*Manis*) reach the eastern Himalayas, but the chevrotain, another southeast Asiatic form, is absent. Goatlike animals called the serow (*Capricornis*), goral (*Naemorhedus*) and tahr (*Hemitragus*) are found, the last-named ranging up to great heights.

The typical high elevation species of the Himalayas include the brown bear (*Ursus arctos*), which replaces the black bear of the lower altitudes, snow leopard, markhor, *Ovis ammon*, bharal, shapu, ibex, Tibetan gazelle and Tibetan antelope (*Pantholops hodgsoni*). Of the deer family the shou (*Cervus elaphus wallichi*) of the Chumbi valley and other parts of Tibet and Bhutan is probably extinct or nearly extinct; while the Kashmir stag or hangul (*Cervus elaphus hanglu*) still survives in much reduced numbers in Kashmir and northern Chamba in Himachal Pradesh. The yak and other animals of the great altitudes are discussed below.

The bird life of the Himalayas is wonderfully rich. Eagles, vultures and many birds of prey soar to great heights. Gorgeous colouring occurs among sunbirds, trogons, kingfishers, etc., but of the parrot family only parakeets and a small lory are known. The peacock occurs in the forests bordering the plains on the Indian side, and pheasants and partridges include varieties adapted to life on the snow at great altitudes. Waders and waterfowl are not important.

Among the snakes the python is found on the Indian side and the cobra penetrates as high as some 8,000 ft. above sea level. Lizards and frogs abound and reach remarkable elevations. *Phrynocephalus* (a lizard) and a frog being found even in Tibet. Very few perchlike (Percoidea) fishes enter the mountains, most fishes of the region belonging either to the catfishes (Siluroidea) or the carp and loach groups (Cyprinoidea); a few of the former and a number of the latter live in Tibetan waters. Most of the fishes of high mountain torrents have suckers with which to hold on to rocks. The salmon family is absent from the region, except where trout have been introduced into Kashmir, the Kulu valley and Bhutan.

The butterflies are renowned for their magnificence and include among others *Papilionidae, Nymphalidae, Amathusiidae* and *Danaidae*. Insect life of all kinds is very rich and locust swarms are carried up by the winds even to the perpetual snow.

Maj. Richard W. G. Hingston of the Indian Medical service, author of *A Naturalist in the Himalaya*, gave valuable accounts of the natural history of animals at great altitudes in the Himalayas. Protective colouring, usually in browns and grays akin to those of the desertlike surface of Tibet, is almost universal. The mouse hare (*Ochotona*) is common and even the sheep and gazelles are coloured like the soil. Most of the birds are protectively coloured, though some show bright colours when on the wing. Unlike the large mammals, the large birds are not protected in colour, and the eagles, kites, ravens and choughs abound. Protective coloration is common among insects, spiders, etc.

The intense cold of the great heights is made still more trying by the fierce winds that rush down from the snows to the plateau as the latter warms up in the morning sun. As a protection most mammals have thick hair and the dogs have wool as well; even the pig is thickly covered with hair. The yak has a coat of wool over which is the long hair that forms a protective skirt under the belly, while the tail may be described as a unique windscreen. The hair under the belly is thought to keep the animal's legs warm when it is resting; the yak stands with its hindquarters to the wind. The smaller animals and the birds mostly shelter among the rocks and stones when the wind becomes strong, but many of them illustrate its power of damaging fur and feathers. The birds generally face the wind and the great vultures are able to some extent to make use of it. The butterflies may protect themselves in a sheltered nook; Hingston found *Parnassius* species as high as 17,000 ft. above sea level.

The sharp changes of temperature within a few hours, known in all mountain regions, are accentuated and may be very trying in winter. Many animals of the high mountains are protected from this by the habit of hibernation in burrows where, a little beneath the snow and the surface soil, the temperature is much more uniform. The mouse hare was seen by Hingston as high as 17,000 ft. and he suggested that it may reach 20,000 ft. as a stray. Several birds go up to 20,000 ft. and more on the mountainside, and choughs followed the Everest climbers as high as 27,000 ft.; they seem least incommoded by the great heights. The habits of mammals and birds have been noticed to change on the great heights; thus birds which elsewhere are wild live there on and round the houses, while communities (even some of birds and mammals) are a characteristic development. For the mythical creature associated with the Himalayas, *see* ABOMINABLE SNOWMAN; *see* also HUNTING. (E. P. G.)

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HIMEJI, a city and cotton textile centre in Hyōgo prefecture, western Honshū in central Japan, is 30 mi. W.N.W. of Kōbe and

near the Inland sea northern shore. It developed as a castle town around the famed Himeji castle (Hakurojo or Egret castle), built in 1346 and reconstructed in 1601 and 1956. The destruction of a large part of the city during World War II and the subsequent disbandment of an army division there led to a temporary decline in population. The population was 104,259 in 1940 and decreased to 83,167 in 1945. It increased to 252,315 by 1955 and 328,689 by 1960. The city recovered and grew because of the export of agricultural products from the fertile Harima plain and the Tsuyama basin and the annexation of towns in the Harima industrial zone. (R. B. H.)

HIMERA, an ancient city on the north coast of Sicily, on a hill above the west bank of the northern Himeras (mod. Grande) river. It was founded *c.* 649 B.C. by Chalcidian inhabitants of Zancle (Messina) and Syracusan exiles. Early in the 5th century the tyrant Terillus, driven out by Theron of Acragas (Agrigento), appealed to the Carthaginians, who came to his assistance but were utterly defeated by Gelon of Syracuse in 480 B.C., on the same day, it is said, as the battle of Salamis (*see* SICILY: *History*). The oppressive rule of Theron's son Thrasydaeus led the citizens *c.* 476 to appeal to Hieron of Syracuse, who betrayed them to Theron; the latter massacred all his enemies and in the following year resettled the town. In 409 the Carthaginian general Hannibal destroyed Himera, founding a new town close to the hot springs (Thermae Himerenses, now Termini Imerese), 7 mi. to the west. Although originally a Punic settlement, it soon became a Greek city. The only relic of the ancient town visible above ground is a Doric temple, in all probability erected in commemoration of the victory of 480 B.C.; many of its lion-head spouts are exhibited in a hall of the Palermo museum. The site was identified in 1823 and excavated in 1861 and subsequently, particularly in 1929–30.

See P. Marconi, *Himera: Lo scavo del tempio della vittoria e del temenos,* in *Atti e Memorie della Società Magna Grecia,* volume for 1930 (1931).

HIMERIUS (*c.* 310–*c.* 386), Greek rhetorician, influential teacher and practitioner of the florid style popular in the 4th century, was born at Prusa in Bithynia. Educated in Athens, he for a time conducted a school there in rivalry with Prohaeresius. He attracted numerous pupils, many of whom (*e.g.,* Gregory of Nazianzus and Basil of Caesarea) later became famous. Libanius knew him and valued his work. The emperor Julian called him to Antioch in 362 to reside at his court; he returned to Athens after Prohaeresius' death (368). He wrote 80 orations and declamations, of which Photius read 73, quoting some as examples of style. Only 24 survive complete; 36 are fragmentary and titles of 15 others are known. Himerius devoted himself exclusively to literature and avoided political subjects. He wrote imaginary orations of the classical orators, epideictic or "display" speeches, praises of famous cities, addresses on events connected with his school and his pupils. There are also some dialogues and improvisations which were subsequently written down. He wrote a highly decorated poetical prose, borrowing ornaments from the lyric poets. His *ekphraseis* or literary descriptions of cities, paintings or scenes of nature are valuable sources for the history of art. His work with its exuberant ornamentation, characteristic of the most learned and ostentatious style of the day, forms a contrast with the style and interests of his contemporaries, Libanius and Themistius.

See the edition by A. Colonna, with bibliography (1951); on his style, *see* E. Norden, *Die antike Kunstprosa,* 2 vol. (1898). (G. Do.)

HIMMLER, HEINRICH (1900–1945), German National Socialist politician and ruthless exponent of racialism and terrorism, was born in Munich on Oct. 7, 1900, the son of a secondary schoolmaster with a devout Roman Catholic background. After World War I he obtained a diploma in agriculture, worked briefly for a firm of fertilizer manufacturers, joined a paramilitary nationalist organization and participated in the Nazi *Putsch* of Nov. 9, 1923. For a short time he was secretary to Gregor Strasser before returning to poultry farming. In 1927 he married Margarete Concerzowo; she bore him a daughter the next year, but he neglected his family and fathered illegitimate children. In 1929 Hitler appointed Himmler *Reichsführer* of the SS. (*Schutzstaffel*—the "Blackshirts"). At that time this was a small body of 200 men, forming a personal bodyguard for Hitler, but over the next 16 years Himmler expanded it into an all-embracing empire within the Nazi state, at once the embodiment and the instrument of racial theories which he had picked up from Alfred Rosenberg. From 1931 to 1934 the SS. was nominally placed under the *Sturmabteilungen* (SA.), with Ernst Röhm as chief of staff, but at the same time Himmler organized the *Sicherheitsdienst* (SD.) or civilian security organization, under Reinhard Heydrich.

When Hitler came to power he made Himmler head of police in Munich; and Himmler set up the first concentration camp at Dachau. Himmler and the SS. carried out the purge of June 30, 1934, and smashed the power of the SA. Thereafter the SS. was placed directly under Hitler, and in 1936 Himmler gained control of all German police forces as well. In 1938 the dismissal of Werner von Fritsch from the post of commander in chief of the army made the first important breach in the army's opposition to control by the SS.

World War II brought a vast extension of Himmler's resources and the empire at his command. He was appointed "trustee for the consolidation of German nationhood" in Oct. 1939. In Poland he directed the SS. in an organized attempt to carry out his racial theories by exterminating Jews and Poles alike. In Russia the political administration of occupied territory was taken out of the hands of the army and given by Hitler to Himmler, with the task of eliminating the Soviet system and establishing the supremacy of the Aryan race. This was done partly in the occupied territories themselves, partly in extermination camps in Austria or in Germany by the SS. Death's Head units and extermination squads. The concentration camps were enlarged, and Himmler organized them as a source of expendable labour and as a laboratory for pseudomedical experiments. At the same time he expanded the Waffen (armed) SS. from 3 divisions at the beginning of the war to 35 at the end, forming a rival military force to the *Wehrmacht.* Himmler also controlled the *Reichssicherheitshauptamt* (the central security organization), and in 1943 he became minister of the interior.

With all this power in his hands Himmler had neither the incentive nor the personality to use it for independent action. Physically unimpressive and of low intelligence, he believed in the creed of Naziism and above all in its theories of race, recruiting "Aryans" of any nationality into the Waffen SS. while carrying out the mass extermination of non-Aryans. He suffered acutely from psychosomatic illness, being subject to severe headaches and intestinal spasms producing pain and hysteria. At the beginning of the war he began to receive treatment from the Finnish masseur Felix Kersten, who was able to give him immediate relief. He became completely dependent on Kersten, confided in him (their conversations are published in Kersten's *Memoirs,* 1953) and often acceded to Kersten's intercession on behalf of Jews and political prisoners.

It is not certainly known how successful Himmler was in discovering the conspiracy against Hitler which culminated in the plot of July 20, 1944, but he undoubtedly uncovered some of its ramifications in gaining control of the *Abwehr* or counterespionage centre directed by Wilhelm Canaris (*q.v.*). The revenge which Hitler exacted against the army after the failure of the plot redounded to Himmler's advantage. The Waffen SS. were further strengthened in relation to the army, and the last desperate *levée en masse* which Hitler ordered in Oct. 1944 was to be under Himmler's command. In the final months, however, Himmler's influence with Hitler was undermined. In April 1945 he tried to approach the Allies for peace negotiations through the Swedish Count Folke Bernadotte. When news of this reached Hitler he ordered Himmler's arrest. Himmler then took on a false identity and attempted to escape, but was arrested by the Allies and brought to Lüneburg. He there killed himself by biting a phial of poison on May 23, 1945.

See W. Frischauer, *Himmler* (1953). (W. KP.)

HINCKLEY, a market town and urban district in the Bosworth parliamentary division of Leicestershire, Eng., 13 mi. S.W. of Leicester by road. Pop. (1961) 41,608. The ditch of a castle erected in the time of William Rufus is still to be traced; the site is a garden of remembrance. In the 19th century Hinckley was a

spa and health resort. The town which is on Watling street has had a weekly market since 1311; the grammar school dates from the 16th century and there is a technical college. Hinckley's main and oldest industry is that of hosiery, footwear is made and there are dye and engineering works. The battle site of Bosworth field (*q.v.*) is 5 mi. N.

HINCKS, SIR FRANCIS (1807–1885), Canadian statesman and premier of united Canada, was born at Cork, Ire., on Dec. 14, 1807. In 1832 he emigrated to York, now Toronto, where he was successively merchant, banker and editor of a Reform newspaper. Elected to the first legislative assembly of united Canada in 1841, he served in 1842–43 and in 1848–51 as inspector general under Reform leaders Robert Baldwin and Louis (later Sir Louis) LaFontaine. In 1851 Hincks became premier in the Hincks-A. N. Morin coalition government and as such promoted railway construction and aided Lord Elgin to negotiate with the United States the reciprocity agreement of 1854. Hincks left Canada in 1855 to become governor of Barbados and the Windward Islands. In 1862 he was appointed governor of British Guiana and on his retirement in 1869 was knighted. Returning to Canada he entered the government of Sir John Macdonald as finance minister. He sponsored the Bank act and negotiated with Sir Hugh Allan for a Pacific railway. Hincks resigned with his leader in 1873 and soon after moved to Montreal where he was president of the Confederation Life Insurance company and the Consolidated Bank of Canada (which failed in 1879). He died at Montreal on Aug. 18, 1885.

Hincks wrote several books and pamphlets, the chief of which were *Political History of Canada, 1840–55* (1877) and *Reminiscences* (1884). (R. S. Lo.)

HINCMAR (*c.* 806–882), archbishop of Reims, was born of Frankish parents. Educated at and later monk of the Benedictine abbey of St. Denis, near Paris, he acquired influence with the emperor Louis the Pious and his son King Charles the Bald, through whom Hincmar became archbishop of Reims on May 3, 845.

Though Hincmar's predecessor, Archbishop Ebbo, had been deposed ten years earlier, the emperor Lothair I secured Pope Sergius II's authorization for a synod at Trier to determine whether Ebbo or Hincmar was the rightful archbishop. Ebbo died (851) unrestored after the synod failed to meet. Because of his excommunication of the emperor's vassal Fulkrich, Hincmar was censured by Pope Leo IV, but upon Lothair's reconciliation (849) with his half brother Charles the Bald, the emperor obtained from the pope Hincmar's archiepiscopal pallium in 851. Under deposition though he was, Ebbo had ordained nine clergy at Reims in 841. At the synod of Meaux (845), Hincmar forbade these clerics to exercise their orders, a prohibition ratified by the council of Soissons (853) and by Popes Benedict III and Nicholas I. Subsequently, when Charles the Bald wished one of Ebbo's clergy, Wulfad, to become archbishop of Bourges, Pope Nicholas instructed Hincmar (April 866) to restore the clerics either personally or at a council. The synod of Soissons (Aug. 866) respectfully pointed out that it was not competent to reverse a judgment confirmed by the pope, whereupon (Dec. 866) Nicholas commanded Hincmar to rehabilitate the clerics. Hincmar's acquiescence and his memoir of 867 did much to mollify the pope.

The council of Mainz (848) condemned the monk Gottschalk (*q.v.*) of Orbais for heretical views on predestination and handed him over to the archbishop of Reims, who, unable to get him to recant at Quiercy in 849, imprisoned him at Hautvillers. That same year, Hincmar published a treatise (*Ad reclusos et simplices*) critical of Gottschalk and two years later invited the grammarian Johannes Scotus Erigena to write against the monk of Orbais. When, in turn, several theologians censured Erigena and Hincmar, the latter at the synod of Quiercy (853) promulgated four articles in defense of the position that there is no predestination to damnation and that Christ died for all men. Counter *capitula* by the synod of Valence (855) and Bishop Prudentius of Troyes (856) occasioned Hincmar's two treatises entitled *De praedestinatione*. The council of Thuzey (860) marked a qualified victory for Hincmar's teaching, and Pope Nicholas' inquiry into the treatment tendered Gottschalk caused Hincmar to assert in 864 that he was ready to have the monk go to Rome if the Holy See so desired.

In his *De divortio Lotharii regis*, the archbishop took a position strongly critical of King Lothair II of Lorraine and his repudiation of Queen Theutberga in 860; two years later he refused to accept Lothair's creature Hilduin as bishop of Cambrai and, over royal opposition, succeeded in having the canonical bishop John chosen for the see in 866. His insistence upon canonical elections at Noyon in 879–880 and at Beauvais in 881–882 put the archbishop dramatically at odds with his own sovereign, while his part in the deposition of his suffragan Bishop Rothad of Soissons in 862 brought down upon him Pope Nicholas' censure and papal restoration of Rothad in 865. A dispute that broke out in 870 between the archbishop and his nephew, Bishop Hincmar of Laon, culminated in the nephew's deposition (871) and Pope John VIII's approval of the sentence. Though Hincmar had clearly demonstrated his loyalty to King Charles the Bald during Louis the German's invasions of France in 858 and 875, he nonetheless took a strong stand at Ponthion (876) against Charles's demand for an oath of fidelity from the bishops and against the papal vicariate which the monarch had obtained for Archbishop Ansegise of Sens. Hincmar died at Épernay on Dec. 21, 882.

The archbishop's works cover a wide range: political (*De ordine palatii*, etc.), dogmatic (*De praedestinatione, De una et non trina deitate*), moral (*De cavendis vitiis*), philosophical (*De diversa animae ratione*), historical (*Vita s. Remigii, Annales Bertiniani*, A.D. 861–882), pastoral (*Capitula synodica*), canonical (*De divortio Lotharii regis, Opusculum LV capitulorum*). His letters are of much interest. His lost works are abstracted in Flodoard's *Historia Remensis ecclesiae*, vol. iii (*Monumenta Germaniae Historica, Scriptores*, xiii, 474–555).

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(H. G. J. B.)

HINDEMITH, PAUL (1895–1963), the leading German composer of the generation after Richard Strauss, was born at Hanau, near Frankfurt am Main, on Nov. 16, 1895. He began to study the violin in 1904 and in 1909 studied composition at the Hoch conservatory in Frankfurt with Bernhard Sekles and Arnold Mendelssohn. He was concert master of the Frankfurt opera orchestra (1915–23) and later played the viola in the Amar-Hindemith quartet led by Licco Amar. He taught composition at the Hochschule für Musik in Berlin (1927–37) and at the conservatory at Ankara (1935–37), where he was invited by the Turkish government to establish music education on occidental lines. In 1938 he left Germany, settling first in Switzerland and in 1940 in the U.S., becoming a U.S. citizen in 1946. From 1940 to 1953 he taught composition at Yale university, giving courses also at Zürich from 1951. He returned to Switzerland in 1953.

Hindemith is one of the most prolific composers of the 20th century. The bold harmonies of his one-act opera, *Mörder, Hoffnung der Frauen* (1921), on a libretto by Oskar Kokoschka, and the Suite 1922 for piano represent a youthful revolt against tradition. His lifelong preoccupation with contrapuntal devices was illustrated in his opera *Hin und Zurück* (1927), based on a music hall sketch, the retrograde or "crab" device in counterpoint being also applied to the action on the stage: events that normally follow each other are reversed. Concerned with the immediate practical value of music, he wrote sonatas for many of the "underprivileged" instruments, such as the trombone, and established the

style in Germany of *Gebrauchsmusik* ("music for use") and *Hausmusik* ("homemusic"). An example of *Gebrauchsmusik* is *Wir bauen eine Stadt* ("We build a town"), a game for children for voices and instruments (1930); an example of *Hausmusik* is *Frau Musica* (1928; revised as *In Praise of Music,* 1944), a cantata with a part for the audience.

Hindemith's works represent a reaction against romanticism and show the main developments in German music between World Wars I and II. His series of concertos entitled *Kammermusik* revive the early polyphonic and baroque styles, treated freely and with an instinctive use of modern harmony. His opera *Mathis der Maler* (1938), much of which was written in a neoarchaic manner, was inspired by medieval counterpoint. Elsewhere he took an almost mystical approach. *Die Harmonie der Welt* (1957) attempts a musical illustration of Johannes Kepler's laws of planetary motion. Among the best of his orchestral works are the *Philharmonic Concerto* (1932), showing his mastery of instrumental writing, and the *Konzertmusik* for brass and harps (1931), written in a neoprimitive manner.

He opposed the 12-note system of his contemporary Arnold Schoenberg and believed that harmony should retain a fundamentally tonal basis. At Berlin, Yale and Zürich he was an inspiration to his many pupils. His theoretical works include *The Craft of Musical Composition* (1945) and *A Composer's World* (1952). He died at Frankfurt on Dec. 28, 1963.

See J. R. Halliday, *P. Hindemith: the Theorist,* 2 vol. (1941); H. Strobel, *Paul Hindemith,* 3rd ed. (1948).

HINDENBURG, PAUL VON (1847–1934), German field marshal, his country's greatest hero of World War I and the second president of the Weimar republic. Paul Ludwig Hans von Beneckendorf und von Hindenburg was born in Posen (Poznan) in German Poland on Oct. 2, 1847, the son of a Prussian officer who traced his military ancestors to the 13th century. Entering the army at Danzig as a second lieutenant in 1866, he served in the Seven Weeks' War and was wounded at Königgrätz while storming an Austrian battery, for which he received the Order of the Red Eagle. In the Franco-German War of 1870–71 he received the Iron Cross for bravery at St. Privat and represented his regiment at the proclamation of the German empire at Versailles.

In the next 40 years Hindenburg rose to the rank of general in the regular advancement of a conscientious officer. Appointed to command the IV army corps at Magdeburg in 1903, he participated in the maneuvres of 1908, where he allowed the corps commanded by William III to lose the battle. In 1911 he retired at his own request because "there was no prospect of a war." He settled in Hanover, where he indulged his passion for shooting; his son Oskar was a second lieutenant in his old regiment.

World War I.—On Aug. 22, 1914, Hindenburg received a telegram appointing him to command the 8th army in East Prussia; Maj. Gen. Erich Ludendorff (*q.v.*), who had distinguished himself at the capture of Liège, was made his chief of staff. According to legend, Hindenburg was selected because of his familiarity with the Masurian lakes (the family home was at Neudeck [Pol. Podzamek]), but he declared that he had never seen the battlefield before. Two Russian armies, under General Aleksandr Samsonov and Paul Rennenkampf, were advancing into East Prussia and driving back the Germans, whose commander, Gen. Max von Prittwitz, became panicky. By the time that Hindenburg and Ludendorff had arrived, the chief of staff, Lieut. Col. Max Hoffmann, had devised a plan for stopping the Russians, to which the two generals agreed. By Aug. 31 Samsonov's army had been surrounded and beaten, 100,000 being killed, including Samsonov, and an equal number taken prisoner. In the following week, Rennenkampf's army was dispersed and defeated and East Prussia was cleared of enemy troops (*see* TANNENBERG, BATTLE OF). At Hoffmann's suggestion the victory was reported from Tannenberg, where the Teutonic Knights had been defeated by the Poles in 1410 (*see* GRUNWALD, BATTLE OF), to even the score in the struggle of *Germanentum* and *Slaventum,* which was a leitmotiv of the war. Hindenburg claimed the credit for the victory and became the most popular man in Germany, cultivating his position until he became a legend. Wooden statues of Hindenburg were erected in many German towns, and his admirers drove thousands of nails into them for the benefit of war charities.

For the next four years Hindenburg and Ludendorff were inseparable. Hindenburg later described their relations as those prevailing in "a happy marriage." Ludendorff, with the help of Hoffmann and others, formulated plans for the conduct of operations and submitted them to his chief, who "invariably" approved them (says Ludendorff). Hindenburg's tranquillity enabled him to restrain the impetuous Ludendorff—"no one ever saw Hindenburg out of temper and nobody ever saw Ludendorff laugh" remarks one biographer. The pair functioned admirably together, and as the war advanced they became the practical rulers of Germany.

Hindenburg could not follow up his victories in East Prussia by advancing across the Narew because the Austro-Hungarian armies had been defeated in Galicia and German forces had to be sent to their assistance. Much confused fighting followed, in the course of which Hindenburg regrouped his forces on a line from Posen to Thorn (Torun). He captured Lodz on Dec. 6, 1914, but did not have enough troops to crush the Russians.

Meanwhile Hindenburg had been in Nov. 1914 appointed commander of all German forces in the east and promoted to field marshal. Since trench warfare had now been introduced in the west, Hindenburg and Ludendorff clamoured for huge reinforcements with which to follow up their victories, but the new chief of the general staff, Gen. Erich von Falkenhayn, believing that the war had to be won in the west, refused. An appeal by Hindenburg to the emperor resulted in a compromise by which a new offensive was approved but only with the troops already available; the Austro-Hungarians were to strike in the south, and it was hoped to catch the Russians in a vast encircling movement. Hindenburg opened his attack on Feb. 7, 1915, but was unable to cross the Narew to Bialystok. When a general offensive directed by Falkenhayn broke through at Gorlice on May 2, Hindenburg's armies, stretching from the upper Vistula to Courland, remained inactive. The Russians withdrew steadily, but their armies were not destroyed. Hindenburg proposed a super-Tannenberg, an outflanking movement to cut off the Russians behind Warsaw, by striking toward Kovno and Vilna. But Falkenhayn preferred a "campaign with limited objectives" to keep the Russian army at bay and cripple its offensive power, for he was unwilling to take from France the troops necessary for Hindenburg's plan. The emperor approved an advance across the Narew in conjunction with an Austrian attack in the south.

At first Falkenhayn's strategy seemed to work well, for the Russians withdrew from Warsaw on Aug. 5, 1915, from Kovno on Aug. 17 and from Novogeorgievsk (Modlin) on Aug. 18. Nevertheless the Russian armies under the grand duke Nicholas escaped destruction. Once more Hindenburg and Ludendorff proposed to surround the Russian centre at the Pripet marshes, once more Falkenhayn refused. Deprived of the necessary forces, Hindenburg's attack on Vilna petered out, and the Russian lines were stabilized. Henceforth Falkenhayn treated the Russian front as subsidiary.

In spite of his protests, Hindenburg was forced to surrender divisions for the German attack on Verdun in Feb. 1916 and could not do more than defeat a Russian offensive launched for the relief of Verdun. When in June the Russians broke through the Austrian front at Luck, Hindenburg was placed in command of the entire eastern front from Riga to Galicia, with headquarters at Brest-Litovsk. He was able to stabilize the new line, but the offensive against Verdun had failed, the British and French were gaining on the Somme, the Italians captured Gorizia and, on Aug. 27, Rumania attacked the Central Powers. Hindenburg replaced Falkenhayn as chief of the general staff, with Ludendorff as first quartermaster general, and they repaired to Pless (Pszczyna), the German headquarters.

Hindenburg's appointment restored German morale, at least for a time, and he exercised the supreme war command in the name of the emperor. But Ludendorff became the directing spirit, especially in negotiations with government and *Reichstag.* It was Ludendorff who inspired the proclamation of the kingdom of Poland in Nov. 1916 and the resumption of submarine warfare in

Jan. 1917. Hindenburg lent the support of his prestige to the proposals of his nominal subordinate. Likewise, the new economic effort, the "Hindenburg program," was inspired by Ludendorff.

Hindenburg's visit to the western front made him conscious for the first time of the danger there. The offensive against Verdun was abandoned, and in March 1917 the German lines were withdrawn somewhat to the east to the "Hindenburg line," against which an Allied offensive organized by Gen. Robert Nivelle in April spent itself in vain. For the rest of 1917 the Germans were not seriously disturbed, for the Passchendaele "push" cost the British more than it did the Germans.

In July 1917 Hindenburg and Ludendorff felt strong enough to bring down the imperial chancellor, Theobald von Bethmann Hollweg, whom they regarded as a defeatist, and to impose an unknown politician, Georg Michaelis, who could be counted on to do their bidding. The new chancellor soon repudiated a peace resolution adopted by the *Reichstag* on July 19 calling for peace without annexation or indemnities on either side. Henceforth the supreme command exercised dictatorial power. It rebuffed a suggestion for peace negotiations from Pope Benedict XV by refusing to make a declaration concerning the restoration of Belgium, and it took its own line in dealing with Russia.

Shortly after the Russian Revolution of March 1917, the German general staff, at the suggestion of the foreign office, allowed Lenin, then in Switzerland, to pass through Germany to Petrograd, where he began to agitate for peace. When the Bolsheviks attained power in November and proposed an armistice, the offer was accepted by the Central Powers, and in the peace negotiations that followed Hindenburg and Ludendorff stood out for "a protective belt" on the eastern frontier and forced their wishes on the government. The two generals then imposed on the Russians the harsh terms of the treaty of Brest-Litovsk.

Hindenburg's greatest task remained: to defeat Great Britain and France before the United States could intervene, and he had already begun to transfer troops from the eastern to the western front. On March 21, 1918, began the "emperor's battle" in France, which was the greatest in history (up to that time) and lasted until Nov. 11. During the next three months the Germans made large advances in three different directions (Amiens, Flanders, the Marne), but they failed to break through the Allied lines at any point and began to encounter the U.S. army. But when the foreign minister, Richard von Kühlmann, declared in the *Reichstag* that the war could not be won by a military victory, Hindenburg and Ludendorff forced his dismissal.

The tide turned in favour of the Allies in July 1918, when their commander in chief, Marshal Ferdinand Foch, was able to launch a long-planned offensive. On Aug. 8, which Ludendorff called "the black day of the German army," the British struck so savagely east of Amiens that the Germans were unable to counterattack and large numbers were captured. At a conference of the highest military and civil officials on Aug. 14, Ludendorff admitted that the war could not be won by military operations. Hindenburg, however, declared that it would be possible to "maintain our troops on French territory and thereby in the end to enforce our will on the enemy." In spite of a decision to get in touch with the Allies, nothing was done, and the German armies continued to resist, though falling back, until on Sept. 29 Bulgaria signed an armistice. This so upset Ludendorff that he demanded the establishment of a parliamentary regime in Germany and the immediate opening of negotiations for an armistice. The new government, headed by Prince Max of Baden, objected to the immediate conclusion of an armistice without careful diplomatic preparation, but was forced by Ludendorff to submit, and an appeal to the United States was dispatched on Oct. 4.

In Oct. 1918 the military situation proved less desperate than had been supposed, but the negotiations for an armistice could not be halted. On Oct. 24 Hindenburg telegraphed to all army group commanders denouncing Pres. Woodrow Wilson's terms (which included the abdication of William II) and ordered a fight to the finish. The government protested and Ludendorff had to resign. But Hindenburg remained. When the emperor, as urged by the chancellor, refused to abdicate, Hindenburg and Wilhelm Groener, Ludendorff's successor, told him that the army would no longer fight under his command and advised him to flee to the Netherlands. William II never forgave the field marshal. (*See* further WORLD WAR I.)

The Republic and the Presidency.—With the signing of the armistice, on Nov. 11, 1918, Hindenburg led the defeated army home, after which he used it to preserve the new government against the efforts of the Communists to overthrow it. He offered to place himself at the disposal of the Allies in place of the emperor, whom they wished to try for "a supreme offense against international morality," but no reply came. He appeared before a committee of the national assembly which was investigating the causes of the war and of the German defeat, and treated it with contempt. After retiring to Hanover, he prepared his memoirs, *Aus meinem Leben* (1920), in which he declared that the German army had not been beaten but had been betrayed by the revolution, thus creating the legend of the "stab in the back."

When Friedrich Ebert died in 1925, the nationalists nominated Hindenburg to succeed him as president of the republic, and on April 26, he was elected by 14,600,000 votes as against 13,800,000 for Wilhelm Marx, the candidate of the Liberals, Catholics and Socialists. Hindenburg made no effort to restore the monarchy and gave the German republic confidence in itself. He was much influenced by Otto Meissner, his secretary of state, who had risen to power under Ebert, and by a camarilla of generals and conservative politicians.

In 1930 Hindenburg appointed as chancellor the Catholic leader Heinrich Brüning, to whom he took a great liking. In order to deal with the economic difficulties, the president allowed the chancellor to rule more and more by decree under article 48 of the constitution. In 1932, however, persuaded that Brüning was planning legislation to the disadvantage of the Prussian Junkers he dismissed him out of hand—a treacherous reward for Brüning's services in securing the re-election of Hindenburg as president two months earlier.

Hindenburg now appointed as chancellor first Franz von Papen and then Gen. Kurt von Schleicher, both personal friends, both deep intriguers. Finally, in Jan. 1933, he was persuaded by Papen to appoint "that Bohemian corporal," Adolf Hitler, whose Nazis were now the strongest party in Germany. By this time the old field marshal had become somewhat senile and probably did not understand the machinations of those about him, including his son Oskar, who had allowed the estate of Neudeck, presented by admiring Junkers, to be registered in his own name in order to escape the inheritance tax. Hindenburg's career was now ended, though he was treated by Hitler with an outward show of respect, and he spent much time at Neudeck. On June 30, 1934, at the time of Hitler's purge, a telegram from Neudeck congratulated him on having "nipped treason in the bud and saved the German nation from serious danger." It bore Hindenburg's signature, but whether it was actually signed by him is doubtful. On Aug. 2, Hindenburg died at Neudeck, and in 1935 his body was moved to Tannenberg.

Opinion about Hindenburg is divided. Certainly he took credit for much that others did, and he tried to evade responsibility at critical moments. It was his misfortune that he clung to office after his faculties began to fail. Perhaps the best description of this massive personality is the title of an English biography, "Wooden Titan."

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HINDĪ is the national language of India. The 1951 census of India failed to ascertain the number of people using Hindī as their mother tongue; instead it computed returns from Hindī, Urdū and Hindustānī. Of the total 149,944,311, over 90,500,000 gave Hindī and 13,500,000 Urdū as their mother tongues; the remainder gave Hindustānī (*q.v.*), the lingua franca of northern India.

Hindī or High Hindī developed as a standard language through the language program offered to British civil servants at the College of Fort William, Calcutta, in the 19th century. It was fash-

ioned on a vernacular spoken near Delhi and in the upper Gangetic Doab, and spread as the language used by government officials. Later it was used for literary purposes and eventually it became the vehicle of prose composition—previously rare in any of the modern Indo-Aryan languages (*q.v.*). (For a sketch of Western Hindī see *Linguistic Survey of India,* vol. ix, pt. i, pp. 50–57, 1916.)

The term "Hindī" is applied to two groups of dialects, viz. Western and Eastern. Western Hindī, *i.e.,* the Indo-Aryan dialects of the middle and upper Gangetic Doab, and the country to the north and south, has as one of its standard dialects Braj Bhāshā (Braj Bhāṣā or Braj Bhākhā), spoken near Muttra (Mathura), with extensive literature directed to the worship of Krishna. Another is Hindustānī, from which High Hindī was derived. Western Hindī represents the language of the Madhyadēśa (Midland), as distinct from the Intermediate and Outer Indo-Aryan languages in the classification devised by Sir George A. Grierson. Western Hindī has four main dialects: Bundēlī of Bundelkhand, Braj Bhāshā, Kanaujī of the central Doab and the country north and vernacular Hindustānī of Delhi and the upper Doab. West of the upper Doab, across the Jumna, is another dialect, Bāngarū. Kanaujī is closely related to Braj Bhāshā, and these two were with Awadhī the great literary vehicles of northern India until about 1850. Nearly all the classical literature of India is religious, Braj Bhāshā being concerned with Krishna, Awadhī with the Rāma cult and associated epic poetry.

Eastern Hindī, an Intermediate Indo-Aryan language spoken in Oudh, Baghelkhand and Chattisgarh, has a large and important literature. Its most famous writer is Tulsī Dās, poet and reformer, who died early in the 17th century; since his time it has been the north-Indian language of epic poetry. Eastern Hindī has Bihārī to its east and Marāthī to the south, both being Outer languages. Awadhī (Avadhī), spoken in Oudh, is the most important dialect of Eastern Hindī. The other dialects, Chattisgarhī and Baghēlī, have little recorded literature. (For a sketch of Eastern Hindī *see* vol. vi of the *Linguistic Survey of India,* 1904.)

Modern Hindī literature, like other Indian literatures under British influence in the early 19th century, developed away from the conventions and themes of indigenous verse, and towards a standard language suitable for western prose forms—the novel, short story, essay, newspaper article, biography, history, literary criticism, tragedy and the one-act play. New themes reflect dynamic changes—social, political, intellectual and material—which entered the Indian social structure through contact with the west. Secular and popular themes were preferred to religious and esoteric themes; *e.g.,* daily life, society in transition and the need for social reform. (*See* HINDĪ LITERATURE.)

See also INDIAN LANGUAGES.

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(ET. B.)

HINDĪ LITERATURE. From the literary standpoint the term "Hindī" covers the western Braj Bhāshā and Khaṛī-bolī and the eastern Awadhī and Bundēlī dialects, and also the literatures of parts of Rājāsthān in the west and of Bihar in the east which, strictly speaking, are not Hindī at all. It also conventionally includes those works of Muslim writers (*e.g.,* Jāyasī) in the Persian script where the content is Hindu rather than Muslim in nature. Almost all the earlier literature is in verse and in a language other than Khaṛī-bolī; the latter, on which modern standard Hindī and Urdū are based, was not widely used as a literary language until the end of the 17th century. Braj in particular persisted as a medium for poetry until the late 19th century, although Khaṛī-bolī has displaced it; hence the anomaly that the language of modern Hindī literature is different from that of the earlier periods. (*See* also HINDĪ; INDIAN LITERATURE.)

The earliest traces of Hindī appear perhaps in the writings of the *siddhas, émigré* Buddhist monks in Bhutan, in the 7th century; but not until the bardic chronicles of Rājāsthān, from the 10th century, does a consistent literature emerge. The *Khummān Rāso* of Dalpat Vijay chronicles the concerted Rājpūt defense against foreign aggression; the *Bisaldev Rāso* (1016) of Nalpati is a poetic romance of an early 11th-century Ajmer king; the finest example, Chand Bardāī's *Prithirāj Rāso,* describes with fair historical accuracy the times of Prithvī Rājā, the last Chauhān ruler of Delhi, his many battles and marriages, and his valour against the Muslim conqueror, and the 17th-century redaction in which it is now known reflects much of Chand's early western Hindī original. A bardic epic still recited by professional minstrels—who modify the language into their own dialect—is the *Ālhā Khaṇḍ* of Jagnāyak (*c.* 1173), relating the heroic exploits of Ālhā and Udal (properly Uday Singh), two chieftains of Bundelkhaṇḍ. Later, in the 14th century, the bard Sārangdhār, in the *Hammīr Rāso* and *Hammīr Kāvya,* celebrated his patron's valour and death at the hands of 'Ala ud-Din Khalji. These writings are mostly in an eastern Rājāsthānī dialect, and their successors live on in the panegyrics of the professional bards of Rājāsthān. Of a very different character are the light verses in the Delhi dialect by Amīr Khusrau (1253–1325), whose major and more serious historical works are in Persian. These poems stand alone, both in their humour and their dialect, the earliest recorded Khaṛī-bolī.

Bhakti and Secular Poetry: 15th to Early 17th Century.—The *bhakti* movement which spread throughout Hinduism (*see* HINDUISM: *Philosophical and Theological Schools*) in the early Muslim period found expression in Hindī in the 15th century through the disciples of Rāmānanda, only one of whose Hindī poems is preserved (in the *Ādi-granth; see* GRANTH). The most influential was Kabīr (1430?–1518), who expressed in powerful but unpolished Awadhī a mystic deistic devotion owing more to Hindu than to Muslim thought, though attacking the outward signs of both faiths. Only the *Bījak,* probably the *Granthāvalī* and the collection of his hymns in the *Ādi-granth* are certainly authentic, though some 50 more works are variously attributed to him; spurious verses bearing the signature "Saith Kabīr . . ." were composed in profusion by itinerant *sādhus* (ascetics) and have been preserved by his followers, the Kabīrpanthīs.

Secular poetry of this period is represented by the works of *Ṣūfī* mystics and by narrative romances, the *Mrigāvātī* of Quṭban (*c.* 1500) and the *Padmāvat* of Malik Muḥammad Jāyasī (*c.* 1540); the latter, inspired by 'Ala-ud-Din Khalji's sack of Chitor in 1303, is narrative poetry of a high order, and is said by the author to be an allegory. Later works of this genre are Usmān's *Chitrāvālī* (1613), Shaykh Nabī's *Jñāndīpak* (1619), and Nūr Muḥammad's *Indrāvatī* (1744); all are in Awadhī and, except the last, in Persian script.

The Vaishṇava *bhakti* poetry falls into two classes: that devoted to Krishṇa (*q.v.*) in Braj Bhāshā, and that to Rāma (*see* RĀMĀYANA), mostly in Awadhī. Of Krishṇaite works, Vidyāpati Ṭhākur, contemporary with Rāmānanda, described the love of Rādhā and Krishṇa in Maithilī (a Bihārī dialect), and though his work is more erotic than devotional it inspired devotional writings in Bihārī, Bengali and Assamese, notably that of the Bengali poet Chaitanya (*q.v.*). Chaitanya's north Indian contemporary Vallabhāchārya (1479–1530) left no Hindī works, but his teaching of the acquisition of divine grace (*pushṭi-mārga*) finds expression in the works of four of his disciples and four disciples of his son Viṭṭhalnāth, collectively called the *Ashṭa-chhāp* ("Eight Diestamps"), the masters of Krishṇaite literature. Of these Sūr Dās (1483–1563) stands supreme; his *Sūr-sāgar* of 5,206 verses, directly inspired by the Sanskrit *Bhāgavata-purāṇa,* is an account of episodes from the young life of Krishṇa, told with skilful penetration. Next there is Nand Dās (b. 1528), a superbly polished and urbane writer, who discusses the merits of the impersonal and personal concepts of deity in the *Bhramar-gīt.* An independent

Krishṇaite writer is the princess Mīrā Bāī (1498–1573), whose intense emotional lyrics express the mysticism of Rādhā-Krishṇa worship in its most sublime form.

Rāma-*bhakti* poetry is overshadowed by the figure of Tulsī Dās (*q.v.*; 1532–1627), whose *Rām-charit-mānas* relates the story of Rāma in seven books and is by no means a slavish translation of the Sanskrit *Rāmāyaṇa*. Its high moral and didactic tone, consummately handled in various styles, still exemplified the norm of conduct to the majority of the north Indian population in the mid-20th century. The Rāma-story appears also in his *Gītāvalī* (1571), *Kavittāvalī* (1612) and *Barvai Rāmāyaṇ* (1612), while the fine *Vinay-pattrika* consists mainly of hymns to Rāma.

The lives of Tulsī and other devotees are recounted in the *Bhakt-māl* of Nabhā Dās (late 16th century), a Braj Bhāshā hagiology in aphoristic and rebarbative verse, barely intelligible without the commentary (1712–13) of Priyā Dās, but almost the only source of biography.

The Rīti Period.—The Mogul courts patronized many Hindī poets, and a predilection for elaborate artifice, especially in poetry written to exemplify the *ars poetica* (*rīti*), followed the *bhakti* period. The *Rasik-priyā* (1591) and *Kavi-priyā* (1601) of Keshav Dās (1555–1617), and his more popular *Rām-chandrikā*, are musical and arresting in their variety of excellence, but wooden as narratives. The *Sat-saī* of Abdur Rahīm Khānkhānā (1556–1613) is courtly and worldly-wise. The zenith of this style was reached by Bihārī Lāl (1603–63?): his *Sat-saī* ("Seven Centuries"; actually 726 couplets) presents a collection of verbal pictures, each self-contained, centred on the amorous utterances of Rādhā and Krishṇa. Of the four poet sons of Ratnākar Tripāṭhī, Bhūshaṇ and Matirām (1616–1715) were the most distinguished. Bhūshaṇ was poet laureate to the Maratha leader Sivaji (Shivaji), whose praises he sings with force and feeling in the *Shivarāj-bhūshaṇ* (1673), at the same time illustrating figures of rhetoric. Matirām, patronized by northern rulers, produced the most lucid of all the rhetorical works of this period, *Lalitlalām* and *Rasrāj*. Lāl Kavi (1657–1707) is celebrated for a work more in the bardic tradition, *Chhatraprakāsh*, a history of the Bundel rājās and particularly his own patron Chhatrasāl (d. 1658); a work of his on *ars poetica* is also known. The poet Dev (1673–1745) wrote prolifically on poetics, the *Prem-chandrikā*, a treatise on *ars amoris*, being his best-known work. In the literary waste of the 18th century—there was a dearth of poetry, rather than of so-called poets—the innocent *Bhramar-gīt* idylls in the *Sujān-sāgar* of Ghanānand (1689–1739), the *kuṇḍaliyas* of Giridhar (b. 1713) (many of which have passed into proverbial currency) and the *Jagad-vinod* and *Padmābharan* of Padmākar Bhaṭṭ (1753–1833) are worthy of mention, the last work being as polished an ending to the *rīti* period as Bihārī's *Sat-saī* was a beginning.

Hindī prose, though known in earlier isolated works, developed into a literary vehicle early in the 19th century, through Inshā Allah's novel *Rānī Ketkī kī kahānī* (c. 1800); through the writers of Fort William college, Calcutta, Sadal Mishra and Lallūjī Lāl (the latter's *Prem-sāgar*, a dreary and stilted translation of part of the *Bhāgavata-purāṇa*, was long popular); and through the presses established by missionaries first at Serampur and later throughout upper India. Rājā Shiv Prasād popularized a somewhat Persianized Hindī through his newspaper *Banāras Akhbār* (1845 ff.), while Rājā Lakshmaṇ Singh's translation of *Shakuntalā* (1868) used a style more akin to Sanskrit. Of supreme influence was "Bhāratendu" Harishchandra (1850–85), poet, dramatist, historical novelist, editor and littérateur. New literary forms were adopted: the *Chandrakāntā* series of novels of Devakīnandan (1861–1913) are disconnected fantasies; his successor Gopāl Rām Goswāmī introduced the picaresque short story; Kishorīlāl Goswāmī produced insipid echoes of the Bengali novel. Mahavīrprasād Dwivedī (1870–1938) promoted a higher standard of prose-writing through his editorship of the periodical *Sarasvatī* (1903 ff.). But it was Premchand (1880–1936) who transformed the Hindī novel from a shadow to a solid reality; the idealism and sincerity of his work is combined with vivid characterization and great insight. Of his many novels, *Godān* (1935) is the finest in Hindī, and many of his short stories are masterly. The novels of Ilāchand Joshī (b. 1902) exploit Freudian ideas, which are also seen in the works of Jainendra and Bhagvatīcharan Varmā. Brindābanlāl Varmā's novels are historical romances, and a splendid historical novel is Hazārīprasād Dwivedī's *Bān-bhaṭṭ kī ātma-kathā*, a quasi-autobiography. Yashpāl's ably constructed and imaginative novels are inspired by Communist ideals. Upendra Nāth "Ashq" has established a reputation as a short-story writer.

Modern Poetry.—Jayashankar Prasād (1890–1937) raised Kharī-bolī poetry to a new level, especially by his mystic *Kāmāyanī*. He was also an accomplished dramatist; after his death Hindī drama looked more toward the one-act play. Maithilīsharaṇ Gupta (1886–) continues the classical poetical tradition; the poetry of Subhadrākumārī Chauhān is naïve and spontaneous; Sumitrānandan Pant and Sūryakānt Tripāṭhī "Nirālā" (d. 1961) represent the aesthetic movement, Mahādevī Varmā the religious mystic and Harivansh Ray "Bachchan" the fatalist. The "progressive" movement brought some good poetry and much bad. Modern trends, often experimental, are represented by "Ajñey" (S. H. Vatsyayan), leader of the "New Poetry," Girijākumār Māthur, and many others.

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HINDU, a follower of Hinduism, the major religion of India, especially a follower of that religion in one of the forms which it has taken since the composition of the early Upanishads (about the 7th century B.C.). Antecedents of Hinduism in south Asia were Vedism, the early religion of the Aryans; Brahmanism, the elaborate priestly cult which developed out of Vedism; and the great array of pre-Aryan and non-Aryan indigenous religions which contributed to later Hinduism's growth. Broadly construed, Hinduism includes all those local and tribal faiths of India which share any of the more widespread objects of worship; it also includes all those sects and schisms which derive from the religion of the Vedas and Upanishads, even in opposition. More narrowly construed, Hinduism excludes aboriginal religions and such major separatist sects as Buddhism and Jainism. In the broader religious sense, 90% of India's population is Hindu; in the narrower senses, numbers cannot be as precisely stated.

The Republic of India is the home of more than 95% of the world's adherents of Hinduism; nearly all the remainder reside in Pakistan and Ceylon. Important Hindu minorities are also found, in decreasing order of population, in Burma, Malaya, South Africa, Fiji, Trinidad and the territories of British East Africa.

The word "Hindu" is a medieval Persian term deriving from the Sanskrit *saindhava*, meaning a dweller on the Sindhu or Indus river. Usage preserves this geographic reference and extends the word to mean all natives of the Indian subcontinent, regardless of religion. *See* also HINDUISM; INDIA-PAKISTAN, SUBCONTINENT OF; *Anthropology*. (M. MA.)

HINDUISM. A precise definition of Hinduism is hard to formulate since the beliefs and practices of the Hindus vary widely both regionally and, within a given region, from class to class. It is a favourite dictum that Hinduism is not a religion but a whole way of life, whose precepts cover a vast range of human activity outside the scope of most modern religions. A distinction must be drawn, however, between the orthodox Hindu and the modern educated Indian of Hindu origin who still respects much of his ancient religion and calls himself a Hindu but breaks so many of the ancient precepts that, strictly, he can scarcely be classed as such. In its traditional form the chief distinguishing features of Hinduism are the doctrine of the transmigration of souls, with its corollary that all living beings are the same in essence; a complex polytheism, subsumed in a fundamental monotheism by the doctrine that all lesser divinities are subsidiary aspects of the one God; a deep-rooted tendency to mysticism and monistic philosophy; a stratified system of social classes, generally called castes, which is given religious sanction; and a propensity to assimilate rather than to exclude. This last feature divides Hinduism sharply from the religions of the west, based on Judaism. The latter, at least in their earlier forms, generally reject as false

all other religious beliefs and practices; Hinduism, on the other hand, concedes some validity to them all. The western attitude is expressed by the words of Yahweh on Sinai, "You shall have no other gods before me" (Ex. xx, 3); in the Bhagavad Gita, the incarnate god Krishna says, "Whatever god a man worships, it is I who answer the prayer."

Hinduism as it is known today has developed slowly from the synthesis of sacrificial cults brought in by the Aryan invaders of *c.* 1500 B.C. with the religions of the various indigenous peoples they conquered. These included the highly civilized peoples of the Harappa culture of the Indus valley and the nameless savage tribes of the hillier parts of the hinterland of India. There are thus distinctive differences in the Hinduism of every main region of India, partly due to the local genius and partly to the survival of prehistoric chthonic cults and practices. To these must be added external factors. Zoroastrianism, Islam, Christianity, the tribal religions of central Asian nomads and perhaps even Chinese Taoism have all influenced the complex of religious belief, custom and practice. *See* also METEMPSYCHOSIS; *Eastern Thought.*

HISTORY AND LITERATURE

Vedic Period.—The earliest phase of Hinduism is rooted in the religion of the Vedas—four collections (Samhitas) of hymns, incantations and sacrificial formulas, known as the Rigveda, the Samaveda, the Yajurveda and the Atharvaveda. Of the four, the Rigveda is the earliest and most important, being probably composed over a period of several centuries and collected in its present form early in the 1st millennium B.C. To each Veda is attached a body of prose writings of later date called Brahmanas (*q.v.*; *c.* 800–600 B.C.), intended to explain the ceremonial application of the texts and the origin and import of the sacrificial rites for which they were supposed to have been composed. Further appendixes, the Aranyakas (*c.* 600 B.C.) and Upanishads (*c.* 600–300 B.C.), respectively expound the symbolism of the more recondite rites and speculate on the nature of the universe and man's relation to it. When Vedic religion gradually evolved into Hinduism between the 6th and 2nd centuries B.C., these texts taken collectively became the most sacred literature of Hinduism. They were known as *shruti* (that which was "heard" or divinely revealed to ancient sages), as opposed to the later strata of religious literature, known as *smriti* (that which is "remembered," or is traditional). But in modern Hinduism the *shruti*, with the exception of a few hymns of the Rigveda and the more important Upanishads, is little known, while some of the *smriti* texts, notably the Bhagavad Gita, are extremely influential.

The Rigveda reflects in general a polytheistic sacrificial religion very different from that of later India. It involved the worship of numerous divinities, most of whom were conceived of as male, and were connected with the sky and natural phenomena. The complex ceremonial, for which the hymns were composed, centred in sacrifice connected with the ritual slaughter of animals and the pressing and drinking of a sacred inebriating liquor called *soma*, and it was afterward abandoned in favour of rituals of a different kind.

In some of the more recent hymns of the Rigveda, however, there are speculations on the source and fundamental nature of the cosmos, and already its origin is attributed to a single being or principle. It is suggested that the world is the product of a creator god, to whom various names, such as Prajapati (Lord of Creatures) and Vishvakarman (All-worker), are given. In one very important hymn (x, 90) creation takes place after the gods have offered a primeval being, identified with Prajapati, as a sacrifice to himself. From his body the whole universe is created, including the four great classes of Indian society, each being made from a different member of the victim. Alternatively it was suggested that the universe developed out of a watery chaos, or from an impersonal entity such as the Hiranyagarbha or Golden Embryo (Rigveda x, 121). These speculative tendencies, coupled with the development of asceticism, led to the mysticism and monism which have been always characteristic of Hinduism. (*See* further VEDIC RELIGION.)

***C.* 600 B.C.–A.D. 650.**—The Aryans who composed the Rigveda do not appear to have believed in transmigration or the reincarnation of the soul; apparently they thought that the righteous dead passed to a heaven resembling the Valhalla of the Nordic peoples, while sinners were relegated to a dark and shadowy land similar to the Semitic Sheol. By perhaps 600 B.C., the new doctrine of the continual process of reincarnation (*samsara*) was known to comparatively small circles of ascetics and was coupled with the idea of *karma* (*q.v.*), the fundamental law of cause and effect by which the evildoer is reborn in unhappy conditions. It spread very rapidly, and seems to have been accepted almost universally in the time of the Buddha (6th century B.C.). Its origin and rapid diffusion are not yet satisfactorily explained, but it may have been derived from cruder doctrines of metempsychosis held by some of the indigenous non-Aryan inhabitants of the Ganges valley. It was accompanied by a desire to escape from the round of birth and death, and this urge produced the splendid mystical literature of the Upanishads and led to the emergence of a number of heterodox sects, some of which, notably Buddhism and Jainism, became distinct religions.

Thereafter Hinduism, at least in its higher manifestations, was concerned not with propitiating the gods but with obtaining release from *samsara*. This was the main aim of the philosophical schools which arose between about 300 B.C. and A.D. 300. Sacrifices were by this time less frequently performed, partly because of a strong feeling against the unnecessary destruction of life but largely because it was felt that they were ineffectual as a means to salvation. Morality and religious observance were thought to be conducive to favourable rebirths on the lower stages of spiritual progress, but for complete emancipation asceticism and mystical gnosis were necessary.

Also in the second half of the 1st millennium B.C., the older gods of the Rigveda began to lose ground before Vishnu and Shiva, the first a minor divinity in earlier times, the second a fertility god, perhaps inherited from the pre-Vedic Harappa culture with whom the Vedic god Rudra was identified. Local divinities in the areas gradually occupied by Aryan culture were assimilated to one or other of these, and the doctrine of *avataras* or divine incarnations made it possible for theriomorphic gods (gods worshiped in the form of a beast) and divinized heroes to become incarnations of Vishnu. The religion of this period is reflected in the two great epics, the Mahabharata and the Ramayana (*qq.v.*), and in the texts on law and human conduct generally called Dharma Sutras and Dharma Shastras. The religious attitude usually known in Indian contexts as *bhakti*, or devotion to a personal deity, also developed. The new gods were normally worshiped with prayer, offerings of flowers and food, incense or music; the rite of worship (*puja*) had replaced that of sacrifice (*yajna*). The most important text of early *bhakti* is the Bhagavad Gita (*q.v.*), inserted into the Mahabharata epic as a discourse addressed to the hero Arjuna by the incarnate god Krishna.

Until just before the beginning of the Christian era it seems that the Indians generally worshiped without the aid of images. The oldest extant icons, other than those of the Harappa culture, are large figures of *yakshas*, or local chthonic divinities, not much more than 2,000 years old. This indicates that iconolatry began among lower levels of the people devoted to deities not fully assimilated into the Hinduism of the time. Similarly, there are no remains of Vedic temples; sacrifices normally took place in the open air, though small shrines housing sacred objects may have existed. Sacred places (*chaityas*), usually groves or mounds, were the centres of popular religion, but they were outside the ambit of orthodoxy. By the Gupta period (*c.* A.D. 300–650) the worship of images in stone temples was fully established, possibly through the influence of the successive invaders of northwestern India about the beginning of the Christian era.

By A.D. 650 a new feature of later Hinduism, the worship of feminine divinities, was also fully established. The Mother Goddess, in various forms and under various names, became an important object of reverence and though the Tantras, the sacred texts of the cult of the Mother, are of later composition, it is evident from inscriptions that her temples existed from the 5th century A.D. onward. Animal and sometimes even human sacrifices were re-

vived, and certain other barbaric practices, such as *sati* burning and religious suicide, seem to have increased in prevalence. This marked the close of the formative period of Hinduism.

Period of the Later Hindu Dynasties.—The 9th–12th centuries saw the work of great philosophers and theologians, such as Shankara (*q.v.*), Ramanuja and Madhva (*q.v.*). Later, an enormous quantity of religious literature was composed in the regional languages, chiefly devotional hymns whose various authors today command respect and reverence second only to that accorded to the great gods themselves. The earliest collections are in Tamil, the songs of the Nayanars or devotees of Shiva, and the Alvars, the devotees of Vishnu, which were written from the 7th century onward. The composition of such hymns in the Indo-Aryan languages began only some centuries later. Among the most important hymnodists are Kabir (*q.v.*) in the 15th century and Tulsi Das (*q.v.*) in the 16th century, who both wrote in Hindi; various singers of the school of Chaitanya (15th–16th century) in Bengali; and Namdev (13th century) and Tukaram (17th century) in Marathi. Noteworthy also is Mira Bai, the 16th-century woman poet of Rajasthan. These teachers, and many others like them in all parts of India, encouraged simple faith and devotion to a personal deity, disparaged exaggerated ritualism and caste pretensions and stressed brotherly love and fellowship. Though all these elements can be found in the early Tamil devotional poetry it is generally thought that Islamic ideas, mediated by Sufi preachers, had some influence on this development. Kabir knew something of Islam, and according to tradition he was brought up as a Muslim. Nanak owes his insistence on the unity of God and his opposition to iconolatry to Islam, and the religion of Sikhism which he founded is clearly syncretistic.

By the end of the 17th century the inspiration of the devotional hymnodists had ceased and there was no advance in Hindu thought or practice during the 18th century. The first European rulers of India found a sterile religion whose chief aim was the preservation of a rigid social order by means of a very complex system of ritual observances and tabus. It was widely expected that India would soon become Christian, but contact with the west tended instead to revitalize Hinduism through the work of a number of reformers (see *Modern Developments* below).

COSMOLOGY

Indian religion contrasts sharply with the religions of the west in its conception of the size and duration of the universe. In place of the comparatively small, transient cosmos of traditional Judaism, Christianity and Islam, Hinduism postulates a universe immense in size and immensely long in duration, passing through a continuous process of development and decline. The fundamental cosmic cycle is the "day of Brahma," a period of 4,320,000,000 years known as a *kalpa*. At the beginning of this day Vishnu lies asleep upon the cobra Shesha, symbolizing endless time, who in turn floats on the cosmic ocean, the primeval chaos. From Vishnu's navel there grows a lotus, and from its bud is born the god Brahma who creates the universe on behalf of Vishnu, who then awakes and controls the cosmos throughout the day. At its end the world is destroyed, according to some accounts by Shiva, and is once more absorbed into Vishnu's body. The god sleeps for a further *kalpa*, the "night of Brahma," after which the process is repeated more or less indefinitely.

According to some sources, Vishnu has a life of 100 "years of Brahma," each of which consists of 360 days of Brahma. He is now 50 years old, and when he reaches his 100th year his personality will be lost in the one real and eternal impersonal entity, the Brahman. After a tremendously long period when nothing but the one Absolute World Spirit exists, a new Vishnu will appear and the process will begin once more. This scheme is to be found with modifications in various early texts, such as the Puranas, long collections of legendary and mythological stories which date from the 4th century A.D. It is evidently an attempt to find room for devotional theism in a scheme which is essentially idealist and monist.

The later devotional sects insist on the fundamental nature of Vishnu, who will always retain his character of a personal god in whom and through whom universes have their being and are again destroyed. The Shaivites have different legends. In south India some maintain that Shiva created the universe by a process analogous to dancing, preserves it by his divine *ascesis* and destroys it at the end of time by a similar process. This myth has produced one of the most beautiful figures of Hindu iconography, the image of the Dancing Shiva (Nataraja). The Shaktas hold that the Mother Goddess gave birth to the universe after a sort of cosmic coitus with her transcendent spouse, Shiva, who plays little or no direct part in the universal process. The educated Hindu believes that all these legends bear some symbolic relationship to the actual evolution of the cosmos, but prefers the version maintained by his own sect.

Within the *kalpa* are 1,000 smaller cycles, the *maha yugas* or "great aeons." (*See* CHRONOLOGY: *Hindu.*) These are divided into four *yugas*, or aeons, each of which is progressively shorter and less blissful than that which preceded it. The world is at present in the fourth aeon, the *kali yuga*, which began in 3102 B.C. and will continue for over 400,000 years, until Vishnu in the form of the Kalkin destroys its evil elements and a new age of gold begins.

PHILOSOPHICAL AND THEOLOGICAL SCHOOLS

Philosophical Schools.—The traditional account of the immense duration of the universe led to a general view that life is essentially unsatisfactory, since man is enmeshed in this universal scheme by the process of *samsara*, continued reincarnation. In theory, the Hindu finds existence a vale of tears, and his long-term aim is to achieve salvation or "release" (*mukti, moksha*) from the round of birth, death and rebirth. Its achievement may involve a series of many lives and demands a long course of spiritual discipline, meditation and devotion. All the six philosophical schools, the Nyaya, the Vaisheshika, the Samkhya, the Yoga, the Purva Mimamsa and the Vedanta, are theoretically directed to this end, though different schools emphasize varying factors as the chief means of attaining it (*see* INDIAN PHILOSOPHY).

Theological Schools.—The theological schools, most of which are branches of the Vedanta school of philosophy, are differentiated by the degree of ultimate reality which they concede to personality, and the degree of identity which they admit between the naked soul of the individual and the Absolute. The school of strict monism (*advaita*) maintains that the ultimate reality is the impersonal world spirit, Brahman, and that the inmost soul of the individual is mystically identical with it. The phenomenal universe, including the gods themselves and all individualized beings, evolves from this Absolute and is fundamentally illusory.

This concept of Brahman is based on the gnosis of the Upanishads, where the term is sometimes used to describe the world spirit, with which the individual soul is essentially one. Originally, in the Rigveda, Brahman implied supernatural power—the magical force, inherent in impressive beings or objects, widely believed in by primitive peoples and known to anthropologists as mana. In later Hindu literature Brahman is always used with a mystical but impersonal connotation. It is grammatically neuter, and must not be confused with the Brahman priest (*brahmana*, literally the possessor of *brahman* in its primitive sense), or the male god Brahma. Brahman, according to the school of strict monism, is characterized by the three attributes of being, consciousness and bliss (*sachchidananda*).

The *advaita* school, looking back to the great 9th-century philosopher Shankara, has perhaps been the most influential in forming the character of intellectual Hinduism. But it is possible that the school of qualified monism (*vishishtadvaita*), based on the teaching of Ramanuja, has had greater effect on the religion of the masses. This school maintains that the ultimate reality has in some sense a personality, and is in fact a God; moreover the soul, though essentially a part of God and intimately joined to him in the state of salvation, never completely loses its sense of individuality. The school of qualified monism holds that the soul can reach salvation more easily through sincere devotion (*bhakti*) to God, and by patiently awaiting his grace in the attitude of mind known as *prapatti* (passive surrender), than through meditation.

The way of devotion (Bhakti Marga) has probably at all times been more popular than the way of knowledge (Jnana Marga). Though most Hindus honour Shankara and pay theoretical respect to his teachings, in its practical manifestations Hinduism is a theistic religion demanding deep devotion of its adherents and, as all who have visited Hindu temples and attended festivals will realize, its main expression is simple piety.

GODS

Most of the great gods of the Rigveda, such as Indra, Agni and Varuna, are of secondary importance in later Hinduism, and have yielded pride of place to other divinities who either play a minor part in Vedic religion or are not mentioned in the Vedas at all. Another god who has lost a great deal of his importance is Brahma (masculine, not to be confused with the neuter Brahman). This name seems to have evolved as an epithet applied to the creator god of the later Vedas, Prajapati, which eclipsed the latter name in popularity. At the time of the Buddha, Brahma was looked on as the high god in eastern India, and he is often referred to in the older parts of the Mahabharata as the creator of all things. But in the Vaishnava cosmology he becomes a mere demiurge. Some attempt to rehabilitate Brahma was made in the medieval doctrine of the *trimurti* or Trinity, postulating three gods of equal importance as the primary manifestations of the ultimate reality—Brahma, the creator; Vishnu, the preserver; and Shiva, the destroyer. This syncretistic system, however, was at no time important and plays a much bigger part in some older textbooks on Hinduism written in Europe than in any ancient Hindu text. At present Brahma is little regarded, and it is said that only one temple of Brahma (at Lake Pushkar, near Ajmer) exists in the whole of India.

Shiva, Vishnu and the Mother Goddess.—Classical Hinduism is centred in these three great divinities and, though many other deities are worshiped, nearly all Hindus look on one or other of the triad as the ultimate being, the disposer of human destiny and of the destiny of the cosmos itself. Thus with few exceptions Hindus may be broadly divided into followers of Shiva, Vishnu or Shakti ("Power," godhead in its active feminine form), whichever is by family tradition their main object of worship. Each group, while reverencing the Vedas, has its own scriptures. In general each has respected the faiths of the other two, though occasional cases of mild religious persecution have been attested, especially on the part of the Shaivites of south India. Certain scriptures, such as the Bhagavad Gita, which is Vaishnava in origin and glorifies Vishnu as the chief god and Krishna as his incarnation, are highly respected by all sects. A man may occasionally worship in a temple, or take part in a festival, connected with a divinity other than his own, since behind the superficial polytheism of Hinduism is a general realization that the various gods severally worshiped are essentially one.

Vishnu.—Vishnu, who probably receives more widespread worship than Shiva, is generally reverenced in the form of one of his incarnations, of which at present only two, Rama and Krishna, are given much attention. The cult of Rama is comparatively recent; though he was known as a great hero much earlier, he appears not to have been generally worshiped as a god until medieval times. He is depicted as the ideal ruler, the embodiment of grace and justice toward men, and significantly is chiefly honoured in those parts of India which came earliest and most completely under Muslim domination. His spouse Sita is the ideal of Hindu womanhood, the perfect wife and mother, entirely devoted to her lord. The cult of Rama is particularly strong in Uttar Pradesh and Bihar, and has been wholly beneficent. Ramaite literature, especially the beautiful Hindi *Ramayan* of Tulsi Das, which is virtually the bible of millions of simple Hindus of northern India, has very high ethical value. (*See* VISHNU.)

Krishna (*q.v.*) is a more complex figure, and his worship is even more widespread than that of Rama. Long and involved legends show him to be a combination of disparate elements. He appears in such archetypal forms as the wonder-working child, the divine lover, the charismatic leader and the dying god. Some Krishnaite religious literature contains rich erotic imagery, notably Jayadeva's mellifluous *Gita-Govinda*; probably he is worshiped most widely as the divine flute player, luring the wives and daughters of the cowherds of Vrindavana (Brindaban) to dance with him in the moonlight, a symbol of God calling the human soul. He appears as the teacher in the Bhagavad Gita.

Shiva.—Shiva, unlike Vishnu, is not believed to incarnate himself for the salvation of the world, but only to afford occasional theophanies to his more devout worshipers. Thus he is a remoter figure than Vishnu, and more calculated to excite awe. He sits on the peak of Mt. Kailas in the Himalayas, in a state of perpetual meditation, generating an immense spiritual force which maintains the cosmos. He is most commonly worshiped in the form of the *linga*, an upright rounded post usually of stone, which is a formalized phallic emblem. This proves his origin as a fertility god, an element of his character which has largely vanished, for he is generally thought of by his worshipers as a very austere divinity. His cult is strongest in the south, but it is also prevalent among Kashmiri Hindus, and he has numerous devotees all over India. The millions of Hindu ascetics are mostly his followers. (*See* SHIVAISM.)

Shakti.—The Mother Goddess is an ambivalent divinity. The gentler aspects of her character appear in her manifestations as Parvati, Uma or Annapurna, the bestower of blessings, the personification of a beneficent nature, in which form she is depicted as a beautiful woman in early middle age. In her fierce form as Kali, Chandi, Durga or Chamunda she is usually thought of as a terrible giantess with black skin, an enormous blood-red tongue and fierce tusks protruding from her mouth, an assortment of weapons in her many hands and a garland of skulls or human heads round her neck. Thus the Mother Goddess stands for nature in all its aspects, and her worship is in part designed to avert evil. Frequent animal sacrifices are still performed in her honour, kids being offered throughout the year and buffaloes at the Dashara festival (*see* below, *Festivals*). Her cult is most prevalent in Bengal and Assam. The Shaktas, who look on the Mother as the chief object of worship, have produced their great teachers; Ramakrishna Paramahamsa, who did so much for the regeneration of Hinduism, began his career as a devotee of Kali in the famous Shakta temple of Dakshineshvari, outside Calcutta. Nevertheless the cult of the Mother has obtained a rather bad reputation on account of some sects of Shaktas whose initiates, in certain ceremonies, partake of the *pancha-makara*, ritually breaking some of the major tabus of orthodoxy, eating meat, drinking alcoholic liquor and having illicit sexual intercourse. These Tantric sects (so called from the Tantras, their sacred texts) evolved a theory that salvation was to be obtained most easily not by knowledge, meditation or devotion but by the utterance of mystical syllables, words and phrases (*mantras*), and by ritual acts of a magical character, among which the *pancha-makara* rite was included. Both animal sacrifice and the practice of *pancha-makara* are repugnant to the trend of modern Hinduism, and both practices are disappearing, though animals are still sacrificed by the uneducated and semieducated, especially at certain famous Shakta temples, such as Kalighat in Calcutta and Kamakhya, near Gauhati, Assam. (*See* SHAKTISM.)

Other Divinities.—As well as the three great gods there are many others who have considerable importance and who are worshiped on special occasions. Of these the best known is probably Ganesha, the elephant-headed son of Shiva and Parvati, petitioned for success before all enterprises. Skanda or Karttikeya, the war-god, also the son of Shiva and Parvati, is of some importance in south India; Lakshmi, the spouse of Vishnu, is the patroness of wealth and fortune; Sarasvati, the beautiful goddess of learning and the arts, is worshiped annually at festivals throughout India, especially by students; Hanuman, the monkey-god associated with the exploits of the divine hero Rama, appears as a personification of the active power of God upon earth, and is a popular object of worship especially in the north and west; in Bengal and Assam, Manasa, the goddess of snakes, is worshiped by peasants, to prevent snake bite and also for general prosperity; another divinity revered in order to propitiate her is Sitala, goddess of smallpox.

Many animals, plants and natural objects are sacred in varying degrees, the most noteworthy being the cow. The bull is specially

sacred because of his connection with the god Shiva, but the cow is divine in her own right and is generally revered as the representative of Mother Earth. Thus all cattle are inviolate and even among those castes where vegetarianism is not the rule, beef is never eaten. Among other sacred animals are monkeys and Indian tree squirrels (*gileri*), especially associated with Rama, and snakes, associated with Shiva. The many-rooted banyan and the pipal, two of the largest trees of India, are sacred; also the tulsi, a wild basil sacred to Vishnu, which is grown on a pedestal in the courtyard of the orthodox Vaishnava home. All rivers and hills are more or less divine, and the extreme holiness of the Ganges, believed to flow from the head of Shiva, needs no emphasis.

A qualified or limited divinity inheres in other beings and objects also. Thus parents are divinities to their children and should be treated as such; similarly a husband is for his wife a divine incarnation, and texts can be found giving the same position to a wife in respect of her husband, though this is not stressed in a predominantly masculine civilization. Teachers are gods on earth to their students. All Brahmans and earnest ascetics possess a degree of divinity, as do very aged people. At regular festivals a workman will worship the godhead inherent in his tools, and it is even laid down that a man's food is a god and he should worship it before he eats it. The evident animistic origin of Hinduism does not detract from its value, and much of the dignity of Hindu culture may be attributed to this belief in the immanence of divinity.

SOCIAL AND ETHICAL ASPECTS OF HINDUISM

For nearly 3,000 years Hinduism has believed in a stratified social system as a divinely ordained feature of the cosmos, and its teachers have given full religious sanction to the four classes (*varna*) and the innumerable castes (*jati*). The doctrine of the four classes goes back to the hymn of the Rigveda describing the primeval sacrifice from which the world was created. From the head of the primeval man appeared the Brahman, from his arms the warrior (Kshatriya), from his trunk the class of merchants and craftsmen (Vaishya) and from his feet the menial (Shudra). Thus the fourfold society is an essential part of the structure of the world, and it must be preserved in order that as many people as possible may achieve salvation.

As there is a fourfold order of society, so there are four stages in the life of each man in the three higher classes who has undergone the ceremony of initiation (*upanayana*). After initiation, which takes place at or just before puberty, he should become a celibate student (*brahmachari*); next he is a householder (*grihastha*), producing sons and fulfilling his family duties; in later middle age, when he has seen his children's children, he retires as a *vanaprastha*, ideally to a hut in the forest, and devotes his life to the things of the spirit; finally as an old man he becomes a homeless religious beggar (*sannyasi*) giving up all earthly ties. This scheme of the four *ashramas*, though laid down in many texts, could obviously never be enforced by law as was possible to some extent in the case of the segregation of the four classes. Though it was never taken literally by more than a comparatively small fraction of the Hindu population, it formed an ideal which set the pattern of Hindu life.

The two fourfold systems, of class and stage of life, are often referred to together as *varnashrama;* the *dharma* or system of conduct appropriate to each class and stage, taken collectively, is known as *varnashrama-dharma*, a term which recurs again and again in earlier religious literature as the fundamental principle of social ethics. It was said that in the earlier stages of the world's development, when men were closer to perfection, *varnashrama-dharma* was practised more or less automatically. With the decline of the cosmos the rules were increasingly broken, and men suffered at one another's hands in a state of terrible anarchy; so Vishnu appointed a divine king to enforce *dharma* by coercion. The state is thus subordinate to society and exists to preserve it.

Within each of the four orders are numerous castes (*jati*) and clans or families (*kula*), and each of these units has its own *dharma*, or standard norm of conduct. Each must be preserved intact, its traditions and way of life unvitiated by miscegenation or innovations. Thus the traditional Hindu social system is thoroughly conservative in principle, although in fact at all times old practices have lapsed into disuse and new ones have been adopted. The change has never been more rapid than in the 20th century. (*See* also CASTE [INDIAN].)

Second only to the preservation of the social order as a whole, Hindu ethics aim at the preservation of the family. The traditional family is a joint one, the paterfamilias being the steward of the family property. Solidarity is maintained by the rite of *shraddha* at which offerings are made for the welfare of the ancestors, who are believed to enter into spiritual communion with the surviving kinsfolk. The utmost respect for the elder members of the family is inculcated and the paterfamilias has authority over the younger members, even when they are full grown. Marriage is indissoluble, even before consummation, and widows may not remarry. The practice of the immolation of the widow on her husband's funeral pyre, wrongly called *sati* (a word meaning a "true wife"), which aroused so much disapprobation and was ultimately forbidden by law in 1829, was, however, never obligatory from the point of view of the sacred texts, though in many families it became virtually so in practice. Polygamy is permitted but not looked on with favour in most castes, except when the first marriage does not produce living male children. Successive Indian governments have modified traditional Hindu marriage law by legislation, forbidding the marriage of children, legitimizing widow remarriage and even, in 1955, forbidding polygamy and allowing divorce. However, feeling against some of these innovations remains strong in many Hindu families, and divorce and widow remarriage are rare.

Personal ethics are not neglected in the Hindu texts and there is much sacred literature of high ethical value, notably the Bhagavad Gita, the Tamil *Kural* and many of the poems of the medieval hymnodists. For the layman the norm of personal conduct was contained in the traditional formulation of the three aims of man (*purushartha*): righteousness or religious merit (*dharma*), profit and material advantage (*artha*) and pleasure (*kama*). All three were regarded as worthy of pursuit, but the claims of the first overrode those of the second, and those of the second overrode those of the third. All three aims were theoretically subservient to the fourth long-term aim of salvation (*moksha*), which was only pursued directly by ascetics. Thus the traditional ideal of the layman's life was one of a balanced *via media*. Modern Hindu teachers, however, appear to have largely forgotten the doctrine of the three aims, and the layman is often told to follow the ascetic's way of life as far as possible.

Everyday Religious Life.—Religious activity is chiefly centred in the home. Every orthodox home has at least one sacred image, picture or emblem, before which *puja* in the form of prayers, hymn singing, the offering of flowers and the burning of incense is performed, especially by the women of the house. In richer houses there is usually a family shrine room or chapel. Every meal is a religious rite and daily rituals, of a sacrificial character but not involving the killing of animals, surviving almost without change from the Vedic period, are still performed by some of the more orthodox Brahmans. Much time is spent in listening to religious literature, read aloud or recited. Rites requiring the help of a trained brahman are performed by a *purohita,* or chaplain, serving a family or group of families.

The personal ceremonies begin from the conception of the child; rites are performed with the participation of the pregnant mother, to ensure the safe arrival of a male child. The birth ceremony (*jatakarma*) should take place before the cutting of the umbilical cord. Ten days after birth the ritual impurity of mother and child is removed and the child is named. Various minor rites take place in infancy; more important is the rite of *upanayana,* originally performed among the three higher classes but now largely confined to Brahmans, celebrated about the time of puberty. At this ceremony a boy is invested with the sacred thread (*upavita* or *yajnopavita*), which he should wear throughout his life over his right shoulder. He is taught the *Savitri* or *Gayatri* verse of the Rigveda, which is repeated at all religious rites and ceremonies, and he is then qualified to study the Vedas, and has the status of

an Aryan. With this the stage of the *brahmachari* commences.

The Hindu marriage ceremony is lengthy and complicated. The kernel of the rite is the threefold circumambulation of the sacred domestic fire by the couple, and their taking seven steps with their garments knotted together. Hindu funerals normally involve cremation. The corpse is burned as soon as possible after death, and the bones are thrown into a river, preferably the Ganges (Ganga) or another sacred stream. For ten or more days the family is ritually impure, and the relatives, with shaven heads, confine themselves as far as possible to the family home, performing *antyeshti* ceremonies for the welfare of the soul of the dead man; without these rites it will find it impossible to achieve a rebirth. They consist of pouring libations of water and offering rice balls (*pinda*) and milk to the departed spirit. On the tenth day the soul acquires a subtle body and reaps the fruits of its former deeds, whether good or evil. The *shraddha* ceremonies, repeated at periodic intervals for the continued welfare of the dead man and for the welfare of other dead members of the family, are of similar character.

Congregational worship hardly exists, though it has been introduced by some reformed sects, such as the Arya Samaj. The temple is the house of the god, as the palace is the house of the king. It is a meritorious act to do him homage, and thus Hindus visit the temple alone or in small family groups, reverence the image of the deity and depart. Although regular *pujas* or ceremonies of worship are performed by trained ministrants at intervals throughout the day in the larger temples, devoutly watched by the laity, there is no real parallel to the Christian religious service or the Muslim *khutba*. The larger temples, however, are centres of religious instruction, where sacred literature is read publicly, and at one time many of them also ran schools.

FESTIVALS

At least once a year each temple of any importance holds its festival. In south India these are marked by the procession of the god round the city or village, either in a very large cart with a towering superstructure (*ratha*), usually pulled by devotees, or on the back of an elephant. Dancing, singing and the recitation of religious stories take place in the temple. Even festivals in quite small villages attract worshipers from nearby and pilgrims come from all over India to the great festivals of such temples as that of Puri in Orissa, where the annual procession of the god Jagannath (a form of Vishnu) is famous throughout the world. (*See* JUGGERNAUT.) The seven sacred cities of Hinduism and the chief centres of pilgrimage are: Varanasi (Benares), Hardwar, Ayodhya, Dwarka, Mathura, Kancheepuram and Ujjain. To these must be added Madurai, one of the most important centres of Dravidian Shaivism; Gaya, equally a centre of Buddhist pilgrimage; and Prayaga (Allahabad), where the religious fair (*mela*) at the confluence of the Jumna and Ganges attracts hundreds of thousands.

Pilgrims and visitors to temples often assume the so-called caste mark. This symbol, painted on the wearer's forehead and sometimes on other parts of his body, really indicates his sectarian affiliations. Vaishnavas wear a mark ∪ and Shaivites wear three horizontal lines ≡. Variations of these marks indicate sects within the two main traditions. These and other religious emblems are often worn painted, tattooed or branded on various parts of the body by ascetics and extreme devotees.

All festivals are fixed according to the Hindu lunisolar calendar, and their occurrence according to the western calendar varies from year to year within a month, as does the Christian Easter. General days of festival are numerous, but lesser festivals and fasts are little regarded except by the more devout Hindus. Probably the most widely maintained are those occurring in the autumn. The first ten days of Ashvina (September–October) are particularly sacred to the Mother Goddess. For nine days she is worshiped in her fiercer forms, animals being sacrificed to her on the ninth day by Shaktas and some Shaivites. The tenth day (Dashara) is one of processions and merrymaking, celebrated even by Vaishnavas. Diwali or Dipavali, at the beginning of Karttika (October–November) is by origin a New Year festival, at which lamps are ceremonially lit, housefronts are illuminated and presents are exchanged. Holi is a spring festival, occurring at the full moon of Phalguna (February–March); it is a sort of Hindu saturnalia, theoretically connected with the god Krishna but evidently originally a fertility ceremony; for townspeople at any rate it has now lost much of its original religious significance. Vasanta-panchami, usually falling in February, is the festival of Sarasvati, the patroness of art and learning; the goddess is worshiped in specially erected shrines and concerts are held in her honour. In the Tamil country the most famous festival is Taipongal, occurring in January or February, when newly cooked rice is offered to various divinities and domestic cattle are honoured to the accompaniment of many festivities. There are many other festivals of varying importance, and all Hindus, whatever their sectarian affiliations, are usually ready to take part in them. (*See* also FEAST AND FESTIVAL: *Hinduism.*)

ASCETICISM

Among westerners Hinduism is especially associated with asceticism, perhaps unjustly, because for the lay Hindu it is not essentially an ascetic religion. The practice of asceticism seems to have begun in a sort of shamanism, the performance of austerities in order to achieve supernatural powers, hints of which are to be found in the Rigveda. With the growth of the doctrine of transmigration it was thought that full release from the round of birth and death (*samsara*) could be gained only by giving up worldly life and concentrating on achieving mystical gnosis, and this has been the ostensible motive for a Hindu's taking to the life of asceticism down to the present day. The doctrine of the four *ashramas* put forward the ideal that every man should end his days in asceticism, but in fact many have not done so, while many others have taken to asceticism in youth.

The ascetic, on "leaving the world," attaches himself to a master (*guru*), who initiates him and trains him in his early career. The sincere ascetic usually learns the technique of breath control and control of the bodily functions known as Hatha Yoga, and from this goes on to rapt meditation, until he feels that he has fully realized the identity of his soul (Atman) with the Absolute (Brahman). He should own nothing, or only the barest necessities, and should depend on food offered to him by laymen.

Many ascetics at all times have achieved great respect, and some have been very powerful spiritual forces in the molding of Hinduism. On the other hand there are innumerable men of a more dubious character who live very comfortably on the donations of credulous laymen. Others, of a psychopathic character, subject themselves to self-tortures—which are not, as some apologists assert, a feature of the degenerate Hinduism of recent times but are fully attested in the earliest Buddhist scriptures, and must have been practised centuries before the Christian era.

The organization of ascetics into disciplined fraternities probably began with the heterodox sects such as Buddhism and Jainism, but orthodox ascetic schools existed from around the beginning of the Christian era. A form of Hindu monasticism, probably owing much to Buddhist precedent, was established by the great teacher Shankara, and the foundation of similar monastic orders is attributed to Ramanuja and other medieval teachers. These ascetic foundations still survive. In the 19th and 20th centuries the celibate order of the *swamis* of the Ramakrishna mission were and are one of the most vital forces of Hinduism. The many schools of Indian asceticism are distinguished by varying sectarian marks, uniforms and practices.

MODERN DEVELOPMENTS

The system of belief and conduct described above has prevailed in Hindu India for many centuries. In the 19th and 20th centuries the system has altered considerably, at least in the cities among literate people, because of the influence of western ideas, changing social conditions and the work of numerous reformers. The earliest of these was the Bengali brahman Ram Mohan Roy who founded a reformed Hindu church, the Brahmo Samaj (*q.v.*), which, though it is now almost extinct, had much influence in the 19th century and campaigned against many of the more objection-

able aspects of Hinduism, such as widow-burning, child marriage and polygamy. The Arya Samaj (*q.v.*), founded by Dayanand Saraswati in 1875, is more nationalist and is still an important force in Uttar Pradesh and the Punjab. The claim of its founder that all wisdom was to be found in the Vedas was accompanied by an attack on the worship of idols, an insistence on monotheism and social equality and much educational activity. The Theosophical society, originally gnostic or cabalistic in character, became virtually a reformed sect of Hinduism when its founder, Madame Blavatsky, moved her headquarters to India in 1879 (*see* THEOSOPHY). At the very end of the century the Ramakrishna mission was founded, inspired by the teachings of the saintly Bengali mystic Ramakrishna Paramahamsa (*see* RAMAKRISHNA). Its founder, the *swami* Vivekananda (*q.v.*), campaigned energetically in favour of Hinduism in Europe and America and was successful in making a number of western converts to his reformed Hindu movement. In the mid-20th century the west was also showing increasing interest in Yoga.

India's achievement of independence, and the significant part played by the Indian republic in international affairs, have added to the importance of Hinduism. Undoubtedly the greatest contribution has been that of Mahatma Gandhi (*q.v.*), whose unique synthesis of religion and politics provided an ideology for the civil disobedience movement which was instrumental in gaining India's independence. Appreciably influenced by Christian ideas, which he assimilated to the Hindu outlook, Gandhi gave a new sense of purpose to many Hindus of all classes and taught them to respect their traditional beliefs and practices but to adapt them to the needs of the times. Continuing the work of early reformers he encouraged the emancipation of Hinduism from the system of class and caste, and fostered a spirit of social service. His work has been continued in the agrarian reform movement led by Vinoba Bhave (*q.v.*) and in many smaller movements.

The great majority of Indians still support their traditional religion, but the educated among them may have their reservations, and unbelief in the form of agnosticism, humanism and materialism has made many inroads on the citadels of the faith. Though the development of industrialization, education and democracy will almost certainly condemn many traditional elements, the lack in Hinduism of an over-all organization, which superficially may seem a source of weakness, may prove a source of strength. Its continuance depends not on popes or high priests but on a multitude of independent brahmans who perform the domestic ceremonies of the laity, and on thousands of ascetics, of varying degrees of intelligence and saintliness, who give the layman spiritual help and advice and need no organization to carry on their work. *See* also references under "Hinduism" in the Index volume.

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HINDU KUSH, a range of mountains in central Asia, nearly 500 mi. long from its junction in the east with the Karakoram to a district some 80 mi. west-northwest of Kabul, where it merges with the ranges of the Koh-i-Baba. It is drained north by the Amu-Darya (ancient Oxus) and thence to the inland basin of the Aral sea; and south to the Gilgit and Kabul rivers and thence to the Indus and Arabian sea. It is a major Asian watershed. Geographical convention places its junction with the Karakoram about long. 74° E. at the watershed between the Hunza basin and the Karambar tributary of the Gilgit river. From there the eastern Hindu Kush extends westward for about 120 mi. to the headwaters of the Rich river of Chitral; the central Hindu Kush from there along the northwestern and western frontier of Chitral for 130 mi.; the western Hindu Kush traverses Afghanistan for nearly 250 mi.

The eastern Hindu Kush is broad-backed and carries a double ridge of peaks on its crest zone. The lower northern ridge is the Asian watershed; the southern ridge, with many peaks over 20,000 ft. and more difficult and inaccessible, is also much more heavily glaciated, particularly on its northern side. Except where the Karambar river cuts through it in the east, the Darkot (15,010 ft.) is the only major pass across it. The high trough between the two ridges is drained eastward by the upper Karambar and westward by the headwaters of the Yarkhun river of Chitral,—fed by the large Chiantar glacier and others of the southern ridge—which escapes southward through a defile about 40 mi. N. of Mastuj. The northern ridge is accessible from north and south at several points; the Baroghil pass (12,480 ft.), as the gateway from the Pamirs to the Darkot, Yasin and the south, is the best known, while the Kora Bohrt (15,000 ft.) leads to the upper Karambar. This ridge forms the southern boundary of Wakhan, a narrow strip of Afghan territory bordering on the U.S.S.R. along the Amu-Darya which is known as the Ab-i-Wakhan there and as the Ab-i-Panja below the frontier post of Kila Panja, at which point the strip is only 10 mi. wide.

West of the Yarkhun defile the two ridges lose their separate identities, being much cut up by tributaries of that river (which is a part of the Kunar) and by the Turikho and its chief affluents, the Rich, Uzhnu and Ziwar. There the central Hindu Kush begins. Opposite Ishkashim, where the Amu-Darya makes its great loop to the north, the range strikes southwest and rises to its highest mountain groups: Saraghrar (24,110 ft.), Noshaq (24,581 ft.), Istor-o-Nal (24,271 ft.) and Tirich Mir (25,236 ft.), with its several satellites over 24,000 ft. Many others rise above 21,000 ft.; all are ice-clad and stand within Chitral. The Afghan side of the range is traversed by long confused valleys, such as the Qazi Deh.

Southwest of Tirich Mir the Hindu Kush loses height, being heavily eroded by the Arkari Gad and its tributaries. The landscape becomes more dreary and the frontier is easier to cross, the Dorah pass (14,941 ft.) at the head of the Lutkho river being the best known pass. Six miles south of the Dorah, the Chitral boundary with Afghanistan leaves the range, which for the last 250 mi. of its course traverses northern Afghanistan, separating the Kabul and eastern provinces (including Nuristan) on the south from

ZBIGNIEW RUBINOWSKI

TIRICH MIR (25,236 FT.), THE HIGHEST MOUNTAIN IN THE HINDU KUSH

Kataghan and Badakhshan. No peaks above 18,000 ft. are known in this section, but up to the early 1960s it still had not been accurately surveyed and its detailed topography remained little known. The districts north of the range are more populated than those farther east, and a number of passes, such as the Khawak (11,650 ft.), are in use. Economic development occurred, including the erection of power plants, and there is an all-weather motor road across the range, connecting the Soviet frontier post at Termez on the Amu-Darya, through Haibak and Charikar, with Kabul. There are several alternative routes fit for animal transport.

A detailed topographical survey, on the half-inch scale, of the frontier districts of Yasin, Dir, Swat and Bajaur and of Chitral, now controlled by Pakistan, was made by the Survey of India in 1928–29, though the resulting maps were not made readily available to the public. Existing evidence points to similar processes of uplift and subsequent denudation as in the Karakoram and other trans-Indus ranges farther east. The Himalayan folds loop round what is known as the "Northwest Syntaxis of India," and splay out across the northwest frontier and the Swat-Kohistan region of West Pakistan. The eastern Hindu Kush and the ranges south of it form an immense buttress thrust against the corrugated plateau of the Pamirs, in much the same way that the Himalayas buttress the Tibetan tableland. Their general physiography exhibits the same type of long lateral valleys with transverse drainage, often in deep defiles. This is well illustrated by the Yarkhun river, which drains the trough between the two ridges of the Hindu Kush, and as it cuts southward through Chitral (where it is known as the Kunar) it collects other rivers and torrents, to become the longest and by far the most important affluent of the Kabul river. The confluence is near Jalalabad, 70 mi. E. of Kabul and 40 mi. W. of the Khyber pass. The Kunar is flanked on the east by a high branch range—sometimes known by its old historic name, the Hindu Raj—often rising above 20,000 ft., and separating Chitral from Yasin, Dir and Swat. Two famous passes lie on it—the Shandur (12,250 ft.) and the Lowarai (10,528 ft.).

Throughout the period of British rule in India, and especially since Russian trans-Caspian expansion during the 19th century, the safety and integrity of Afghanistan was a major concern of the Indian government. The Russo-Afghan boundary, though demarcated, is not an ethnological one and is easy to cross. The principal passes across the Hindu Kush, therefore, have been of the first importance to India, an importance inherited by Pakistan, since the Khyber pass can be reached from the Soviet border by motor within 48 hours.

Partly for political reasons, partly because of inadequate maps before 1930, no serious attempts were made to climb the highest peaks before World War II. A few small mountaineering reconnaissances were made by British officers stationed in Chitral. The summits of the four highest were all reached later: Tirich Mir was first climbed by a Norwegian party in July 1950; Istor-o-Nal, the third highest, was climbed by a U.S. party in June 1955; Saraghrar, the fourth highest, by Italians in 1959; and Noshaq, the second highest by two separate independent expeditions, Japanese and Polish, in Aug. 1960. It is interesting to note that the Poles went by railway via Moscow and Tashkent to Termez, thence by motor-truck to Ishkashim; ponies and Wakhani porters were used in the Qazi Deh valley to within climbing distance of Noshaq. (K. M.)

History.—The Hindu Kush was the Caucasus of Alexander's historians. It was also included in the region of Paropamisus, though the latter term embraced more, Caucasus being apparently used only when the alpine barrier was referred to. It was rightly regarded as a part of a great alpine zone believed to traverse Asia from west to east, whether called Taurus, Caucasus or Imaus. The historian Arrian himself applied Caucasus distinctly to the Himalayas also. The application of the name Tanais to the Syr seems to indicate a real confusion with the Colchian Caucasus. Alexander, after building an Alexandria at its foot (probably at Hupian near Charikar), crossed into Bactria, first reaching Drapsaca, or Adrapsa. This has been interpreted as Anderab, in which case he probably crossed the Khawak pass, but the identity is uncertain. The ancient Zend name was Paresina, the essential part of Paropamisus; this accounts for the great Asiatic *Parnassus* referred to by Aristotle, and the *Pho-lo-sin-a* of Chinese traveler Hsüan-Tsang (*c.* 605–664). According to the Arabian traveler and narrator Ibn Batutah (1304–1368) the range became known as the Hindu Kush (meaning "Hindu-killer") "because of the number of Indian slaves who perished in passing" its snows.

The Hindu Kush, formidable as it seems, often has been the limit between petty states but hardly ever the boundary of a major power. Greeks, Hephthalites (White Huns), Samanids of Bukhara, Ghaznevids, Mongols, Timur and Timurids, down to Sadozais and Barakzais, have ruled both sides of this great alpine chain. Some went on to invade India.

See also AFGHANISTAN.

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HINDU LAW: *see* INDIAN LAW.

HINDUSTANI LANGUAGE. Hindustani is the name used in English to refer to the lingua franca of modern India before its partition in 1947. Hindustani, like Bengali, Marathi, Gujarati and most other Indian languages except those of the southeastern part of the peninsula, has its ancient origins in the Prakrits or vernaculars associated with Sanskrit. The widespread common language Hindustani is closely associated with two specialized literary languages, Hindī and Urdū.

Hindī, written from left to right in the Devanagari or Sanskrit script, borrows largely from Sanskrit. Urdū, written from right to left in an adapted form of the Perso-Arabic script brought by the Muslim invaders from over the northwest frontier, is naturally full of loan words from Persian and Arabic. Still, Urdū and Hindī are "of one language" with Hindustani and the other Sanskritic languages of India. Through the well-known relationship of Sanskrit, Persian, Greek and Latin, they belong, with most of the languages of Europe, to the great linguistic family usually called Indo-European.

The everyday speech of well over 50,000,000 persons of all communities in the north of India and in West Pakistan is the expression of a common language, Hindustani. This language is shared at different levels and in varying degrees by about 50,000,000 more in the north, in Hyderabad (Deccan) and in all parts of India. This vast language community of about 100,000,000 persons is the third largest in the world, coming next after Chinese and English. The basic common language of many millions of Indians and Pakistanis is a form of Khari-boli (*i.e.*, "standing" or current language).

There is convincing evidence of the existence and development of Khari-boli from the 13th century. The use of what can be recognized as Khari-boli in certain early writings indicates that it was being employed also as a spoken language. Hindustani, in this sense, was the natural language of the people in the wide neighbourhood of Delhi and ultimately became the lingua franca of the Mogul camp and was carried everywhere in India by the lieutenants of the empire, long before the publications issuing from Ft. William. It has several recognized varieties, Dakhini, Urdū, Rekhta and Hindī. Dakhini is the name usually employed for Hindustani in south India, and was the first to be employed for literature. It contains many archaic expressions now extinct in the standard dialect. Urdū or Urdū zaban, "the language of the camp," is, with Bengali, the official language of Pakistan and the standard form of speech of the Muslims of India.

All the early Hindustani literature was in poetry, and this literary form of speech was named "Rekhta" or "scattered," from the way in which the words borrowed from Persian were scattered

through it. The name was applied to the dialect used in poetry, Urdū being the dialect of prose and of conversation. The introduction of these borrowed words, which has been carried to an even greater extent in Urdū, was facilitated by the fact that Persian was the official language of the Mogul court. In this way, Persian (and, with Persian, Arabic) words came into current use and, though the language remained Indo-Aryan in its grammar and essential characteristics, it soon became unintelligible, in its elegant form, to anyone who had not at least a moderate acquaintance with the vocabulary and literature of Iran. This extreme persianization of Urdū in the earlier days was probably the work of Hindu officials employed by the Mogul administration and acquainted with Persian, rather than by the Muslim elite who normally would prefer the Persian language itself. It is clear that in the days of the Mogul empire, Urdū began to develop and its use as a literary language followed a natural course. It exercised a strong influence on the development of spoken Hindustani, contributing a measure of standardization.

Hindī scholars are inclined to nullify the effects of Urdū upon the formation of Hindī through their labours on sanskritization to replace Persian elements. Up to the 19th century, the only literary forms which arose from colloquial Khari-boli, and gave it some stability and prestige, must be described as Urdū.

The epoch of Akbar was the period of the formation of the language. But its final consolidation did not take place until the reign of Shah Jahan. Changes were comparatively immaterial until the time when European sources began to mingle with those of the east. Like the greater part of those from Arabic and Persian, the contributions from these sources were chiefly in vocabulary.

The development of Hindustani as the lingua franca, with publication in it as well as in persianized Urdū and sanskritized Hindī, owes an enormous debt to Fort William college and the labours of John B. Gilchrist and his assistants, both Hindu and Muslim. Gilchrist was appointed head of the college upon its foundation in 1800. From the Hindustanee press in Bengal there had already come his large *Grammar of the Hindoostanee Language* (1796). He had also written *A Dictionary, English and Hindoostanee* (1787–90) and is described by John Elphinstone as the "founder of Hindee philology."

Among those who worked with Gilchrist in the "Hindoostanee" department were William Hunter, Lalluji Lal and Sadal Mishra. Gilchrist's early references to Khari-boli are of great interest. He described it as the "sterling tongue of India" . . . "distinguished by the general observance of Hindoostanee grammar and nearly a total exclusion of Arabic and Persian."

Inspired by Gilchrist, Lalluji Lal wrote the *Prem-sagar* in a form of Khari-boli, "the grand object" being to teach "our scholars the Hindoostanee in its most extended sense, and with proper advantages among the grand Hindoo mass of the people at large in British India."

People who speak what is called Khari-boli may read and write Urdū in the adapted Persian character or Hindī in the Devanagari, or both. To the cultural specialization of the two languages have now been added national and political forces since the separation of Pakistan from India. Since partition, Hindī has been declared the national language of India while Urdū is associated with Pakistan and, in particular, West Pakistan. Nevertheless Urdū remains one of the languages of India, which is its origin and home. It is interesting to note that after the conquest of the Punjab, the British government introduced not only hundreds of junior officials, referred to in the newly conquered province as "Hindostanees," from what is now Uttar Pradesh, but also their language, Urdū.

The Muslim gentry of the Punjab petitioned the government of India in favour of Persian, rejecting Urdū. Pakistan owes its Urdū to British policy in the early formative years after the annexation of the Punjab.

To sum up, Urdū may be described as the persianized Hindustani of educated Muslims, while Hindī is the sanskritized Hindustani of educated Hindus. Hindustani is the great lingua franca of peninsular India understood by both Hindus and Muslims alike.

See also HINDĪ.

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(J. R. FH.; ET. B.)

HINNY, a hybrid between a horse and an ass in which the latter is the female parent. *See* MULE.

HINSHELWOOD, SIR CYRIL NORMAN (1897–), English chemist, was awarded, with Nikolai Semenov (*q.v.*), the 1956 Nobel prize for chemistry for his work on chemical kinetics. Hinshelwood was born in London on June 19, 1897. He was educated at Westminster City school and at Oxford university, where he held in succession fellowships at Balliol, Trinity and Exeter colleges. In 1937 he was elected Dr. Lee's professor of chemistry at Oxford. From the Royal society, of which he was elected a fellow in 1929 at the early age of 31, he received the Davy medal in 1943 and a Royal medal in 1947, and he was elected president in 1955. During 1946–48 he was president of the Chemical society. His early studies dealt with molecular kinetics and later he investigated chemical changes in the bacterial cell with physicochemical explanations of the biological responses of bacteria to changes in environment. He claimed that changes, more or less permanent, in resistance to a drug could be induced in bacterial cells by prolonged exposure to the drug, as a result of a change in the enzyme patterns of the cell impressed on them by the drug. This conclusion was of great significance with regard to the development of "resistance" in bacteria subjected to the action of chemotherapeutic agents and antibiotics. Hinshelwood was knighted in 1948. His publications include *The Kinetics of Chemical Change* (1926; 4th ed., 1940) and *The Chemical Kinetics of the Bacterial Cell* (1946). (D. MCK.)

HINSLEY, ARTHUR (1865–1943), English cardinal, was born at Carlton, Selby, Yorkshire, Eng., on Aug. 25, 1865. Educated at Ushaw, near Durham, and at the English college in Rome, he was ordained at Rome in 1893. He was professor at Ushaw (1893–97), assistant priest at Keighley, Yorkshire (1898), and headmaster of St. Bede's grammar school, Bradford, Yorkshire (1899–1904). After serving as pastor of Sutton Park, Surrey, and of Sydenham, Devonshire, he returned to academic life in 1917 as rector of the English college at Rome, a position he held until 1928. In 1926 he was consecrated titular bishop of Sebastopolis, and in 1930 titular archbishop of Sardis. He was visitor apostolic in Africa in 1927. During service as apostolic delegate in Africa (1930–34), he contracted paratyphoid fever, which seriously affected his hearing and vision. He was canon of the patriarchal basilica of St. Peter's in Rome during 1934–35, after which he retired.

The death of Francis Cardinal Bourne, archbishop of Westminster, on Jan. 1, 1935, left English Catholics without a ruling prelate for the jubilee of George V, and consequently Hinsley was called out of retirement and made archbishop of Westminster on March 25, 1935. On Dec. 13, 1937, he was made cardinal.

Outspoken on political matters, Hinsley had criticized the negative stand of Pope Pius XI at the time of the Italian invasion of Ethiopia in 1935. His experience in Africa had confirmed him as a staunch advocate of English imperialism. Though he had been long out of England, he became famous before and in the early years of World War II, not only to English Catholics but to the English people generally, for his forthright stands against totalitarianism. He despised national socialism, denounced the Hitler party as "pagan upstarts" and, although no friend of communism, paid frequent tribute to the Russian people for their defense against Germany.

Cardinal Hinsley died at Buntingford, Hertfordshire, on March 17, 1943.

HINTERLAND, the region lying behind a littoral country yet regarded as a part of it geographically and perhaps economically. The term, which may be translated as "back country," is German in origin, first coming into prominence in 1883–85, when Germany insisted on the right to exercise jurisdiction in the territory behind those parts of the African coast that it had occupied. The doctrine of the hinterland was a revival of the U.S. theory of continuity and contiguity, set forth by secretaries of state John C. Calhoun and Daniel Webster, which had held that a state occupying a certain territory should have the right of preference in the future disposition of territory contiguous to it. Extensive regions in Africa were claimed after 1895 by Great Britain, Germany, France and Portugal on the basis of the hinterland doctrine. Neither the U.S. theory of contiguity nor the doctrine of the hinterland ever obtained wide support. The weakness common to both of them was the lack of effective occupation and control over the areas claimed.

See M. F. Lindley, *The Acquisition and Government of Backward Territory in International Law* (1926). (N. L. Hl.)

HINTON, SIR CHRISTOPHER (1901–), British engineer who played a leading part in developing the atomic industry in Great Britain, was born at Tisbury, Wilts., on May 12, 1901, and served an engineering apprenticeship in the Great Western railway shops at Swindon before going up to Cambridge to read for the mechanical sciences tripos. In 1926 Hinton joined the research department of Brunner Monds, which became the Alkali division of Imperial Chemical Industries Ltd. By 1931 he was chief engineer at I.C.I., Northwich. On the outbreak of World War II, Hinton went to the ministry of supply, being deputy director general of filling factories from 1942 to 1946. After the war he became director of the production division of the department of atomic energy, and subsequently a member of the Atomic Energy authority. 1956 saw the commissioning of the Calder Hall power station, the first in the British program for the peaceful development of nuclear power. In 1958 Hinton became chairman of the central electricity generating board. He was knighted in 1951 and was made a knight of the British empire in 1957. In 1954 he was elected a fellow of the Royal society and in 1957 an honorary fellow of Trinity college, Cambridge. (J. F. Br.)

HIP, the projecting part of the body formed by the top of the thighbone and the side of the pelvis, in quadrupeds generally known as the haunch. The hip joint is the connecting joint between the thighbone (femur) and the pelvis. *See* Joints and Ligaments; Skeleton, Vertebrate.

HIPPARCHUS (fl. 146–127 B.C.), was the greatest astronomical observer of antiquity and an able mathematician. He was born at Nicaea in Bithynia, which lies east of the sea of Marmara. The dates of his birth and death and the place of his death are not known. He carried out his observations in Bithynia, at Rhodes, where he spent much time, and also, it seems, at Alexandria. The year 127 B.C. is usually quoted as the latest date known for his actual work, and the French astronomer J. B. J. Delambre (1749–1822) clearly showed how some observations of Hipparchus on the star η Canis Majoris seem likely to have been carried out in that year.

Most of our knowledge of Hipparchus is contained in the writings of Strabo of Amasya (fl. A.D. 20) and in that great astronomical compendium, the *Almagest* of Ptolemy (fl. A.D. 127–151). Ptolemy often quotes Hipparchus verbally, and it is obvious that he thought very highly of him; indeed, as a result of the slow progress of early science, he speaks of him with the respect due to a distinguished contemporary, although almost three centuries separated the work of the two men. It is difficult always to determine to which of them credit is due.

It is certain, however, that in all his work Hipparchus showed a clear mind and a dislike for unnecessarily complex hypotheses. He rejected not only all astrological teaching, as might be expected, but also the heliocentric views of the universe which seem to have been proposed, according to Archimedes (287–212 B.C.), by Aristarchus of Samos (fl. *c.* 270 B.C.) and which were resuscitated by Seleucus the Babylonian, a contemporary of Hipparchus. It must be remembered that strong arguments had been advanced against the motion of the earth, and the general climate of opinion had never been favourable to following up the lead given by Aristarchus. Moreover, the movable eccentric and the epicyclic systems accounted well for most of the irregularities observed in the motions of the sun, the moon and the planets, and it was not until the 15th century A.D. that regular observations over very long periods showed the geocentric hypothesis to be too complex to be acceptable. It was, of course, the Ptolemaic geocentric system which was handed down to western European science, but it must be remembered that the views of Hipparchus had a profound influence on Ptolemy, as he himself acknowledged.

Few details are known of the instruments which Hipparchus used. However, it seems likely that he observed with the usual devices current in his day, although Ptolemy credits him with the invention of an improved type of theodolite. In all his instruments Hipparchus would, of course, have used open sights.

Precession of the Equinoxes and Length of the Year.—Hipparchus is best known for his discovery of the precession of the equinoxes; *i.e.*, of the alterations of the measured positions of the stars resulting from the movement of the points of intersection of the ecliptic and of the celestial equator. It appears that he had written a work bearing "precession of the equinoxes" in the title, and this term is still in current use although the phenomenon is more usually referred to merely as "precession." This notable discovery was the result of painstaking observations worked upon by an acute mind. Hipparchus observed the positions of the stars and then compared his results with those of Timocharis of Alexandria 150 years before, and with even earlier observations made in Babylonia. He discovered that the celestial longitudes were different, and that this difference was of a magnitude exceeding that attributable to errors of observation. Hipparchus therefore proposed precession to account for this, and gave a value of 45″ or 46″ for the annual changes.

This is very close to the figure of 50″.26 accepted nowadays, and is a value much superior to the 36″ which Ptolemy obtained. It strongly confirms the reputation of Hipparchus as an observer of outstanding precision.

His discovery of precession enabled Hipparchus to obtain more nearly correct values for the tropical year (the period of the sun's apparent rotation from an equinox to the same equinox again) and also for the sidereal year (the period of the sun's apparent rotation from a fixed star to the same fixed star). Again he was extremely accurate, so that his value for the tropical year was too great only by $6\frac{1}{2}$ minutes.

Star Catalogue.—Observations of star positions, measured in terms of celestial latitude and longitude, as was customary in antiquity, were carried out by Hipparchus and entered in a catalogue—the first star catalogue ever to be completed. Hipparchus measured the stellar positions with greater accuracy than any observer before him, and his observations were of use to Ptolemy and later to Edmund Halley. To catalogue the stars was thought by some of Hipparchus' contemporaries to be an impiety, but he persevered. He had been stimulated in 134 B.C. by observing a "new star" and, concluding that such a phenomenon indicated a lack of permanency in the number of "fixed" stars, he determined to catalogue them, and no criticism was able to deflect him from his purpose.

Hipparchus' catalogue was completed in 129 B.C. and listed about 850 stars (not 1,080 as is often stated), the apparent brightnesses of which were specified by a system of six magnitudes similar to that used today. For its period, this catalogue was a monumental achievement.

Lunar and Solar Work.—In his work on the sun and moon Hipparchus used the observations of others as well as his own. He showed that the movable eccentric and the deferent and epicycle systems were equivalent in the motions they gave for the sun and moon and, indeed, for the planets. Both methods gave the position of the sun correct to within 1′, and Hipparchus rejected the peculiar notion, prevalent in his day, that the sun moved in an orbit inclined to the ecliptic. He also redetermined the inclination of the ecliptic and obtained a value correct to within 5′ of the modern figure.

The motion of the moon is more complex than that of the sun,

owing to the perturbations which the moon suffers from both earth and sun; in consequence, there are more irregularities to be taken into consideration. Hipparchus satisfactorily accounted for that inequality of the moon's motion which is due to the elliptical form of its orbit; he utilized circular motions but inclined the deferent at an angle of 5° to the ecliptic. His theory gave reasonably satisfactory results for the motion at full and new moon. Hipparchus was dissatisfied however, for, as he appreciated, the errors at quadrature were too great. He concluded that there was some further inequality in the moon's motion, but he was unable to discover any means of solving this problem. With his scientific approach, he stated that he left the solution of this question to his successors.

Hipparchus also attacked the problem of the relative size and distance of the sun and moon. It had long been appreciated, of course, that the apparent diameter of each was the same, and various astronomers had attempted to measure the ratio of size and distance of the two bodies. Eudoxus obtained a value of 9:1; Phidias (father of Archimedes) 12:1; Archimedes himself 30:1, while Aristarchus believed 20:1 to be correct. The present-day value is, approximately, 393:1. Hipparchus followed the method used by Aristarchus, a procedure which depends upon measuring the breadth of the earth's shadow at the distance of the moon (the measurement being made by timing the transit of the shadow across the moon's disk during a lunar eclipse). This method really gives the parallax, and thus the distance, of the moon, the parallax for the sun being too small to give a significant result; moreover the accuracy obtainable for the distance even of the moon is poor. Hipparchus was dissatisfied with his results, so he attempted to find the limits within which the solar parallax must lie for observations and calculations of a solar eclipse to agree; he also hoped that differences between solar and lunar parallax might thus be revealed. He obtained no satisfactory result from his efforts, however, and concluded that the solar parallax was probably negligible. At least, then, he appreciated that the distance of the sun was very great indeed. But it must be mentioned that Cleomedes (fl. 2nd century A.D.) claimed that Hipparchus gave the sun's volume as 1,050 times that of the earth (modern value = 1,300,000); and Theon of Smyrna (fl. 2nd century A.D.) made him give it as 1,880 times.

Planetary Studies.—Hipparchus was unsuccessful in forming a satisfactory planetary theory, and, as has already been remarked, he was true scientist enough to avoid building hypotheses on insufficient evidence. Theon claims that Hipparchus preferred the mathematical device of the epicycle to that of the movable eccentric, but it seems clear that he looked upon such devices purely as mathematical conveniences, and was not concerned with the reality or otherwise of these combinations of circular motion. Ptolemy went further in his description of the planetary work of Hipparchus and wrote: "It was, I believe, for these reasons and especially because he had not received from his predecessors as many accurate observations as he has left to us, that Hipparchus, who loved truth above everything, only investigated the hypotheses of the sun and moon, proving that it was possible to account perfectly for their revolutions by combinations of circular and uniform motion, while for the five planets, at least in the writings which he has left, he has not even commenced the theory, and has contented himself with collecting systematically the observations and showing that they did not agree with the hypotheses of the mathematicians of his time. He explained in fact not only that each planet has two kinds of inequalities but also that the retrogradations of each are variable in extent, while other mathematicians had only demonstrated geometrically a single inequality and a single arc of retrograde motion; and he believed that these phenomena could not be represented by eccentric circles nor by epicycles carried on concentric circles, but that, by Jove, it would be necessary to combine the two hypotheses." (J. L. E. Dreyer, *History of the Planetary Systems From Thales to Kepler*, Cambridge University Press, 1906.)

Those who studied this problem before the time of Hipparchus had but one main aim, to explain the irregularities which occurred when a planet was in opposition. No notice was taken of those irregularities which occurred when a planet was in other parts of its orbit, doubtless because of the habit of observing only around times of opposition. Hipparchus advocated more frequent observing for longer periods, and he carried out such work himself with an accuracy unsurpassed in his time. The need for accurate and frequent observations made over a long period may be appreciated when it is recollected that Jupiter takes almost 12 years to complete an orbit round the sun and Saturn nearly 30 years, and that such sidereal periods must be carefully observed before any law can be formulated. Ptolemy used the older observations which Hipparchus had sifted and those which Hipparchus himself had made as well as his own, before he formulated the planetary views enshrined in the *Almagest*. In his own planetary work Hipparchus adopted the generally accepted order for the sun, moon and planets, namely (in order from the earth) the moon, Mercury, Venus, the sun, Mars, Jupiter and Saturn.

Mathematics.—It is to be expected that the astronomical work of Hipparchus should lead him to develop certain departments of mathematics. He made an early formulation of trigonometry and tabulated a table of chords (chord $\alpha = 2 \sin [\alpha/2]$); he is known to have had a method of solving spherical triangles. It is also generally agreed that the theorem in plane geometry known as "Ptolemy's theorem" was originally due to Hipparchus, and was later copied by Ptolemy. This theorem has implicit in it the trigonometrical addition formulas for $\sin (A \pm B)$ and $\cos (A \pm B)$, and Lazare Carnot (1753–1823) showed how the whole of plane trigonometry can be deduced from these formulas.

Hipparchus criticized severely the geographical work of Eratosthenes (*c.* 273–192 B.C.) and himself did some work in this field. His main contribution was to apply rigorous mathematical principles to the determination of places on the earth's surface, and he was the first to do so by specifying their longitude and latitude—the method used today. Hipparchus was, no doubt, led to this method by his work on the trigonometry of the sphere. He tried to measure latitude by utilizing the ratio of the longest to the shortest day at a particular place instead of following the customary method, due to the Babylonians, of measuring the difference in length of day as one travels northward. Hipparchus also divided the then known inhabited world into climatic zones, and suggested that the longitude of places could be determined by observing, from these places, the moments when a solar eclipse began and ended; but this bold scheme, while theoretically satisfactory for a small area of the earth's surface, was not a practical proposition in his day.

See also references under "Hipparchus" in the Index volume.

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HIPPASUS OF METAPONTUM (fl. *c.* 500 B.C.), Pythagorean philosopher, was probably of the first generation after Pythagoras. Tradition said that he was drowned after revealing a mathematical secret of the brotherhood. He may also have published a *mystikos logos* or work on the mysteries which for some reason was resented. He held the Heraclitean fire-doctrine, whereas the Pythagoreans maintained that number is the first principle, and seems to have regarded the soul as composed of igneous matter; so he approximates Pythagorean dualism of light and dark to the theories of Heraclitus.

See H. Diels and W. Kranz, *Fragmente der Vorsokratiker*, i, 7th ed. (1954). (A. C. LD.)

HIPPEASTRUM, a genus of bulbous lilylike plants of the amaryllis family (Amaryllidaceae; *q.v.*). *See* AMARYLLIS.

HIPPED ROOF, in architecture, a roof which starts on all sides on the same level at the eaves and slopes up toward a ridge or point in the centre. Hipped roofs were apparently common in the domestic work of the Mediterranean countries from the time of Greece, and are still the most common form for informal buildings throughout the near east and in Italy, southern France and Spain. With the coming of the Renaissance into northern Europe the hipped roof tended to supersede the gable, owing to the emphasis on the horizontal line of the cornice. Thus most

of the Renaissance châteaux of France and many of the earlier Georgian manors of England have hipped roofs. A remarkable development of hipped roof design was made by the Chinese, particularly in the north, where many of the great temple and palace halls have widely projecting and gently curved hipped roofs in which the hips (the intersections of the slopes) and the ridges are richly decorated with molded tiles and terminated by fantastic dragons or grotesque beasts. *See* ROOF.

HIPPEL, THEODOR GOTTLIEB VON (1741–1796), German writer, who belonged to Kant's circle and whose writing shows a spiritual affinity with that of Laurence Sterne, was born at Gerdauen, East Prussia, on Jan. 31, 1741, the son of a headmaster. He studied theology and law and in 1780 was appointed chief burgomaster of Königsberg, becoming in 1786 president of the town. He died there, a bachelor, on April 23, 1796.

Hippel's resemblance to Sterne, both in his humorous, subjective style and in his psychological insight, is revealed especially in his novel, *Lebensläufe nach aufsteigender Linie* (1778–81), which contains an element of pietism in his melancholy contemplations of death and mortality. Sterne's influence can also be seen in his second novel, *Kreuz- und Querzüge des Ritters A bis Z* (1793–94), in which the quixotic hero after various clandestine misadventures is finally reconciled with society. His two essays in praise of marriage, *Über die Ehe* (1774) and *Über die bürgerliche Verbesserung der Weiber* (1792), with their emphasis on female emancipation, also attracted much attention. In addition he published a number of legal, masonic and moral works as well as hymns and, in his youth, two comedies. His literary influence was mainly noticeable in J. P. F. Richter.

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HIPPIAS, tyrant of Athens from 528/527 to 510 B.C., was the eldest son of Pisistratus (*q.v.*), whom he succeeded. He was a patron of poets and craftsmen, and under his rule Athens was economically prosperous. Politically, he attempted at first to reconcile the opposition: Cleisthenes and Miltiades (*qq.v.*), both members of aristocratic families which had been hostile to the tyranny, were archons in the early years, and Miltiades was later (*c.* 516) sent out to take over control of the Chersonese (Gallipoli peninsula). But difficulties developed at home and abroad; the rise of Persia was already casting a shadow over Greece; and Sparta was becoming more active under Cleomenes I. At home the opposition became restless, and when his brother Hipparchus was assassinated (514) Hippias was driven to repressive measures. An attempt by nobles in exile to force their way back failed, but in 510 the Spartans under Cleomenes I, influenced by the Delphic oracle, invaded Attica, besieged the tyrant's party on the acropolis and forced their surrender and evacuation.

Hippias had recently married his daughter to the son of the tyrant of Lampsacus on the Hellespont, who was on good terms with the Persian king. He hoped for restoration to Athens with the help of other Greeks, but when a proposal by the Spartans to reinstate him had been rejected by their allies, Hippias went to the Persian governor at Sardis. The Athenians ignored the governor's demand for Hippias' restoration and at first even sent help to the Ionians in their revolt from Persia (498). After crushing the Ionians the Persians turned against Athens, and Hippias, by now a very old man, was with the force that crossed the Aegean in 490 (*see* GRECO-PERSIAN WARS). He advised the landing at Marathon, hoping to repeat his father's successful return from his second exile, but though there was a fifth column inside Athens the Athenian army won a decisive victory.

Hippias is said to have died at Lemnos on the way back.
(R. ME.)

HIPPIAS OF ELIS, Greek sophist who claimed to be at home in all the learning of his day. He was born before the middle of the 5th century B.C. and was alive in 399 B.C. He is depicted in Plato's *Protagoras* and in the *Hippias Major* and *Hippias Minor*. Hippias acquired great wealth and fame as a teacher throughout the Greek world. His vast literary output included elegies and tragedies as well as technical treatises in prose. He propounded an ideal of individual self-sufficiency and appealed from convention to nature. He was perhaps the first to preach cosmopolitanism. He made a significant contribution to mathematics by discovering the *quadratrix* (*see* CURVES, SPECIAL) and developed a system of mnemonics. His historical compilations and investigations, such as the list of Olympic victors, were used by later writers. His influence on contemporary thinkers was certainly considerable but cannot now be traced in detail.

For fragments and testimonia *see* H. Diels and W. Kranz, *Fragmente der Vorsokratiker*, ii, 7th ed. (1954). (G. B. KD.)

HIPPO (fl. *c.* 450 B.C.), Greek philosopher who revived the belief of Thales that the world originates from water or moisture, was born either in Samos or at Rhegium in southern Italy. He held that fire first originates from water and that these two, operating as contrary forces, produce the physical cosmos. But he was more especially concerned with problems of medicine and physiology: disease and death were due to the drying up of the natural moisture in the body. He was a critic of Empedocles, and his physiology resembled that of the Pythagoreans. He must have been well known at Athens, either personally or through his writings, since Cratinus in a comedy attacked him as an "atheist," and he was often so designated.

See E. Zeller, *Die Philosophie der Griechen*, rev. ed., vol. i (1920); K. Freeman, *Companion to the Presocratic Philosophers* (1946).
(D. J. A.)

HIPPOCRATES (fl. 400 B.C.), Greek physician, traditionally regarded as the "father of medicine" and as the author of a number of medical works known as the *Hippocratic Collection*.

The major source of material on his life is the biography written by Soranus, a Greek physician of the 2nd century A.D. According to Soranus, Hippocrates was born on the island of Cos off the coast of Asia Minor at a date corresponding to 460 B.C. Both Soranus and Plato speak of him as a member of the sect, family, guild or society known as the Asclepiadae (*i.e.*, sons of Asclepius). Unfortunately nothing is known of the rights, duties or functions of these Asclepiadae. It is said that Hippocrates prosecuted his early medical studies in the famous temple of Asclepius at Cos (*q.v.*), and that he traveled widely. He is stated to have taught and practised in Thrace, Thessaly, Delos, Athens and elsewhere, and to have died at Larissa at an advanced age.

The character and abilities of Hippocrates as a physician were held in almost universal veneration by medical men in the ages which followed. Nevertheless, early references to him are very scanty. He is mentioned twice by Plato with respect (in the dialogues *Protagoras* and *Phaedrus*). In view of the fact that Plato was his younger contemporary, it is surprising that he does not mention Hippocrates more often—especially in the *Timaeus*, which deals with physiological subjects. There are some passages in the Platonic dialogues which have been influenced by works now included in the *Hippocratic Collection*. Aristotle mentions the name of Hippocrates once only (in his *Politics*) but a number of parallels can be discovered between works of the *Hippocratic Collection* and those of Aristotle, most frequently in Aristotle's *Historia Animalium*. On the other hand, Hippocrates has had few detractors. Among them were the physician Andreas, who practised in Egypt at the end of the 3rd century B.C., and Asclepiades of Bithynia, who practised in Rome in the 1st century B.C. Their works have not survived.

This uncertainty as to Hippocrates himself in no way alters the significance of the so-called *Hippocratic Collection*, brought together probably not long after 300 B.C. by the Alexandrian medical school and attributed to Hippocrates, whose name was already held in high veneration. The subsequent history of the *Collection* is such that it provides an ideal battleground for textual criticism, and a vast amount of study has been expended upon it without any clearly established conclusions as to the authorship of the various works other than that the *Collection* as a whole embodies the philosophy of the school at Cos. The *Collection* includes the *Hippocratic Oath*, the *Aphorisms* and works on various aspects of medicine—on epilepsy, on epidemics, on the treatment of head wounds, on ancient medicine, etc. There are excellent English translations by W. H. S. Jones (1923) and by J. Chadwick and

W. N. Mann (1950). For the significance of the *Collection* in the history of medicine, the text of the *Oath,* and bibliography, *see* MEDICINE AND SURGERY, HISTORY OF: *Early Greek and Roman Medicine.*

See also references under "Hippocrates" in the Index.

HIPPOCRATES OF CHIOS (*c.* 460 B.C.), famous Greek geometer known for compiling a book of the elements of mathematics, thus being a precursor of Euclid; for finding the areas of certain lunes, *i.e.*, plane figures bounded by arcs of circles; and for reducing the problem of doubling the cube to that of finding two mean proportionals between two given numbers.

Tradition says that Hippocrates was a merchant whose goods had been captured by pirates. He went to Athens to prosecute them, stayed in that city for a long time, attended lectures on mathematics and added to his income by teaching that subject. Aristotle's account of the story was that Hippocrates had been cheated by customs officers in Byzantium, and that though he was a good geometer, he was a poor businessman.

The book of the elements of mathematics compiled by Hippocrates is said to have been the first of his achievements. It is known only through references in the work of later commentators, especially Proclus (*c.* 450) and Simplicius (*c.* 530). Hippocrates' quadratures of lunes were based upon the theorem that the areas of two circles have the same ratio as the squares on their diameters. A summary of these quadratures, written by Eudemus, with elaborate proofs, has been preserved by Simplicius.

The third of the achievements attributed to Hippocrates was the discovery that if two mean proportionals be inserted between a number and its double, the first of these mean proportionals is the edge of a cube whose volume is double that of the cube that has the first of the numbers as its edge (*see* CUBE).

See also SCIENCE: *Ancient Science.*

See Sir Thomas Little Heath, *A History of Greek Mathematics,* 2 vol. (1921); B. L. v. D. Waerden, *Science Awakening* (1954).

(B. L. v. D. W.)

HIPPOCRATIC OATH, still taken at some universities by graduates in medicine, whereby they undertake to follow an ethical code. For the text of the Hippocratic oath, *see* MEDICINE AND SURGERY, HISTORY OF.

HIPPOCRENE (Gr. *he hippou krene*), "the fountain of the horse," is a spring which lies a little to the east of the summit of Mt. Helicon, in Boeotia. Like the other spring there, Aganippe, it was sacred to the Muses and Apollo, and hence taken as the source of poetic inspiration. The spring, surrounded by an ancient wall, is now known as *Kryopegadi* or the cold spring.

According to the legend, it was produced by the stamping of the hoof of Pegasus. (J. Bo.)

HIPPODAMUS (5th century B.C.), of Miletus, was a man of many interests and considerable abilities who won a reputation as a town planner and interested Aristotle as a political philosopher.

He came to Athens shortly before the middle of the 5th century B.C. at a time when the city was increasingly becoming the intellectual centre of the Aegean world and the most receptive environment for new ideas in philosophy and in the arts. Hippodamus replanned the Piraeus on the rectangular grid plan that was to become standard throughout the Greek world, and a large building in the market, the Hippodameum, took his name; later he probably also planned the layout of the Athenian-led panhellenic colony at Thurii in southern Italy (443). For his services to Athens he received Athenian citizenship and his son Archeptolemus (executed 411) became politically prominent.

Aristotle was more interested in Hippodamus' ideal state, the first of its kind. This had 10,000 citizens and a threefold division pervaded the institutions. Citizens were divided into artisans, farmers and soldiers; land was sacred, public or private. There were to be three classes of laws, reflecting three classes of lawsuits, for violence, damages and homicide. Similarly there were to be three classes of magistrates responsible respectively for the general public, foreigners and orphans. According to Aristotle Hippodamus was an eccentric; he wore flowing hair and expensive ornaments on cheap garments.

See Aristotle, *Politics,* 1267b–1268a. (R. ME.)

HIPPODROME, a Greek building for horse and chariot races, corresponding to the Roman *circus.* It was usually placed on a hill slope, so that the excavated material from one side could serve for an embankment for the other. One end was semicircular and the other square. The seats ran continuously around the semicircle and the two long sides, in rising tiers, and down the centre was a division. Because as many as ten chariots raced at a time, a width of about 400 ft. was necessary. The usual length varied from 600 to 700 ft. In the hippodrome at Constantinople much of the area was supported on tiers of great vaults instead of the more usual embankment. On the centre division, between an Egyptian obelisk and a memorial column, was placed the famous bronze serpent tripod from the oracle at Delphi. Begun by Severus in 203, and completed by Constantine in 330, it was both the largest and the most splendid hippodrome of the ancient world. Among its decorations were the four Greek bronze horses that now stand on the façade of St. Mark's at Venice.

HIPPOLYTUS, SAINT (*c.* 165–*c.* 235), antipope, a noteworthy theologian, controversialist and martyr, was established in Rome as one of its leading presbyters in the reign of Pope Zephyrinus (*c.* 199–217). Origen heard him lecture there in 212. The monarchian controversy was then in full swing, and Hippolytus, an exponent of the Logos doctrine of the apologists, savagely attacked Zephyrinus, and still more his successor, Calixtus, as being modalists or patripassians (*see* APOLOGISTS, EARLY CHRISTIAN; MONARCHIANISM). When the latter became pope in 217/218 Hippolytus in disgust withdrew from communion, headed a dissident group and was consecrated antipope. He maintained opposition to the official leadership under Popes Urban I and Pontianus, but was exiled with the latter to Sardinia in 235 during the persecution of the emperor Maximinus. Both men died there, but Hippolytus first became reconciled with the pope. His feast day is Aug. 13 in the west and Jan. 30 in the east.

As a theologian Hippolytus conceived of God as a monad who, while indivisible, was nevertheless plural, having his Word and his Wisdom in himself. God exteriorized the Word in the act of creation, and at the incarnation it became Son in the full sense. This teaching caused Hippolytus to be accused of ditheism, but he insisted that it did not really involve two Gods since the Word issued from the Father as light from light. In ethics he was conservative and rigorist, being scandalized by Calixtus' measures to extend absolution to graver sins such as adultery. As a result he thought of the church as a society composed exclusively of just men. In eschatology he defended the older millenarianism while trying to spiritualize it.

Hippolytus was a laborious, learned compiler rather than an original theologian; his writings are too often marred by an embittered, scurrilously controversial tone. Partly because he was a schismatic and partly because he wrote in Greek, he was soon forgotten in the west. His most important work is the *Philosophumena* (or "Refutation of All Heresies"), which seeks to show that the various Christian heresies are traceable to false pagan philosophies. His fragment *Contra Noetum* is invaluable for the monarchian controversy. His commentary on Daniel and his *De antichristo* illustrate his old-fashioned exegesis and eschatology respectively. The church order known as the *Apostolic Tradition* (extant only in later versions; *see* HIPPOLYTUS, CANONS OF SAINT) is now generally attributed to him, and illuminates liturgical practice *c.* 217. Of his numerous other treatises only fragments survive.

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HIPPOLYTUS, a minor divinity in Greek cult. At Athens he was associated with Aphrodite; at Troezen girls just before marrying dedicated to him a lock of their hair. To the Greeks his name suggested that he was destroyed by horses.

In Euripides' tragedy of the same name Hippolytus is son of Theseus, king of Athens, and the Amazon Hippolyta. Theseus' queen is now Phaedra, daughter of Minos of Crete and sister of Ariadne, and Phaedra is dying of love for Hippolytus. This is the doing of Aphrodite, whom Hippolytus has slighted, preferring a life honouring the chaste and athletic Artemis. When Phaedra's passion is revealed to Hippolytus, he reacts with such revulsion that Phaedra, who has already contemplated suicide, now fearing for her own good name and that of her children, kills herself, leaving a note accusing Hippolytus of having attacked her. Hippolytus, loyal to an oath he has made not to tell what really happened, is unable to defend his innocence to Theseus. Theseus both banishes him and calls down upon him one of the three curses Poseidon has given him. Hippolytus has not gone far before a bull of more than natural size and aspect appears from the sea and frightens Hippolytus' horses until he can no longer control them. They smash the chariot and drag their master to death. Artemis appears in time to tell Theseus the truth, but not to save her protégé, and Hippolytus expires in the arms of his father.

Seneca's *Phaedra* treats the same story; Racine's masterpiece *Phèdre* focuses the interest on the heroine. The theme is that of the biblical story of Joseph and Potiphar's wife and, in the *Iliad*, of the story of Bellerophon (*q.v.*) and Stheneboea (Anteia).

See H. J. Rose, *A Handbook of Greek Mythology* (1928); Edith Hamilton, *Mythology* (1942). (G. E. Dk.)

HIPPOLYTUS, CANONS OF SAINT, a collection of 38 canons preserved in an Arabic translation, with the title "Canons of the Church and Precepts written by Hippolytus, Archbishop of Rome, according to the ordinances of the Apostles." The original text was certainly Greek and written in Egypt; the Arabic version may possibly rest on a Coptic translation. These canons, which are neither the authentic work of St. Hippolytus nor the oldest church order, are a later adaptation of the *Apostolic Tradition* of St. Hippolytus. The author of the canons generally follows the order of his source and treats the same subjects: ordinations, catechumenate, baptism, prayer and discipline of the Christian community. But he alters the text at his own convenience and makes additions of his own, for instance, on the monastic life. He certainly lived after the Council of Nicaea (325), and was anti-Arian but not a supporter of the *homoousios* (*see* Council). His creed seems related to those produced by the Councils of Antioch (341) and of Constantinople (360). His firm opposition to Christians' undertaking military service points to a period of hostility between church and state, so he cannot have written after the Roman empire officially became Christian at the end of the 4th century. Unlike the *Apostolic Tradition* the canons do not seem to describe an actual Christian community. Instead, they contain a mixture of apostolic fiction, ideal reform and actual practice, like other apocryphal church orders.

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HIPPONAX (6th century B.C.), Greek poet of Ephesus who invented the scazon or choliamb ("limping iambic"), an iambic trimeter in which the second last syllable is long instead of short (*see* Iamb). Banished from Ephesus he went to Clazomenae where he wrote insulting verse about the sculptors Bupalus and Athenis. His poetry, which is often coarse and biting, with many rare words, survives only in papyrus fragments and lines quoted by later authors.

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HIPPOPOTAMUS (*Hippopotamus amphibius*), the largest living nonruminating, even-toed ungulate mammal (*see* Artiodactyl), which inhabited the lakes and rivers of the whole of Africa within historic times; it is now more restricted in distribution, although plentiful in many parts of the continent, ranging from the upper Nile to Natal, S.Af. It occurred over most of Europe during the Pleistocene period and smaller species lived in the lands bordering the Mediterranean and in India, Burma and Madagascar. As late as 1652 hippopotamuses disported themselves in the swamp now occupied by Church square, Cape Town, S.Af. Advancing white settlement has, however, exterminated them in the more populous regions.

W. SUSCHITZKY

FEMALE HIPPOPOTAMUS (HIPPOPOTAMUS AMPHIBIUS) AND YOUNG

The hippopotamus is a large animal with a barrel-shaped body and short limbs; it may reach a length of 14 ft., a height of 4 ft. at the shoulder and a weight of 4 tons. The skin, which is 2 in. thick in places, is nearly hairless except for a few tufts on the lips, at the end of the tail and elsewhere. The colour is grayish-black above, lighter below, with a suffusion of pink in the lighter parts. The eyes and nostrils protrude so that they are above water when the animal is floating with the rest of the body submerged. The gape is enormous and the upper lip is thick and bulging; the incisor and canine teeth are very large and of continuous growth. The incorrect statement that the hippopotamus sweats blood has become popular because, on the animal's leaving the water, the thick, oily pinkish secretion of numerous skin glands is released and spreads over the skin where it dries with a slightly glazed surface.

Hippopotamuses live in herds, sometimes of large size, in rivers and swamps and feed, mostly at night, on water plants and grasses and other vegetation ashore, where they often do much damage to crops. When under water they can swim fast and also walk along the bottom. On land a hippo can run as fast as a man and can even gallop at a faster pace for short distances. They do not wander very far from water. The voice is a loud grunt or bellow. A single young is born after a gestation of about eight months; the baby often rides on its mother's back while she is swimming or floating at the surface. In the breeding season the males are aggressive and engage in battles that are sometimes fatal. Hippopotamuses are generally inoffensive in disposition, but old bulls sometimes become dangerous and make unprovoked attacks on canoes and small boats, smashing them in their enormous jaws. The fat meat of the hippopotamus is much esteemed by the natives of Africa. Except for the ivory of the teeth, the animal is of little economic value. In drought years large numbers of hippopotamuses sometimes perish when the swamps dry up.

The smaller pygmy hippopotamus (*Choeropsis liberiensis*), about five feet long and darker in colour, lives in the streams, wet forests and swamps of west Africa. It lives singly or in pairs—not in herds—and appears to be less aquatic in habits than the larger species. (L. H. M.)

HIRA, a ruined city, south of Kufa in Iraq, which played an important role in the history of the Arabs before Islam. As the word itself indicates (Syriac *herta*, "camp"), the town was originally a military encampment.

It was under the Lakhmids, the Arab vassals of Persia, that Hira attained its fame and importance. As their capital, it became, for at least two centuries before Islam, a centre of diplomatic, political and military activities which involved Persia, Byzantium and the Arabian peninsula. The Lakhmids adorned the town and its environs with palaces and castles, but twice during the 6th century A.D. it experienced the ravages of war at the hands of the

Ghassanid Arabs, the vassals of Byzantium.

It is, however, in the history of Arab culture before Islam that Hira is most important. Various aspects of material culture flourished in it, and the Arabic script (according to tradition) was developed there. Especially significant was Hira's role in the development of Arabic poetry and Arab Christianity. Toward the Lakhmid court gravitated some of the best-known poets in pre-Islamic Arabia (*e.g.*, 'Abid, Tarafah and al-Nabighah), while in Hira itself flourished the famous poet 'Adi ibn Zayd. Even more significant was its role in the spread of Christianity. As the seat of a Nestorian bishopric, Hira exercised a strong influence over the religious life of the east, and through this influence Christian monotheism penetrated the Arabian peninsula.

Its fortunes closely linked to those of its Lakhmid rulers, Hira began to decline in the first decade of the 7th century after the Persians had brought the Lakhmid dynasty to an inglorious end. In A.D. 633 the town capitulated to Moslem arms and agreed to pay tribute. Its decline was accelerated by the establishment of Kufa, which eclipsed it, and by the fact that the Abbasid caliphs did not make it their residence. Finally Hira vanished almost entirely, except from the literary consciousness of Arab poets who remembered it to point a moral or adorn a tale.

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HIRADO-SHIMA, an island lying off the west coast of Kyushu in Nagasaki prefecture, Japan. Area 66 sq.mi.; pop. (1960) 40,879. The town of Hirado was the first port open to foreign trade and is celebrated as the site of the original Dutch factory and the "English House" (17th century). It was frequented by Chinese ships, and during the period of Christian persecutions the port towns of Hirado and Nagasaki (*q.v.*) were the only ones open to foreign trade. It is the place where one of the finest blue and white porcelains of Japan (*Hiradoyaki*) was produced in the 17th and 18th centuries. (R. B. H.)

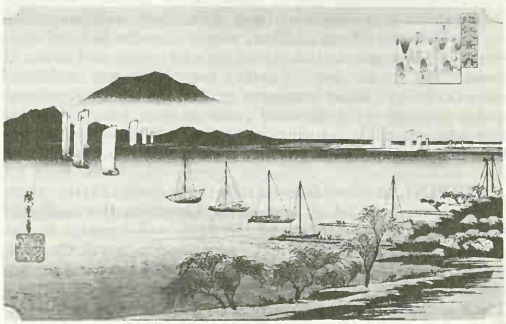
HIRE PURCHASE: *see* Installment Credit.

HIROHITO (1901–), emperor of Japan, was born on April 29, 1901, the son of the emperor Yoshihito (Taishō) (*q.v.*). After being educated at the Peers' school he visited Europe in 1921, becoming the first crown prince to go abroad. Upon his return, he was named prince regent when his father retired because of mental illness. His marriage in 1924 to Princess Nagako stirred up controversy because the princess came from the Shimazu family instead of the Fujiwara family as decreed by tradition. The emperor and empress had two sons and four daughters; a fifth daughter died in 1928. The eldest son, Akihito, was born in 1933. Hirohito became emperor Dec. 25, 1926, and his reign, although designated Shōwa or "bright peace," was characterized by internal unrest and an aggressive foreign policy culminating in World War II. It appears that the emperor had grave misgivings about militarism and foreign expansion and tried to restrain the militarists, but in vain. In 1945, when Japan was near defeat, Hirohito threw his influence against the army and on the side of those favouring peace. He broke precedent on Aug. 15, 1945, when he spoke on the radio to announce Japan's surrender. When surrendering, the Japanese government sought a pledge from the Allies that the emperor would be retained; the U.S. reply was noncommittal, but eventually a policy of supporting a modified imperial system was adopted. To bring the throne closer to the people, Hirohito publicly repudiated the doctrine of the emperor's divinity in Jan. 1946; he later made numerous public appearances and permitted pictures and stories about his personal and family life to be published. The campaign to "humanize" the emperor increased his popularity and reduced the effect of Communist agitation to abolish the imperial system. When in 1959 he permitted Crown Prince Akihito to marry a commoner, Shoda Michiko, he again broke with tradition. (N. I.)

HIROSAKI, a town in Aomori prefecture in north Japan. Pop. (1960) 152,132. The fine isolated cone of Iwaki-yama, a mountain of pilgrimage, rises to the west. Hirosaki developed as a castle town, many traces of which are found in the old buildings and street names. It has failed to develop modern industry. Local products include a distinctive green lacquer ware (*Tsugaru-nuri*), apples and processed apple products such as cider, jam and juice. (R. B. H.)

HIROSHIGE, ANDŌ (1797–1858), Japanese artist, was one of the last great masters of the *Ukiyo-e* or popular school of painting in Japan, a school which specialized in the making of colour prints. He was adopted into the Andō family but received his art name, Utagawa Hiroshige, from his teacher Utagawa Toyohiro. Even as a child Hiroshige had shown considerable artistic promise, but it was not until he accompanied an embassy from the shogun in Edo (now Tokyo) to the emperor in Kyōto and traveled along the Tōkaidō road in 1832 that his great talent developed. On this trip Hiroshige stayed at the 53 overnight stations along the way and he made numerous sketches of everything he saw. Upon his return to Edo, he published in 1832 a series of 55 prints entitled the "Fifty-three Stages of the Tōkaidō"—one for each station plus the beginning of the highway and the arrival in Kyōto. The success of this series was immediate and made Hiroshige one of the most popular *Ukiyo-e* artists of all time.

Later Hiroshige made many other journeys within Japan and issued series of prints depicting the famous "Sixty-nine Stages of the Kisokaido," "Views of Edo," "Lake Biwa" and "Famous Places



BY COURTESY OF THE ART INSTITUTE OF CHICAGO

"BOATS RETURNING TO YABASE," FROM THE SERIES "EIGHT VIEWS OF LAKE BIWA" BY ANDŌ HIROSHIGE; ABOUT 1835. IN THE ART INSTITUTE OF CHICAGO

in Kyōto." Repeatedly new designs were executed of the 53 Tōkaidō views wherein he employed his unused sketches of previous years. He also designed some lovely bird and flower prints which are an interesting contrast to his landscapes. Hiroshige's work declined toward the end of his life, largely because of the demands of his publisher for new subjects and the artist's need for money. Various sources have estimated that Hiroshige created over 5,000 prints and that as many as 10,000 copies were made from some of his wood blocks. Hiroshige had assistants but not one of his pupils ever approached the talent of his master, although the names Hiroshige II and III were given to two of his successors. Possessing the ability to reduce the pictured scene to a few simple elements of a highly decorative character, Hiroshige captured the very essence of what he saw and turned it into a strikingly effective composition. Snow, rain, mist and moonlight scenes compose some of his most poetic masterpieces. These are the prints that so influenced the French painters of the late 19th century.

See Arthur Davidson Ficke, *Chats on Japanese Prints* (1915); James A. Michener, *The Floating World* (1954). (M. O. Gs.)

HIROSHIMA, a prefecture (*ken*) in southwest Honshu, Japan, with an area, including offshore islands, of 3,255 sq.mi. and a population (1960) of 2,184,043. The Chūgoku mountains run along the northern boundary, and delta plains are extensively developed along the Inland sea coast in the south. Agriculture supports most of the population, followed by manufacturing industry and retail trade. Important products are rice, oranges, rush (ma-

terial for mats), cattle, oysters and salt. The majority of the factories are on the traditional small scale but large modern factories produce textile goods. There are shipyards at Kure (*q.v.*), Innoshima, Onomichi and Hiroshima city, the prefectural capital. (R. B. H.)

HIROSHIMA, a seaport, capital of Hiroshima prefecture, in southwestern Japan. Population (1960) 431,336. The town of Hiroshima grew up on the delta of the Ota river, where the Mori clan built a castle in 1591 which survived until 1945. From the Meiji era (1868–1912) to World War II, the city was a military centre. On Aug. 6, 1945, Hiroshima was the first city to be struck by an atomic bomb—dropped by the United States air force. The greater part of the city was destroyed, and about 75,000 people were killed or died later as a result of the bombing. Reconstruction was commenced immediately after the end of the war. New permanent buildings were begun about 1950 under a city-planning scheme. Bridges are important as the city is split into six islets by the river delta, and recovery began with the rebuilding of the Inaribashi bridge. Being the largest city in the Chūgoku and Shikoku districts, Hiroshima has many administrative offices and public-utility centres. The chief modern industries include the Matsuda truck factory, the Mitsubishi shipbuilding and machinery factories and the Kirin brewery. The city produces 80% of the needles used in Japan.

From ancient days, Hiroshima was known for its association with the neighbouring islet of Itsuku-shima, site of the famous Itsuku-shima shrine and associated shrines and buildings including the Hall of a Thousand Mats, pagoda, treasure hall and *torii*. But now Hiroshima is thought of as a city dedicated to world peace. The Atomic Bomb Casualty commission was established there in 1947 to conduct long-range medical and biological research and to investigate the effects of radiation upon man. There are five public hospitals including the "A-Bomb hospital" and 40 private clinics established to give free treatment to A-bomb sufferers. (R. B. H.)

HIRPINI, an inland Samnite tribe in the south of Italy, whose territory was bounded by that of the Lucani on the south, the Campani on the southwest and the Apuli and Frentani on the east and northeast. To the north were the Pentri and Caraceni, who, with the Hirpini and Caudini, constituted the Samnite confederation in the wars of the 4th century B.C. (*see* SAMNITES). The Roman policy of separation cut the Hirpini off from these allies by the refoundation of their town of Maleventum as the Latin colony of Beneventum in 268 B.C., and thereafter they were a separate unit. They joined Hannibal in 216 B.C., and retained their independence until, after joining in the Social War (the war of the *socii* or allies), which in their part of Italy could hardly be said to have ceased till the final defeat of the Samnites by Sulla in 82 B.C., they received the Roman franchise. Apart from Beneventum (Benevento) their chief towns were Abellinum (Avellino) and Aeclanum. Of their Oscan language, besides the evidence of their place names, only a few fragments survive.

HIRSAU (formerly HIRSCHAU), a village of Germany which after partition of the nation following World War II was located in the *Land* of Baden-Württemberg, Federal Republic of Germany, is situated on the Nagold in the northeast of the Black Forest, 3 km. (2 mi.) N. of Calw by road and 47 km. (29 mi.) W. of Stuttgart by road. Pop. (1961) 1,826. Apart from the ruins of its monastery, notable features of the village include the church of St. Aurelius, the 15th-century bridge over the Nagold, the pump room in its park, the medicinal baths, the museum and the sanatorium. Hirsau is on the railway from Horb to Pforzheim and Karlsruhe.

Hirsau has some small manufactures, but it owes its origin and historical interest to its former Benedictine monastery, Monasterium Hirsaugiense, at one period one of the most famous in Europe. Its picturesque ruins, of which only the chapel with the library hall are still in good preservation, testify to the pristine grandeur of the establishment. It was founded about 830 by Count Erlafried of Calw, at the instigation of his son, Bishop Notting of Vercelli, who enriched it with, among other treasures, the body of St. Aurelius (Bishop of Armenia, d. Milan 383). Its first occupants (838) were a colony of 12 monks from Fulda, disciples of Rabanus (Hrabanus) Maurus and Walafrid Strabo, headed by the abbot Liudebert. During about a century and a half, under the fostering care of the counts of Calw, it enjoyed great prosperity, and became an important seat of learning; but toward the end of the 10th century the ravages of the pestilence combined with the rapacity of its patrons, and the selfishness and immorality of its inmates, to bring it to the lowest ebb. After it had been desolate and in ruins for upward of 60 years it was rebuilt in 1059 at the suggestion of Pope Leo IX, and under Abbot Wilhelm von Hirsau (abbot from 1069 to 1091) it more than regained its former splendour, a large new monastery, dedicated to St. Peter and St. Paul, being built. By his *Constitutiones Hirsaugienses,* a new religious order, the Ordo Hirsaugiensis, was formed.

The friend and correspondent of Pope Gregory VII, and of Anselm of Canterbury, Abbot Wilhelm took active part in the politico-ecclesiastical controversies of his time. About the end of the 12th century the material and moral welfare of Hirsau was again very perceptibly on the decline; and it never afterward rose into importance. In consequence of the Reformation it was secularized in 1558; in 1692 it was laid in ruins by the French. A tower, chapel and the library hall survive, the last named having been converted into a museum in 1959. The surviving ruins of the older monastery of Aurelius stood derelict until 1955, when they were converted into a Roman Catholic church.

See W. Süssmann, *Forschungen zur Geschichte des Klosters Hirschau* (1903); R. Wagner, *Hirsau-St. Aurelius* (1959). (G. E. R.; R. WR.)

HIRSCH, MAURICE, BARON DE (BARON MORITZ VON HIRSCH AUF GEREUTH) (1831–1896), German capitalist and philanthropist, was born at Munich on Dec. 9, 1831. His grandfather, the first Jewish landowner in Bavaria, was ennobled in 1818, and his father, who was banker to the Bavarian king, was created a baron in 1869. The family for generations occupied a prominent position in the German-Jewish community. At the age of 13 young Hirsch was sent to Brussels to school, but when 17 years old he went into business. In 1855 he became associated with the banking house of Bischoffsheim & Goldschmidt, of Brussels, London and Paris. He amassed a fortune, which he increased by purchasing and working railway concessions in Austria, Turkey and the Balkans and by speculations in sugar and copper.

While living in splendour, he devoted much time to schemes for the relief of his persecuted coreligionists, and took a deep interest in the educational work of the Alliance Israélite Universelle, on two occasions presenting the society with 1,000,000 fr. For several years he regularly paid the deficits of the alliance, amounting to several thousand pounds a year. In 1889 he capitalized his donations and presented the society with securities producing an annual income of £16,000.

On the 40th anniversary of Emperor Francis Joseph's accession to the Austrian throne Hirsch gave £500,000 for the establishment of schools in Galicia and the Bukovina. His greatest charitable enterprise was in connection with the persecution of the Jews in Russia. He gave £10,000 for the repatriation of the refugees in 1882 and offered the Russian government £2,000,000 for the endowment of a system of secular education in the Jewish pale of settlement. The Russian government, while willing to accept, declined to allow any foreigner to be concerned in its administration. Thereupon Baron de Hirsch devoted the money to a colonization scheme which should enable persecuted Jews to establish themselves in agricultural colonies outside Russia. He founded the Jewish Colonization association as an English society, with a capital of £2,000,000, and in 1892 presented to it a further £7,000,000. On the death of his wife, *née* Clara Bischoffsheim, in 1899 the capital was increased to £11,000,000, of which £1,250,000 went to the treasury in death duties. This fund became one of the largest charitable trusts in the world. The association, prohibited from working for profit, came to possess large colonies in South America, Canada and Asia Minor and adopted as its purpose the alleviation of Jewish distress, including emigration and distributing agencies, technical schools, co-operative factories, savings and loan banks and model dwellings in the congested Russian ghettos.

Hirsch also founded in 1891 the Baron de Hirsch fund in the

United States for the benefit of Jewish immigrants, endowing it with £493,000. The activities of the trust involved helping newly arrived Jewish immigrants, educating them for U.S. citizenship, aiding them to move from the cities to smaller towns and operating a trade school for Jewish boys, to name only a few. By mid-20th century the fund supported the Jewish Agricultural society, which aided farmers by means of loans and also helped to settle displaced persons on farms in the U.S. Baron de Hirsch's minor charities were on a princely scale. While in London he distributed over £100,000 among the local hospitals. In this manner he disposed of the whole gross proceeds derived from his successes on the English turf. Baron de Hirsch died on April 21, 1896.

(L. W.; X.)

HIRSCH, SAMSON RAPHAEL (1808–1888), Jewish religious thinker, founder of *Trennungs-Orthodoxie* ("separatist Orthodoxy"), was born in Hamburg on June 20, 1808. He studied rabbinics at Mannheim and philosophy at Bonn university, and was rabbi in Oldenburg, Emden and Nikolsburg before being called to Frankfurt am Main (1851). There he became the leading spirit in the establishment of a modernized Orthodox Jewish congregation and school system which could withstand the challenge of enlightenment without abandoning the best in European civilization. "Torah combined with worldly wisdom" became the slogan of the growing "neo-Orthodox" group. Due to the efforts of Eduard Lasker (*q.v.*), Prussia adopted a law (July 28, 1876) permitting Jews to secede from the general Jewish community and establish separate religious societies. Thereupon, Hirsch led his congregation out of the community, which in his view was unfaithful to the Law. Hirsch wrote *Nineteen Letters* (1836; Eng. trans., 1899), *Horeb* (1837), commentaries on the Pentateuch (1867–78), *Psalms* (1882), the Hebrew prayer book (1895), and edited the monthly *Jeshurun*. Six volumes of his essays were published (1902–12). He died at Frankfurt on Dec. 31, 1888.

Hirsch presents Judaism as a community based on faith, aiming at the sanctification of life, the spiritualization of man and the attainment of an awareness of divine presence on earth. While searching for the symbolic meaning of the ritual and ceremonial laws, he steered clear of mysticism. In opposition to Abraham Geiger (*q.v.*) he rejected biblical criticism and the application of scientific methods to the study of Judaism. Though limited to a segment of Jewry, Hirsch's influence has been lasting and deep.

See I. Grunfeld (ed.), *S. R. Hirsch: Judaism Eternal* (1957).

(N. N. G.)

HIRT, HERMANN (1865–1936), German philologist, who was in his generation the most distinguished follower of Karl Brugmann and the neogrammarians (*Junggrammatiker*), was born at Magdeburg on Dec. 19, 1865. He was educated at Leipzig and Freiburg, and appointed professor of Indo-European philology and Sanskrit at the University of Giessen in 1912. His most original research was on accent and vowel gradation, published in *Der indogermanische Akzent* (1895), *Der indogermanische Ablaut* (1900) and many articles. From these studies he went on to a comprehensive *Indogermanische Grammatik* (7 vol., 1921–37), which no subsequent scholar has undertaken to revise or supersede. Hirt had less knowledge of ancient texts than Brugmann but he profited from the general advances in learning, particularly in the Celtic and Slavic fields, and he worked continually on the Germanic languages. He was intensely concerned with prehistory, not only of language but also of the Indo-European people and their culture, which he treated in *Die Indogermanen* (2 vol., 1905–07). He died on Sept. 12, 1936, at Giessen. (S. Ln.)

HIRTIUS, AULUS (*c.* 90–43 B.C.), Roman soldier and writer. From *c.* 54 B.C. he served under Julius Caesar in Gaul, and was sent to negotiate with Pompey in Dec. 50. He then served in Spain and the east, was praetor in 46 and governor of Transalpine Gaul in 45. He was nominated with Gaius Vibius Pansa by Caesar for the consulship of 43; and after the dictator's assassination in March 44, he and Pansa supported the senatorial party against M. Antonius (Mark Antony), with whom Hirtius had at first sided. In 43 the consuls set out for Mutina, where Antonius was besieging Decimus Brutus. They inflicted a serious reverse on Antonius at Forum Gallorum, and a few days later (April 21) they again defeated him in battle near Mutina, but Hirtius was killed in action and Pansa died of wounds. The two consuls were granted a public burial in the Campus Martius; traces of Hirtius' tomb have been found, including a stone inscribed *A. Hirtius A.f.* Hirtius was also a writer: he is almost certainly the author of the continuation of Caesar's *Commentaries*, the eighth book of the *Gallic War*, and probably also of the history of the Alexandrine War, although he did not himself serve in it. His language is good, but his style is monotonous and lacks vigour. He was a personal friend of Cicero, but his correspondence with him, which was published in nine books, has not survived.

See O. Seel, "Hirtius," *Klio* Beiheft (1935); A. Degrassi, *Inscriptiones Latinae Liberae Rei Publicae*, no. 419, p. 257 (1957). (H. H. Sd.)

HIRUDINEA, the class name for leeches, annelid worms popularly known for the bloodsucking habits of most of the group. *See* Leech; Annelida: *Class Hirudinea*.

HIRUNDINIDAE, a family of songbirds, sparrow-sized and of graceful flight, that includes swallows and martins. *See* Swallow; Martin.

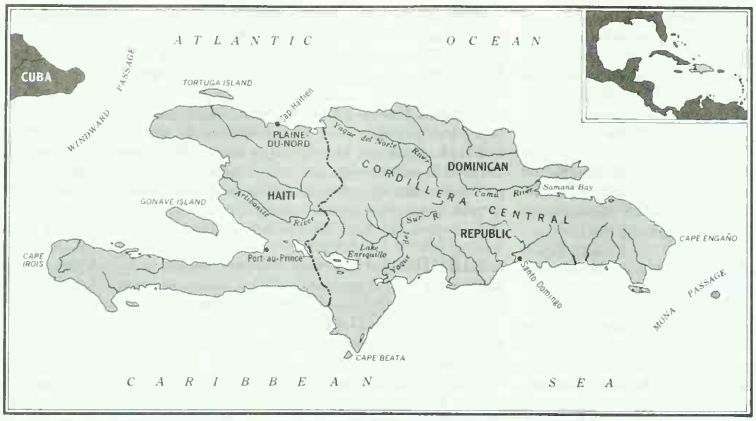
HIS, WILHELM (1831–1904), Swiss-German anatomist, one of the leading embryologists of his time and an authority in the embryology and anatomy of the brain, was born in Basel on July 9, 1831. As a medical student in Berlin, His received lasting impressions from the great anatomist and physiologist Johannes Peter Müller (*q.v.*) and from the embryologist Robert Remak. Afterward he studied in Würzburg under Rudolf Virchow and the histologist R. A. von Kölliker (*qq.v.*). Before taking his M.D. in Basel he visited Prague, Vienna and Paris and returned a few years later to Paris to attend the lectures of the neurologist C. E. Brown-Séquard. This background, and publications on the histology of the cornea of the eye and the lymphatic organs, gained him the professorship of anatomy and physiology in Basel at the age of 26. Fifteen years later he was called to Leipzig, where he established a new institute of anatomy, and where he remained until his death, on March 1, 1904. He and the physiologist Karl Ludwig were mainly responsible for the eminence of the Leipzig medical school in the late 19th century.

His's work in embryology covered the entire development from the early stages to the definite form of the organs, especially of the brain, and of the body as a whole. His discovery that the individual nerve fibre originates from a single nerve cell became the cornerstone of the neuron theory of the nervous system. Stressing mechanical factors as immediate causes of developmental changes, he stimulated later work in experimental embryology. His method of enlarged plastic reconstruction of embryonic organs from serial microscopic sections played an important part in the advancement of embryology. Asked for his opinion about the identity of a skeleton that was supposed to be that of Johann Sebastian Bach, he developed an anthropological method which has since been used repeatedly for the identification of a skull as that of a historical person.

His's son, also Wilhelm His (1863–1934), professor of medicine in Berlin, is known for his contributions to the physiology and pathology of the heart and as the discoverer of the bundle of specific muscle fibres (bundle of His) in the septum of the heart which transmits the nervous impulse from the atria to the ventricles. (F. Wn.)

HISHAM IBN AL-KALBI (Abu-al-Mundhir Hisham ibn Mohammed ibn al-sa'ib al-Kalbi) (d. *c.* 819), Arab historian, who wrote a valuable account of the genealogies of the ancient pre-Islamic Arabs. He was born in Kufa but spent much of his life in Baghdad. Like his father, who was also his teacher, he devoted his energies to collecting information about the history and descent of the Arabs. He died in Kufa about 819. He is said to have written 140 works, most of which are lost. His account of the genealogies of the Arabs, which is continually quoted by Abu-al-Faraj al-Isfahani (*q.v.*) in his *Kitab ol-Aghani*, has been preserved only in part; one of his works has survived intact, *Kitab al-Asnam* (Eng. trans., *The Book of Idols*, with introduction and notes by N. A. Faris, 1952).

HISPANIOLA, the second largest island of the West Indies (*q.v.*), divided politically into the Republic of Haiti (République



THE DISPOSITION OF HAITI AND THE DOMINICAN REPUBLIC ON HISPANIOLA

d'Haïti) and the Dominican Republic (República Dominicana). The island has been known by various names. Christopher Columbus, discoverer of the island in 1492, named it La Isla Española, supposedly from which it was anglicized to Hispaniola. During Spanish colonial times it was commonly called Santo Domingo, after the capital city, and this name is still sometimes used. In English-speaking countries the form became San Domingo. The entire island has also been referred to as Haiti, supposed by some to be the precolonial name used by native aboriginal Indians (Arawaks) who also called it Quisqueya. Hispaniola is the name given to the island by the United States government.

The shape of the island can be described as resembling a lobster's claw with the western pincers open as though ready to grasp the island of Gonâve. Several large peninsulas extend from the main body of Hispaniola. The southwestern peninsula of Haiti reaches more than 120 mi. and the northwestern peninsula extends about 50 mi. The greatest length is nearly 400 mi. and the greatest width is 150 mi. The area is 29,418 sq.mi., of which nearly two-thirds (18,703 sq.mi.) is in the Dominican Republic and the remaining, western section (10,714 sq.mi.) is in Haiti.

Hispaniola's location is tropical, between latitude 17° 36′ (Cape Beata) and 20° 04′ N. (Tortuga Island) and from longitude 68° 20′ (Cape Engaño) to 74° 29′ W. (Cape Irois). This location on the northern flank of the Caribbean sea furnished an excellent position for control of Spanish expansion to Cuba, Mexico, Panama and South America during the early colonial period.

The rest of this article deals with the geography of the island. For its history, people, administration, social conditions and economy *see* DOMINICAN REPUBLIC and HAITI.

Geology and Structure.—The general structure of Hispaniola is geanticlinal, with the oldest rocks exposed in a broad belt through the centre of the island and the younger rocks flanking each side. The foundation is composed of igneous and metamorphic rocks, such as granite, schist and serpentine, of pre-Cretaceous age. The strata that were folded in Late Cretaceous time were also intruded by diorites. The ruggedness and irregularity of Hispaniola, however, are not primarily the result of folding, but of intense faulting. The Cordillera Central is much deformed, being faulted along several different axes. Faulting, accompanied by some folding, began in the Late Oligocene and continued during the Miocene and much of the Pliocene. The Late Cenozoic uplift resulted in the Cordillera Central being lifted considerably higher than it stands now and in the uplift of the Cordillera Septentrional. The Pliocene orogeny also probably produced the great faulted valleys of the Cibao and San Juan rivers and Lake Enriquillo, along with the Artibonite river, after which they received the deposition of great quantities of sediments from the mountains. Crustal movements are still in progress.

The alignment of features is dominantly east-west in the southern part, toward Jamaica, and in the eastern part, toward Puerto Rico. Northwest-southeast trends are predominant in the central, northern and northwestern sections of the island.

Physiography. — Hispaniola consists of alternate series of mountain ranges, long valleys and plains, with the mountains predominant. More than one-third of the island lies above 1,500 ft. elevation. The orientation of such land forms causes contrasts in climatic conditions and poses problems of transportation across the country from north to south.

Hispaniola has the highest relief of the West Indies, reaching to more than 10,400 ft. elevation in the Cordillera Central in the Dominican Republic with Monte Tina and Pico Trujillo as the loftiest peaks. The highest elevation in the northern cordillera is 3,993 ft. and in the southern mountains 5,350 ft. The southwestern peninsula is the most elevated part of Haiti, rising to 8,793 ft. about 15 mi. W. of the Dominican border. The island is unusual because the basin of Lake Enriquillo in southwestern Dominican Republic has land below sea level, the surface of the lake being about 150 ft. below sea level.

The main rivers draining Hispaniola are the Yaque del Norte (248 mi. in length) and the Camú in northern Dominican Republic and the Yaque del Sur in the south, and the Artibonite in Haiti. Hispaniola's coast line, though much indented, has relatively few deepwater, protected anchorages.

Climate.—The climate of Hispaniola can be described as modified tropical, resulting from the location of the island near the outer margin of the tropics and the somewhat complex mountain and valley structure. The influence of the steady trade winds, which blow from the northeast in winter and from the east and southeast in summer, is felt in both temperature and moisture conditions, which vary according to exposure and elevation.

Temperatures are constantly high near sea level, but freezing temperatures occur occasionally at moderate elevations near the centre of the island. Average temperatures range from 72° F. (22° C.) in January and February to 83° F. in July and August. Average extreme temperatures rarely go above 95° F. or below 50° F.

Rainfall is abundant in much of the island, averaging about 55 in. annually over-all. Seasonal rainfall is highest in the southern sections during the months of May to November with a definite dry season. In the north the seasonal emphasis is reversed, with the wettest season occurring from December to April, though the summer is less rainy rather than really dry. The driest sections are the leeward plains, such as the lower Yaque del Norte and the basin of Enriquillo, where rainfall is less than 30 in. annually.

Hurricanes occasionally strike the island, sometimes causing serious damage. They may occur between August and November and generally cross from south to north.

Vegetation.—More than 60% of Hispaniola is covered by forests and woods and an additional 15% is classed as pasture land. The Dominican Republic has a higher proportion of its land still in forests than does Haiti, in part because of the lower density of population. Large tracts of land in the eastern plains of the Dominican Republic are still covered by forests, whereas much of even the steep mountain slopes of Haiti has been deforested because of the great population pressure for cultivated land.

The humid slopes of the mountains facing the trade winds are still clothed in dense forests. On the leeward slopes and where the rainfall is distinctly seasonal are more open stands. In the higher elevations of the Cordillera Central and in the highest mountains of southeastern Haiti are extensive stands of pine. On the driest plains, as in western Dominican Republic and the

Artibonite plain of Haiti, forests give way to scrubby growth and even desertic plants, except along the river courses. Scattered tree growth occurs in semiarid savanna grasslands. The stately royal palm (*Roystonea regia*) is widely distributed and is an extremely useful tree. Other than the valuable pine stands, the chief timber resources are mahogany, cedar, lignum vitae (*Guajacum officinale*) and logwood (*Haematoxylon campechianum*).

Mangrove swamps are common along the coast where tidal mud flats are formed. The largest areas are the head of Samaná bay, the northern coast east of Cap-Haïtien and around Gonâve bay.

Animal Life.—There are a great variety and number of insects, but aside from some domestic animals which have been introduced, larger animal species are lacking. Before the arrival of the Spaniards land mammals were rare except for rodents. There is a great variety of birds and marine fishes, as well as mollusks, which are typical of the West Indian region. There are a few nonpoisonous snakes. Scorpions, centipedes and some large spiders are poisonous, but their bites are not usually fatal.

Land Use.—The major geographical features of Hispaniola are arranged in nearly parallel systems of mountains alternating with plains. Because of the existence of several distinct mountain systems and related plains, a large number of major regions could be delineated. In general, the mountains are forested and sparsely populated. Coffee growing is the chief agricultural activity and this enterprise is spread through most of the mountainous regions of Hispaniola in the humid areas.

The most populous plains region is the long and highly productive plain extending from Samaná bay northwestward to the northern coast of Haiti. In the humid eastern section, called the Vega Real (Royal plain), many crops are grown, the chief commercial one being cacao. Tobacco is dominant in the upper Yaque plain and irrigated rice in the semiarid lower plains, while sugar cane dominates the Plaine-du-Nord of Haiti. The southern plains of Hispaniola are also productive, though irrigation is necessary in many areas because of deficient rainfall. Sugar cane is by far the main crop and livestock grazing is also very significant. On the Haitian plains, cotton is also an important commercial crop and food crops assume great significance. (D. R. D.)

HISSAR, a town and a district in the Ambala division of the Punjab, India. The town (headquarters of the district) is situated near the Sirsa branch of the Western Jumna (Yamuna) canal, 97 mi. W.N.W. of Delhi. Pop. (1961) 60,222. It is completely surrounded by a wall with four gates. Jama mosque and remains of Feroze Shah's palace are buildings of historical significance. There are two arts and science colleges and a veterinary college, all affiliated to Panjab university. Hissar has one of the biggest government livestock farms (40,663 ac.) in northern India; horses, sheep, goats, mules and cattle are bred there, the bulls being of the finest quality. The town is linked with Rewari, Ferozepur and Ludhiana by rail and is also served by roads.

Hissar was founded in 1356 by the emperor Feroze Shah Tughluq, who constructed a canal from the Jumna river to supply it with water; the canal decayed during the 18th century owing to constant attacks by marauders. Hissar was largely depopulated during the famine of 1783, but was afterward occupied by the Irish adventurer George Thomas, who built a fort and repopulated it.

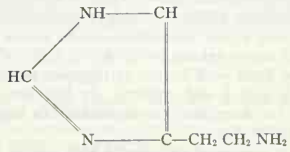
Hissar District lies along the northeastern border of the Thar desert. Pop. (1961) 1,299,471. Area 5,380 sq.mi. The district for the most part is a level plain; the southern part is dotted with sand dunes, and around Tosham are the outliers of the Aravallis, rising into hills of rock. The northern part of the district is a level plain and the sand dunes are absent. The Ghaggar is its only river, and its supply of water is uncertain. The climate of the district is dry; average annual rainfall is meagre (14.62 in.) and hot dessicating winds blow from the middle of March until July. Of the total area, 72% is under cultivation, 20% of this being irrigated by the Western Jumna, Bhakra, Sirhind and Ghaggar canals. Because of uncertain rainfall and limited irrigation, crop failures are frequent. The principal crops are millets, gram, barley, wheat, cotton and sugar cane, the last three being irrigated. The chief trading centres are Hansi (pop., 1961, 33,712), Sirsa (33,363) and Bhiwani (58,194), which has cotton textile mills, an industrial school and two colleges. (O. P. B.)

HISTAMINE, a substance with varied and dramatic pharmacological effects, is found in extracts of all living cells, both animal and plant. Identified in 1910 by G. Barger and H. H. Dale, the compound itself, or a substance very similar to it, has been incriminated in certain types of headache, and in initiating the chain of events called triple response, reddening, flare and wheal, which is producible by heavy stroking of the skin. It is one of the irritating ingredients present in wasp venom, bee stings, heads of gnats and also in nettles. Above all, it is alleged to be the substance which is responsible for some of the symptoms of allergic and anaphylactic reactions such as asthma, hay fever, urticaria or hives (similar to the triple response) and serum sickness. Histamine is presumably always present in body tissues, but in an inactive, bound form which may be converted to the free, active compound in response to various stimulants. If all the histamine bound in the tissues of a human being were released at one time, the amount would be lethal. A quantity sufficient to kill an animal on injection is quite ineffective when given by mouth, however, since it is rapidly destroyed or inactivated in the intestine.

Histamine causes a contraction of the smooth musculature of some structures such as the lungs and the uterus. In asthma, the bronchioles of the lung are acutely obstructed because of exudate formation and muscular spasm caused by histamine. It also brings about capillary dilatation associated with an increased capillary permeability that leads to concentration of the blood. Intravenous injection in man of as little as 0.5 to 1 mg. produces headache, a marked dilatation of capillaries and arterioles, associated with the appearance of "blushing" and a lowering of blood pressure. These and still other responses may vary quantitatively and even qualitatively with different species of animals. The uterus responds to histamine (at term or immediately post partum) by contracting, but this action on the uterus is not employed clinically because of the many other and undesirable effects.

Some of the actions of histamine are put to practical use. Thus this remarkably versatile agent is the most potent known stimulant of the secretion of gastric juice, especially gastric hydrochloric acid. The doses which elicit this effect are smaller than those required to produce any of the other actions. Hence histamine is an important diagnostic tool in gastric function tests. Absence of an acid-secreting response may be associated with gastric carcinoma. Furthermore, observation of the separate components of the triple response produced on intradermal injection of histamine is used to ascertain the presence of a normal local arterial blood circulation and a functioning local peripheral nervous system.

Although a great deal of information has been uncovered concerning the responses to histamine, its precise role under normal physiological conditions and the exact mechanisms whereby it produces its various effects were, even 50 years after its discovery, only incompletely understood. It appears certain, however, that histamine is formed in the body from the amino acid histidine, a harmless and indeed essential component of dietary protein, by removal of carbon dioxide in an enzymatically catalyzed decarboxylation reaction. Histamine is destroyed in the body by oxidative deamination in the presence of the enzyme histaminase, or it may be inactivated by enzymatic acetylation. In solid form, histamine can be obtained as white deliquescent needles. It has the following chemical structure:



The ring component is known as imidazole, and histamine may be called β-aminoethyl imidazole.

The ill favour accorded to the word histamine is evidenced by the wide use made of the term antihistamine or antihistaminic. This denotes a group of substances that have a remote structural resemblance to histamine and block it in many but not all of its actions. The antihistaminics have been used with success clinically to give temporary relief in many allergic conditions.

See also references under "Histamine" in the Index volume.

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HISTIAEUS (d. 494 or 493 B.C.), tyrant of Miletus under the Persian king Darius I. According to Herodotus he rendered great service to Darius while he was campaigning in Scythia (513) by persuading the tyrants of other cities not to destroy the bridge over the Danube by which the Persians were to return. Choosing his own reward, he acquired territory near Myrcinus on the Strymon river in Thrace. The success of his enterprise led to his being recalled to Susa, where he was virtually a prisoner of Darius, Aristagoras, son-in-law of Histiaeus, becoming ruler of Miletus in his stead.

Having failed against Naxos in a joint expedition with the satrap Artaphernes, Aristagoras began to stir up the Ionians to revolt, encouraged, according to Herodotus, by a secret message from Histiaeus (*c.* 499). Histiaeus persuaded Darius that he could quell the revolt and was allowed to leave Susa. On his arrival at the coast, however, he found himself suspected by the satrap and was ultimately driven to establish himself as a pirate at Byzantium. After the total defeat of the Ionian fleet at the battle of Lade (*c.* 495), he made various attempts to re-establish himself but was captured and crucified by Artaphernes at Sardis.

The theory of Herodotus that the Ionian revolt was caused by the message of Histiaeus alone is incredible; there had already been a Greek revolt *c.* 513 in the Bosporus and Hellespont area (*see* GRECO-PERSIAN WARS).

See Herodotus, iv, 137 ff.; v, 11; 25 ff.; vi, 1–30.

HISTOLOGY, the study of tissues, is that branch of biology concerned with the normal microscopic structure of plants and animals and with those aspects of the behaviour and function of living organisms that can be studied with the microscope. To place this study in relation to other morphological sciences, it is important to realize that there are several dimensional levels of structural organization in multicellular organisms. The cell is the smallest unit of structure that exhibits all of the characteristics of living matter; its study is called cytology (*q.v.*). A tissue is an aggregation of cells and their derivative intercellular substances that work together in the performance of a particular specialized function; their study is histology. An organ is a larger structural unit, usually visible to the naked eye and composed of two or more tissues; investigation at this level is called organology. A group of organs that co-operate to promote one of the general bodily functions is called an organ system (*e.g.*, the circulatory system comprises the heart, arteries, capillaries and veins); studies at this relatively gross level constitute systematic anatomy (*see* ANATOMY, GROSS).

Although, strictly speaking, histology deals with the tissues, it is somewhat arbitrary to make a distinction between this area of study and cytology inasmuch as investigation of the characteristic patterns of association of cells that make up the tissues cannot profitably be pursued without regard for the various types of cells involved; thus histology embraces much of cytology.

The terms histology and microscopic anatomy are often used interchangeably, but a fine distinction can be drawn between the two studies: histology relates to tissues as such, whereas microscopic anatomy deals with tissues as they are arranged in larger entities such as organs and systems. In this sense microscopic anatomy may be thought of as equivalent to organology (*see* ANATOMY, MICROSCOPIC).

This article is concerned exclusively with animal tissues; for a discussion of plant tissues, *see* PLANTS AND PLANT SCIENCE: *Anatomy of Plants: Minute Structure.*

KINDS OF TISSUE

Traditionally four basic tissues are recognized in the bodies of higher animals: epithelial, connective, muscular and nervous. These represent specializations for the performance of the general bodily functions of interchange with the environment, maintenance of structural integrity, locomotion and integration of functional activities. Each of these basic tissues can be further subdivided into a number of morphologically identifiable associations of cells and intercellular substances that perform more specific functions.

Epithelial Tissue.—Epithelium is composed of cells closely associated in continuous sheets, covering external or internal surfaces. It therefore forms the interface between the organism and its environment. On external surfaces it is specialized, by formation of an impervious superficial layer, for protection against desiccation or invasion. On internal surfaces, as in the lining of the alimentary tract, it is structurally adapted for absorption, secretion and excretion. Where a greater volume of secretion is required than can be supplied by a plane surface, the epithelium may evaginate to form ridges or folds that greatly increase the surface area or it may invaginate to form a system of branching tubes, lined by secretory cells, that constitute a gland. Because glands develop as outgrowths of epithelium-lined surfaces, most of them communicate with an internal or external body surface via ducts through which they discharge their secretory product; these are called exocrine glands. Certain glands, however, lose their connection with the epithelial surface from which they originally developed in embryonic life and become organized in clumps or solid cords of cells arranged in intimate relation to sinusoidal blood capillaries; such glands, which secrete directly into the blood stream, are called endocrine glands (*see* ENDOCRINE GLANDS; GLANDS).

For descriptive purposes epithelia are classified on the basis of the shape of the cells (squamous or flattened, cuboidal, columnar), their arrangement in a single layer (simple) or in multiple layers (stratified) and the presence or absence of surface specializations (*e.g.*, ciliated or nonciliated; keratinized or nonkeratinized). Thus a single layer of flattened cells such as is found lining the peritoneal cavity is described as a simple squamous epithelium. The term keratinizing stratified squamous epithelium is applied to the multiple layers of flattened cells that comprise the epidermis, in which the superficial cells become transformed into dead scales consisting largely of keratin. Simple columnar epithelium occurs in the digestive tract, the ducts of glands and the uterus and oviduct. Not all of the cells making up an epithelium are necessarily of the same type. Cells bearing cilia may be interspersed with nonciliated absorptive cells or mucus-secreting goblet cells. The stratified germinal epithelium of the testis consists of a highly heterogeneous cell population including sustentacular cells and germinal elements in various stages of their maturation into spermatozoa. Epithelial cells may be highly modified to form special sensory receptors as in the retina, ear, taste buds, etc. The single layers of flat cells lining the vascular system and the large serous cavities (pleura, peritoneum, etc.) are sometimes called the endothelium and mesothelium respectively. (*See* EPITHELIUM.)

Connective Tissue.—This tissue consists of cells, fibres and amorphous ground substance. The relative proportions of these three constituents vary greatly from one region of the body to another. In loose areolar connective tissue the extracellular components consist of randomly oriented, loosely interwoven collagenous and elastic fibres embedded in a gelatinous ground substance. Fibroblasts, the principal cells of connective tissue, and fixed macrophages are deployed along the fibres; a sparse population of free cells, including lymphocytes, mast cells, eosinophils and plasma cells, migrate through the interstices in this loose fibrous framework. In dense collagenous connective tissue, which forms the dermis of the skin and the capsules of various organs, the collagen fibres, aggregated in heavy wavy bundles, greatly predominate over other components. Tendon is a form of dense connective tissue that is relatively acellular and has a particularly regular, parallel arrangement of closely packed collagen fibres that gives it remarkable tensile strength. In cartilage the ground sub-

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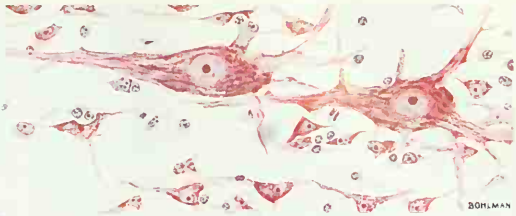
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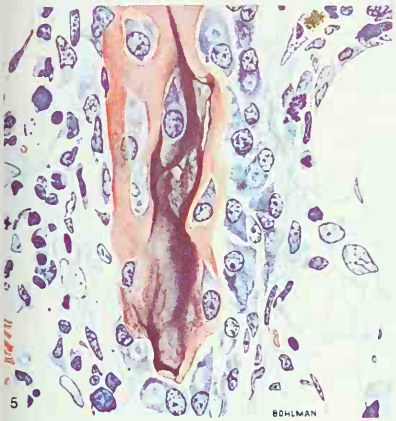
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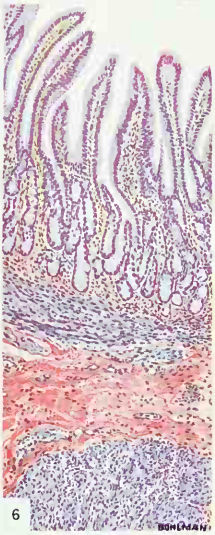
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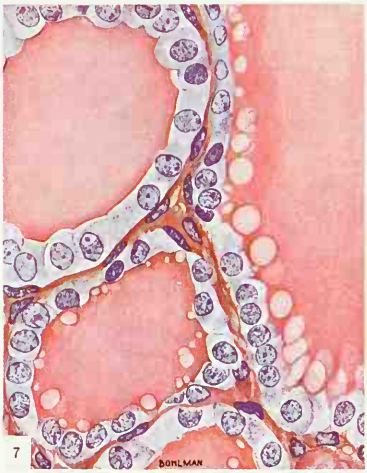
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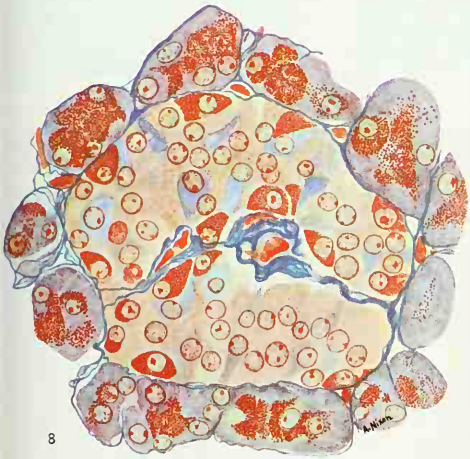
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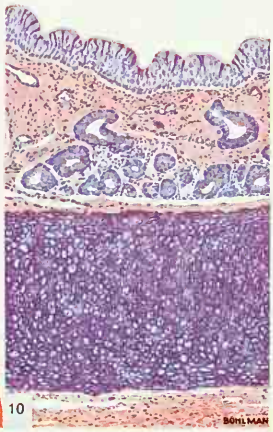
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BY COURTESY OF W. BLOOM AND (8) W. BLOOM IN "THE ANATOMICAL RECORD," VOL. 49, PUBLISHED BY THE WISTAR INSTITUTE OF ANATOMY AND BIOLOGY AND (1-5, 7, 9) W. B. SAUNDERS COMPANY, FROM MAXIMOW AND BLOOM'S "TEXTBOOK OF HISTOLOGY" (4TH ED., 1942); ALL DRAWN BY ESTHER BOHLMAN, EXCEPT 8 BY AGNES NIXON

A VARIETY OF TISSUES IN MICROSCOPIC PREPARATIONS

1-3. Intestinal epithelial cells of guinea pig (magnification, X 1440): 1, living, unstained; 2, stained supravitally to show mitochondria; 3, sectioned and stained with haematoxylin-eosin (as in 4, 6, 7, 9, 10)

4. Nerve cells—two large, several smaller—from monkey brain (about X 275)

5. Bone (pink and purple), surface layer of bone-forming cells (blue) and bone marrow cells; stained, haematoxylin-eosin-azure II (X 710)

6. Small intestine of man, composed of epithelium thrown into villi (above), smooth muscle (light blue) and connective tissue (pink, below) (X 27)

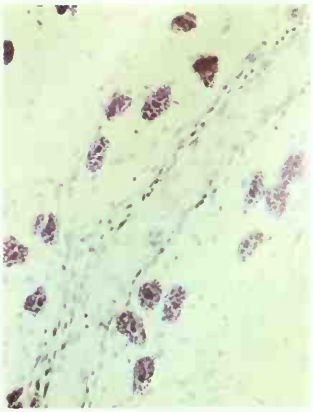
7. Thyroid gland of man: cuboidal epithelium surrounding masses of colloid (pink) containing vacuoles (X 640)

8. Pancreas of man: glandular cells, which secrete pancreatic juice, border an islet of Langerhans (orange-stained cells are believed the source of insulin); stained, Mallory-azan method (X 605)

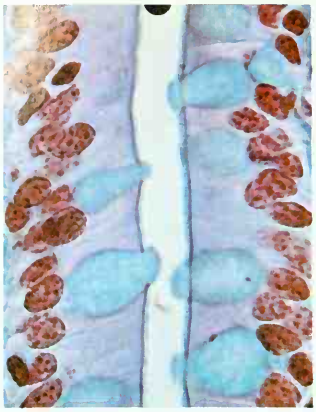
9. Heart of man: cross-striated cardiac muscle (red) with darker intercalated disks, connective tissue (pink) and lining layer of endothelium (right) (X 190)

10. Trachea of man: ciliated epithelium (above), covers a layer of connective tissue with glands, a thick band of cartilage (dark purple) and connective tissue (pink) (X 27)

HISTOLOGY

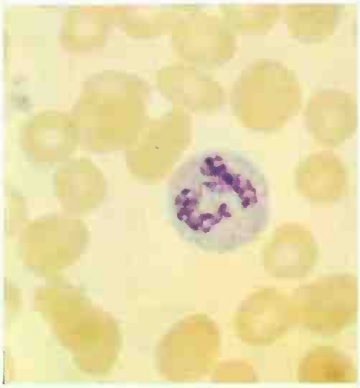


Connective tissue showing granulated mast cells along a venule. The smaller cells are mainly fibroblasts

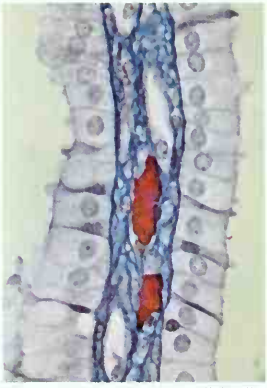


Simple columnar epithelium of the intestine; the unicellular glands, goblet cells, contain green-staining secretion

Simple columnar epithelium of small intestine showing striated border and two goblet cells

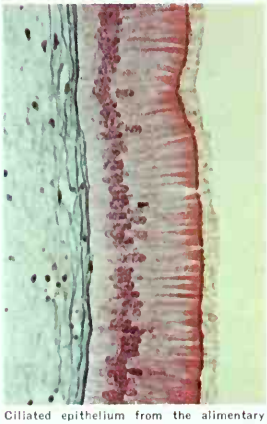


A blood smear with many red blood cells and a single white blood cell



Simple low columnar epithelium lining the collecting ducts of the kidney

Stratified squamous epithelium of the skin of the finger tip. The upper layers of cells, stratum corneum (right), are dead; those below the red stained stratum lucidum (middle right) are living. A coiled sweat gland penetrates the epidermis



Ciliated epithelium from the alimentary tract of a mussel. Epithelium similar to this lines the respiratory tract and paranasal sinuses of man and other mammals

A relatively high magnification of nonkeratinizing stratified squamous epithelium from the gingiva (gums) of the oral cavity

PHOTOGRAPHS BY DON W. FAWCETT M.D.

MICROSCOPIC VIEWS OF ANIMAL TISSUE

stance is the most plentiful component; the cells are isolated in lacunae in an abundant hyaline matrix reinforced by collagenous or elastic fibres. In bone, also, the extracellular components predominate. The bone cells and collagen fibres are laid down in concentric lamellae of bone matrix that is heavily impregnated with calcium salts. The blood-forming (hematopoietic) tissue is a highly cellular variant of connective tissue, with a dense population of cells in various stages of differentiation into the mature leucocytes and erythrocytes of the circulating blood. (*See* BLOOD; CONNECTIVE AND SUPPORTING TISSUES.)

Muscular Tissue.—Muscle consists of multinucleate, syncytial fibres or end-to-end associations of individual cells in which the contractile property of protoplasm has developed to an unusual degree. Two general types of muscle may be distinguished, smooth and striated (including cardiac muscle). Smooth or plain muscle is composed of elongated fusiform cells with a single central nucleus. It contracts relatively slowly and is not under voluntary control. Muscle of this type is found in the wall of the alimentary tract, the walls of blood vessels, the uterus, the urinary bladder and in various other hollow viscera. It provides motive power for, among other processes, digestion, circulation and excretion. Skeletal, striated or striped, muscle is made up of cylindrical syncytial fibres of indefinite length that have multiple, peripherally placed nuclei and contain large numbers of contractile myofibrils that exhibit a characteristic repeating pattern of cross striations. Muscle of this kind is widely distributed as part of the locomotor system of the body. It contracts rapidly and is usually under voluntary control. Cardiac muscle, also cross striated, is so unlike locomotory skeletal muscle, in its branching plexiform organization and in being composed of individual cellular units with centrally placed nuclei, that it is often considered in a separate class. It has an intrinsic rhythmicity of contraction and is not ordinarily under voluntary control. (*See* MUSCLE AND MUSCULAR SYSTEM: *Microscopic Structure and Function.*)

Nervous Tissue.—This tissue is composed of neurons, cells that receive, initiate and conduct impulses, and supporting cells called neuroglia. There are at least two varieties of glial cells and an indeterminate number of different kinds of neurons. A neuron generally has a centrally placed vesicular nucleus and a large stellate cell body with three or more tapering processes. The processes are of two kinds: two or more short branching processes called dendrites and a single longer process called the axon. Axons may be relatively short, ending in contact with the dendrites of other neurons in the central nervous system, or very long, extending from the brain or spinal cord to muscles in the extremities, as much as two or three feet away from the central nervous system. Axons may be enclosed only in a sheath of Schwann cells or they may be enveloped in a thick, laminated myelin sheath, which is a specialization of the membrane of the Schwann cells.

The gray matter of the central nervous system consists mainly of the cell bodies of neurons, whereas the white matter is largely composed of tracts of myelinated axons. It is the myelin sheaths of the nerves that give the white matter its glistening white appearance. The peripheral nerves consist of mixed bundles of myelinated and unmyelinated axons whose cell bodies lie in the central nervous system or its associated ganglia. (*See* NERVOUS SYSTEM: *Histology.*)

HISTOLOGICAL METHODS

The histologist seeks to understand and describe the structure of living cells and tissues in relation to their function. The usefulness of direct examination in the living condition is limited, however, by (1) the natural transparency of the tissues, which does not permit easy differentiation of their components, and (2) their considerable thickness, which interferes with transillumination and produces a confusing superimposition of parts. It is therefore usually necessary to work with killed, chemically preserved (fixed) tissues that have been cut into thin slices, called histological sections. These lend themselves to study by transmitted light and can be stained with various dyes to increase the contrast of the tissue components so that they can be more easily resolved and recognized with the optical microscope. The ideal histological method would be one that would result in minimum deviation from the condition in the living state and yet permit maximum resolution of the various components. This goal is difficult to attain and countless methods of preparing tissues have been developed that claim in one way or another to approach this ideal more closely.

Examination of Living Tissues.—Because it is difficult to reconstruct dynamic events from the study of fixed images, the examination of living tissues *in situ* (in its natural place) continues to be an important part of histology. A few serous membranes such as the mesentery and the omentum are thin enough to be examined directly at reasonably high magnifications while they are kept moist and at body temperature in a warmed chamber on the microscope stage. Methods are available for immobilizing a tadpole for days or weeks to permit microscopic examination of the tissues in the thin transparent portions of its tail. Permanent transparent chambers can be inserted in the ear of a rabbit. Using such preparations, observations have been made on such varied subjects as the capillary circulation, growth of blood vessels and nerves, the development of muscle and adipose tissue, etc. Certain tissues can be transplanted to the anterior chamber of the eye of experimental animals where they can be observed directly through the transparent cornea. Mobile organs with long vascular pedicles can be temporarily brought outside the body for proper illumination and microscopic examination. In this way the circulation of the spleen has been clarified, the liberation of secretion by the pancreatic cells has been observed and, in exteriorized ovaries, the process of ovulation has been recorded cinematographically. These several methods for studying living tissues yield information that could not be obtained in any other way.

Tissue and Organ Culture.—The discovery by Ross Harrison in 1907 that nerve cells of larval amphibians can survive, function and multiply in suitable natural media outside the body introduced the method of tissue culture. Efforts have since been made to cultivate in vitro (literally, "in glass"; *i.e.*, in laboratory vessels) most of the cell types in the body. Technical advances in this field have made it possible to develop clones from single cells and to cultivate certain pure cell strains almost indefinitely in chemically defined culture media. These isolated cells, flattened against the glass surfaces of the culture vessel, are particularly favourable for cytological observation and micromanipulation. The phase contrast microscope provides a means of converting differences in refractive index of the cell components into differences in intensity. Thus the organelles of living cells can be seen in nearly as good contrast as in killed and stained preparations and their behaviour can be recorded cinematographically.

Embryonic organ rudiments explanted in organ cultures will often continue to grow and differentiate in vitro. Although such preparations are too thick to observe directly, they can be fixed and studied in histological sections. The isolation of such rudiments from the complex environment of the intact organism aids in the analysis of factors controlling differentiation. (*See* also TISSUE CULTURE.)

Smears.—The cellular contents of the blood and various body fluids may be spread in thin films and examined either fresh or after fixation and staining. This method is of great value in the clinical examination of blood and in the screening of vaginal smears, sputum and other body fluids for the diagnosis of cancer.

Vital Staining.—Some dyes of relatively low toxicity can be injected into living animals (vital staining) or applied to surviving cells and tissues newly removed from the body (supravital staining) and are taken up selectively by certain cells or tissue components. This method can be used to evaluate the phagocytic capacity of cells or can be employed as a means of tagging cells and following their subsequent movements.

Examination of Fixed Tissues.—For proper examination with the optical microscope at high magnification (up to 1,500 diameters), tissues are prepared by chemical fixation or hardening, embedding, sectioning, staining and mounting between a glass slide and a cover glass. The purpose of the fixing fluid is to kill the tissue rapidly and preserve it in as lifelike a state as possible. To obtain sufficiently thin preparations, the fixed tissue is infil-

trated with paraffin or celloidin and sliced a few thousandths of a millimetre thick with a precision cutting tool, the microtome. The sections may then be stained with any of a great many combinations of aniline dyes that colour various tissue constituents more or less selectively. This has long been the principal method of histological investigation and most of what is now known of the structure of tissues was obtained from the study of histological sections prepared in this way. The staining methods commonly used were developed empirically on the basis of their capacity to increase the contrast of the tissue constituents and enable the microscopist to resolve fine structural details. The colours were seldom meaningful indicators of the chemical nature of the substances stained. Where speed is critical as for immediate diagnostic work, tissues may be hardened by quick-freezing. Biopsy material is often treated in this manner, the tissue being rushed from the operating room to the laboratory where it is frozen and cut on a freezing microtome.

Histochemistry.—Special techniques have been developed to permit chemical characterization of substances in their natural locations within cells and tissues. They include such physical methods as: (1) ultraviolet absorption to localize and identify nucleoproteins; (2) polarized light to detect ordered arrays of macromolecules below the limits of resolution of the ordinary microscope; (3) fluorescein-conjugated antibodies and fluorescence microscopy to localize specific proteins or polysaccharides; and (4) radioisotopes and radioautography to localize "tagged" molecules. Chemical methods include procedures that permit the identification of lipids by their selective uptake of certain lipid-soluble dyes and the localization of deoxyribonucleoprotein or of polysaccharides by means of reagents that produce a coloured compound with the products of the hydrolysis or oxidation of these substances. In addition there are methods for the localization of various enzymes by incubating tissue sections with substrates that yield insoluble hydrolytic products that are either already coloured or capable of being coloured by subsequent coupling or conversion.

Histochemistry differs from biochemistry (*q.v.*) in its emphasis upon the morphological localization of the chemical compounds in the tissues; it provides information that often cannot be obtained by biochemical analysis of tissue homogenates.

Electron Microscopic Examination of Tissues.—Details of tissue organization that are beyond the reach of the optical microscope are now accessible to the electron microscope, which extends greatly the range of resolvable fine structure, permitting magnifications of 200,000 diameters or more and resolution of objects separated by as little as 15 Å units. This instrument cannot be used for the examination of living material. The tissue must be fixed, dehydrated, embedded in acrylic plastic or in epoxy resins and cut with a glass or diamond knife into ultrathin sections less than $\frac{1}{10,000}$ mm. in thickness. These sections can be examined directly or after staining (coating) with heavy metals. Photographic images of great clarity can be recorded showing details of cell and tissue structure down to macromolecular dimensions.

Histopathology.—Histology is the basic science that seeks a better understanding of the normal microscopic structure of the tissues through the application of the various methods outlined above. Histopathology, on the other hand, brings many of these same methods to bear upon the study of disease. By examining the structural alterations in tissues, the pathologist attempts to relate the microscopic lesions to the symptoms and disturbances of function that represented disease in the patient. The pathologist bases his opinions upon the knowledge of the normal structure of the tissues and the range of their functional variations established by the histologist (*see* PATHOLOGY). *See* also MICROSCOPE.

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HISTORY (ARTICLES ON). The article HISTORY surveys the methods used by prominent historians in their study of the past and also outlines the changing conceptions of historical writing and the philosophy of history. For information on any specific historical topic the reader should first consult the Index, which is a guide to the headings under which the relevant information may be found, including sections as well as complete articles. Special aspects of history are also dealt with in articles under the classifications of military affairs, economics, law, literature, the sciences, architecture, geography and international relations. The relevant introductory article to such a section should be consulted; *e.g.*, LITERATURE (ARTICLES ON). The most complete general survey of a country's history is to be found in the appropriate section of the individual articles on the country, state, colony or island: FRANCE; GERMANY; INDIA; PENNSYLVANIA; MAURITIUS; etc. There are a few exceptions to the rule: the history of England is treated in the article ENGLISH HISTORY; the history of Russia to the Revolution is treated in RUSSIAN HISTORY; and the history of Persia (modern Iran) is summarized in PERSIAN HISTORY. There are biographical articles on all notable historical figures, including presidents of the United States, British prime ministers and English monarchs since the Norman Conquest.

Prehistory and Ancient History.—Evidence of the life of prehistoric man is discussed in ARCHAEOLOGY; also sections on archaeology and ethnology are included in the articles on continents, nations and many smaller regions. There are articles on ancient tribes, peoples and civilizations, as in BABYLONIA AND ASSYRIA; ETRUSCANS; AEGEAN CIVILIZATION; MESOPOTAMIA; EGYPT: *History;* while more specialized aspects are covered by articles on NINEVEH; TRADE ROUTES; etc.

GREECE: *History* gives a general view of Greek history and civilization and can be amplified by entries under MACEDONIA, KINGDOM OF, individual city-states, such as THEBES and ATHENS, and by biographies of the leading figures. The achievements of the Greeks are discussed in articles on Greek architecture, philosophy, literature and science while certain phases of Greek history and institutions are treated in separate articles such as ACHAEAN LEAGUE; GAMES, CLASSICAL; ARCHON. GRECO-PERSIAN WARS outlines the aims and strategy of both sides, while individual entries on battles such as MARATHON, BATTLE OF, and SALAMIS offer greater detail on the tactics used. Similarly PELOPONNESIAN WAR covers the long struggle between Athens and Sparta. The Macedonian conquest of Greece and Alexander's empire are dealt with under GREECE: *History;* and in biographical articles on PHILIP II of Macedon, and ALEXANDER III the Great, whose principal battles have separate articles. The breakup of Alexander's empire and the subsequent period are discussed in HELLENISTIC AGE, while the SELEUCID DYNASTY and PTOLEMIES are also treated separately.

ROMAN HISTORY covers the entire period from the founding of Rome to the collapse of the western empire. The continuation of the empire in the east is treated in BYZANTINE EMPIRE. PUNIC WARS deals with the struggle with Carthage and is supplemented by biographies such as HANNIBAL; FABIUS; SCIPIO; and by articles on battles. The Carthaginian viewpoint is put forward in CARTHAGE: *History.* The most important source for amplifying the events in Italy during the civil war is in the biographies MARIUS, GAIUS; SULLA, LUCIUS CORNELIUS; CAESAR, GAIUS JULIUS; etc. There are biographies on all the prominent emperors, leading writers and politicians and entries on various facets of Roman society; *e.g.*, ROMAN LAW; ROMAN RELIGION; CENSOR; CONSUL; MUNICIPIUM; PROVINCE, ROMAN. The people and provinces of the empire are treated separately as in the articles on GOTHS; GALATIA; SICILY; FRANKS.

Medieval History.—The brief article DARK AGES analyzes the exaggerations implied in this popular term while MIDDLE AGES offers an introduction to the ideas and institutions of medieval Europe. More detailed discussion of history in this period comes under the articles on modern countries: FRANCE; GERMANY; etc., or on regions now part of other states: ANDALUSIA; AQUITAINE; BURGUNDY; etc. This is amplified further by the historical section in articles on cities: FLORENCE; ANTWERP; etc. Much of the history of the period is covered by HOLY ROMAN EMPIRE; PAPACY; MONASTICISM, and articles on each religious order; CRUSADES; FEUDALISM; COMMUNE (MEDIEVAL). Individual popes, emperors and kings are treated separately.

The impact of the Arabs is discussed in AFRICA: *History;* CALIPHATE; and SPAIN: *History;* while their contributions to mathematics and philosophy are covered in articles on those subjects and in biographies. The Mongol invasions are treated in GENGHIS KHAN; GOLDEN HORDE; MONGOL EMPIRES. Among discussions of the Turkish advance are the historical sections of BULGARIA; BYZANTINE EMPIRE; HUNGARY; TURKEY.

BRITAIN covers events and customs from pre-Roman Britain to the landing of St. Augustine, from which point the narrative is taken up by ENGLISH HISTORY. Important background material is included in articles such as ANGLO-SAXON LAW; VIKING; DOMESDAY BOOK; NORMANS; MAGNA CARTA. The invasion of France in the 14th and 15th centuries is developed in HUNDRED YEARS' WAR. There is also a wide covering in biographies of kings, important families and key political figures.

Discussions of medieval law are included in ENGLISH LAW; GERMAN LAW; etc., while the political background is supplied in such articles as CLARENDON, CONSTITUTIONS OF; ASSIZE; PARLIAMENT; MISSI DOMINICI; etc. The articles BARON; DUKE; etc., discuss the significance and distinction of titles and there are separate entries for imperial or royal houses, such as HABSBURG; HOHENZOLLERN; BOURBON. Economic history is covered by articles such as COMMERCE, HISTORY OF; FUGGER; HANSEATIC LEAGUE; TRADE ROUTES. The emergence of Islam is outlined in ARABIA: *History;* ISLAM; MOHAMMED.

Modern History.—The two great upheavals of the early modern period are outlined in RENAISSANCE and REFORMATION. Certain aspects are treated more fully in biographies on COLUMBUS, CHRISTOPHER; LUTHER, MARTIN; MICHELANGELO; ERASMUS, DESIDERIUS; etc., and in articles on RENAISSANCE ART; RENAISSANCE ARCHITECTURE; ROMAN CATHOLIC CHURCH; THIRTY YEARS' WAR; TRENT, COUNCIL OF. Colonizing activities are summarized in GEOGRAPHY and treated in detail in NORTH AMERICA; LATIN AMERICA; and articles on colonies, such as CANADA: *History;* VIRGINIA: *History.*

Modern English history is covered in ENGLISH HISTORY and the Civil War in detail in CIVIL WAR, ENGLISH; other important topics are treated fully in articles such as BILL OF RIGHTS, ENGLISH; LEVELLERS; etc., as well as in biographies of the leading figures. The philosophical impact of the age is seen in the articles on the history of philosophy and in biographies while other aspects of the age are often amplified in biographies of monarchs and prime ministers. Foreign affairs in the 18th century are covered in articles on prime ministers, wars, military and naval biographies and in the history of the colonial period of countries: CANADA; INDIA-PAKISTAN, SUBCONTINENT OF; etc. Certain specialized aspects of the 19th century are amplified in the articles CHARTISM; CRIMEAN WAR; SOUTH AFRICAN WAR, while Irish affairs are treated in biographies of the leading figures and in IRELAND: *History.*

Much material on modern European history, in addition to the historical sections on individual countries, is to be found in GRAND ALLIANCE, WAR OF THE; SPANISH SUCCESSION, WAR OF THE; AUSTRIAN SUCCESSION, WAR OF THE; FRANCO-GERMAN WAR; EASTERN QUESTION; and RUSSO-TURKISH WARS.

The emergence and growth of Russia is discussed in RUSSIAN HISTORY and in PETER I and CATHERINE II; while more recent developments are expanded in RUSSIAN REVOLUTION; COMMUNISM; MARXISM; INTERNATIONAL, THE; and in biographies such as MARX, KARL HEINRICH; and LENIN.

FRENCH REVOLUTION, which stresses the ideological importance of the movement, is supplemented by sections of EUROPE: *History;* FRANCE: *History,* and in the biographies of writers and protagonists. The subsequent wars are covered in FRENCH REVOLUTIONARY WARS; NAPOLEONIC WARS; articles on battles and the appropriate sections of French, Italian, German, Spanish, Austrian and Russian history.

COMMONWEALTH OF NATIONS outlines the history of the British commonwealth, while the individual nations and states are treated fully in articles ranging, for example, from AUSTRALIA: *History* to surveys of small islands. Articles dealing with major provinces correspond to the individual articles on the states of the United States.

The United States.—The issues of the American Revolution are outlined in ENGLISH HISTORY; UNITED STATES (OF AMERICA): *History,* and in the articles on the 13 original colonies. AMERICAN REVOLUTION, devoted to the military history of the war, contains references to additional articles on major campaigns, battles and biographies; DECLARATION OF INDEPENDENCE is accompanied by a facsimile of the document. The text of the constitution is given in UNITED STATES (OF AMERICA): *History;* and discussed in BILL OF RIGHTS, UNITED STATES; and CONSTITUTION AND CONSTITUTIONAL LAW: *United States.* There is also a biography of each president that covers his administration. The background of the struggle between North and South is surveyed in UNITED STATES (OF AMERICA): *History,* and amplified in DRED SCOTT DECISION; MISSOURI COMPROMISE; etc., biographies of BROWN, JOHN; CLAY, HENRY; DAVIS, JEFFERSON; LEE, ROBERT EDWARD; LINCOLN, ABRAHAM; etc., while AMERICAN CIVIL WAR is supplemented by articles on the major battles; *e.g.,* BULL RUN; GETTYSBURG; VICKSBURG. Additional material is also found in the articles on individual states and in CONFEDERATE STATES OF AMERICA.

Asia.—The history of Asia is covered in articles on countries and regions as in INDIA: *History;* INDIA-PAKISTAN, SUBCONTINENT OF: *History;* MANCHURIA: *History;* JAPAN: *History,* and is augmented by entries on dynasties: T'ANG; MING; etc., and on prominent events: T'AI P'ING REBELLION; RUSSO-JAPANESE WAR, while the development of feudalism in Japan is amplified in BAKUFU; BUSHIDO; SHOGUN. Episodes in Indian history are expanded as in INDIAN MUTINY, and in articles on prominent leaders.

The 20th Century.—Developments in the 20th century are broadly covered in EUROPE: *History* and in the articles on separate countries and outstanding events. WORLD WAR I and WORLD WAR II are general surveys of military and naval events, each of which contains references to additional articles on campaigns, battles and the political and economic background. The development of communism in Russia and China is traced in RUSSIAN HISTORY and CHINA: *History,* while the prelude to militant communism is presented in FAR EAST; RELATIONS WITH THE WEST and in its acute stages in KOREAN WAR.

The spread of nationalism to new areas and efforts to impose forms of international government are seen in articles on the recently established nations of Africa and elsewhere, indexed under their former and present titles. LEAGUE OF NATIONS; PEACE, INTERNATIONAL; and UNITED NATIONS cover the attempts to enforce a supranational form of government.

The examples given in these paragraphs make no attempt to provide an exhaustive list of historical material, but merely illustrate the way in which the mass of historical information is organized, how it is treated and how it may most easily be consulted.

HISTORY. The word "history" is used in two senses. It may mean either the record of events or the events themselves. The term was originally limited to inquiry and statement; it was only in comparatively modern times that the meaning of the word was extended to include the phenomena that form their subject. The older, narrower meaning is the subject of this article, which is divided into the following sections:

I. Historiography
  A. Classical
    1. Herodotus
    2. Thucydides
    3. Later Greek Historians
    4. Roman Historians
  B. Early Christian
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  D. Byzantine
    1. General Characteristics
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  E. Modern European
    1. 17th and 18th Centuries
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  G. United States

1. Trends in Common With Europe
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I. Islamic
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K. Chinese
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5. Modern Influences
L. Japanese
1. Early Writings
2. Tokugawa Period
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II. Methodology
1. Source Material
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III. Philosophy of History
1. Idea of a Design in History
2. Theological Origins
3. Scientific Approach
4. Theories of Vico and Herder
5. Modern Theories
IV. Societies and Institutions
1. United States
2. Great Britain
3. France and Germany
4. Other European Countries
5. Latin America
6. Other Countries

I. HISTORIOGRAPHY

A. Classical

In the *Poetics* Aristotle discounted history on the ground that it merely recorded particular facts and did not, like drama, depict the general truth of a consistent plot. The distinction is a basic one if the function of history is to establish what actually happened; but it ignores the degree to which a historian may emphasize in his evidence the features that permit significant generalization and present them in appropriate literary form. Aristotle's dictum applies only to chronicles: it does not cover the work of Herodotus or Thucydides; and one may look beyond local history for the germ of Greek historiography.

The Greeks gained a sense of tradition from their myths and sagas, which had taken shape in epic poetry and were kept alive by their cults, as may be seen in Pindar. But though tradition represents continuity, it lacks historical perspective. The critical inquiry of Ionian rationalism led to a distinction between mythical prehistory and history proper; yet the Greeks were slow to attack their mythology with radical criticism, and Herodotus still moved easily between his own times and the obscure past in treating the origins of the Persian Wars. Thucydides' contribution, when he investigated the state of early Greece, was to apply rules of evidence to such information as that preserved in the *Iliad* of Homer.

As a result of their overseas trade and travel, especially under the Persian empire, the Ionians developed an ethnographical literature. Thus they were able to measure their traditions against the antiquity of the east and to recognize the importance of first-hand inquiry, which is the root meaning of "history." Writers in this style, the "logographers," used literary prose, and their work reached its height in the 5th century B.C. with Hecataeus, Herodotus (in describing Egypt and Scythia) and Hellanicus.

1. Herodotus.—Out of these conditions Herodotus, "the father of history," created a new intellectual discipline. When he described the Lydians and Persians, for instance, and practised the art of storytelling, he associated these features in his narrative freely but significantly with the main lines of the expansion of Persian power, that is, in historical context. Against this varied background he presented the political and military picture of the Persian Wars. Despite weakness in detail, he controlled his vast subject matter with an expert hand and blended the elements of Greco-Persian relationship into a great unity, as he saw it. By showing an interplay of human and divine, the clash of Greek and barbarian, the rivalries of states and ambitions of individuals from mythical times onward, he depicted a complex process of human action, which culminated in the victory of free men over despotism. Much of what Herodotus believed was old-fashioned, and he stood closer to Homer and Attic tragedy than to the rationalism of the Sophists; yet he owed his historical vision to the Athens of Pericles. He completed his work at the time when the Athenians had to justify their power by an appeal to their record of Panhellenic service. Under this fortunate conjunction of circumstances and personal insight he broke the barrier to Greek historiography.

2. Thucydides.—Thucydides, on the other hand, was a man of the Peloponnesian War (431–404 B.C.). He had grown up in a world divided by the power politics of the Athenian empire and the Spartan league, which set the immediate quarrel of Athens and Corinth in its political context. He was interested in the factors of human behaviour that influenced questions of aggression and security. From the Sophists he had learned to analyze such moral concepts as that of justice in the light of historical evidence; from medical science he took analogies for the play of forces in "the body politic," especially under the "pathological" conditions of war. From the outset, therefore, Thucydides was well fitted by talent and training to analyze the political character of the Peloponnesian War; then, as the terrible events of the war added to his evidence and understanding, he probed ever more deeply into the human passions underlying political action, until he gained final perspective with the fall of Athens. Thus in 30 years' writing and revision he drew patterns of regularity in the varied interplay of human nature and political circumstance that make history and developed literary techniques to display events in their true nature and to express in speeches not only the words but the inner motives of policy. Thucydides achieved his aim of composing a history of permanent value for serious students of politics. His work is a model of intellectual clarity and intense description. It presents tragic events as consistently in their historical context as Aristotle required of drama—even too strictly so, where his magisterial selection of evidence leaves the reader at a loss to judge the whole variety of circumstances for himself. Yet only a mind of supreme power could have established this new type of historiography, the critical history of contemporary affairs, with such virtuosity in style.

3. Later Greek Historians.—Thucydides' uncompleted work was continued into the 4th century B.C. by Xenophon, by "the Oxyrhynchus historian" (so called from the papyrus fragment of his work found at Oxyrhynchus [Behnesa] in Egypt) and by Theopompus. Ctesias revived Herodotus' theme of Persian civilization and Ephorus wrote a general history of Greece. Local chronicles and biography enlarged the field of historiography. New trends in method also developed out of Thucydides' techniques. First, the style of factual narrative and political interpretation can be seen as leading to Polybius; second, the judgment of human motives, under philosophical influence, encouraged moralizing history; third, his rhetoric expanded under the teaching of Isocrates into a regular system of composition. Moralizing and rhetorical history took shape in the work of Theopompus and Ephorus and, with antiquarian research, passed to Timaeus. Finally, the dramatic depiction of episodes—apparently in the light of Aristotle's *Poetics*—gave rise to a form of "tragical" history, which was practised by Duris (*c.* 340–*c.* 260 B.C.) and Phylarchus (writing about events between 272 and 220 B.C.). Although men of affairs, like the historians of Alexander the Great, wrote the raw material of history, these developments tended to separate the examination of evidence from the artistic presentation of history. The issue was defined by Polybius, whose experience in Rome inspired him to write a general history of the expansion of Roman power in the Mediterranean. Following the pragmatic tradition of Thucydides he discussed the principles of historical causation and criticized the rhetorical trend of Timaeus and the "tragical" fashion of Phylarchus, not altogether fairly, on the ground that

the historian must know his facts and interpret them in the light of political and military experience. At the same time he applied Greek constitutional theory to an analysis of the functioning of the Roman state.

4. Roman Historians.—The Romans developed historical interests—alongside their family traditions—from the association of Greek saga with Italy, above all in the myth of Aeneas, when in the 3rd and 2nd centuries Naevius and Ennius treated early Rome and the struggle with Carthage in epic form. This work was influenced by Hellenistic learning; then the senatorial historians like Fabius Pictor wrote in Greek primarily in order to interpret Roman institutions and policy to the Hellenistic world. It was Cato, turning in Latin to the history of Italy and Rome, who stimulated the growth of Roman historiography. The popularity of antiquarian studies led about 123 B.C. to the publication of the *Annales Maximi*. This edition of records, ostensibly beginning with the kings, provided not only systematic material but a ceremonial form of arrangement under official years; it appealed to Roman traditionalism and established the annalistic type of history. In elaborating the basic records from other historical material, especially the traditions of the noble houses and the results of antiquarian research, the annalists adopted Greek rhetorical methods to display the formal material and depict scenes of war and debate, with characterizing speeches. Cicero laid down the principles of rhetoric that should govern the presentation of Roman history, especially in matters of style. Thus the Romans learned from Hellenistic historiography and applied their literary technique to the chief purpose of their history, which was political and moralizing in character. Even Caesar's *Commentaries*, in their elegant reporting, were designed to influence public opinion.

Roman politics after the Gracchi involved a struggle for power in the state between the optimates, who stood on their hereditary monopoly of office, and ambitious men outside their circle who demanded a career for talent. The issue turned on the concept of civic virtue: if the aristocracy was degenerate, then its claims lapsed. Thus Sallust (86–*c.* 34 B.C.) showed political corruption in the Rome of Catiline and set the rising figure of Marius against the optimates in historical perspective. He analyzed the problem of degeneracy in general terms which had a direct political significance and applied strict selection and emphasis to his narrative, often tendentiously. His model was Thucydides, and his tone and expression mark the influence of Cato the censor, the champion of ancient virtue; but he wrote with a stylistic aggressiveness that suited his disruptive theme. The critical history of the Civil War was carried on with less doctrinaire concentration by Asinius Pollio.

Yet in the eyes of Italians who were not caught up in Roman politics this kind of history neglected the imperial responsibilities of Rome, and the emperor Augustus encouraged their patriotism and sentimentality. When Livy began his history as a prose epic, alongside Virgil's *Aeneid*, and went on to recount Rome's triumph over Carthage and its conquest of the Greek world, he appealed to the civic virtue of the past. Within the traditional annalistic form he expanded his material by using such work as that of Polybius and applied the rules of both Ciceronian rhetoric and dramatic art to his writing. In conscious opposition to the severity of Sallust he adopted the periodic style that appeared to him appropriate to the greatness of Roman history, above all in the oratory of his speeches. His interpretation was Augustan in spirit; for even his sympathy for Pompey in the Civil War reflects a liberal republican attitude that suited the claims of Augustus. It is worth noting alongside Livy as a sign of Rome's cosmopolitan position, that Timagenes (an Alexandrian who came to Rome in 55 B.C.) and Pompeius Trogus (an Augustan historian from Gallia Narbonensis) reverted in Hellenistic fashion to the broader history of civilization.

The idealism of the early Augustan period lost its strength under the dynastic policy of the empire. Among the historians, Aufidius Bassus and Pliny the Elder (both in the 1st century A.D.) traced the course of affairs at home and described the great frontier wars in factual style; at the same time personal memoirs cast a lurid light upon the intrigues at court. This was the condition of the source material when Tacitus came to history from his official experience under Domitian and his part in the crisis of Nerva's succession. He saw the principate as a permanent form of tyranny, which offended his principles of civic virtue: power tends to corrupt, while subjection leads to degeneracy. The situation was "pathological," and he saw it as Sallust saw the late republic, in a Roman version of Thucydides' conception: hence his "psychological" interpretation, in the dark pessimism of the *Annals*. From the literary point of view his minor works display his virtuosity in rhetoric, biography and ethnography: his history combines these techniques with that of "tragical" description to give dramatic colour to his interpretation of significant events; and his highly wrought style is fused with the passion of his thought.

Alongside the personal achievement of Tacitus, the Roman empire also enjoyed the work of more regular historiography. In Greek, Arrian preserved the best tradition about Alexander, while Appian and Dio Cassius wrote histories of Rome to their own times; in Latin, Ammianus Marcellinus continued Tacitus in Tacitean style into the 4th century, with important contemporary evidence. Biography rose to its height with Plutarch in Greek and Suetonius on the *Caesars* in Latin. These writers had full control of their historical techniques, which would survive to inspire the Byzantine historian Procopius. For the rest, Livy and Pompeius Trogus are reduced to epitome, and imperial biography declines to the *Historia Augusta* (*see* AUGUSTAN HISTORY). Thereafter, as the interest in material and presentation became weaker, a new problem of interpretation arose, and the Christian historians challenged the traditions of Greece and Rome with a conception of world history written *sub specie aeternitatis*. (A. H. McD.)

B. Early Christian

According to Carlyle, "Church history, if it spoke wisely, would have momentous secrets to teach us; nay, in its brightest degree, it were a sort of continued Holy Writ." Early churchmen certainly had no hesitation about accepting the biblical insistence on the value of historic fact. As they contemplated the course of things, they perceived not merely blind chance or a ceaseless round of recurring events but God making his ways known to men; and for this reason they tend to speak in terms of purpose rather than of sequence—not so much "it next happened" as "that it might be fulfilled." The idea that history is, or displays, the fulfillment of a divine plan appears to harmonize with the actions and sayings of Jesus himself. He made his claim to be the Lord's anointed in terms appropriate to the culture and education of the Hebrews among whom he lived; *i.e.*, in accordance with the forecasts made in Scripture. So when Jesus entered Jerusalem "lowly and riding upon an ass," as Zechariah had foretold, or when he drove the money-changers from the court of the gentiles in order to show that the days of the Son of Man had arrived when the Temple should be "a house of prayer for all the nations," it was natural enough for the simple folk of Palestine to acclaim him as Messiah.

Similarly, when St. Luke composed the Acts of the Apostles, he related, as the first happening after the Ascension, the election of the 12th man to replace the traitor Judas. In doing this the author put forward the claim that the Christian church, the new Israel of God, based on 12 apostles, took the place of the 12 tribes of the old Israel. History is thus seen as a purposeful structure in which the earlier events offer indications of what is to come. It serves also as a schoolmaster drawing lessons from the past. So, as early as *c.* A.D. 100 the author of the First Epistle of Clement points to the horrible example of such persons as Cain and the blessedness of the patriarchs, Noah, Abraham, Jacob and the rest, in order that his readers might learn to draw a clear distinction between right and wrong and thus mend their manners.

At first, however, most Christian writers devoted their talents to doctrinal controversies, and it was left for Eusebius of Caesarea *c.* A.D. 310 to cast his eyes back over three centuries and compose the first formal ecclesiastical history. As he beheld the church transformed from a persecuted sect to become the bulwark of imperial statecraft, he detected, in the providential ordering of conditions which favoured the rapid growth of Christianity, sure

signs that God exercised a control over events in the interests of man's salvation. Yet Eusebius, with his scholarly habits and slow, pedestrian style, avoided rhetoric and miracle. He arranged his material in dull but accurate fashion according to a strict chronological scheme and quoted extensively from the sources he used, thus managing to combine the temper of an enthusiast with a due sense of the historian's responsibility.

The patient and straightforward collection of facts which distinguishes the work of Eusebius was continued by such church historians as Socrates Scholasticus and Sozomen. The former declared, "I did not bother about majestic style but noted down what I found in the written records or heard from reliable informants," and the latter laid down the principle that, "the historian must regard everything as secondary to truth." Yet both realized that facts had to be arranged and interpreted if they were to be understood, and two explanatory doctrines recur in their writings. The first of these is that good and evil strive against each other on the stage of history so that the primitive purity of life and thought which characterized the early church is inevitably corrupted through the machinations of the devil. Secondly, the course of history is held, as by the writers of the Old Testament, to manifest the principle of God's justice. The disasters which attended the reign of the apostate emperor Julian are thus put forward as examples of the fate which overtakes the wicked, but this line of apologetic became less satisfactory when, under the blows of the Vandal invaders, the western empire tottered toward its inglorious end. St. Augustine, in *De civitate dei* ("The City of God"), explained that although, as is just and right, good leads to good and bad to bad, this rule is not always observed since a streak of oddity and paradox runs through history, as through all situations in which man comes face to face with the mysteries of God. The pattern of history therefore displays hints and intimations of the divine activity rather than any precise and ordered regularity.

(R. L. P. M.)

C. Western Medieval

The writing of history suffered in the general cultural decline that spread over Europe after the Roman empire in the west was replaced by the barbarian Germanic kingdoms. The tradition of universal history, known to the west in translations of the Chronicle of Eusebius (d. *c.* 340) of Caesarea, was feebly continued by Paulus Orosius (fl. *c.* 417) in his historical apology for Christianity, the *Historiarum adversus paganos libri vii* ("Seven Books of Histories Against the Pagans") and by his successors. But in the early middle ages the best writing was on a local or national level. In Merovingian Gaul, Gregory of Tours (d. 594) produced a fascinating account of barbarian life and politics in his *Historia Francorum* ("History of the Franks"), a remarkably accurate and well-written work considering the depths to which arts and letters had subsided by the end of the 6th century. The most outstanding early medieval writer was Bede (d. 735), whose *Historia ecclesiastica gentis Anglorum* ("Ecclesiastical History of the English Nation") was the brightest literary light in the whole of the period called the dark ages. The only other historical writing of the stature attained by Gregory of Tours and Bede was the Anglo-Saxon Chronicle. It was begun in the 9th century under the aegis of Alfred the Great (d. 899) and was continued by many authors down to the middle of the 12th century.

The writing of chronicles in the early middle ages was almost a monopoly of the monastic scriptoria because it was only in the monasteries, over a stretch of six centuries, that literacy and some learning were kept alive. The 12th century was an age of cultural revival and ecclesiastical reform; the old Benedictine and the new reformed monastic orders were both flourishing; and the monastic chronicles achieved their best writing. All over Europe scores of monastic writers were producing lengthy and detailed accounts, often as continuations of earlier and lesser annals or chronicles. In the works of such writers as William of Malmesbury (d. *c.* 1143) or Roger of Howden (d. 1201) there emerges a clear grasp of history consisting of more than listing events in chronological order. The better monastic historians discussed not only what happened but how and why. They were concerned not only to preserve a record of the past but to instruct posterity by portraying the lessons to be learned from great deeds and important events. Perhaps the most notable effort to show the meaning of history was the *De duabus civitatibus* ("The Two Cities") by Otto of Freising (d. 1158), in which the providential view of history as set out in St. Augustine's *De civitate Dei* ("The City of God") is the framework for a detailed narrative.

In the 13th century there was a general decline in the value of monastic chronicles, although there were exceptions such as Matthew Paris (d. 1259), a monk of St. Albans, Eng., who wrote a massive and detailed account of his own times. Most of the chroniclers included in their texts copies of governmental or other documents, the originals of which in many instances no longer survive. Matthew made a huge collection of such documents and incorporated them in his *Additamenta*, a separate volume or appendix. Vernacular chronicles, often written by laymen connected with town governments, made their appearance in increasing numbers during the 13th century and later.

The later middle ages do not compare favourably in the quality of historical writing with the earlier period. Jean Froissart (d. *c.* 1404) and Philippe de Commynes (d. 1511) left entertaining narratives of the Hundred Years' War, but their conception of the nature of history was superficial and unduly influenced by their concept of chivalry. The early humanists in Italy, in the 14th century, both helped and hurt the development of historiography. They brought a new sense of development, or periodization, to the grand sweep of European history. Petrarch (d. 1374), for example, considered ancient times to be a distinct period ending with the triumph of Christianity in the Roman empire and followed by a period in politics and the arts which he dubbed "Gothic"; *i.e.*, barbarian, debased and unimportant. In his concept of a revival of the arts and letters of antiquity, in his own day, there was implicit the notion that all history could be divided into the tripartite ancient, medieval and modern eras familiar to students of history today.

(R. S. Ho.)

D. Byzantine

1. General Characteristics.—The Byzantines stressed their continuity with classical Greek learning and culture, particularly in connection with historiography, one of the branches of literature in which both ancient and medieval Greek writers excelled. Their historiography was also molded by traditions of the late Roman empire and of Christianity. The main forms it took were contemporary history, biography, world chronicles and ecclesiastical history, though there is considerable overlap and these divisions cannot always be rigidly applied. Ecclesiastical histories as such, born of the Christian world, were more prominent in the 4th–6th centuries than later, when works professing to deal with ecclesiastical history became deeply involved in political history, as the 14th-century Nicephorus Gregoras' apologia for his opposition to hesychasm, where the author expressly says that he has to adopt "a complex structure where political and ecclesiastical affairs are mingled."

2. The Chronicle.—A more popular form was the world chronicle set in the biblical framework provided by the Chronicle of Eusebius, though the Byzantine chronicles usually reckoned from the Creation of the world, not from the birth of Abraham as Eusebius had done. The 9th-century Theophanes, whose chronicle was the basis of many later annals, uses the Alexandrine reckoning which put the birth of Christ 5,492 years after the Creation. These annals set out events in chronological sequence without much analysis as to cause and effect. Side by side with the *annus mundi* Theophanes gives the imperial regnal year, the Persian and Arab rulers, the pope and the four patriarchs. These chronicles were often written by monks or by the less highly educated for use in monastic or popular circles, and they were characterized by the more sensational features associated with a popular press, stressing unusual natural phenomena, extraordinary miraculous events or the more striking features of eminent personalities. Events before the compiler's lifetime were usually copied from whatever earlier annals or sources he had at his disposal, and the work was then completed by his own contemporary entries. The

language was not consciously imitative of Attic Greek, but was often strongly tinged with ecclesiastical and demotic usages, and on occasion the chronicle was written in verse. Apart from reflecting the tastes of the compiler and his public, these world chronicles are of value to the historian in their preservation of certain sources no longer extant and in the contemporary information which they supply. Though devoid of aesthetic form by reason of their annalist pattern, at their best these chronicles, though crude, are also robust and vigorous, as in the case of Theophanes.

3. Contemporary History.—The chief contribution to Byzantine historiography was the contemporary history. Such by-products as the narrative of a single event in prose or poetry or the biographies were not regarded by Byzantines as being "history" properly speaking. Archbishop Eustathius considered that his account of the sack of Thessalonica by the Normans in 1185 was a "narrative" which must be strictly truthful but which was written with feeling, and therefore lacked objectivity, that essential characteristic of history. This lack of objectivity also ruled out the various biographies, both secular and hagiographical, which drew on traditions both Christian and pagan in origin, but necessarily had a strongly panegyrical element. Anna Comnena (12th century) specifically stated in her contemporary history, the *Alexiad,* that she would not yield to the conventions of panegyric but would unswervingly cling to the truth, even if it meant emphasizing her father Alexius I's mistakes.

Such histories were written by the educated laity, mostly of high rank, who had themselves taken part in the events which they describe. Despite the objectivity which they prized so much, historians stand self-revealed in their works from the vain, shrewd, observant scholar and courtier Michael Psellus (11th century) to the touchy humanist Nicephorus Gregoras and the likeable, detached monk Joasaph (the former emperor John VI Cantacuzenus).

These contemporary histories had certain common characteristics. They looked to antiquity, particularly to Herodotus and Thucydides, for their models; they were written in the learned and not the spoken language, though there were many variations in style from the self-consciously archaic Attic of Psellus or Anna Comnena to the more lucid and lively Greek of John Cantacuzenus. Imitation of classical authors was carried so far as to call contemporary foreigners or nomads by the names of peoples whom the ancient Greeks had known. These histories began in the near-memory of their author and purported to provide contemporary history based on reliable sources, oral, documentary and eyewitness. Their material was not necessarily arranged strictly chronologically as in the chronicles, but grouped round a theme or personality. Like the ancient historians, the Byzantines sought not only to give a true account of what happened but they desired to analyze cause and effect and thus to offer information of use to statesmen and others. As the 11th-century lawyer and historian Michael Attaliates pointed out, history was of the greatest value since much could be learned from the lives of good and bad alike. This critical, analytical contemporary history is worlds apart from the crude vituperative of the annals of chroniclers such as Theophanes.

Conscious pride in the Christian Roman empire did not prevent Byzantine historians from perceptive and outspoken criticism of even imperial action as in the case of the popular Manuel, who was strongly censured for wanting to modify the doctrine of the Trinity in order to facilitate the conversion of Muslims. In artistry and aesthetic presentation as well as independence of approach, the Byzantines take the lead among medieval historians. Apart from their sense of style, they are outstanding for their range and variety, from the vivid portraits by Michael Psellus or the subtle undertones of Nicephorus Gregoras' irony to the compelling drama of John Cantacuzenus' experiences. In method and in sophistication they are unrivaled. But though they had the outlook of a later western generation they lacked the auxiliary aids to scientific historical research which only developed later in the post-Reformation west at a time when the Greeks were under Ottoman domination and in no position to collaborate in this modern movement. (J. M. Hy.)

E. Modern European

The Italian Renaissance led to the production of more, and generally better, historical writing. Literate men were no longer exclusively clerics and were more interested in society and the state. Even if writers only exchanged the authority of the church for that of the classics, they did have some means of comparison with the ideas and standards of another age. The writings of Machiavelli and Francesco Guicciardini showed a healthy and critical skepticism as well as detached observation. Nevertheless history became a department of literature and the scholarly criticism of ecclesiastical manuscripts was rarely extended to other historical sources. Although printing and the expansion of Europe produced a more receptive public, it was not until the Reformation, with its conflicting claims for authority, that analysis and criticism were carried further. Even then they were applied solely to church history. The Protestant *Magdeburg Centuries* (1559–74) was the first piece of modern historical research and provoked Caesar Cardinal Baronius' massive reply with the *Annales ecclesiastici* (1588–1607). The plea of Jean Bodin (d. 1596) for the consultation of original sources was novel but largely ignored in secular history until the 19th century.

1. 17th and 18th Centuries.—In the 17th century the Bollandists in Belgium began the vast collection of the *Acta Sanctorum* and in France the Benedictines of St. Maur (*see* Maurists) founded the École des Chartres, which for 200 years produced works of unequaled erudition. Charles du Cange's glossary became a standard work and Jean Mabillon's *De re diplomatica* (1681) performed a great service for Latin diplomatic (*q.v.*). All these works were concerned with ecclesiastical history: political history remained a quarry of fact, fable and anecdote. J. Bossuet's *Histoire universelle* is a late, but standard, example of this type. Antiquarianism as a study made some headway and the Académie des Inscriptions, founded in 1663, later began a collection of national and classical antiquities in France. The 18th century saw the return of a more critical approach to historical writing and historical works were widely read. Voltaire's *Charles XII* and *Siècle de Louis XIV* were in some ways characteristic works of the Enlightenment. Historians' perceptions were frequently acute; established institutions came under heavy fire; social habits and customs were analyzed, thus preparing the way for constitutional, comparative and social history. But no advance was made in the accuracy of scholarship or original research.

The works of the Enlightenment were at best little removed from propaganda or vehicles of current moral and political philosophy. The legacy of the age was an interest in institutions, provoked largely by a comparison of the governments of France and England, and a realization that geography, climate and other factors contribute to the individuality of a people. Traces of sentimental medievalism are found in 18th-century works, but these are mainly by-products of literary or antiquarian pursuits. The French Revolution caused a complete disruption in historical writing and afterward the new ideas and problems raised by the politics of the age and the Revolution itself impelled historians in completely new directions. Napoleon had given qualified support for historical research by appointing Pierre Daunou (d. 1840) as head of the archives and by restoring the École des Chartes, which had been suppressed by the Revolution.

2. 19th Century.—After 1815 study of the Revolution—a subject of widely varying interpretations—led to much original research, the beginning of modern methods and the division of historians into various schools of thought. In France there emerged a Romantic school, concerned either with the Revolution, the middle ages or with nationalist works on the history of France. Jean Sismondi attacked the theme of irresponsible power, while Augustin Thierry and Amable Barante, influenced by Sir Walter Scott's novels, found the key to history in imagination. The greatest of this school, Jules Michelet, ranged widely in his writings and at times became almost visionary; although his facts were sound enough, his interpretations were highly dangerous. A subsidiary school of Catholic historians, influenced by the sentimental medievalism of Chateaubriand and including historians such as

De Maistre, Lamennais and Montalembert, was paralleled in Germany by the Münich school, far less sentimental, far more accurate and equally polemical, led by J. Mohler and J. Döllinger.

By contrast, a school of political historians, led by François Guizot (d. 1874), emphasized international relations and the structure of society, while Louis Blanc and Alphonse de Lamartine dealt with the same issues from a republican standpoint. In France medieval studies achieved respectable standards of scholarship only with Léopold Delisle and the *Revue Historique*, founded by Gabriel Monod. The Revolution itself gave rise to a vast literature, De Tocqueville interpreting it as a series of cumulative causes and François Aulard in terms of popular sovereignty. Accurate historical studies were helped by the revived École des Chartes, the Société de l'Histoire de France and the Académie des Sciences Morales et Politiques.

The prelude to the great development of historical writing in Germany was Karl Stein's foundation of the *Monumenta Germaniae historica*, the first volume of which appeared in 1826. The influences which helped to form German historical writing were in part traditional—the opposition of Protestant and Catholic and an increasing interest in the conflicting claims of German and Roman laws and institutions. They were in part new—movements such as Hegelian philosophy and the biblical higher criticism that was already prevalent by the time Leopold von Ranke began his monumental series of works. The characteristic features of German writing lay in its thoroughness, erudition and bulk. Ranke attempted to make history into an objective, accurate, scientific study by returning almost exclusively to original documents, using them critically and by attempting to eliminate the writer's own prejudices. All subsequent historians were influenced by his methods regardless of their acceptance of his conclusions. Ranke's belief in letting history speak for itself met opposition from three directions: from the didactic school, led by Georg Gervinus, which treated history as a series of moral conclusions; from the Prussian school, led by F. Dahlmann, J. Droysen and L. Häusser and dominated by Heinrich von Treitschke, which encouraged the cult of the state and attacked Ranke's refusal to be committed; and from the exponents of *Kulturgeschichte*, led by Karl Lamprecht and Jacob Burckhardt, who believed in a more general approach, trying to recreate a period or society by stressing cultural achievements as well as politics. Burckhardt, like Ranke, also stressed the importance of original sources but placed emphasis on historical imagination. His greatest work, *The Civilization of the Renaissance in Italy* (1860), established *Kulturgeschichte* as a valuable form of history and did much to undermine the conception of history as a mere pile of facts. After the decline and discredit of the nationalist Prussian school the influence of both Ranke and Burckhardt revived.

Earlier, a school of church history centred on Göttingen, led by J. Mosheim (d. 1755), prepared the way for Johannes von Müller and August von Schlözer. This encouraged a study of German institutions and law in which Gustav von Hugo and Friedrich von Savigny took a leading part, and in turn led to an investigation of early German society, folk movements and ultimately the constitutional and economic aspects of early society. Another direction of inquiry—the contrast of German and Roman institutions—produced Karl Otfried Müller's Etruscan studies and the Roman studies of Barthold Niebuhr and Theodor Mommsen.

3. 20th Century.—In general, the trends of the 19th century continued to preoccupy historians in the 20th. The French Revolution gave rise to further interpretations: Louis Madelin saw Danton as its great hero, Albert Mathiez interpreted it in terms of class and economic structure with Robespierre as its hero, while Georges Lefebvre put forward a more moderate socialist interpretation. Modern work has tended to shelve the problem of why the Revolution started in favour of regional and specialized studies on the events themselves. Medieval studies advanced greatly in scholarship with the work of Ferdinand Lot, Marc Bloch, Petit-Dutaillis and Alfons Dopsch, who improved on the earlier work of Savigny and Fustel de Coulanges. The French third republic attracted scholars such as Élie Halévy, Hanotaux and Pierre Renouvin. In Germany the Bismarckian era received formidable attention at the hands of Erich Marcks, A. Meyer and Erich Eyck. World War I and its causes, and the subsequent opening of state archives led by Germany, produced a flow of interpretations and editions of state papers in which Friedrich Thimme and Luigi Albertini were prominent. A new impetus was given to diplomatic history. More philosophic interpretations of the problems of 20th-century society were produced by Friedrich Meinecke, Oswald Spengler and Benedetto Croce. The spread of nationalism in Europe encouraged historians in the new states founded by the treaty of Versailles to explore and evaluate the individuality of their own countries.

Economic history as a separate study evolved in the late 19th century. The earlier works of Gustav von Schmoller and Fustel de Coulanges were superseded by more detailed and accurate studies, in which Henri Pirenne (d. 1935) took a leading part. Although some of his theories were later exploded, Pirenne's work on medieval Belgian towns was extremely important. Marxist writing, although essentially economic in interpretation, fell into a different category, since it claimed to offer a complete solution of historical issues in materialist terms. Most work produced in eastern Europe after 1945 conformed to this pattern.

The greatest changes in historiography in the 20th century have been the division of writing into Marxist and non-Marxist, the vast increase in the documents available in all fields, and the decline of comprehensive works in favour of particular studies. Efforts at comprehensiveness have been made, the most successful of which have been co-operative enterprises. The very volume of historical writing and its varied opinion have given rise to the independent field of historiography. (X.; W. A. T.)

F. Modern British

1. 16th and 17th Centuries.—In the 16th century historians in England, like their continental counterparts, were gradually emerging from medieval modes of thought. Sir Thomas More, for instance, although conservative in some matters, wrote (*c.* 1513) a *History of King Richard III* that is distinctly modern in approach. The chroniclers of the Tudor period relied heavily on their monastic precursors, but they treated legendary accounts of English origins with increasing skepticism. The *Summarie of Englyshe Chronicles* (1565), by John Stow, was in this respect an advance on earlier Tudor writers, such as Richard Grafton, Edward Hall and Polydore Virgil. Fortunately his Elizabethan contemporary, Raphael Holinshed, preserved many of the best stories in his *Chronicles of England, Scotland and Ireland* (1577), thereby providing Shakespeare with some of his finest plots and scenes. In his invaluable *Survey of London* (1598), Stow represented another enduring characteristic of English scholarship: an enthusiasm for local antiquities and topography. Many books and records had been lost in the dissolution of the monasteries, guilds and chantries; those treasures which survived were doubly precious. The collecting and editing of old manuscripts was for two centuries a main preoccupation of scholars, from Sir Robert Bruce Cotton (d. 1631) to Robert (d. 1724) and Edward Harley (d. 1741), the 1st and 2nd earls of Oxford, whose names are perpetuated by the Cottonian and Harleian collections in the British museum. John Leland, "the father of English antiquaries," never saw in print any of the vast quantities of notes he made on a tour of inspection and collection for Henry VIII. It was not until the 18th century that Thomas Hearne, himself one of the greatest editors of medieval texts, published Leland's *Itinerary* (1710–12) and extracts from his *Collectanea* (1715).

In the midst of the Elizabethan church settlement, Archbishop Matthew Parker found time to take a leading part in these scholarly activities. The religious and political ferment of Tudor and Stuart times stimulated historical writing of a sort: John Foxe's *Book of Martyrs* (1563) in England and John Knox's *History of the Reformation in Scotland* (written during the 1560s) dealt with recent events in anything but a dispassionate manner. Similarly Sir Edward Coke, William Prynne and John Selden went to medieval law for arguments against the Stuart monarchy. Francis Bacon's masterly *History of Henry VII* (1622) had a political purpose: short as it was it was by far the best historical biography

up to that time. Another famous Elizabethan, Sir Walter Raleigh, started on his *History of the World* (vol. i, 1614) while imprisoned in the Tower of London by Elizabeth's successor. The expeditions of Raleigh, Drake and many other Tudor adventurers were enshrined by Richard Hakluyt in *The Principall Navigations, Voiages, Traffiques and Discoveries of the English Nation*, the second edition (1598–1600) of which consists of three magnificent volumes of personal narratives, letters and other documents. Perhaps the greatest historical scholar of the period was William Camden, who was allowed to use contemporary state papers for his account of Elizabeth's reign, *Annales rerum Anglicarum et Hibernicarum regnante Elizabetha* (1615–25). His largest work, the *Britannia* (1586), contained many novel features: descriptions of past manners and customs, pedigrees of families, notes of archaeological remains of all kinds, including Stonehenge and the Roman wall.

The antiquaries of the 17th century were not content merely to collect. Sir William Dugdale provided in his *Antiquities of Warwickshire* (1656) the model for large-scale county histories, imitated for almost every English shire in subsequent centuries by a remarkable succession of local historians. Dugdale was, like Camden, a royal herald and a great authority on genealogy and family history. His greatest achievement, however, was the compilation, with the help of Roger Dodsworth, of *Monasticon Anglicanum* (1655–73), a huge repository of information about medieval English religious houses. One of his contemporaries, Thomas Madox, laid the foundations of administrative study in his *History and Antiquities of the Exchequer* (1711); another, Sir Henry Spelman (d. 1641), wrote learned monographs such as *The History and Fate of Sacrilege*. Narrative history was still mainly concerned with the near past. Lord Chancellor Clarendon's *History of the Rebellion and Civil Wars in England* described in splendid prose events in which he himself had taken part and persons he had known as friends or enemies. Bishop Gilbert Burnet (1643–1715) called his account of the later Stuarts *The History of His Own Time* and his personal prejudices must be heavily discounted in using the work. By the end of the 17th century general histories of England were being produced by painstaking writers such as Laurence Echard, but they lacked judgment and had little documentary basis.

2. 18th Century.—In the 18th century scholars considered themselves sufficiently equipped to deal with more extensive periods. Histories of the world and national histories, mostly of poor quality, abounded. The Scottish philosopher David Hume wrote in six volumes an interpretive *History of England* (1754–62) from Roman times to 1688, which ran through many editions but is now interesting only for the original views he expressed. A much more impressive Scottish achievement was the large-scale works of William Robertson, first the *History of Scotland During the Reigns of Queen Mary and of James VI* (1759), then the *History of the Reign of the Emperor Charles the Fifth* (1769), and finally, by a natural progression, on the Spanish Empire overseas, the first thorough *History of America* (1777). Greatest of all these sweeping surveys was Edward Gibbon's *The History of the Decline and Fall of the Roman Empire*, published in six volumes between 1776 and 1788. His combination of scholarship, literary style and rational interpretation has stood the test of time far better than any other comparable writing of the Age of Reason. Outside Great Britain the *Decline and Fall* is still the best-known historical work by a British writer (*see* GIBBON, EDWARD).

3. 19th Century.—The opening up of public and private records, the building of great libraries and the spread of education contributed to the great expansion of historical writing in the 19th century. The novels of Sir Walter Scott and his imitators stimulated interest in the past. Stylists like Lord Macaulay made a fortune in meeting the growing demand for well-written history. He and Henry Hallam put forward the Whig view of English history. The latter's *Constitutional History of England* (1827) lacks the cocksureness of Macaulay but is much less readable. Macaulay's *Essays* (1843), originally contributed to the *Edinburgh Review*, led him on to a more elaborate study of a period than any previously undertaken. His *History of England From the Accession of James II* reached only the middle of William III's reign before death overtook him while writing the fifth volume. A century later his great-nephew, G. M. Trevelyan, worthily carried on the story to the end of Queen Anne's reign. Based on solid research, Macaulay's facts are seldom wrong, though his interpretations are often questionable.

A stylist of a very different order was Thomas Carlyle, who set out to replace "drum and trumpet" history by the story of the common man and showed much sympathy with the masses in his highly coloured picture of *The French Revolution* (1837). A growing conviction that great men decide the fate of nations led him to studies *On Heroes, Hero-Worship, and the Heroic in History* (1841), followed by a brilliant commentary on Oliver Cromwell's *Letters and Speeches* (1845), which rehabilitated the Puritan leader. Ironically Carlyle's most substantial work (published 1858–65) was devoted to *The History of Friedrich II of Prussia*, whose campaigns he analyzed to the admiration of the Prussian general staff. It was left for a delicate clergyman, John Richard Green, to provide in his *Short History of the English People* (1874) the first adequate account of social and economic forces. To fill the long gaps before and after Macaulay's *History*, J. A. Froude, S. R. Gardiner (supplemented by Sir Charles Firth), W. H. Lecky and Sir George Trevelyan dealt at length with much of the Tudor, Stuart and Georgian periods. Froude's vivid account of the English Reformation—*The History of England From the Fall of Wolsey to the Defeat of the Spanish Armada* (1856–70)—is strongly Protestant and antifeminine: he could see no good in Mary Stuart and gave Lord Burghley all the credit for Elizabeth's successful reign. Froude was one of the first British historians to make extensive use of foreign sources, particularly the rich Spanish archives at Simancas, but he was careless with his quotations and the meanings he put upon them. Subsequent Tudor specialists, such as A. F. Pollard and Sir John Neale, have had to correct much of what he wrote, in addition to writing original work on Henry VIII and Elizabeth I. Gardiner's plain narrative is still the basis of Stuart studies, but much of Lecky and other Victorian writers on the 18th century has been overthrown by the analytical methods applied to the *Structure of Politics at the Accession of George III* (1929) by Sir Lewis Namier and his disciples.

Although regius chairs of history had been established in 1724 at both the old universities by George I, the first distinguished scholars to occupy them (if one excepts the poet Thomas Gray) were Bishop William Stubbs at Oxford (1866) and Sir J. R. Seeley at Cambridge (1869). The massive scholarship of Stubbs transformed medieval studies; his *Constitutional History* (1873–78) and *Select Charters* (1870) remain set books for university examinations. Seeley's *Expansion of England* (1883) started a powerful school of imperial history, including such names as Sir Charles Lucas, H. E. Egerton and A. P. Newton. The successors of Stubbs at Oxford have included several famous medievalists, from E. A. Freeman to Sir Maurice Powicke and V. H. Galbraith. Cambridge has had men of equal distinction, notably Lord Acton in his old age and F. W. Maitland, perhaps the most acute mind ever to deal with English medieval history, particularly in its legal aspects.

4. 20th Century.—The vast masses of documents made available in print, as well as in manuscript, by the labours of the various record commissions, the Public Record office and the Historical Manuscripts commission, not to mention innumerable publications of national and local learned societies, have daunted the individual historian since the opening of the 20th century. No single man could now hope to master the original material for even a brief historical period. Co-operation in various forms has been one answer, monographic studies of ever increasing minuteness another. Lord Acton inaugurated the *Cambridge Modern History* for experts to sum up existing knowledge, and further Cambridge histories, Oxford histories and other well-known series written in collaboration have followed. *The Dictionary of National Biography* (started in 1882) and the *Victoria History of the Counties of England* (started in 1900) would have been impossible ventures by any other means. The production of lengthy Ph.D. theses on

highly specialized historical topics has become a characteristic of most British universities. They provide correctives of older work and may reach the public eventually through the writings of skilled authors of popular history or those few professors who are readable as well as erudite. (A. T. M.)

G. United States

The writing of history in the United States has followed the general trends of writing in Europe but has also provided uniquely American interests arising from historical experiences that were essentially different from those of the older and more settled European cultures.

1. Trends in Common With Europe.—Romantic historical writing was represented in the United States by George Bancroft, who produced a *History of the United States* (10 vol., 1834–74) that was concerned with the dramatic period of colonization and independence; by Francis Parkman, who wrote in a scholarly and absorbing style on the French in America; and by J. L. Motley, who found a congenial subject in the revolt of the Dutch from Spanish tyranny. W. H. Prescott wrote on 16th-century Spain and its empire; his works, especially *History of the Reign of Ferdinand and Isabella* (1837) and *Conquest of Mexico* (1843), were not only literary masterpieces but also showed notable ability to organize in systematic fashion great masses of historical facts. Nationalistic writing was usually interlaced with political liberalism and involved the gathering of historical source material which began with the publication (1829–30) of Jared Sparks's documents on the American Revolution. Bancroft was as much a nationalist as a romantic and no other historian has matched the eloquence and ardour with which he set forth the American story down to the administration of George Washington. Richard Hildreth carried the record down to the Missouri Compromise and James Schouler was the first historian to cover the period from the making of the constitution to the end of Reconstruction; neither could match the fervour or colour of Bancroft, but their books were more accurate and less biased. The most vigorously nationalistic writer on the period from the constitution to the Civil War was the German liberal scholar Hermann von Holst, who supported the abolition of slavery and upheld national unity against state rights. Vigorous national pride and military ardour permeated the writings of Theodore Roosevelt on the history of the extension of the frontier beyond the Allegheny mountains. Two efforts, influenced by European writing, were made to write a national history of the United States on a broader basis than politics: the first, by Woodrow Wilson (*A History of the American People* [1902]), was more readable than impressive; the second, the four volumes produced by Charles Austin Beard and his wife, Mary, between 1927 and 1942, stressed economic, social and intellectual development.

Critical methods in historical writing were chiefly produced by contact with German scholarship, but French and British scholarship had some influence. German historians gained prestige after 1857; the first graduate historical seminar was established at Johns Hopkins university by Herbert Baxter Adams in 1881, and the school of political science at Columbia university was founded by J. W. Burgess in 1880. Both contributed to the creation of an indigenous school of critical historians. Among the more substantial products dealing with American history are Edward Channing's incomplete history of the United States, the masterly work of H. L. Osgood on the colonial period and of J. G. Randall and Allan Nevins on the Civil War and its antecedents. The best anthology of this critical scholarship at the turn of the century was embodied in the "American Nation Series," edited by A. B. Hart. In other fields J. H. Breasted wrote on ancient Egypt, H. C. Lea on the medieval church, and C. H. Haskins and G. B. Adams on medieval history.

As in Europe, what came to be known as the "new history" was a revolt against the more or less exclusive concern with institutions and political events, and its rise in the United States is associated with J. H. Robinson, who was as much influenced in his later years by Thorstein Veblen as he had been earlier by H. C. Lea. He christened the new trend in his very influential collection of essays entitled *The New History* (1911). Robinson's personal interests lay chiefly in intellectual history but he also emphasized the importance of social, economic and cultural factors in history. The *Intellectual and Cultural History of the Western World* (1941; rev. ed. 1963) by H. E. Barnes put into substantial printed form the whole panorama of Robinson's most immediate concerns in the field of history.

As in Europe, the expansion of the conception of historical writing and the increased specialization in research led to the production of co-operative historical undertakings of which the first notable achievement was the *Narrative and Critical History of America* (1884–89), edited by Justin Winsor, followed by the "American Nation" cited above. An entirely new "American Nation Series" was edited by H. S. Commager and R. B. Morris. The outstanding co-operative work devoted to social history was the *History of American Life*, edited by D. R. Fox and A. M. Schlesinger. Regional projects have been produced, such as the *History of the South*, edited by W. H. Stephenson and E. M. Coulter, while the main co-operative work on European history is the *Rise of Modern Europe*, edited by W. L. Langer.

The first effort to cover the outstanding statesmen and politicians in biographical form was the "American Statesmen Series," edited by J. T. Morse and published in 39 volumes between 1882 and 1917. But the most important biographies have been individual products, among them S. E. Morison's biography of Columbus, D. S. Freeman's exhaustive treatment of George Washington and Robert E. Lee, Dumas Malone's life of Thomas Jefferson, Irving Brant's able work on James Madison and A. J. Beveridge's masterly studies of John Marshall and Abraham Lincoln.

2. Trends Peculiar to the United States.—The great masterpieces on American colonial history were those by H. L. Osgood and C. M. Andrews; Osgood's was completed as planned but Andrews' was left about half finished at his death. Perhaps more original and stimulating than either was C. W. Alvord's *The Mississippi Valley in British Politics*, which shifted emphasis from the eastern seaboard to the vast new region west of the Alleghenies. The most extensive work on this period is *The British Empire Before the American Revolution* by L. H. Gipson, which dealt with the British empire as a whole and interpreted the antecedents of the American Revolution in a manner very favourable to Great Britain. The most novel work on the colonial era has been that of H. E. Bolton and his students, mainly at the University of California. They advanced beyond the older concentration on the English colonies and the Atlantic seaboard and even beyond the emphasis on the role of the French, seeking to integrate the Spanish achievements into a well-rounded conception of the colonization of the United States. The outstanding work on the American Revolution was produced by C. H. Van Tyne. This corrected many of the biases of the extreme nationalist historians and treated the British more fairly. The social and institutional history of the period was treated best, if briefly, by J. F. Jameson and E. B. Greene. There has been no monumental work on the period of the confederation and constitution making, and any detailed comprehension of the period must be derived from piecing together material from the masterly biographies of the leading public figures.

For the era of Thomas Jefferson and James Madison, one of the great landmarks of American historical writing is the nine-volume *History of the United States From 1801 to 1817* (1889–91) by Henry Adams. There is no real masterpiece on the rise of democracy and the westward movement. The nearest approach was the extensive work of J. B. McMaster, which covered the period from the constitution to the Civil War in the spirit of J. R. Green's social history. The most influential historian dealing with the westward movement and its relation to democracy was F. J. Turner, who founded a whole school that followed up his inspiration and suggestions. Turner did not write extensively on this theme, but he stimulated a veritable library of books devoted to the subject. The best work of synthesis is by R. A. Billington, *Westward Expansion: a History of the American Frontier* (1949).

The struggle over slavery, the Civil War and Reconstruction produced an even more extensive historical literature than the

colonial period. Earlier work was followed by the impressive enterprises of J. F. Rhodes, Allan Nevins, J. G. Randall and others and the volumes on Reconstruction that grew out of the seminar of Professor W. A. Dunning at Columbia.

Rhodes's *A History of the United States From the Compromise of 1850* in its original form covered the period from the antecedents of 1850 to the end of Reconstruction in 1877. Although not a professional historian, Rhodes wrote in scholarly and dependable fashion and his work has remained the great classic on this convulsive era. While strongly opposed to slavery, he wrote without venom of the South and its leaders and strongly criticized the Northern excesses in the period of Reconstruction. Much the same viewpoint was taken by Nevins in his eight-volume series. Randall has done the most complete work on Abraham Lincoln in relation to both the political and military problems of the Civil War, while the best works on the military history of the Civil War are those of Douglas S. Freeman on Robert E. Lee and of K. P. Williams on Lincoln and his generals. The best statement of the southern point of view is in *Life and Labor in the Old South* by U. B. Phillips. At the outset of his work on the United States from 1865 to 1901, E. P. Oberholtzer repeated Rhodes's criticism of the severity and corruption of the Northern rule during Reconstruction, but the scholarly reinterpretation of this period was the work of Dunning and his students, and this view was popularized in Claude Bowers' *The Tragic Era*. It has been challenged, however, by J. H. Franklin in his *Reconstruction: After the Civil War* (1961).

The period since Reconstruction has produced no monumental work comparable to that of Rhodes, although Rhodes carried his story briefly down to 1909 in two later volumes, and Oberholtzer dealt with the period from 1877 to 1901. Neither author had any real comprehension of the triumph of business after Reconstruction or of its implications for political life. This crucial development must be gathered from biographies, books on the growth of American industry and finance, monographs on businesses, accounts of technological developments and histories of labour unions. The best synthesis in this field is *The Age of Enterprise: a Social History of Industrial America* (1942) by T. C. Cochran and W. Miller. The most impressive work on the influence of economic developments and ideas is Joseph Dorfman's *The Economic Mind in American Civilization* (1946–49), while the most authoritative summary of social and institutional developments in the 20th century was contained in the co-operative work *Recent Social Changes* (1929), edited by William F. Ogburn.

Imperialism and interventionism received considerable attention, inspiring A. T. Mahan's work on *The Influence of Sea Power Upon History, 1660–1783* (1890), J. W. Pratt's *The Expansionists of 1898* and A. K. Weinberg's *Manifest Destiny*. The definitive work on the United States' role in World War I is C. C. Tansill's *America Goes to War*, one of the finest contributions to American diplomatic history. The policy of F. D. Roosevelt in entering World War II was defended by W. L. Langer and S. E. Gleason in *The World Crisis and American Foreign Policy* and criticized by Tansill in *Back Door to War* and by C. A. Beard in *President Roosevelt and the Coming of the War, 1941*. The best official work on the naval aspect of the war is the 14-volume history of American naval operations by S. E. Morison and his associates. Because the cold war followed closely on the heels of World War II, historical writing on recent events was less objective than it had been after World War I.

Writings on American cultural history are creditably represented by the volumes of V. L. Parrington, M. E. Curti and R. H. Gabriel on intellectual history, H. W. Schneider on philosophy, E. P. Cubberley on education, Dirk Struik on science, Sigfried Giedion on technology, F. R. Packard and R. H. Shryock on medicine, Van Wyck Brooks on literature and O. W. Larkin on art.

The conception of American history has transcended the boundaries of the United States: the history of Latin America has been undertaken by J. F. Rippy and others, while J. T. Shotwell edited an ambitious 25-volume co-operative work on Canadian-American relations and C. F. Wittke and J. B. Brebner produced good general surveys of Canadian history. (H. E. Bar.)

H. Russian

1. Early Chronicles.—The history of Russia from the 9th to the 17th centuries was recorded in the form of chronicles and other narratives, based primarily on Byzantine models. Few of the narratives dealing with the earliest period survived. Of these the most important is the Primary Russian Chronicle, compiled in Kiev in the 12th century. Chronicles were also compiled in Novgorod and other princely towns. Together with charters and treaties, these narratives provide the principal source of information about Russian affairs not only at the height of the Kievan period but also in the era of Mongol domination and during the subsequent years in which the modern Russian state was being established. The earlier accounts were written by monks in a traditional form in which supernatural events and the parochial interests of individual princes played a large role, but by the 16th century the chronicles began to reflect a more general outlook.

2. Later Trends.—In the course of the 17th and 18th centuries the secular began to replace the religious in Russian intellectual life and European influences were introduced both by Russians who had familiarized themselves with western culture and by German scholars brought in under the auspices of the Academy of Sciences established in 1725. Among the former V. N. Tatishchev was the most prominent and among the latter G. F. Müller and A. L. von Schlözer undertook the systematic collection and interpretation of the widely scattered documentary sources that had survived the neglect of earlier centuries. In the 19th century the writing of history evolved rapidly from the patriotic general accounts of N. M. Karamzin and M. P. Pogodin, and the encyclopaedic compilation of S. M. Soloviev, to the work of a new generation of historians who combined knowledge of the sources with a sound grasp of the principles of historical interpretation. For these scholars, two general fields of study were of particular interest. One was the evolution of Russian legal institutions, studied by A. D. Gradovski, V. I. Sergeevich and N. M. Korkunov, among others. The other was concerned with the peasantry, the commune, civil strife and social change. The most distinguished scholar in this field was V. O. Klyuchevski, whose published lectures (5 vol., 1904–21) are still widely regarded as the outstanding general interpretation of Russian history. Two scholars, Sir Paul Vinogradoff and E. A. Kosminski, made valuable contributions to the study of medieval English village communities.

Among the scholars whose careers spanned the tsarist and the Soviet periods, A. E. Presnyakov on the 15th and 16th centuries and S. F. Platonov on the 16th and 17th achieved a new level of synthesis because of the variety of specialized studies on which they could draw. A greater interest was also displayed in regional history, and in this category the work of M. S. Hrushevski on the Ukraine and of M. K. Lyubavski on the grand duchy of Lithuania was particularly important. P. N. Milyukov, whose long career embraced many aspects of Russian social and cultural history, was at the same time an outspoken liberal critic of tsarism. M. N. Pokrovski, who wrote the first general Marxist interpretation of Russian history (5 vol., 1910–13), also became involved in politics. In interpreting their country's history, most Russian scholars were in agreement in seeing essential differences between traditional Russian institutions and those of western Europe. An important minority, however, was inclined to identify Russia's development much more closely with that of Europe. They saw an essential similarity between Russian serfdom and European feudalism and assumed that a modern Russia was following in the footsteps of the west as regards the development of political, economic and social institutions.

3. The Communist Era.—After the revolution a number of prominent historians went into exile, where they stimulated a new interest in Russian history and produced such important multivolume interpretations as those of P. N. Milyukov and others (3 vol., 1931–33) and of G. V. Vernadski and others (10 vol., 1943–). New trends of interpretation also arose among the exiled scholars and of these Eurasianism was the most distinctive. The Eurasians were impressed by the significance of both the Asian and the European influences on Russian institutions and be-

lieved that the continental size and multinational character of modern Russia gave its history greater complexity and more significant dimensions than were reflected in the traditional conceptions of Russia and its relationship to Europe. Within the Soviet Union historical scholarship came under the close supervision of the Communist party and the most important academic and administrative positions now went to the Marxist historians headed by Pokrovski. His Marxist interpretation stressed the contrasts between Soviet and tsarist institutions but later came under criticism for failing to recognize those aspects of the Russian tradition on which a new patriotism could be built. After the 1930s the Communist party directed historians to stress the achievements of their country in all fields of endeavour, the success of such great leaders as Ivan the Terrible and Peter the Great in crushing the domestic and foreign enemies of the Russian state, and the inevitability of a world communist society of which the Soviet Union is the prototype. Some historians have developed these themes and have played an important role in molding public opinion. Others have made distinctive contributions in the reinterpretation of early Russian charters and treaties, in the publication of documents and specialized studies concerning economic history, the revolutionary movements, the various nationalities of the U.S.S.R. and in the preparation of bibliographical aids and other reference works. (C. E. B.)

I. Islamic

Historiography constitutes a large proportion of the literary output of the Islamic peoples. It is an expression of a strong sense of tradition, consciousness of past glories and awareness of the fundamental unity and privileged position of the Islamic community, analogous to the medieval European conception of Christendom. Patterns set in Arabic historiography were followed with great success in Persian and Turkish and, more recently, in the less extensive literatures of Hausa and Swahili in Africa and Malay in Asia. That a similar phenomenon failed to materialize in Urdu is due simply to the fact that Indian historians preferred to write in Persian.

1. Arabic.—Arabic historiography covers the period A.D. 750 to 1650, apart from a few works of the 20th century. Before the Islamic era (from A.D. 622) the Arabs had no prose literature, although tales of tribal battles (the "Days of the Arabs") and genealogical tables of individuals and tribes were retailed orally. Not until they had built up a world empire stretching from the Atlantic to India and several generations had passed since the death of Mohammed (*q.v.*) did any strong sense of history appear. Early historical writings were largely biographical and were intended as an aid to religious studies by verifying events and vouching for reliability of transmitters of Hadith, the name given to the teachings and life of Mohammed. They used the *isnad* system of Hadith, whereby each incident was supported by a chain of authority showing the passing on of the account from an eyewitness through a succession of intermediaries of subsequent generations to the actual historian himself. In this early period (8th and 9th centuries) history was termed *akhbar* (plural of *khabar*, "information," "story"), and was written as a series of rather disjointed incidents. Mention must be made of the life of the Prophet by Ibn Ishaq, available only in the revision by Ibn Hisham. Ibn Sa'd (d. 845) wrote the collected biographies of the Prophet and his companions. Another early historical form was the short monograph on a restricted topic, such as a particular campaign. Local history is exemplified by the history of Mecca by al-Azraqi (d. *c.* 858).

Toward the end of the 9th century the general history became popular. Such works dealt predominantly with the Islamic world but they also gave some account of pre-Islamic history, based on biblical and Persian sources. In addition, earlier Arabian tribal history was included along with some reference to Greek and Indian culture. For the Islamic period, political facts predominated, and the annalistic method was employed. A new term for "history" was used, *tarikh* ("dating"). *Isnads* were given to support statements, but later historians omitted them, merely quoting previous historians. Ya'qubi, in his world history, takes the caliph's reign as the annalistic time unit, but the most famous of all Arabic histories, the *Annals* of al-Tabari (d. 923; *see* Tabari, al-), recounts events year by year. This is a brilliant work, tiresome though the annalistic method is, and it was freely drawn on by later historians. Among these was Miskawayh (d. 1030), who in his vivid *Tajarib al-Umam* treats the past as an example for the present. Last among the major general histories is the *Kamil* of Ibn al-Athir (d. 1234), which abridges and completes Tabari. Later historians, with a longer period to cover, used longer units for their annals—the decade, the reign or even the century.

The history (*Kitab al-'Ibar*) of Ibn Khaldun (d. 1406) must be mentioned here for its Introduction ("muqaddimah"), now available in Franz Rosenthal's translation (*Ibn Khaldun, The Muqaddimah*, 3 vol., 1958, with a good introduction). This is, for its time, unique in seeking to show a pattern in the rise and fall of nations, in which environment plays an important role. According to Rosenthal (*A History of Muslim Historiography*, p. 104, 1952), Ibn Khaldun showed "fundamental originality," his great achievement being "the application of scattered political and sociological ideas to history, which he recognized as a living force joining the past with the present in one continuous process." He did not, however, found a school of historians and was merely "a unique interruption in the course of Muslim historiography."

The breakup of the Islamic empire encouraged the writing of local histories, many of which were eulogies of petty dynasties. Such works, besides chronicling political events, often contained useful topographical sections. But the plan which found favour in large-scale works was to devote the bulk of a local history to the collected biographies of famous local figures. Outstanding examples are the history of Baghdad by al-Khatib al-Baghdadi (d. 1071) and that of Damascus by Ibn Asakir (d. 1176).

Arabic historiography was eclipsed with the domination of the Arab world by the Ottoman Turks. The last great historian was al-Maqqari (d. 1632), whose subject was Arab Spain.

2. Persian.—Persian historiography dates back to 963, when al-Bal'ami completed his abridged translation of Tabari, *Tarjamah i Tarikh i Tabari*. Henceforward Persian historiography, tremendous in bulk when works written in India are included, followed Arabic models. Among the most famous works is the history of Genghis Khan and the Mongol conquests by Juvaini, written in the ornate rhymed prose also found in later Arabic historiography. Among the many histories of Timur (Tamerlane), Yazdi's *Zafarnama* (1424) is the best. In Mogul India many official histories were written in Persian, notably the *Akbar-nama* (life of the emperor Akbar) by Abu'l Fazl.

3. Turkish.—Bal'ami's translation of Tabari was further translated into Turkish by Nasuh Matraqci in 1520. The most famous Turkish histories, however, are two histories of the Ottomans: the *Tac üt-tevarih* by Sadeddin (d. 1599) and the year-by-year history by Naima (d. 1716). *See* also Arabic Literature; Persian Literature. (J. A. Hd.)

J. Indian

1. Early Historical Writing.—Hardly any historical writing has survived from ancient India. To explain this it has been argued that the growth of a historical sense must have been impeded by Hindu beliefs, with their implication that the affairs of the world in a degenerate era were unworthy of serious study. The fabulous doings of mythical kings in a golden age seemed more edifying. On the other hand it has been argued that references to the keeping of archives and genealogies suggest that there was at least some interest in the past. But apart from eulogistic biographies of kings and other documents in which the distinction between legend and fact was very tenuous, the only historical work to have survived is a verse chronicle of the kings of Kashmir, Kalhana's *Rajatarangini* (Eng. trans. by M. A. Stein, *A Chronicle of the Kings of Kashmir*, 2 vol., 1900). Writing in the 12th century A.D., Kalhana stressed the importance of treating the past with the impartiality of a judge and was not afraid to criticize previous chroniclers, though he himself was somewhat credulous. Believing that the world was in a state of decline, he emphasized

the virtue of resignation and saw the working of karma and fate underlying the course of history.

Muslim writers, whose religion had a historical founder, showed a greater interest in history and a more precise sense of chronology, writing in the context of a tradition of Muslim historiography from outside India. Their concern was with the doings of Muslim rulers, and their method was to narrate rather than explain. The inscrutable will of God often seemed a sufficient explanation. The writings of Abu'l Fazl (1551–1602) are outstanding, for besides narrating in eulogistic fashion the history of Akbar's reign he also paid detailed attention to the administrative system of the Mogul empire at a time when it was at the peak of its efficiency. A notable study of its decline and of the rise of the English East India company was completed in 1783 by Ghulam Husain Khan in his *Siyar-al-Muta'akhkhirin* ("Manners of the Moderns"), which combined a vivid though detailed narrative with a degree of analysis. First translated into English in 1789, it was treated as authoritative by James Mill and was praised by Macaulay. (*See* also H. M. Elliot and J. Dowson, *The History of India as Told by Its Own Historians: the Muhammadan Period*, 8 vol., 1867–77; P. Hardy, *Historians of Medieval India*, 1960.)

2. Period of British Rule.—Under British rule the writing of Indian history was conditioned by European ideas and methods of research. James Mill used original sources, especially those published in parliamentary papers, for his *History of British India* (6 vol., 1817), but also used utilitarian principles to condemn Indian ideas and customs. More sympathy for Indian ways was shown by James Grant Duff in his *History of the Mahrattas* (3 vol., 1826) and by Mountstuart Elphinstone in his *History of India* (2 vol., 1841). Unlike Mill, both these historians had had personal experience of India as servants of the English East India company. Another of the company's officers, James Tod, showed his respect for the traditions of the Rajputs and made use of their bardic literature in his *Annals and Antiquities of Rajasthan* (2 vol., 1829–32), though he was perhaps too eager to find among them institutions similar to those of feudal Europe. The Sanskrit scholar H. H. Wilson, who had also served in India, disagreed with Mill's criticisms of Hindu civilization, but characteristically expressed his views only by annotating Mill's *History*.

Mill had also criticized many aspects of British policy in India and subsequent historians were equally outspoken. J. D. Cunningham was removed from his post in the company's political service as a result of criticisms, in his *History of the Sikhs* (1849), of British policy leading to the first Sikh War. But after the mutiny and the rise of nationalist feeling in India, greater caution prevailed among British writers of Indian history. With the idea of counteracting the liberal tendency, inspired by Edmund Burke and Mill, to believe that British power was founded on injustice, both Sir James Fitzjames Stephen and Sir John Strachey set out to defend the reputation of Warren Hastings, the former in his *Story of Nuncomar and the Impeachment of Sir Elijah Impey* (1885), the latter in his *Hastings and the Rohilla War* (1892). The task of providing such moral justifications soon came to weigh less heavily on British historians, but the need for a strong government to prevent the disorder that had prevailed in India in the 18th century and in earlier periods of disunity remained one of their recurrent themes. The policies and administrative problems of the British government remained their major concern. The rise of the nationalist movement was almost ignored by V. A. Smith in his *Oxford History of India* (1919). Scant attention was paid to the economic, social or intellectual life of the people under British or Muslim rule in the monumental *Cambridge History of India*, the publication of which began in 1922. Even W. H. Moreland's pioneer studies of Indian economic history in the Muslim period contained the implication that conditions were better under British rule. The political situation also influenced Indian writers. Criticism of British land revenue policy was one of R. C. Dutt's chief aims in his *Economic History of India* (2 vol., 1901–03). The desire to show that Hindu achievements had rivaled those of the west was a strong motive in other historians. Thus R. K. Mukherji stressed India's former maritime progress in his *Indian Shipping* (1912) and argued, in his *Local Government in Ancient India* (1919), that democracy could be found in the ancient Indian village. In general, Indian historians have taken more interest than their western colleagues in the Hindu period. The writing of a chronological narrative of the political events of that period has often taken priority over analysis and explanation, partly because of the difficult nature of the evidence.

3. Period of Independence.—After 1947 more attention was paid to economic, social and intellectual history. In the large-scale *History and Culture of the Indian People*, undertaken by Indian historians under the editorship of R. C. Majumdar and A.D. Pusalker, more space than usual was allotted to the Hindu period and the 18th century was to be treated as a time of Maratha dominance rather than merely as one of preparation for British rule. The first volume was published in 1951. (KE. A. B.)

K. Chinese

1. Earliest Histories.—Traditional Chinese thought was notably historically minded; in the official classification of literature, history ranked next after the Confucian canonical books, and a knowledge of the histories was a required part of a conventional education leading to official rank. Even popular literature relied heavily on the historical past for plots and characters. The earliest surviving records, the oracle bones of An-yang (15th–11th centuries B.C.), like the state documents collected later to form the *Book of Documents* (*Shu Ching*), were recorded by a class of professional scribe-diviners who also had charge of the calendar. The earliest histories in the full sense were the annalistic records of the feudal kingdoms of the Chou period (*c.* 1122–256 B.C.) produced by the same authorities. Of these only the *Spring and Autumn Annals* (*Ch'un Ch'iu*) of the state of Lu, the editing of which is traditionally ascribed to Confucius and which became part of the canon, and the corrupt text of the *Bamboo Annals* (*Chu-shu chi-nien*) of the state of Wei survive. They are dry court chronicles of isolated facts of ritual or political importance. No attempt was made to join them into a connected account, but great care was taken in fixing the precise date of events. In the *Spring and Autumn Annals* an attempt was also made to express moral judgments by the use of a vocabulary implying approval or disapproval.

Simultaneously freer styles of narrative history also arose. There were three main types: collections of anecdotes recounting notable decisions taken by rulers, or counsel offered by their ministers, such as the *Discourses of the States* (*Kuo-yü*) and the later *Stratagems of the Warring States* (*Chan-kuo ts'e*); romances centring around some famous person; and anecdotal narrative histories, one or more of which were broken up and appended to the *Spring and Autumn Annals* as the *Tso Commentary* (*Tso Chuan*). These works lacked both the rigid chronological framework and the exclusively court-centred ritualistic interests of the state annals and were less highly valued.

2. Official Dynastic Histories.—With the unification of China under the Ch'in emperors in 221 B.C., the records of the old feudal states were deliberately destroyed, but compilation of records by court historians continued. Under the Han emperors, Ssu-ma Ch'ien (*c.* 145–90 B.C.) completed a design begun by his father, who had been grand historian before him, to write a complete history of China down to his own day. This book, the *Historical Records* (*Shih Chi*), was the first masterpiece of Chinese historiography and provided the model for many later works. It comprised a strictly chronological section of basic annals modeled upon the old annalistic style, dealing with the acts of successive emperors. Also included were chronological tables of various types; memoirs giving integrated accounts of particular aspects of government; sections on the hereditary houses of the old feudal kingdoms; and a section of biographies, accounts of various categories of notable people and of foreign nations. Much of the material in this last section was folklore and romantic tradition similar to the old narrative histories. Pan Ku (A.D. 32–92), in compiling his *History of the Former Han*, adopted the plan of the *Historical Records*, omitting the feudal families but limiting his period to a single dynasty. This plan was followed by the long series of official dynastic *Standard Histories* which continued the

record down to 1911 (including the *Draft History of the Ch'ing* [*Ch'ing-shih kao*], completed in the 1920s). The earlier dynastic histories, like the *History of the Former Han*, were largely written by individual historians using official archives. From the T'ang period (618–906), however, a highly organized College of Historians (*Shih yüan*) took charge of the compilation, not only of the histories of former dynasties but also of the materials from which the history of their own times would be written.

Diarists compiled a daily record of the activities of the court that were later supplemented from official documents and worked up into a chronological *Veritable Record* (*Shih-lu*) of the reign. From these, *National Histories* (*Kuo shih*) were written periodically. They were comprehensive histories dealing with a reigning house and were often later incorporated in the *Standard History* of the period. These official compilations were scissors-and-paste histories composed largely of official documents. The contribution of the historian was normally limited to personal judgments on persons and affairs which were strictly separated from the record itself and to implicit criticism by omission. The purpose of the histories was, however, primarily didactic; they were to provide emperors with a mirror of the past, a standard by which to judge their own conduct as well as an official dynastic record. Increasingly, they became collections of precedents for administrative procedure. Their value was restricted by their concentration on the court and the capital, by their piecemeal compilation, often followed by very hurried editing, and by their limitation to a dynastic period. This often imposed upon history a stereotyped pattern of dynastic prosperity and decay and prevented the description of longer-term developments.

3. Historical Criticism.—Criticism of this system was common, even among the bureaucrat historians. Liu Chih-chi (661–721), whose *Shih-t'ung* was the first great work of historical criticism, attacked both the form of the histories and the means by which they were compiled. Later in T'ang times Tu Yu in *T'ung-tien* (*Comprehensive Institutions*) and Su Mien in *Hui-yao* (*Collected Acts*) produced a new genre of administrative history. Tu Yu's work was an encyclopaedic history of institutions from the earliest times, collecting systematically large numbers of documents on a great range of topics. This type of institutional encyclopaedia was frequently imitated later and provides important source material.

The Sung period (960–1279) was noteworthy not only for the great increase in the writing of various private nonofficial histories but also for the development of critical techniques in writing history. Ssu-ma Kuang (1019–86) wrote the *Comprehensive Mirror for Aid in Governing* (*Tzu Chih T'ung Chien*), a continuous narrative history of China from 403 B.C. to A.D. 960, which is probably the finest single historical work in Chinese, and at the same time compiled a separate work (*Kao-i*) dealing with the discrepancies in his very numerous sources and giving his reasons for preferring certain authorities. Equally meticulous was Li Hsin-chuan's *Chien-yen i-lai hsi-nien yao-lu*, a chronicle of the early southern Sung period (1127 onward), where the author not only records divergent records of the facts but cites classical authority and precedent for the exact terms in which he records events.

A final flowering of historical criticism took place in the late 17th and 18th centuries as part of the general revival of Ch'ing scholarship. Many works of detailed textual criticism were written upon the standard works of the past. A number of other scholars, notable among them Chao I (1727–1814) and Chang Hsüeh-cheng (1738–1801), sought for historical themes other than the dynastic cycle. The scope of history was also broadened to include subjects such as historical geography.

4. Local Histories.—Local histories (*Fang-chih*) exist in great numbers from the 10th century onward. They began to flourish on a large scale in southern and central China under the Ming dynasty (1368–1644) and under the Ching dynasty were compiled for the whole empire, often as a result of official policy. Biographies, family histories and Buddhist historical works abounded. With the possible exception of the last named, all share certain characteristics with the official and semiofficial works. Events were recorded in isolation, no connection or causal relationship was attempted and original documents were quoted rather than the writers' summary of a situation. Chinese historiography is incomparably rich in source material and has a long tradition of meticulous textual criticism. But, largely because of the long-standing authority of the official histories, there have been comparatively few attempts at large-scale synthesis and, save for some notable exceptions, little interest in the fundamental causes and patterns of events.

5. Modern Influences.—With the introduction of western learning in the later 19th century, Chinese historians, like Chinese intellectuals as a whole, suffered a revulsion against the past. The first wave of "modern" or nontraditional historians were iconoclasts, who questioned the validity of the records of the distant past with which they were primarily concerned. Representative of these was Ku Chieh-kang. This tendency was reversed during the 1930s, when archaeological discoveries gave clear and astonishing proof of the accuracy of many of the records which had been called in question. The next generation of young historians fell under the spell of the Marxist interpretation of history. After bitter schisms in the late 1920s and 1930s, good work was later produced. Parallel to the movement toward Marxist history the old tradition of meticulous scholarship, textual editing and the collection and publication of sources has continued, and since the victory of Communism in 1949 these two tendencies—to doctrinaire Marxism and to pure textual scholarship—have characterized historical production. (D. C. Tw.)

L. Japanese

1. Early Writings.—Japanese historical methods derived largely from China in antiquity and from the west in modern times, though in the interim some native forms were evolved. The deliberate sinification of the Japanese polity and culture, at its height in the 7th and 8th centuries A.D., included historiography. Imperially appointed committees were commanded to produce histories apparently intended to be comparable to the Chinese dynastic works. Written in Chinese, in annalistic form and based on Chinese calendars, they were dynastic and administrative histories. The first and most celebrated, the *Nihongi* or *Nihon Shoki* ("Chronicles of Japan"), appeared in A.D. 720. Apparently legitimist in intention, no distinction was made between the account of the divine origin of the dynasty and the description of contemporary events. Even so, there are signs that the compilers had some notion of the importance of care in the use of sources, frequently submitting alternative versions of events (often, it is true, mythical ones). Dynastic claims thus established, subsequent official chroniclers adopted the Chinese view that the function of history was didactic. The official series ended at A.D. 888; its reliability for the 8th and 9th centuries is considerable, although the range of interest is slight.

During the 11th–15th centuries a number of popular historical tales were written by private authors in Japanese prose. Though still somewhat constricted by chronological schemes, these were no longer focused on the enfeebled throne: some dealt with great Fujiwara statesmen; and in the last there is an approach to thematic treatment of the struggle between the court nobles and the military at the beginning of the feudal period. This type of history, derived from successful works of fiction, contained some imaginative colouring but enough verifiable material to repudiate the term "historical romance."

The abandonment of Chinese as the medium of historical writing symbolized some degree of cultural independence, but Japanese historians tended to become insular. During the feudal period, until the establishment of the Tokugawa shogunate in 1603, only one official committee was appointed—in the 13th century—while individual historians followed the popular histories to produce more searching and sophisticated works. In the 13th and 14th centuries they selected from the ancient chronicles and the recent past events justifying their own Buddhist or Shintoist attitudes to contemporary politics. The rigours of the chronological scheme were mitigated by purposive selection or omission of events, together with explicit interpretation and argument. Characteristic

works were the *Gukanshō*, written in the 13th century by a Buddhist with Confucian ideas of political morality, and the *Jinnō Shōtōki*, a Shintoist work, whose title, "Records of the True Descent of the Divine Emperors," proclaims its own bias, though modified Confucian morality was invoked even in this work.

2. Tokugawa Period.—In the Tokugawa period (1603–1868) a huge quantity of historical writing was produced and advances were made in the techniques of research and presentation. There were works officially sponsored by the Tokugawa, compiled by individuals or by teams, as well as works by private authors. Most historians reverted to the use of Chinese and often explicitly used Chinese histories as models—tending, therefore, to perpetuate the limited annalistic form of the earliest histories.

The first of the official histories was the *Honchō Tsugan*, a chronical compiled by a single scholar and covering Japan's history down to 1611. The most important was the huge and meticulously collated *Dai Nihonshi* ("Great History of Japan,"), initiated in 1657 under the direction of Tokugawa Mitsukuni and not completed for several generations. The work was explicitly modeled on the famous Chinese history, the *Shih Chi*. The *Honchō Tsugan* favoured the military group, the Bakufu, exclusively: the compilers of the *Dai Nihonshi*, though working for the Tokugawa, claimed that their purpose was to glorify the imperial line and yet they also supported the Bakufu supremacy. This seeming ambiguity is found in other works of the period and was considered in the 19th century to justify those who wished to restore imperial power at the expense of the Bakufu.

Arai Hakuseki (1657–1725), a statesman as well as a scholar, developed more sophisticated modes of arrangement and presentation while maintaining standards in research. In his most important work, the *Dokushi Yoron*, he abandoned the chronicle form, subdividing the 9th to 16th centuries to provide didactic illustrations for a shogun. A Confucian and a supporter of the institution of the Bakufu, he investigated the rise and fall of successive shogunates. Unbiased historical interpretation is not to be expected of a man in his position, nor is it found in his work, but his iconoclastic approach to Japanese mythology (in his *Koshitsū*) and his innovations in method give him a more modern appearance than any other historian of the period.

While the nature of the regime ensured that most works should in some way support the Bakufu, there was already, in the middle of this period, growing up a body of scholars intensely loyal to the imperial line. These men, of whom the most celebrated and extreme was Moto-ori Norinaga (1730–1801), devoted themselves principally to the ancient chronicles and the heyday of the imperial glory. They sought to purify the native Shintō tradition of all foreign accretions. Thus their work was more religious, antiquarian and linguistic than historical, but they founded a native school of historiography that still flourishes.

The opening of Japan in the mid-19th century profoundly affected Japanese historiography. Western works were translated, their methods and attitudes adopted or adapted, those of the school of the German historian, Leopold von Ranke, proving at first particularly influential and congenial to the native tradition. Since then Japanese historical works have embodied most of the attitudes and methods of modern western historiography, while their range has been extended, with much emphasis on economic history.

3. Restoration Period.—Though socially and culturally the Meiji restoration represented modernization, there was also present an element of political and historical reaction. It is natural, therefore, that an early governmental measure was the creation of an office for the collection of historical material, which is now the Shiryō Hensanjo, the Historiographical institute of Tokyo university. The office was also ordered to produce the *Dai Nippon Hennenshi*, an immense work in Chinese and in chronicle form, intended to be a continuation of the *Dai Nihonshi* and to emphasize the legitimacy of the new regime. This was abandoned in 1893, partly because of the difficulty of reconciling the old methods with the new, of which one of the project's leading spirits, Shigeno Yasutsugu, was very conscious. It remains true that Japanese writing of Japanese history has been less fruitfully invigorated by western influence, probably because many of the scholars engaged in it tend to have little or no knowledge of western languages and so lack direct insight into modern techniques of research and textual criticism.

The occupation of Korea, Manchuria and part of China led to the historical study of these territories for administrative purposes. Whatever the motive, Japanese scholars have contributed greatly to our historical knowledge of these regions. It is in this field that recent Japanese historians, working with more erudition and industry than imagination and originality, have made their greatest contribution.

II. METHODOLOGY

The methodology of history does not differ in broadest outline from that of other disciplines in its regard for existing knowledge, its search for new and relevant data and its creation of hypotheses. It is the same for all historical writing, success depending on skill and experience, and division of the past on temporal or topical lines merely reflects the human limitations of historians. Although historical methodology has four facets, the more skilled the historian the less he gives them conscious consideration, and any historian is likely to be concerned with two or more concurrently. The four facets are heuristic, knowledge of current interpretation, research and writing.

The first two may be briefly considered. Heuristic has been adopted as a convenient term for the technique of investigation that can be acquired solely by practice and experience. In the case of the historian it embraces such things as knowledge of manuscript collections, methods of card indexing and classifying material and knowledge of bibliography. It underlies other aspects of methodology as in knowledge of the capabilities of historians working in the same and similar fields or in the power of dealing expeditiously with documentary material. The necessity for knowledge of current interpretation is based on the working principle that inquiry proceeds from the known to the unknown; and the historian has to be well acquainted with existing work in his own field, in contiguous historical fields and in allied disciplines. The work in each case consists of both "fact" and interpretation, and the amount the historian accepts will vary. In his own field he will normally not accept facts, and certainly not current interpretation, on trust; in contiguous historical fields he will accept facts and current interpretation by experts in those fields, but qualified by heuristic and his general historical knowledge; in allied disciplines, such as anthropology, economics, geography, natural science, philology, psychology, sociology, he must unless there is strong evidence to the contrary presume the technical skill and intellectual honesty of scholars in those fields. There is, of course, no reason why a historian cannot be reasonably versed in one or more of these and other disciplines, and should the nature of his enquiry demand it he must be.

Historical research is the term applied to the work necessary for the establishing of occurrences, happenings or events in the field with which the historian is concerned. Knowledge of these is entirely dependent on the transmission of information from those living at the time, and this information forms what is known as the source material for the particular period or topic. The occurrences themselves can never be experienced by the historian, and what he has at his disposal are either accounts of occurrences as seen by contemporaries or something, be it verbal, written or material, that is the end product of an occurrence. These accounts or end products have been variously termed relics, tracks or traces of the occurrences that gave rise to them; and from them the historian can, with varying degrees of certainty, deduce the occurrences. The traces are thus the "facts" of history, the actual occurrences deductions from the facts; and historical research is concerned with the discovery of relevant traces and with deduction from those traces insofar as this will aid the search for further relevant traces.

1. Source Material.—Source material falls into three groups which can be differentiated as written, material and traditional. Written source material has two subdivisions, literary, sometimes called subjective, and official. The first consists of events as seen

through the eyes of an individual and therefore as interpreted by him, normally entailing selection of occurrences or attribution of motive. The second subdivision, the official, consists of records produced in transacting business at any level from individual to international. The information given is basically in statement form, impersonal, and containing only the most superficial suggestions of causation and motivation. In practice the boundary between literary and official sources is blurred and a document may contain elements of both. The second main division, material source material, consists of objects that have resulted from activities of human beings in the past. The third group, traditional source material, covers what is handed on verbally or as practices, although later generations may commit such things to writing. Obvious examples are archaic forms, traditional practices, nursery rhymes, folklore and place names. Comparison with parallel source material and knowledge of current interpretation will normally show the historian whether his particular source can be presumed true, partially true or faked. If true or partially true allowance has to be made for the subjective element in literary and some traditional sources and for the difficulty of reconstructing the events themselves from the traces surviving in official, material or other traditional sources.

The classification of source material is essentially pragmatic, based on the differing techniques required in handling sources of the different groups: an inscribed tombstone, for example, can be either a written or a material source depending on whether the historian's concern is with the content of the inscription or with the stone. Specialized training in what are sometimes known as ancillary disciplines may, depending on the nature of his investigation, be necessary for the historian. The most important of these are archaeology, chronology, diplomatic, epigraphy, heraldry, numismatics, paleography and sigillography. It need hardly be said that the historian must have competence in the languages used in his source material. Many historians give part of their time to the editing of source material. This is not historical writing but is of use to other historians in the same field. The collection of facts as an end in itself, is, however, antiquarianism not history, and the essential end product of historical investigation is the historian's own writing.

2. Using Source Material.—The question of what history is belongs to the philosophy rather than the methodology of history. The word history itself is used ambiguously to describe both the past and what is written about the past; but it is this second meaning that is relevant to the working definition that history is the past experience of society. For what reasons society may wish to utilize its past experience is not the concern of the historian, whose task is to make available to society that past experience and to record it for future reference. An individual utilizing his own past experience has to recall the significant elements of that experience with accuracy and establish their causal and chronological relationships. The historian behaves similarly concerning the past experiences of society; but the reconstruction of events from traces, the selection of those relevant to his task, and the establishing of relationships allow a varying freedom of choice by the historian, which thus introduces the subjective element of the historian's personality. This cannot be eliminated from historical writing and the historian's aim is to make the margin of intellectual error as small as possible. The handling of source material demands only care and technical competence, and it is mainly in the construction of hypotheses and in the establishing of relationships that this intellectual error can enter. A check is provided by the opinions of other historians working in the same field. His work will, if accepted, become part of current interpretation, sometimes described as accepted history, but as with all current interpretation subject to revision by himself or others.

Historical methodology has become more clearly formulated during the last century, but there have been historians at times long past whose work can be judged by present-day standards. There are, however, certain important differences between present and the general run of past methodology. Much medieval writing, for example, bows to precedent in literary sources and in current interpretation, and uncritical acceptance of an earlier writer's work can occur century after century. The comparative neglect of official sources by the majority of European historians before the 19th century gave no corrective to literary sources. The greatest impediment to the development of modern methodology lay, however, in the varying concepts of history, some of which survive today. The concept of history as a form of literature made it a type of imaginative art on which judgment was passed on grounds of elegance rather than accuracy. Closely allied with this is the "ethical" concept of history where historical writing became a series of value judgments on individuals and actions. The converse of this was the impossible "objective" or "scientific" history of the later 19th century, although it did popularize the concept of research and developed the ancillary disciplines. The use of history for propaganda purposes is in its crudest form virtually a branch of fiction and thus independent of research; in its more subtle forms it can encourage accuracy in research, but it will encourage also the suppression of inconvenient traces and intellectual dishonesty in the elucidation of relationships. In this it indicates one of the main impediments to methodological and historical development: the holding by the historian of a priori theories or laws to which all events and relationships must conform, whether it be the theory of divine intervention in human affairs favoured in medieval times or the Marxist theory current over much of the modern world. (C. F. SL.)

III. PHILOSOPHY OF HISTORY

1. Idea of a Design in History.—The belief that it is possible to discern in the course of human history some general scheme or design, some over-all purpose or pattern, is very old, however various may have been the forms in which, at different times and periods, it has found expression. The reasons for its persistence and vitality are numerous, but two very general considerations may be picked out as having, in one way or another, exercised a fairly continuous influence. First, it has often been assumed that, if the belief in an over-all pattern is rejected, it is necessary to acquiesce in the view that the historical process consists in no more than an arbitrary succession of events, a mere agglomeration of occurrences or patchwork of random incidents and episodes. But such a view (it has been contended) cannot be seriously entertained, if only because it offends against the basic demand for system and order which constitutes an ineradicable element in the human mind and consciousness and which pervades and directs all rational inquiry, all meaningful thought about the world, as ordinarily conceived and understood. Secondly, it has frequently been felt that to refuse to allow that history is finally intelligible in the sense proposed implies a skepticism concerning the value of human life and existence which in the last analysis represents an affront to the dignity of human nature itself. Thus, to take one example, Immanuel Kant spoke of the "repugnance" that will inevitably be experienced if we look at the past "as if the whole web of human history were woven out of folly and childish vanity and the frenzy of destruction, so that one hardly knows in the end what idea to form of our race, for all that it is so proud of its prerogatives." And—to move to the 20th century—a similar attitude partly underlies A. J. Toynbee's rejection of the notion that history is "a chaotic, disorderly, fortuitous flux, in which there is no pattern or rhythm of any kind to be discerned" (*An Historian's Approach to Religion*). It has been the aim of a number of works in what is traditionally known as the philosophy of history to demonstrate that such pessimism is unjustified and to show that, despite superficial appearances to the contrary, the historical process, considered as a whole, is both rationally and morally comprehensible.

2. Theological Origins.—European speculation about the meaning of history derived from origins that were chiefly theological. The idea that history conforms to a purposive principle, and that this principle has its source in the wisdom of God, is implicit, for instance, in the conception of the past set forth by St. Augustine in his *De civitate Dei* despite the distinction that is there drawn between sacred and secular history. And more than a thousand years later the Augustinian tradition still survived in

such works as J. B. Bossuet's *Discours sur l'histoire universelle* (1681). Bossuet regarded history as being throughout its course providentially governed: thus, for him, to grasp and understand the great progression of empires and religions which occupies the central place in its forward movement "is to comprehend in one's mind all that is great in human affairs and have the key to the history of the universe." The rise and fall of states and governments depend in the last resort upon the secret orders of Providence; Providence, in fact, is the source of that manifest historical justice and retribution to which, on nearly every page, the annals of the past bear clear and unmistakable witness. Bossuet's vast book made a considerable impression when it was first published; nonetheless it was the last major work of its genre, and the development of historical speculation in the 18th and 19th centuries is marked by a tendency to reject theological and providential interpretations in favour of an approach more closely aligned, in method and aim, to that adopted by natural scientists in their investigations of the physical world.

3. Scientific Approach.—In the eyes of many thinkers of the Enlightenment and post-Enlightenment periods, the project of establishing a science of history and society, comprising hypotheses and laws of a predictive and explanatory power comparable to that attained by theories in the physical sciences, acquired an almost obsessive importance. The age of religious and metaphysical conjecture concerning human affairs had passed; instead it now seemed both necessary and feasible to construct upon the hard data of observed fact and experience interpretations which would not only rescue the human studies from their prevailing condition of ignorance, uncertainty and primitive superstition but which would also put into men's hands an indispensable instrument for foreseeing, and to some extent controlling, their own future development and destiny. Thus the idea of creating a universally valid social and historical science came to be linked in many minds with the promotion of reformist and revolutionary ideals. Condillac and Condorcet, Comte and J. S. Mill, Marx and Engels were all (though in widely varying ways) wedded to the belief that the application of scientific procedures to the study of human affairs was a realizable possibility; but equally they were men deeply concerned with projects of a practical character and committed to schemes involving radical changes in social and political life. Theory was complementary to practice; knowledge was power.

Yet even in the 19th century, when speculation of this type was at its height, there were informed critics—Joseph de Maistre and Arthur Schopenhauer, for example, or the great Swiss historian Jacob Burckhardt—who challenged the optimistic and rationalistic presuppositions upon which it was based and who cast doubt upon the idea that the subject matter of history was amenable to such treatment. It was pointed out, for instance, that notions like that of the perfectibility of man or of there being some foreseeable and desirable goal toward which the course of events was inevitably leading, which played an important role in many of the accounts put forward, were not empirically established truths but mere articles of faith; moreover, in subscribing to them, historical theorists often appeared to be tacitly importing into their allegedly scientific interpretations ancient teleological and metaphysical ideas of a kind which it was their declared intention to banish forever from the sphere of social theory. And in the 20th century these and similar criticisms were repeated and amplified by philosophers and historians alike: it was argued that the high-sounding generalities and concepts appealed to were too vague and imprecise, and too laden with question-begging assumptions, to qualify as scientific in any acceptable sense, and that in any case the complexity and particularity of individual historical occurrences does not permit of their subsumption under universal laws in the proposed manner without doing violence both to the facts themselves and to the ways in which it is natural to describe and interpret them.

Such strictures have considerable force. Nevertheless it can scarcely be denied that, whatever their ultimate shortcomings, the classical philosophers of history contributed in significant ways toward extending the boundaries of human thought and understanding. Their tendency to insist, for example, upon the relevance of scientific modes of procedure to the area of historical and social inquiry at least achieved the salutary effect of throwing into relief the inadequacy and superficiality that chiefly characterized the work previously done in this domain; it also, if indirectly, brought to the fore the entire question of the status of history as a legitimate form of knowledge. For if history should prove resistant to attempts to assimilate it to other accredited branches of investigation, it would become necessary to show why this is so and to exhibit, carefully and exactly, those features of historical thinking that lend it its distinctive and irreducible character.

4. Theories of Vico and Herder.—Among the 18th-century theorists two writers can, in fact, be picked out who had sufficient genius and prescience to realize that a fruitful approach to the problem of establishing history as a reputable discipline might, after all, lie along lines different from those suggested by the success of the natural sciences and who in this respect anticipated much later thought on the subject. Giambattista Vico's *Scienza nuova* (1744) was a work whose importance remained for a long time unrecognized, partly, no doubt, because of the obscure and scholastic manner in which the Italian philosopher expressed his ideas. Central to the book is the contention that the kind of knowledge which men can achieve of their own actions, creations and institutions—the material of history—is of a radically different kind from the knowledge that is acquired by the observation and investigation of the nonhuman or "natural" world: indeed, knowledge of the former type is of a superior or "more certain" character. In order truly to know something it is necessary in some sense to have made it, and whereas the reality which the physical scientist studies is the creation of God and therefore only properly known to him, "the world of nations" that forms the subject matter of history is the creation of men and is therefore something that men can "hope to know." Thus Vico was led to stress the differences rather than the analogies between historical and other forms of inquiry and laid emphasis upon the need for the historian to recreate imaginatively the spirit of past ages and the outlooks and attitudes of mind possessed by the men who lived in them, instead of trying to impose upon them inappropriate interpretative models—"pseudomyths"—suggested by ways of thinking and feeling current in his own time. It is true that Vico propounded a cyclical theory of human history, according to which "nations" or cultures pass through determinate stages; he employed it, however, in a manner that underlined man's nature as a historical being, whose powers and capacities do not conform to a fixed and static pattern but are subject to change and development in the course of time; it is not through a priori intuition or through attention to the subjective findings of introspective self-consciousness that we can acquire the deepest insight into what we are (as so many of his contemporaries assumed), but through a critical and sympathetic interpretation of the evidence provided by historical research.

In a somewhat similar manner the German writer J. G. von Herder, in his influential *Ideen zur Philosophie der Geschichte der Menschheit* (1784–91), implied that it was necessary to view human actions and achievements from a standpoint which took proper account of "time, place and national character": in other words, cultural milieu and the inevitable limits imposed by historical situation and circumstance. It was no use, Herder claimed, to look at the things men have done in the past as if they were the manifestations of an unchanging human consciousness and as if they could be explained by reference to abstract universal laws eternally valid for all men at all places; to do this was to fall into error, the error of failing to recognize the complex and pervasive influences which act upon human beings as members of particular societies and as belonging to particular historical periods, and which subtly, but no less inevitably, determine their typical modes of expression and behaviour.

Many of the ideas propounded by Vico and Herder, and later by Hegel, appear sufficiently familiar today, but it is easy to forget that this has not always been so and that the emergence of conceptions comprehended under what in the course of time came to

be known as the "historical sense" is a comparatively recent phenomenon, representing a genuine revolution in European thought; it is largely because of this revolution that social and political theories of the kind put forward in the 17th century by men like Hobbes and Spinoza seem oddly artificial to 20th-century eyes, so remote are the categories in terms of which they exhibited the conditions of human life from those that subsequently found acceptance.

5. Modern Theories.—The task of trying to delineate the specific character of historical knowledge and understanding, rather than that of attempting to construct vast speculative schemes in the earlier manner, has indeed, since the end of the 19th century, increasingly engaged the attention of philosophers concerned with history. To such thinkers as Wilhelm Dilthey, Benedetto Croce and the English philosopher and historian R. G. Collingwood, the claim that, in the absence of some all-embracing system (whether conceived in teleological or quasi-scientific terms), the course of history could be regarded as constituting no more than a meaningless chaos appeared to be entirely unacceptable. History is intelligible in the sense that ordinary working historians make it so, and this is the only kind of intelligibility which it is either necessary or legitimate to demand. What can reasonably be sought is a clearer and deeper insight into the conditions that make historical knowledge possible, the presuppositions upon which historical inquiry rests and from which it proceeds; it was with such an investigation in mind that Collingwood wrote that "the chief business of twentieth-century philosophy is to reckon with twentieth-century history" (*An Autobiography*). Like Croce before him, he wished to see history released from what he termed "its state of pupilage to natural science," arguing that historical explanation radically diverges from the model of understanding proposed by 19th-century positivists and that the historian explains events, not by showing them to be instances of universal laws or regularities, but by exhibiting them as the expressions of past thinking on the part of purposive agents, thinking which he must imaginatively reconstruct or "re-enact" in his own mind.

By suggesting in this way that the philosopher should concern himself with the examination of historical procedures and aims, and that he should relinquish the ambition of providing a synoptic interpretation of the historical process as a whole, Collingwood and his continental predecessors in effect added a new dimension of meaning to the notion of philosophy of history. The desire to discover large-scale patterns and comprehensive cultural uniformities continued to manifest itself in the 20th century in the work of writers like Oswald Spengler, A. J. Toynbee and Pitirim Sorokin; but, with the climate of philosophical opinion predominantly hostile to system building of any kind, such projects for the most part met with a critical response in Great Britain and the United States. Instead, Anglo-American philosophers tended to concentrate upon investigating the terms and concepts which perform a key role in historical description and explanation as this is actually carried on and upon examining such matters as the ways in which historians argue for and substantiate their interpretations, the categories and schemes in terms of which they discuss and arrange their material, and the part played by imagination and understanding in their treatment of human character and motivation.

This type of approach often produced results of considerable interest and value; among other things, a great deal of light was thrown upon features of historical thinking too frequently disregarded by theorists who claimed that history either is, or can without much difficulty be transformed into, "a science." Even so, its adoption was perhaps accompanied by a too ready acquiescence in the view that "history is in order as it is," the philosopher's function being confined to offering a purely descriptive analysis of typical modes of historical argument and narration. Normative and appraisive questions concerning the validity or adequacy of accepted procedures can legitimately arise here, as in other spheres; and there seems to be no compelling reason to assume that such problems necessarily lie beyond the scope of philosophical criticism and evaluation. (P. L. G.)

IV. SOCIETIES AND INSTITUTIONS

The growth during the 19th and 20th centuries in the number of societies and institutions designed to promote the study of history has been remarkable. This flourishing of historical societies, while common to the entire western world, has been particularly notable in France, Germany, Great Britain and the United States.

The following is a list of some of the more important historical societies and institutions, excluding, in general, those not organized on a national or international basis. There is, consequently, no mention of the vast majority of societies devoted to the study of local history, nor of the many societies attached to universities, colleges and schools—probably the most productive of new historical studies. For societies concerned with prehistory and ancient history, *see* ARCHAEOLOGY, SOCIETIES OF. *See* also ACADEMIES.

1. United States.—There are probably more historical societies in the United States than in any other single country. Among the national societies, a dominant position is occupied by the American Historical association (founded 1884; publ. *American Historical Review*)—the principal organization for scholars in all branches of history. There are also the National Historical society (f. 1915) and the Society of American Historians (f. 1939). Numerous national societies exist to promote the study of some particular branch of historical knowledge; for example, the American Catholic Historical association (f. 1919; publ. *Catholic Historical Review*), the American Military institute (f. 1933 as the American Military History foundation; publ. *Military Affairs*), the American Society of Church History (f. 1888; publ. *Church History*), the Association for Asian Studies (until 1956 the Far Eastern association; publ. *Journal of Asian Studies*), the Association for the Study of Negro Life and History (f. 1915; publ. *Journal of Negro History*), the Economic History association (publ. *Journal of Economic History*), the History of Science society (f. 1912; publ. *Isis*), the Institute of Early American History and Culture (f. 1943; publ. *William and Mary Quarterly*), the Medieval Academy of America (f. 1925; publ. *Speculum*), the Mississippi Valley Historical association (f. 1907; publ. *Mississippi Valley Historical Review*), the Society for French Historical Studies (publ. *French Historical Studies*) and the Southern Historical association (publ. *Journal of Southern History*).

There is a great profusion of state historical societies and societies for the study of local history, for which the American Association for State and Local History (f. 1941; publ. *History News, Bulletins*) acts in some degree as a co-ordinating agency. In most of the older states, historical societies tend to be independent, self-supporting organizations; elsewhere they are frequently tied in some way to the state university. Of the state historical societies the most prominent are the Massachusetts Historical society (f. 1791; publ. *Proceedings*), the Historical Society of Pennsylvania (f. 1824; publ. *Pennsylvania Magazine of History and Biography*), the Maryland Historical society (f. 1844; publ. *Archives, Maryland Historical Magazine, Maryland History News*) and the New York State Historical association (f. 1899).

2. Great Britain.—The outstanding national organizations are the Royal Historical society (f. 1868) and the Historical association (f. 1906). The Royal Historical society, fellows of which tend to be drawn principally, though by no means exclusively, from university teaching circles, publishes *Transactions*, the Camden series (it absorbed the Camden society in 1897) and a valuable Guides and Handbooks series. The Historical association has close links with the teaching profession. Apart from its journal, *History*, it publishes an *Annual Bulletin of Historical Literature* and a useful series of pamphlets for students and teachers of history. The Institute of Historical Research, attached to the University of London, helps co-ordinate the research work of graduates from all British universities and of foreign students working on British history; it was founded in 1921, publishes a *Bulletin* and houses various co-operative projects, such as the Victoria County History and the History of Parliament.

The most important of the more specialized societies are the Society of Antiquaries of London (f. *c.* 1586, refounded 1707; publ. *Archaeologia, The Antiquaries Journal*), the Society of

Genealogists (f. 1911; publ. *The Genealogists' Magazine*), the Society for Nautical Research (f. 1910; publ. *The Mariners' Mirror*), the Society for Army Historical Research (f. 1921; publ. *Journal*), the Economic History society (publ. *Economic History Review*), the Scottish History society (f. 1886) and the British Records society (f. 1932). There are county history societies in most British counties.

3. France and Germany.—Outstanding among the French historical societies is the Société de l'Histoire de France (f. 1833; publ. *Annuaires, Bulletins, Mémoires, Textes inédits de l'histoire de France*), which has had an important role in the development of modern European historiography. Other national societies include Société d'Histoire Moderne (f. 1901; publ. *Revue d'histoire moderne et contemporaine*), Association Marc Bloch (f. 1945; publ. *Annales Économies Sociétés Civilisations*), Société d'Histoire Générale et d'Histoire Diplomatique (f. 1886; publ. *Revue d'histoire diplomatique*), Société d'Histoire Ecclésiastique de la France (publ. *Revue d'histoire de l'Église de France*) and Société de l'Histoire de la Guerre (f. 1918; co-operates in publ. *Revue d'histoire de la deuxième guerre mondiale*). There are numerous local history societies—for the ancient provinces of France, for modern *départements* and for groups of *départements*.

In Germany the Gesamtverein der Deutschen Geschichts- und Altertums-vereine (f. 1852; publ. *Blätter für deutsche Landesgeschichte*) has 150 affiliated societies. Local history societies exist for most of the ancient divisions of Germany, those for Prussia and Bavaria being particularly important. National organizations include Verband der Historiker Deutschlands (f. 1949), Monumenta Germaniae Historica (f. 1819; publ. *Deutsches Archiv für Erforschung des Mittelalters*) and Deutsche Orient-Gesellschaft (f. 1898; *Mitteilungen*).

4. Other European Countries.—*Austria:* Instituts für Österreichische Geschichtsforschung (publ. *Mitteilungen*). *Belgium:* Société des Bollandistes (publ. *Analecta Bollandiana*), Société pour le Progrès des Études Philologiques et Historiques (publ. *Revue Belge de philologie et d'histoire*). *Denmark:* Dansk Historisk Forening (publ. *Historisk Tidsskrift*), Det Kongelige Danske Selskab for Faedrelandets Historie, Den Danske Komité for Historikernes Internationale Samarbejde, Dansk Selskab for Oldtids- og Middelalderforskning. *Finland:* Suomen Historiallisen Seura. *Greece:* Historical and Ethnological society. Society for Byzantine Studies. *Italy:* Instituto Storico Italiano per il Medio Evo, Societa Napoletana di Storia Patria, Instituto Storico Germanico. *Netherlands:* Historisch Genootschap. *Norway:* Norsk Historisk Forening (publ. *Historisk Tidsskrift*). *Portugal:* Academia Portuguesa da Historia (publ. *Anais, Boletim*, and source material for Portuguese history), Instituto Português de Arqueologia, História e Etnografia (Lisbon), Instituto de Estudos Históricos (Coimbra). *Spain:* Real Academia de la Historia (publ. *Boletín*). Historical research in Spain is done mainly under the auspices of the Consejo Superior de Investigaciones Científicas (C.S.I.C.). The Patronato "Marcelino Menéndez Pelayo"—for history, philology and art—is one of eight *patronatos* into which the C.S.I.C. is divided and controls various institutes devoted to different branches of history; *e.g.*, Instituto "Fernández de Oviedo" (publ. *Revista de Indias*), Instituto "P. Enrique Flórez" (publ. *Hispania Sacra*). *Sweden:* Kungl. Vitterhets-Historie-och Antikvitets-Akademien (publ. *Fornvännen*, etc.). *Switzerland:* Allgemeinen Geschichtforschenden Gesellschaft du Schweiz (publ. *Schweizerische Zeitschrift für Geschichte*), Société Général Suisse d'Histoire (publ. *Revue Suisse d'histoire*), Société d'Histoire de la Suisse Romande. *Turkey:* Turk Tarih Kurumu (publ. *Belleten*).

5. Latin America.—*Argentina:* Academia Americana de la Historia y de la Ciencia, Academia Nacional de la Historia (publ. *Boletin*), Sociedad de Historia Argentina. *Bolivia:* Academia Nacional de la Historia. *Brazil:* Instituto Histórico e Geográfico Brasileiro (publ. *Revista*). *Chile:* Academia Chilena de la Historia. Sociedad Chilena de Historia y Geografía. *Colombia:* Academia Colombiana de Historia (publ. *Boletín de Historia y Antigüedades*). *Mexico:* Instituto Panamericano de Geografía e Historia (publ. *Revista de Historia de América*), Academia Mexicana de la Historia (publ. *Memoria*), Academia Nacional de Historia y Geografía. *Peru:* Instituto Histórico del Perú. *Venezuela:* Academia Nacional de la Historia (publ. *Boletin*), Sociedad Bolivariana de Venezuela (publ. *Revista*).

6. Other Countries.—*Australia:* Royal Australian Historical Society (publ. *Journal and Proceedings*), Royal Historical Society of Victoria, Historical Society of Queensland, Tasmanian Historical Research association. *Canada:* Canadian Historical association (publ. *Canadian Historical Review*), Institut d'Histoire de l'Amérique Française (publ. *Revue de l'histoire de l'Amérique Française*), Nova Scotia Historical society, Ontario Historical society. *Ghana:* Historical Society of Ghana. *Republic of Ireland:* Irish Historical society (publ. *Irish Historical Studies*). *Jamaica:* Jamaica Historical society (publ. *Jamaican Historical Review*). *Nigeria:* Historical Society of Nigeria (publ. *Journal*).

See also references under "History" in the Index volume.

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HIT, a small walled town of Ramadi *liwa* (province), Iraq, lies on the right bank of the Euphrates, about 60 mi. above Al Fallujah, where the desert plateau of the west approaches close to the river

and provides a high, defensible site. Pop. (1957) 6,808. The town is built on an ancient mound or tell (the site of the ancient Is), and has long been known for its bitumen wells and seepages, which have been exploited over at least 3,000 years for house and road building and the caulking of boats. Hit is also important as the Euphrates crossing-point of the Kirkuk-Mediterranean oil pipelines; and until the decline in river traffic could be regarded as the head of navigation on the Euphrates river. (W. B. Fr.)

HITCHCOCK, THOMAS, JR. (1900–1944), generally regarded as polo's greatest player, was born in Aiken, S.C., Feb. 11, 1900. The son of a 10-goal polo player, Hitchcock became a brilliant defender against Great Britain for the Westchester cup. In 1922 he received his 10-goal rating and dominated polo for the next two decades. In World War II Hitchcock served with the U.S. army air forces as commander of a fighter group. He was killed in an air crash in England on April 19, 1944. *See* also Polo: *United States*. (J. D. McC.; X.)

HITCHIN, a market town, railway junction and urban district of Hertfordshire, Eng., lies 16 mi. N.W. of Hertford by road. Pop. (1961) 24,254. An ancient but flourishing town in an agricultural area, it appears as Hiz in Domesday Book, when it was a royal manor. Timber-framed, gabled and Georgian buildings line its main streets. The church of St. Mary (12th to 15th centuries) has a fine porch and good woodwork. Hitchin priory is an 18th-century mansion on the site of the 14th-century Carmelite foundation of which only part of the cloisters remains. Portions of a 14th-century Gilbertine nunnery appear in The Biggin, a picturesque almshouse. Industries include engineering, building contracting, tanning and parchment making, medicinal distilling and rose growing. There is a twice-weekly market. (Wi. W.)

HITLER, ADOLF (1889–1945), Austrian-born politician who became dictator of Germany in 1933, was born on April 20, 1889, at Braunau-am-Inn, on the Bavarian border. His father, Alois (b. 1837), was illegitimate, and for a time bore his mother's name, Schicklgruber, but by 1876 he had established his claim to the surname Hitler. Adolf never used any other name, and the name Schicklgruber was only revived by his political opponents in Vienna in the 1930s.

Adolf Hitler spent most of his childhood in the neighbourhood of Linz, the capital of Upper Austria, after his father's retirement from the Habsburg customs service. Alois Hitler died in 1903, but left an adequate pension and savings to support his wife and children. Adolf received a secondary education and, although he had a poor record at school and failed to secure the usual certificate, did not leave until he was 16 (1905). There followed two idle years in Linz, when he indulged in grandiose dreams of becoming an artist without taking any steps to prepare for earning his living. His mother was overindulgent to her willful son and even after her death in 1908 he continued to draw a small allowance with which he maintained himself at first in Vienna. His ambition was to become an art student but he twice failed to secure entry to the Academy of Fine Arts. Thereafter he lived a lonely and isolated life, earning a precarious livelihood by painting postcards and advertisements and drifting from one municipal lodginghouse to the next.

Hitler already showed traits that characterized his later life: inability to establish ordinary human relationships; intolerance and hatred both of the established bourgeois world and of non-German peoples, especially the Jews; a tendency to passionate, denunciatory outbursts; readiness to live in a world of fantasy and so escape from his poverty and failure.

In 1913 Hitler moved to Munich. Temporarily recalled to Austria to be examined for military service (Feb. 1914), he was rejected as unfit; but when World War I broke out he volunteered for the German army and joined the 16th Bavarian reserve infantry ("List") regiment. He served throughout the war, was wounded in Oct. 1916 and gassed two years later. He was still hospitalized when the war ended. Except when hospitalized, he was continuously in the front line as a headquarters runner; his bravery in action was rewarded with the Iron Cross, second class, in Dec. 1914, and the Iron Cross, first class (a rare decoration for a corporal), in Aug. 1918. He greeted the war with enthusiasm, as a great relief from the frustration and aimlessness of his civilian life. He found comradeship, discipline and participation in conflict intensely satisfying; and was confirmed in his belief in authoritarianism, inequality and the heroic virtues of war.

Rise to Power.—Discharged from the hospital in the atmosphere of confusion that followed the German defeat, Hitler determined to take up political work in order to destroy a peace settlement which he denounced as intolerable. He remained on the roster of his regiment until April 1920 and as an army political agent joined the tiny German Workers' party in Munich (Sept. 1919). In 1920 he was put in charge of the party's propaganda and left the army to devote his time to building up the party which in August was renamed the Nationalsozialistische Deutsche Arbeiterpartei (of which "Nazi" was an abbreviation). Conditions were ripe for the development of such a party. Resentment toward the victorious powers and economic chaos brought general discontent. This was sharpened in Bavaria, where Hitler lived throughout the 1920s, by traditional separatism and dislike of the republican government in Berlin. In March 1920 a *coup d'état* by the army established a strong right-wing government. Munich became the gathering place for dissatisfied ex-servicemen and members of the *Freikorps* which had been organized in 1918–19 from units of the German army unwilling to return to civilian life, and for political plotters against the republic. Many of these joined the Nazi party. Foremost among them was Ernst Röhm, a member of the staff of the district army command, who had actually joined the German Workers' party before Hitler and who was of great help in furthering his schemes for developing it into an instrument of power. It was he who recruited the "strong-arm" squads used by Hitler to protect party meetings, to attack Socialists and Communists and to exploit violence for the impression of strength it gave. In 1921 these were formally organized under Röhm into a private party army, the SA (*Sturmabteilung*). Röhm was also able to ensure the protection of the Bavarian government, which depended on the local army command for the maintenance of order and which tacitly accepted his breaches of law and his policy of intimidation.

Although conditions were thus favourable to the growth of the party, only Hitler was sufficiently astute to take full advantage of them. When he joined the party he found it small, ineffective, committed to a program of nationalist and socialist principles, but uncertain of its aims and divided in its leadership. He accepted its program, but regarded it only as a means to an end—political power. His propaganda methods and his personal arrogance caused friction with the other members of the committee, resolved when Hitler countered their attempts to curb his freedom by offering his resignation. Aware that the future of the party depended on his power to organize publicity and to acquire funds, they were forced to give in and in July 1921 he became president with unlimited power. From the first he set out to create a mass movement, whose mystique and force would be sufficient to bind its members in loyalty to him. He engaged in unrelenting propaganda through the party newspaper, the *Völkischer Beobachter* (acquired in Aug. 1920), and through a succession of meetings, rapidly growing from audiences of a handful to thousands, where he developed his unique talent for magnetism and mass leadership. At the same time he gathered round him several of the Nazi leaders who later became infamous—Alfred Rosenberg, Rudolf Hess, Hermann Göring and Julius Streicher.

The climax in this rapid growth of the Nazi party in Bavaria came in an attempt to seize power in the Munich *Putsch* of Nov. 1923 (*see* Bavaria), when Hitler and Gen. Erich Ludendorff took advantage of the prevailing lawlessness and opposition to the Weimar republic to force the leaders of the *Land* government and the local *Reichswehr* commander to proclaim a national revolution. When released, however, they rescinded the proclamation. When placed on trial, Hitler, although his part in the *Putsch* had been far from glorious, characteristically took advantage of the immense publicity afforded to him. He also drew a vital lesson from the *Putsch*—that the movement must achieve power by legal means. He was sentenced to prison for five years, but served only nine months, and that in comfort at Landsberg. He used that time to prepare the first volume of *Mein Kampf*.

Hitler's ideas included little that cannot be traced to earlier writers or to the commonly accepted shibboleths of Viennese radicalism in his youth. He regarded inequality between races and individuals as part of an unchangeable natural order, and exalted the "Aryan race" as the sole creative element of mankind. The natural unit of mankind was the *Volk*, of which the German was the greatest; and the state only existed to serve the *Volk*—a mission which the Weimar republic betrayed. All morality and truth was judged by this criterion; whether it was in accordance with the interest and preservation of the *Volk*. For this reason democratic government stood doubly condemned. It assumed an equality within the *Volk* which did not in fact exist; and it supposed that what was in the interests of the *Volk* could be decided by discussion and voting. In fact the unity of the *Volk* found its incarnation in the *Führer*, endowed with absolute authority. Below the *Führer* the party (which Hitler often called the "movement," to distinguish it from democratic parties) was drawn from the best elements of the *Volk* and was in turn its safeguard.

The greatest enemy of Naziism was not, in Hitler's view, liberal democracy, which was already on the verge of collapse. It was rather the rival *Weltanschauung*, Marxism (which for him embraced Social Democracy as well as Communism), with its insistence on internationalism and class conflict. Behind Marxism he saw the greatest enemy of all, the Jew, who was for Hitler the very incarnation of evil, a mythical figure into which he projected all that he feared and hated.

During Hitler's absence in prison, the Nazi party disintegrated through internal dissension. In the task of reconstruction after his release he faced difficulties that had not existed before 1923. Economic stability had been achieved by currency reform and the Dawes plan; the republic had become more respectable. Hitler was forbidden to make speeches, first in Bavaria, then in many other German states (these prohibitions remained in force until 1927–28). Nevertheless the party grew slowly in numbers, and in Feb. 1926 Hitler successfully established his position against Gregor Strasser, who had built up a rival Nazi movement in north Germany.

The slump of 1929 opened a new period of economic and political instability. Hitler made an alliance with the Nationalist Alfred Hugenberg in a campaign against the Young plan. Through it Hitler was able for the first time to reach a nation-wide audience with the help of Hugenberg's Nationalist party organization and the newspapers it controlled. It also enabled him to commend himself as a gifted agitator to the magnates of business and industry who controlled political funds and were anxious to use them to establish a strong right-wing, antiworking-class government. The subsidies he received from the industrialists placed his party on a secure financial footing and enabled him to make effective his emotional appeal to the lower middle class and the unemployed, based on his proclamation of his faith that Germany would awaken from its sufferings to reassert its natural greatness. Like his later intrigues with the conservatives, Hitler's dealings with the Nationalists and the industrialists provide a striking example of his skill in using those who sought to use him.

Mass agitation and unremitting propaganda, set against the failure of the government to achieve any success in internal or external affairs, produced a steadily mounting electoral strength for the Nazis, who became the second biggest party in the country with more than 6,000,000 votes at the 1930 election. Hitler opposed Hindenburg in the presidential election of 1932, capturing 36.7% of the votes on the second ballot (*see* GERMANY: *History*).

Placed in a very strong position by his unprecedented mass following, he took part in a series of intrigues for the support of the aging president, in which the other principal participants were Franz von Papen, Gen. Kurt von Schleicher, Otto Meissner and Oskar Hindenburg. In spite of a decline in the party's votes in Nov. 1932, he held to the chancellorship as the only office he would accept, and this by constitutional, not revolutionary, methods. Throughout, he showed a unique ability to exploit conditions favourable to success. He created the Hitler myth; he propagated it by every device of mass agitation, and with an actor's ability to be absorbed in the role which he created for himself. Yet all the time he remained a shrewd and calculating politician, aware of the weaknesses of his own position, perceiving more quickly than anyone else how a situation could best be turned to his own advantage. In Jan. 1933 he reaped his reward when Hindenburg invited him to be chancellor of Germany, and he took office with the support of Papen and Hugenberg, and with Field Marshal Werner von Blomberg as minister of defense.

Hitler's personal life grew more relaxed and stable with the added comfort that accompanied the success of the party. After his release from prison he went to live on the Obersalzberg, near Berchtesgaden. His income at this time was derived in a haphazard manner from party funds and from writing in nationalist newspapers. When he became chancellor he accepted the material comforts that followed, but remained independent of them. He was indifferent to clothes and food, never smoking or drinking tea or coffee, far less alcohol. He continued, even as *Führer*, to rebel against routine or regular work—a characteristic which he ascribed to his artistic temperament.

When he went to live at Berchtesgaden his half sister Angela Raubal and her two daughters accompanied him. Hitler became devoted to one of them, Geli, but his possessive jealousy drove her to suicide in Sept. 1931. For weeks Hitler was inconsolable. Later Eva Braun, a shop assistant from Munich, became his mistress. Hitler rarely allowed her to come to Berlin or appear in public with him and would not consider marriage on the grounds that it would hamper his career. Eva was a warmhearted girl with no intellectual ability. Her great virtue in Hitler's eyes was her unquestioning loyalty, and in recognition of this he made her his legal wife at the end of his life.

Dictator: 1933–39.—Once in power, Hitler proceeded to establish an absolute dictatorship. He secured the president's assent for new elections on the grounds that a majority in the *Reichstag* could not after all be obtained. The *Reichstag* fire, on the night of Feb. 27, 1933 (apparently the work of a Dutch Communist, Marinus van der Lubbe), provided an excuse for a decree overriding all guarantees of freedom, and for an intensified campaign of violence. In these conditions, the Nazis polled 43.9% of the votes. In March the *Reichstag* assembled in the Potsdam garrison church, a theatrical gathering designed by Hitler to show the unity of his own movement with the old conservative Germany, represented by Hindenburg. Two days later an enabling bill, giving full powers to Hitler, was passed in the *Reichstag* by the combined votes of Nazi, Nationalist and Centre party deputies.

Thus far successful, Hitler had no desire to carry too far a radical revolution. Conciliation was still necessary if he was to succeed to the presidency and retain the support of the army; nor had he ever intended to disappropriate the leaders of industry, provided they served the interests of the Nazi state. Ernst Röhm was the chief protagonist of the "continuing revolution"; he was also, as head of the SA, greatly distrusted by the army. Hitler tried first to secure Röhm's support for his policies by persuasion and by giving him government office, but failed to win him over. Göring and Heinrich Himmler were eager to remove Röhm but Hitler hesitated until the last moment. Finally, on June 29, 1934, he reached his decision. Röhm and his lieutenant Edmund Heines were executed without trial, together with Gregor Strasser, Schleicher and a variety of other victims. The army leaders, satisfied at seeing the SA broken up, approved Hitler's actions. When Hindenburg died, on Aug. 2, they, together with Papen, assented to the merging of the chancellorship and the presidency—with which went the supreme command of the armed forces of the *Reich*—and officers and men took an oath of allegiance to Hitler personally. Economic recovery and a reduction in unemployment (coincident with world recovery, but for which Hitler took credit) made the regime more acceptable, and a combination of tyranny and success brought the support of 90% of the voters in a plebiscite.

In power, Hitler devoted little attention to the organization and running of the domestic affairs of the Nazi state. Responsible for the broad lines of policy, as well as for the system of terror which upheld the state, he left detailed administration to his subordinates. Each of these exercised arbitrary power in his own sphere, but by deliberately creating offices and organizations with overlapping au-

thority Hitler effectively prevented any one of these private empires from ever becoming sufficiently strong to challenge his own absolute authority.

Foreign policy claimed his greater interest. His objectives were laid down in *Mein Kampf*, and Hitler worked toward them with consummate skill. He had early admired the pan-Germanism of the Austrian Georg von Schönerer, and the reunion of the German peoples was his first ambition. Beyond that, the natural field of expansion lay eastward, in Poland, the Ukraine and Russia—expansion which would necessarily involve renewal of Germany's historic conflict with the Slav peoples, who would be subordinate in the new order to the Teutonic master race. He regarded Fascist Italy as a natural ally in this crusade against bolshevism, provided their rivalry in central Europe could be overcome, and was ready to abandon the Germans of the Tirol to this end. Britain was a possible ally provided it abandoned its traditional policy of maintaining the balance of power in Europe and limited itself to its interests overseas. France alone in the west was the natural enemy of Germany, and must therefore be subdued to make possible expansion eastward.

Before such expansion was possible it was necessary to remove the restrictions placed on Germany by the treaty of Versailles. Hitler used all the arts of propaganda to allay the suspicions of the other powers. He posed as the champion of Europe against the scourge of bolshevism and insisted that he was a man of peace who wished only to remove the inequalities of the Versailles treaty. Germany withdrew from the disarmament conference and from the League of Nations (Oct. 1933), but Hitler hastened to sign a nonaggression treaty with Poland (Jan. 1934). Every repudiation of the treaty was followed by an offer to negotiate a fresh agreement and insistence on the limited nature of Germany's ambitions. Only once did he overreach himself, when the Austrian Nazis, with the connivance of the German embassy, murdered Chancellor Engelbert Dollfuss of Austria, and attempted a *coup d'état* (July 1934). The attempt failed, and as Mussolini moved troops to the frontier Hitler disclaimed all responsibility, and sacrificed those who had acted with his sanction. In Jan. 1935 a plebiscite in the Saarland returned that territory to Germany, and Hitler took the opportunity to renounce any further claims on France. In March of the same year he announced the introduction of conscription, and although this provoked the united opposition of Britain, France and Italy at the Stresa conference of the League of Nations, his peace propaganda was sufficiently successful to permit the negotiation of a naval treaty (June 1935) with England, involving the abandonment of the Versailles treaty. His greatest stroke came in March 1936, when he used the excuse of a pact between France and the Soviet Union to remilitarize the Rhineland—a decision which he took against the advice of his own general staff. Meanwhile the alliance with Italy, foreseen in *Mein Kampf*, rapidly became a reality as a result of the sanctions imposed by Britain and France against Italy; in Oct. 1936 the Rome-Berlin axis was established; shortly afterward came an anti-Comintern pact with Japan, and these two were linked a year later.

By 1937–38 a new stage had been reached. In Nov. 1937 Hitler outlined his plans of future conquest (beginning with Austria and Czechoslovakia) to a secret meeting of his military leaders. He now dispensed with the services of those who were not wholehearted in their acceptance of Nazi dynamism—Hjalmar Schacht, who declared Germany's further rearmament a danger to its economy, Werner von Blomberg and Werner von Fritsch, representative of the caution of professional soldiers, and Konstantin von Neurath, Hindenburg's appointment at the foreign office.

In Feb. 1938 Hitler invited the Austrian chancellor, Kurt von Schuschnigg, to Berchtesgaden and forced him to sign an agreement giving the Austrian Nazis virtually a free hand. When Schuschnigg attempted to repudiate the agreement and announced a plebiscite on the question of an *Anschluss* with Germany, Hitler immediately ordered the occupation of Austria by German troops. The enthusiastic reception which Hitler himself received decided him to settle the future of Austria by outright annexation. He returned in triumph to Vienna, the scene of his youthful humiliations and hardships. No resistance was encountered from Britain and France. Hitler had taken special care to secure the support of Italy, and when this was forthcoming proclaimed his undying gratitude to Mussolini.

Having given assurances that the *Anschluss* would not affect Germany's relations with Czechoslovakia, Hitler proceeded at once with his plans against that country. Konrad Henlein, leader of the German minority in Czechoslovakia, was instructed to agitate for impossible demands on the part of the Sudetenland Germans, thereby enabling Hitler to justify the annexation of Czechoslovakia. But the willingness of Britain and France to compel the Czech government to cede the Sudetenland areas to Germany presented Hitler with the choice between substantial gains by peaceful agreement and even greater acquisitions by a spectacular war against Czechoslovakia. Mussolini's intervention appears to have decided him, and he accepted the Munich agreement on Sept. 30—only to feel resentment immediately afterward at being cheated out of an impressive military conquest.

It was to be expected therefore that Hitler would waste no time in provoking an occasion for occupying the whole of Czechoslovakia. This he did by fostering Slovak discontent. On March 16, 1939, from the Hradcany castle in Prague, he proclaimed the dissolution of the state whose existence he, as an Austrian, had always regarded as unnatural. Immediately afterward the Lithuanian government was forced to cede Memel (Klaipeda) on the northern frontier of East Prussia, to Germany.

Hitler was now ready to advance toward the ultimate objective of *Lebensraum* in the east. Confronted by an uncompromising Poland, guaranteed by Britain and France, he strengthened the alliance with Italy (the "pact of steel," May 1939) and negotiated a nonaggression pact with the Soviet Union signed on Aug. 23—just within the deadline set for an attack on Poland before the winter. He still disclaimed any quarrel with Britain, but to no avail, and the invasion of Poland (Sept. 1) was followed two days later by a British and French declaration of war.

Throughout these years Hitler had pursued unwaveringly the objectives of his foreign policy as they had been laid down in *Mein Kampf*. He showed astonishing skill in judging the mood of the democracies and exploiting their weaknesses—in spite of the fact that he had scarcely set foot outside Austria and Germany and spoke no foreign language. Up to this point every move had been successful—even his anxiety over British and French entry into the war was dispelled by the rapid success of the war in Poland. The result was to convince him more and more of his own infallibility, and to induce him to push ahead still faster with his plans for conquest.

World War II.—Hitler from the first had assumed direction of the major strategy of the war. When the success of the campaign in Poland failed to lead to the peace negotiations with Britain for which he had hoped, he ordered the army to prepare for an immediate offensive in the west. Bad weather, however, provided the reluctant generals with the opportunity to postpone the western offensive and this in turn led to two major changes in planning. The first, on the suggestion of Adm. Erich Raeder, commander in chief of the navy, was Hitler's order to occupy Denmark and Norway in April 1940. Hitler took a close personal interest in the operation, and from this time his intervention in the detail of military operations was to grow steadily greater.

The second was the adoption of Gen. Erich von Manstein's plan for an attack through the Ardennes (opened May 10) instead of through the Low Countries. Against his generals' advice Hitler held back Gen. Heinz Guderian's tanks south of Dunkerque, thus enabling the British to organize the evacuation from Dunkerque. But the campaign as a whole was a brilliant success and Hitler could claim the major credit for its over-all planning. On June 10 Mussolini entered the war on the side of Germany, and at the end of June, Hitler avenged the treaty of Versailles by signing an armistice with France on the site of the Armistice of 1918.

The next step was the subjugation of Britain by aerial bombardment, followed by invasion. But in the summer of 1940 long-term preparations were begun for the invasion of the Soviet Union, and as the expected surrender of Britain still failed to materialize, the eastern campaign quickly came to dominate Hitler's conception of

the grand strategy of the war to the exclusion of everything else. The Soviet Union had occupied eastern Poland and Bessarabia, and Hitler sought to counter any further moves by forcing the governments of Hungary and Rumania to accept an agreement which he dictated, and by urging the abandonment of Mussolini's plans for the invasion of Greece. Mussolini, however, piqued at being kept in ignorance of Hitler's intentions, invaded Greece; and the lack of success of the Italian armies made it necessary for German forces to come to their aid in the Balkans and north Africa. Hitler's plans were further disrupted by a *coup d'état* in Yugoslavia in March 1941, overthrowing the government which had made an agreement with Germany. Regarding this as an insult to Germany and himself, Hitler immediately ordered his armies to subdue Yugoslavia. The campaigns in the Mediterranean theatre, although successful, remained subordinate to the eastern offensive, with which Hitler was so preoccupied that he lost the opportunism and flexibility which he had shown in political affairs. Even when Raeder and Erwin Rommel urged Hitler to destroy the whole British middle east position by a final blow at Suez, he would spare no more forces from Operation "Barbarossa."

The attack against the U.S.S.R. was launched on June 22, 1941, with Hitler so confident of success that he refused to provide winter clothing and equipment for his troops. The German army advanced swiftly into the Soviet Union but failed to destroy its Russian opponent. Hitler became completely overbearing toward his generals. He disagreed with them about the object of the main attack and he wasted time and strength by failing to concentrate on a single objective, by frequently reversing his own decisions. In Dec. 1941 an unexpected Russian counterattack made it clear that Hitler's hopes of a single campaign would not be realized.

The next day came the Japanese attack on Pearl Harbor. Hitler precipitately declared war on the United States—although the pact with Japan was purely defensive and he had not been informed of the Japanese intentions. Misled by an essentially central European view of world politics he apparently took no account of the force which a mobilized United States could bring to bear in Europe.

Hitler's conduct throughout 1942 was marked by further errors of judgment—he paid insufficient attention to the Mediterranean and the Atlantic at a time when a relatively small additional effort in those theatres might have been decisive. In the Soviet Union his continued unreadiness to concentrate on a single objective probably forfeited the opportunity to capture Stalingrad while it was still lightly defended.

Meanwhile he directed Himmler to prepare the ground for the "new order" in Europe. The concentration camps were expanded, and there were added to them extermination camps such as Auschwitz and Mauthausen, as well as mobile extermination squads. The Jews of Germany, Poland and the Soviet Union were most numerous among the victims; in German-occupied Europe between 4,500,000 and 5,500,000 had been killed by the end of the war as the only solution in Hitler's view to the Jewish "problem." (This approximate total is a compromise between the 6,000,000 quoted during the Nürnberg trials and the 4,500,000 later admitted by German sources.) The sufferings of other races were only less when measured in numbers killed. Such barbarism was indiscriminate, even where, as in the Ukraine, Hitler might have encouraged nationalist feelings to his own advantage.

At the end of 1942 defeat at El Alamein and at Stalingrad brought the turning point in the war, and Hitler's character and way of life began to change. Hitherto the success which he had imagined had been largely realized, but to preserve the world of fantasy from defeat and failure he isolated himself more and more from reality. Directing operations from his headquarters in the east, he refused to visit bombed cities or to read reports of setbacks; those close to him, especially Martin Bormann, his secretary, took care that only pleasing information reached him; and he became increasingly dependent on his physician, Theodor Morell, and the injections which he supplied. Even so, he had not yet lost the power to react vigorously in the face of misfortune. After the arrest of Mussolini in July 1943 and the Italian armistice, he not only directed the occupation of all important positions held by the Italian army but ordered the kidnapping of Mussolini, with the intention that he should head a new Fascist government. On the eastern front, however, the refusal to withdraw led only to greater losses without any possibility of holding up the Soviet advance. Inevitably, relations with his army commanders grew increasingly strained, the more so with the growing importance given to the SS divisions, directly responsible to Hitler. Meanwhile the failure of the U-boat campaign and the bombing of Germany made more evident how reduced were the chances of victory.

All these factors made more desperate the few soldiers and civilians who were ready to remove Hitler and negotiate a peace. Several attempts were planned in 1943–44; the most nearly successful was made on July 20, 1944, when Col. Graf Claus von Stauffenberg exploded a bomb at a conference at Hitler's headquarters in East Prussia. But Hitler escaped, with superficial injuries, and with few exceptions those implicated in the plot were executed. The destruction of the army's independence was now made complete, and National Socialist political officers appointed to all military headquarters.

Thereafter Hitler was increasingly ill and fatigued; but he did not relax or lose control over the Nazi party or the army, and he continued to exercise an almost hypnotic power over his close subordinates, none of whom was able to wield any independent authority. In Dec. 1944 he moved his headquarters to the west, to direct an offensive in the Ardennes for which the last reserves of manpower were mobilized. When it failed, his hopes for victory became ever more visionary, based on the use of new weapons, or on the breakup of the grand alliance, especially after the death of Roosevelt. Far from trying to save what could be rescued from defeat, he ordered mass material destruction, and condemned his armies to death by refusing to allow surrender.

From Jan. 1945 Hitler never left the chancellery in Berlin or its bunker, abandoning a plan to lead a final resistance in the south as the Russians closed in on Berlin. In a state of extreme nervous exhaustion, prematurely senile if not insane, he at last accepted the inevitability of defeat, and thereupon prepared to take his own life, leaving to its fate the country over which he had taken absolute command. Before this, two further acts remained. In the small hours of April 29 he married Eva Braun, the ceremony being performed by one of Goebbels' staff. Immediately afterward he dictated his political testament, justifying his career and appointing Karl Dönitz as head of the state and Josef Goebbels as chancellor.

On April 30 he said farewell to Goebbels, Martin Bormann and the few others remaining, then retired to his suite and shot himself, while Eva took poison. In accordance with his instructions their bodies were burned.

Summary.—Hitler's success must be attributed to the susceptibility of postwar Germany to his own unique talents as a political leader. His rise to power was not inevitable, and any change in a complex conjunction of circumstances might have relegated him to the obscurity and failure of his youth; yet there was no one who equaled his ability to exploit and shape events to his own ends. The power which he wielded was unprecedented, both in its scope and in the technical resources at its command; but he made no permanent contribution, moral or material, to mankind. His originality and distinctiveness lay in his methods rather than his ideas and purpose, which were shared in whole or in part by millions of people, in Germany and elsewhere. By the time he was defeated he had broken down the whole structure of the world in which he lived and inaugurated a new era with even greater potentialities of power and destruction.

See also references under "Hitler, Adolf" in the Index volume.

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(A. Bk.; W. Kp.)

HITTITES. The rediscovery of this people, which alongside Egypt and Mesopotamia constituted one of the principal powers of the near east in the 2nd millennium B.C., is a signal achievement of orientalist scholarship during the late 19th and the early 20th centuries. The interpretation of Hittite written records has raised from oblivion the whole political, social, juridical, linguistic, religious and artistic culture of a great nation.

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I. RESEARCH AND DISCOVERY

Prior to the advent of modern historical scholarship the notion and very name form of Hittites had been canonized in modern languages through the accepted translations of the Bible. The total knowledge of the "Hittites" (the "Hethiter" of Luther's German rendering; the "Héthéens" of French tradition) was derived from the Old Testament, which bore witness to the Hebrews' familiarity with an ethnic designation *Hittim*. At the time of the arrival of the Jews the Hittites figured as one of a number of tribes inhabiting Palestine; *e.g.*, Amorites, Canaanites and Jebusites (Gen. xv, 19–21; Josh. i, 4; iii, 10). This was matched by traditions of early dealings between Jews and Hittites (Gen. xxiii, 3 ff.; xxvi, 34; xxxvi, 1–3; Ezek. xvi, 3). In Gen. x. 15 Heth is described as one of the sons of Canaan, and Num. xiii, 29 delimits the topographical distribution of ethnic units in Palestine ("the Hittites, the Jebusites, and the Amorites dwell in the hill country"). In the time of Solomon, however, the Hittites were grouped with such foreigners as Moabites, Ammonites, Edomites and Sidonians who helped to stock the royal harem (I Kings xi, 1). Especially two references to "kings of the Hittites" pointed to considerable political stature and military significance. Solomon provided Egyptian horses for the kings of the Hittites and the kings of Syria (II Chron. i, 17) and according to II Kings, vii, 6 the king of Israel hired the kings of the Hittites and the Egyptians against the Syrian host, causing it to "flee in the twilight."

When in the course of the 19th century Egyptian and Mesopotamian records became intelligible, historical evidence on the Hittites began to supplement biblical tradition. Such Pharaohs of the 18th dynasty as Thutmose III were shown to have had dealings with the "Heta," and Ramses II of the 19th dynasty had purportedly triumphed over them in a great battle at Kadesh in Syria, followed later by a peace treaty inscribed in the temple walls at Karnak. The annals of Assyrian kings from Tiglath-pileser I (*c.* 1100 B.C.) down to *c.* 700 B.C. were found to abound in references to military dealings with the "land of Hatti," a grouping of small city-states in northern Syria and the Cilician region.

Simultaneously archaeological discoveries in Asia Minor and northern Syria added tangible remains of previously unknown civilizations. Searching for the Galatian city of Tavium, the French explorer Charles Texier in 1834 found vast city ruins of obscure provenance near the village of Bogazkoy (*q.v.*) in north-central Anatolia. A long succession of travelers (*e.g.*, William Hamilton, Georges Perrot, Karl Humann, Ernest Chantre) subsequently visited the site during the 19th century and provided a preliminary mapping of readily accessible surface finds. As early as 1812 the Swiss scholar J. L. Burckhardt reported seeing a stone covered with peculiar hieroglyphic writing built into a house wall at Hamath (Hama). From 1870 onward such reports were multiplied by other travelers, not only from Hamath, Aleppo and other Syrian localities but also from Asia Minor. There they were associated with characteristic rock carvings and reliefs found all the way from Cilicia to Bogazkoy and even in the Smyrna (Izmir) region on the west coast.

In 1880 the British archaeologist Archibald Sayce ascribed this plethora of dispersed material to the Hittites, whose onetime control of the entire area was thus asserted, as implied also in the title of *The Empire of the Hittites*, a book published by William Wright with Sayce's collaboration in 1884.

The discovery of the archives of the 18th-dynasty Pharaoh Ikhnaton at Tell el-Amarna in 1887 supplied new evidence. Political texts in Akkadian, the contemporary language of diplomacy, confirmed that the Hittites had been a great power in the 14th century B.C. and that their central habitat was to be sought not in Syria but in Asia Minor. The archives contained two letters in intelligible cuneiform writing exchanged between a king of Arzawa and Pharaoh Amenhotep III, the father of Ikhnaton. The unknown Arzawa language of those letters was seen also on tablet fragments found by Chantre at Bogazkoy in 1893, and seemed to have had wide extension in Asia Minor. In 1902 the Norwegian Assyriologist J. A. Knudtzon claimed Indo-European affinities for the Arzawa language, but general skepticism soon forced him to recant.

In 1906 excavations were begun for the German Oriental society by Hugo Winckler at the site of Bogazkoy, in the great bend of the Kizil Irmak river (the classical Halys). Vast archives of cuneiform tablets were discovered, proving conclusively that this was the capital city of the "land of Hatti." Akkadian texts included a cuneiform version of the peace treaty previously known from the temple walls of Karnak in Egypt. Such immediately intelligible materials enabled Winckler to draw a preliminary outline of Hittite imperial history in the 14th and 13th centuries B.C. The bulk of the texts, in the Arzawan idiom, appropriated the name "Hittite." This language was interpreted by the Czech scholar Bedrich (Friedrich) Hrozny (*Die Sprache der Hethiter* [1917]) and shown to be clearly Indo-European, as surmised by Knudtzon. The philological side of the new science of Hittitology thenceforth progressed rapidly through the text editions and exegetic works of such scholars as Ferdinand Sommer, Emil Forrer, Hans Ehelolf, Johannes Friedrich and Albrecht Goetze. Archaeological exploration of Anatolia and surrounding regions helped to clarify especially the prehistoric make-up of the area (*see* ALACA HUYUK; ALISHAR HUYUK; KULTEPE; SAKJEGOZU). Continued excavations at Bogazkoy by Kurt Bittel between 1931 and 1939, and from 1952 onward, provided a sound scientific mapping of all aspects of the site, unlike Winckler's rather one-sided quest for tablets. The hieroglyphic materials were increased especially by British excavations at Carchemish on the Euphrates under D. G. Hogarth and C. L. Woolley. After many false starts, their interpretation proceeded far through painstaking internal analysis by Forrer, Piero Meriggi, Ignace Gelb, Hrozny and Helmuth T. Bossert, revealing a language related to but not identical with Hittite (*see* ANATOLIAN LANGUAGES).

At length a long bilingual Phoenician-hieroglyphic inscription, found by Bossert in 1947, confirmed many conclusions and provided new insights. Subsequent Turkish excavations of the Old Assyrian merchant colony at Kultepe and British explorations at Beycesultan in western Anatolia promised added contributions to understanding of the complex racial, ethnic, linguistic and cultural interpenetrations of ancient Anatolia. The following sections of this article will employ the sum total of accumulated modern knowledge, unlike this chronological listing of the successive steps by which its core was attained.

Relief showing king standing before the god Santas (Sandon)

Gold pectoral with central rosette and six concentric bands, each decorated differently

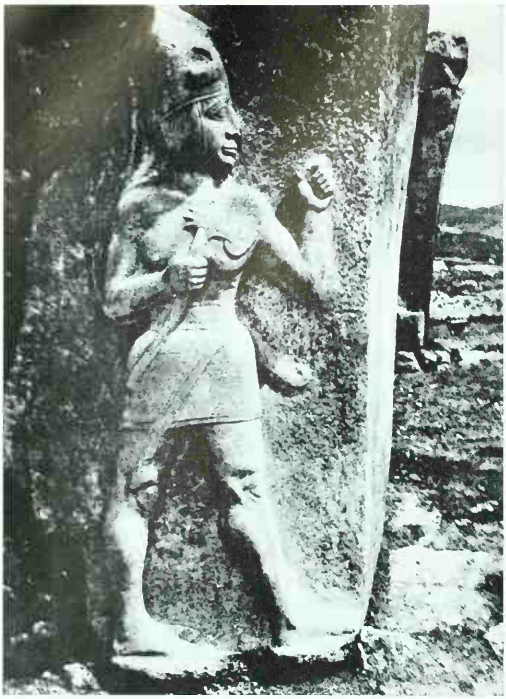
Relief of King Tudhaliyas IV with his patron god, Sharruma. From Yazilikaya

Hittite-Hurrian sculpture of bird-headed demons

HITTITE ART

BY COURTESY OF (TOP LEFT AND RIGHT) THE ORIENTAL INSTITUTE, THE UNIVERSITY OF CHICAGO, (BOTTOM LEFT) THE TRUSTEES OF THE BRITISH MUSEUM, (BOTTOM RIGHT) HANS G. GÜTERBOCK, THE ORIENTAL INSTITUTE, THE UNIVERSITY OF CHICAGO

HITTITES



Relief image of a deity from the Royal gate at Bogazkoy

Lion censer made of steatite

Hieroglyphic Hittite inscription from Carchemish

Silver stamp seal, the so-called Tarkondemos seal

HITTITE ART

Exterior view of the lower half of the Lion gate at Bogazkoy

BY COURTESY OF (THE LEFT) GERMAN ORIENTAL ASSOCIATION, FROM BULLETIN 19 - O. PUCHSTEIN, "BOGHASKOI. DIE BAUWERKE" J. C. HINRICHS, 1912. (TOP RIGHT) THE ORIENTAL INSTITUTE, THE UNIVERSITY OF CHICAGO. (CENTRE RIGHT) THE BRITISH MUSEUM, (BOTTOM RIGHT) MEYER, "REICH UND KULTUR DER HETHITER", PHOTOGRAPH, (BOTTOM LEFT) HELMUTH BOSSERT. "ALTANATOLIEN" 1942. REPRODUCED BY PERMISSION OF ERNST WASMUTH G.M.B.H., BERLIN

II. HISTORY

A. Beginnings, to the Empire

1. Early Beginnings.—Archaeology, which at the advent of the historical era becomes a mere accessory to the study of written documents, is the principal source of information concerning prehistoric Anatolia (*see* Asia Minor: *Archaeology*). Although archaeology fails to provide unequivocal ethnic data, it makes possible some insight into the racial and cultural characteristics of the inhabitants. Natural barriers divide the main explored habitation areas of Asia Minor into a vast elevated central (Cappadocian) plateau separated by the Taurus ranges from a southern (Cilician) coastal region and a remote separate belt near the west coast. On the plateau the late Chalcolithic and Early Bronze (often named Copper Age) periods of the 3rd millennium developed a preliterate civilization of remarkable sophistication, as evidenced by the elegant shapes of otherwise traditional burnished monochrome pottery and the advanced state of metalwork in the royal tombs at Alaca Huyuk. This period of cultural calm and presumably autochthonous ethnic consistency was interrupted by the intrusion, during the closing century of the 3rd millennium, of brightly decorated polychrome pottery (so-called Cappadocian ware), pointing to an infusion of foreign elements plausibly connected with the arrival of the Indo-European Hittites. Shortly thereafter the historical era began on the plateau with the establishment of Old Assyrian merchant colonies at several Anatolian centres, notably Kultepe.

The written records of those commercial settlements from the colony period of the 20th and 19th centuries contain the earliest historical references to the Hittites, since no reliance can be placed on the mention of a king Pamba of Hatti in a spurious inscription attributed by Kassite Babylonia (*c.* 1400 B.C.) to Naramsin of Akkad of the 3rd millennium. Besides onomastic elements of unmistakable local affinities, the writings of the Assyrian foreigners at Kultepe and Alishar Huyuk contain the names of two early kings, Pithanas and his son Anittas of Kussara. This establishes the historicity of those rulers, the latter of whom figures as spokesman in the oldest extant Hittite text from Bogazkoy, the probably apocryphal literary Anittas inscription. It tells of early military rivalries between local rulers of fortress cities in and around the Halys bend, prior to the establishment of a central Hittite power. According to inferences from the Kultepe tablets the region was divided into a number of city-states, among which Burushatum (Hittite Purushanda) was eminent, because its rulers are called *ruba'um rabium*, "great prince," like those of Kanesh (Kultepe).

This state of affairs probably obtained as a result of settlement by successive bands of invaders. In determining the route of the migrations from east-central Europe, the most likely early Indo-European habitat, a choice must be made between the Balkans and the Caucasus. Little except straightness of route argues for the former approach; the contacts of the Hittites with western Anatolia are tenuous, and archaeology provides no support. Definite arguments for an eastern route are certain old traditional privileges enjoyed by the military in the eastern part of the realm and the Hittite adoption, through probable Hurrian mediation, of an offshoot of Old Akkadian cuneiform which diverges sharply from that of the Assyrian colonists. Early migrational contact with the Hurrian habitat north and northeast of Mesopotamia provides the most satisfactory explanation.

As told by Anittas, Pithanas conquered the city of Nesa, capturing its king but sparing the inhabitants. Anittas' own military prowess is evidenced notably by his victory over the king of Hatti, as a result of which Hattusas (Hattusa or Hattushash), later destined to be the imperial capital, was destroyed and the site laid under a curse. After subduing other actual and prospective rivals, Anittas transferred his court from Kussara to Nesa, which was provided with fortifications and temples. Legendary though most of this is, the importance of both Nesa and Kussara to early Hittite history is well documented elsewhere. The Hittites called their own Indo-European language *nesili*, "Nesite," whereas *hattili* refers to the old aboriginal "Hattic" idiom. (Hatti became the name of the nation; in Hebrew guise it yielded the biblical "Hittite," referring to the "Late Hittite" settlements in Syria and perhaps Palestine; it is now habitually applied to the Indo-European conquerors of the native Anatolian "Hattians" and to the nation resulting from the fusion.) The first firmly historical Hittite kings were styled "king of Kussara"; this may be a reference to the real or pretended ancestral seat of the dynasts, or to their actual administrative residence before the resurgence of Hattusas and its rise to the status of a capital city. Around 1750 the latter is mentioned again jointly with Kanesh in a missive to the king of Mari on the Euphrates.

2. Old Kingdom.—Knowledge of the political history of the Hittite Old Kingdom is based mainly on two remarkable Bogazkoy texts: the "Farewell Address" or "Political Will" of Hattusilis I and the edict of Telipinus, both attested also in more or less extensive Akkadian versions. Apart from the shadowy Tudhaliyas I and possibly one or two successors, the proclaimed dynastic succession of the realm begins with Labarnas I, who according to Telipinus extended his territory all the way to the coast and installed his sons as governors in a number of conquered cities such as Tuwanuwa, Hupisna, Landa and Lusna (perhaps the classical Tyana, Cybistra, Laranda and Lystra). According to much later sources he also conquered Arzawa, a country located to the southwest of the Hittite heartland which looms large throughout the political history of the Hittites.

Thus a nucleus of empire was established and bequeathed to Labarnas' son of the same name, who was still known as "king of Kussara" but during his reign transferred the capital northward to Hattusas and probably in consequence assumed the name Hattusilis. He penetrated the Taurus range and invaded northern Syria, attacking the kingdom of Yamhad with its capital Halpa (Aleppo). His career was troubled by domestic intrigue, leading him to disown a rebellious son, Huzziyas, a daughter and at length also a nephew in the line of succession. In addressing his kin and the assembly of nobles (*pankus*) Hattusilis I designates the young Mursilis as his successor, and in pithy language exhorts his family and people to observe virtue and moderation, reminding them of calamities and dangers occasioned by past conflict. He may have died from wounds suffered in the Syrian campaign, for Mursilis I is said to have avenged his death by destroying Halpa. From there Mursilis pressed on southward, probably delivered the *coup de grâce* to Mari, which had been earlier razed by Hammurabi, and put an end to the latter's Amorite dynasty by sacking Babylon. He also fought the Hurrians on the upper Euphrates and returned to Hattusas with rich booty and many captives.

This occurrence, recorded in the Babylonian Chronicle, provides a correlation between Hittite and Mesopotamian events. However, these very centuries of the 2nd millennium down to 1400 B.C. constitute a notorious crux in both chronologies. Collations of Mari documents with data derived from an Assyrian king list regarding the reign of Shamshi-Adad I have caused the "low" chronology of W. F. Albright and F. Cornelius to place Hammurabi around 1700 B.C. and the sack of Babylon at 1530. This dating, current especially in Germany, has the apparent advantage of contracting the obscure gap between the Hittite Old and New Kingdoms but it has been sharply challenged by A. Goetze and B. Landsberger, who revise the dates upward by at least 120 years. The dating adhered to here is that proposed by Sidney Smith in *Alalakh and Chronology* (1940), which occupies a middle position and sets Mursilis' capture of Babylon at *c.* 1590. (*See* also Babylonia and Assyria: *History: Middle Period: Chronology.*)

Upon his return home Mursilis fell victim to a plot hatched by his brother-in-law Hantilis. This ushered in a succession of palace revolutions and regicides which jeopardized or canceled the political gains of past kings. Hantilis attempted continued military adventures in the grand manner, fighting against Ashtata on the Euphrates, Carchemish, and Hurrian invaders from the east (*see* Hurrians). The Gasga mountaineers, a constant source of harassment in the north from then on, captured the religious centre of Nerikka east of Hattusas and forced a strengthening of the capital's fortifications.

After Hantilis' death a desperate power struggle ensued, in the course of which the king's offspring was eliminated by his son-in-law Zidantas, himself slain by his son Ammunas. After further

murders the throne was seized by Telipinus, a brother-in-law of Ammumas' successor, Huzziyas, who had evaded designs on his own life. In his edict Telipinus attempts to end lawlessness and to regulate royal succession, designating the *pankus* as high court in cases of constitutional crimes. The initiative was successful, for the stipulations of the edict were scrupulously observed until the end of the New Kingdom, and were departed from only with keen awareness of the necessity for justification. The political fortunes of the state must have reached a low ebb during this era of turmoil; from Telipinus onward historical records fail and we enter the "dark ages" between the Old and New Kingdoms, the length of which is subject to the chronological conjectures outlined above. Telipinus' successor, Alluwamnas, is well assured of a place in history but the following Hantilis II, Zidantas II and Huzziyas II are at best of doubtful authenticity; the "low chronology" gladly dispenses with them in order to contract the time gap. This time is marked by Hurrian penetration and domination not only in northern Mesopotamia but in Syria, the Cilician region and eastern Anatolia as well, leaving the marks which will be encountered in the New Kingdom.

HITTITE ASIA MINOR. THE LOCATIONS OF LUQQA, WILUSA AND AHHIYAWA, AND THE IDENTIFICATION OF LAZPA WITH LESBOS, ARE CONJECTURAL. MODERN NAMES IN PARENTHESES.

B. Empire and "Late Hittite" Periods

1. Beginnings of the New Kingdom.—A dynastic renewal took place with the accession of Tudhaliyas II, from whom the New Kingdom or Empire is dated. Its humble beginnings are marked by a campaign against Halpa, designed to counteract the city's defection to the new Hurrian power centred in upper Mesopotamia. In 1457 a victory by Pharaoh Thutmose III broke the Hurrian hold on Syria and assured Egyptian hegemony for a couple of decades. This dominance subsequently declined during the reign of Amenhotep II, and the resurgent Hurrian power of the Mitanni kingdom under a ruling class of Indo-Iranian origin attracted the allegiance of Yamhad, Nuhasse and Cilician Kizzuwatna. This stripped Tudhaliyas' son Hattusilis II (according to some an Arnuwandas I intervenes) of his southern outposts, and the heartland itself fell prey to invaders. Tudhaliyas III had to fight against Arzawa in the west, the Gasgas in the north and the hinterland Hurrians of Hayasa in the east. Catastrophe threatened, and Hattusas itself was sacked and burned by the Gasgas. The increased stature of Hatti's enemies is seen in the Amarna correspondence between the Arzawan ruler and Amenhotep III, referred to in the introductory section.

2. Suppiluliumas.—Disregarding an apocryphal Arnuwandas II, the accession of Tudhaliyas' son Suppiluliumas is firmly dated *c.* 1375; at this point the chronology problem ceases to exist. This ruler, destined to raise the Hittite kingdom to imperial power, began his reign by carrying out a much-needed consolidation of Hatti itself, before embarking on foreign adventures. He rebuilt Hattusas and probably erected the monumental fortification works still visible at Bogazkoy. Local government was reorganized into a close-knit system of provinces governed by the royal house.

Except for a successful campaign against Arzawa, Suppiluliumas' military career was devoted to involved struggles with Mitanni and the re-establishment of a firm Hittite foothold in Syria. An initial exploratory raid through the Taurus mountains was repulsed with heavy losses to the invader by King Tushratta of Mitanni, a close friend of the Pharaohs and one of the dominant personalities of his time. Renewing the initiative in more subtle fashion, Suppiluliumas schemed to circumvent the frontal defenses of Mitanni in northern Syria by crossing the Euphrates farther north and approaching its capital, Washshukanni, from the rear. In order to secure the route and safeguard the expedition a preliminary campaign was undertaken against the Hurroid mountain people of Hayasa or Azzi; a state treaty subsequently established the allegiance of its king Hukkanas and was sealed by a dynastic marriage of Suppiluliumas' sister to the ruler. A rapid campaign then resulted in the capture and sacking of Washshukanni. As Tushratta retreated and avoided battle, Suppiluliumas crossed the Euphrates into Syria, utilizing Mitanni's discomfiture and Egypt's internal preoccupation with Ikhnaton's religious reforms to secure the allegiance of the Syrian princelings. Only King Shuttarna of Kadesh, the most confirmed of Egypt's satellites, had to be brought around by armed might, and the Hittites advanced as far as Damascus. As a result of this undertaking Halpa and Alalah became firmly attached to Hatti; treaties of allegiance were concluded with Tette of Nuhasse and Aziru of Amurru, while Carchemish and Ashtata on the Euphrates persisted in their pro-Mitannian ways.

The debilitated Mitanni kingdom fell prey to internal upheavals. Close association with Egypt had been the cornerstone of Tushratta's foreign policy; Ikhnaton's political apathy now made a sham of such reliance. Abetted by Ashur-uballit I of the renascent Assyrian kingdom, which for centuries had been tributary to the Hurrian peoples, a rival dynastic faction under Artatama of Hurri (a cousin of Tushratta who had earlier conspired with the Hittites) and his son Shuttarna brought about the assassination of Tushratta. As a result Assyria gained its independence, infiltrated Mitanni and emerged as a new power factor in the region. Suppiluliumas, who had left his son Telipinus in charge of Syrian affairs and returned to Hattusas for the performance of pressing religious duties, lost no time in returning to the scene. Carchemish fell to the Hittites after an eight-day siege. This consolidated Hittite power in all of northern Syria, where Suppiluliumas installed his sons Telipinus and Piyassilis as kings of Halpa and Carchemish. Kizzuwatna, cut off from foreign contacts and surrounded by Hittite power, then found it expedient to return to loyalty. The treaty between Suppiluliumas and Sunassura of Kizzuwatna is the last of a series beginning with that of Telipinus and Ishputahsu and marks Kizzuwatna's end as an independent state.

Suppiluliumas' pre-eminent international reputation at the time is shown by an event at the time of the siege of Carchemish.

Anchesenamun, daughter of Ikhnaton and childless widow of Tutankhamen, wrote to the Hittite king and asked for one of his sons in marriage. Under Egypt's matrilinear succession laws the new husband was to be Pharaoh; a desire to avoid having some repugnant design of local schemers foisted upon her evidently motivated the queen's unusual action. After some inquiries, intended to test the genuineness of the request, a Hittite prince was dispatched. Thus a son of Suppiluliumas was on the verge of ascending the Egyptian throne but was murdered on his way to Egypt by adversaries of the queen's plans.

Tushratta's son and lawful heir Mattiwaza had fled from his country and turned to Suppiluliumas for help. Guided by the desirability of counteracting the Assyrian influence in Mitanni by supplanting the Assyrophile Shuttarna in favour of a loyal vassal, the Hittite king concluded with Mattiwaza a famous extant treaty of mutual assistance. Piyassilis of Carchemish reconquered Washshukanni for Mattiwaza and thus a Mitannian buffer state was set up to shield the Hittite dominions in Syria from the growing Assyrian menace. This goal was achieved for a time; even king Niqmad of the Canaanite commercial city of Ugarit on the Syrian coast became a tributary of the Hittites. Yet soon after Suppiluliumas' death Mitanni fell to Ashur-uballit, which made the Euphrates the Assyrian-Hittite frontier.

3. Mursilis II.—Suppiluliumas died *c.* 1335 B.C. in a plague epidemic brought into Hatti by Egyptian prisoners of war, perhaps from a punitive expedition in retribution for the murder of the Hittite pretender to the throne of the Pharaohs. His son and coregent of the closing years, Arnuwandas, suffered the same fate after a very brief reign and was succeeded by his younger son, Mursilis II. Throughout Hittite history the accession of a new king was habitually attended by widespread revolt among the dependencies and vassaldoms. In Mursilis' case there was more than customary uncertainty whether Suppiluliumas' personally created realm would long survive the empire-builder's demise. Northern Syria, where at Carchemish Piyassilis had been succeeded by Shar-Kusuh, another son of Suppiluliumas, persisted in its newly consolidated loyalty; the continued allegiance of Amurru was cemented by a treaty with Aziru's grandson Duppi-Teshub. The main threat arose in the west, in the guise of Arzawa (subdued anew by Suppiluliumas after a remarkable independent ascendancy) and its own subdependencies Hapalla, Mira, Kuwaliya and Seha. Mursilis, the prolific personal annalist who also edited an account of his father's exploits, has bequeathed to posterity detailed descriptions of his military operations. An elaborate two-year campaign against Uhhazitis of Arzawa ended in renewed subjection of that mountain country. Loyal vassals were installed also in the minor principalities and bound to Hatti by state treaties. The chronic Gasga trouble in the north necessitated almost annual pacification operations (ten in all) and Hayasa had to be reconquered by Mursilis in both delegated and personally conducted campaigns. The first stirrings of warrior-Pharaoh Horemheb's renewed Egyptian expansionist policy were felt in Syria. Shar-Kusuh died unexpectedly while accompanying his brother Mursilis at ceremonies at the cult centre of Kummanni in Kizzuwatna (the classical Comana Cataoniae); in his absence Carchemish fell to hostile forces. Personal armed intervention by Mursilis proved adequate to restore order in the region and assure the succession of his nephew as king of Carchemish.

4. Muwatallis and Hattusilis III.—The accession of Mursilis' son Muwatallis *c.* 1315 B.C. was unmarred by the customary flurry of revolts among Hatti's satellites. Mursilis' political arrangements in the Arzawa region persisted unchallenged, and a new treaty was concluded with a King Alaksandus of Wilusa. But a struggle for domination of Syria with resurgent Egypt under Ramses II became imminent after the early 19th-dynasty Pharaohs (Ramses I, Seti I) had reconquered Palestine and made Syrian Orontes the Egyptian-Hittite frontier. The encounter, one of the great battles of the ancient world, took place at Kadesh on the same river in the fifth year of Ramses' reign (1299 B.C.). The outcome was indecisive but Ramses, the notorious usurper of historical monuments, claimed a great victory and caused the event to be celebrated by court poets and elaborately depicted on temple walls at Karnak, Abydos and Abu Simbel. In any case Muwatallis pursued the enemy to Damascus and consolidated his Syrian holdings by deposing Bentesina of Amurru, who had chosen the Egyptian side, and by concluding a treaty with Rimisarma of Halpa.

During his protracted Syrian operations Muwatallis had transferred his residence from Hattusas to the more southerly (Kizzuwatnian?) city of Dattassa. In the meantime his brother Hattusilis fought the Gasgas on the northern frontier and had been installed as viceroy of Hakpisa and Nerikka in the so-called "upper country" east of Hattusas. It seems that he harboured certain grudges against Muwatallis' accession in the first place and was inclined to disloyal actions, such as sheltering the disgraced Bentesina of Amurru. Muwatallis, leaving no first-rank heir, was succeeded *c.* 1285 by Urhi-Teshub, the son of a secondary wife, who took the throne name of Mursilis (III). When the young king tried to curb the power of his uncle, Hattusilis finally revolted against him; Urhi-Teshub was taken prisoner at Samuha and banished to Nuhasse in Syria; from there he tried to conspire with Babylon and was subsequently exiled "across the sea" to Alashiya (Cyprus), where his further efforts at international intrigue remained fruitless.

These events are known from the so-called "Autobiography" of Hattusilis III (acceded 1275 B.C.), a remarkable document designed to present the king's actions in a favourable light and to justify his dealings with Urhi-Teshub which were in seeming violation of the edict of Telipinus. Hattusilis by implication denies his predecessor's claim to legal accession in the first place by never mentioning his throne name, Mursilis, which was not discovered until 1953 on a royal seal found at Bogazkoy. The *coup d'état* seems to have caused no noteworthy upheavals in the political fabric of the empire; probably Urhi-Teshub was both inexperienced and unpopular. Hattusilis re-established the capital at Hattusas and reinstated his protégé Bentesina as king of Amurru; the Hittite hold on Amurru was later affirmed further through Hattusilis' successor's treaty with Ishtarmuwa. Except for some military action in the Arzawa lands, the regime of Hattusilis and his constitutionally and temperamentally influential wife Puduhepa, the daughter of a Kizzuwatnian priest, was one of protracted peace though not of total political serenity. Common danger resulting from the growing power of Assyria under Adad-nirari I and Shalmaneser I led to a *rapprochement* with Kassite Babylon under Kadashman-Turgu and Kadashman-Enlil. For a while Hattusilis managed to neutralize Assyrian hegemony in Mitanni; yet in spite of contemptuously rejecting Shalmaneser's claim to political equality he finally had to acquiesce in the Euphrates frontier. A beneficial result of this tension was the increasing entente between Hatti and Egypt, formalized by the famous peace treaty of 1269 B.C. (Egyptian text at Karnak, Akkadian from Bogazkoy), and sealed later with a dynastic marriage of Hattusilis' daughter to Ramses II.

5. Last Years of the Empire.—This consolidated the relations between the two great powers of the era and secured the *status quo* in Syria also during the reign of Hattusilis' son and successor Tudhaliyas IV (*c.* 1250–20 B.C.). As a gesture of good will Merneptah, the elderly son of long-lived Ramses II, even shipped grain to "Heta" at a time of famine soon after his belated succession to the throne. Tudhaliyas' main interest seems to have been religion, to judge from the cultic reforms carried out by him and from his role as the chief developer of the rock sanctuary of Yazilikaya. In the political sphere the progressive ascendancy of Assyria under Tukulti-Ninurta perpetuated friction in border areas, leading to mass deportations of Hittite subjects by the Assyrians and retaliatory countermeasures by Tudhaliyas in the form of trade embargoes in Syria. The military focus shifts to the western frontier. Successful campaigning by the Hittite king seems to have secured control of Assuwa near the west coast of Asia Minor (whence later the Roman name of the province of Asia, gradually extended to embrace the whole continent).

Relations with the country of Ahhiya(wa) enter a new phase of hostility. References to this western power, which has been plausibly but inconclusively compared with Greek Achaea as a name for a political unit of the contemporaneous Mycenaean thalassocracy in the eastern Aegean, occur from the time of Sup-

piluliumas onward, especially in the so-called Tawaklawas and Milawata letters from the reigns of Mursilis II and Muwatallis. These, and numerous more fragmentary Hittite texts and references, point to mostly friendly relations with the rulers of definitely maritime Ahhiyawa and to somewhat sporadic but nevertheless immediate colonial contacts with them in western Asia Minor, notably with reference to the Hittite dependency of Luqqa (Lycia?) and the city of Milawata (probably either Milyas in Pamphylia or later Ionian Miletus). In accordance with a common practice between friendly dynasts—exemplified by Tushratta's repeated consignment of the miracle-working Ishtar image of Nineveh to the ailing Pharaoh Amenhotep III—the gods of Ahhiyawa and Lazpa (Lesbos?) had once been summoned by incantations to the sickbed of Mursilis II. In the time of Tudhaliyas IV such somewhat platonic contacts were replaced by the harsh realities of power politics. With reluctant but increasing consistency the authors of Hittite political texts began to include Ahhiyawa among the great powers. Its king seems to have invaded the Hittite dependency on the Seha river, and an Ahhiyawan named Attarissiyas figures in the so-called "Indictment of Madduwattas," one of the last historical documents from Hattusas, drawn up by Tudhaliyas' son and successor Arnuwandas. Driven from his country by Attarissiyas, Madduwattas had been received and installed as vassal at Zippasla by Tudhaliyas, who also repulsed a subsequent attack by the Ahhiyawan on his adversary's new dominion. Later, however, Madduwattas turned traitor to his benefactor and joined Attarissiyas in military operations against Hittite territory in Arzawa and Alashiya.

This whole pattern of western aggression is connectible with the incipient great incursions of the so-called "Sea Peoples" which were soon to overwhelm both the Mycenaean and the Hittite cultures and reach the confines of Egypt itself. In Asia Minor the immediate destruction occurred at the hands of the invading Indo-European Phrygians whose later famous dynastic name Midas is already paralleled by Mitas of Pahhuwa, a contemporary of Madduwattas and his partial peer as a traitorous operator in the mountains of Hayasa.

Thus, after a brief final interlude under Arnuwandas' brother Suppiluliumas II, Hattusas was burned by invaders *c.* 1190 B.C., and the Hittite empire collapsed forever.

6. "Late Hittite" Period.—While the heartland of Hatti was inundated by nonliterate Phrygians and recedes for centuries from the immediate scene of recorded history, the trans-Taurian sections of the former empire underwent no such drastic break in continuity. The Cilician and Syrian dominions, annexed by Suppiluliumas and welded firmly into the unified realm during the succeeding century and a half, retained their Hittite identity for another five centuries, despite political and cultural vicissitudes. Lying in the path of contacts between the cosmopolitan near east and the political centre of gravity of the forbidding warrior kingdom on the northern plateau, they were subject to early and varied influences which did not fail to have an impact on the empire as a whole.

Culturally and also ethnically a strong Hurrian influx manifested itself around the middle of the 2nd millennium, superimposed especially in Kizzuwatna on a Luwian stratum resulting in its turn from a fusion of aboriginal and Indo-European components distinct from the "Hattic" and "Hittite" elements in the north. This ethnic layer was influential to the extent that the imperial dynasty itself seems to have been of southern extraction, despite its purposely assumed traditional Hattic throne names (the names of many royal princes—Shar-Kusuh, Urhi-Teshub—and those of most queens—Nikalmati, Ashmunikal, Daduhepa, Henti, Tanuhepa, Malnikal, Puduhepa—were purely Hurrian).

After the catastrophe, probably accompanied by an influx of northern refugees, the area disintegrated politically into a multitude of small independent principalities and city-states. These perpetuated specifically Hittite tradition in such royal names as Sapalulme (Suppiluliumas), Mutallu (Muwatallis), Katuzili (Kantuzzilis or Hattusilis), Lubarna (Labarnas) and in copious inscriptions in "Hittite hieroglyphs" which became their prevalent writing medium. The partially successful decipherment of these reveals a deplorable lack of historically rewarding information in the texts.

The earliest biblical references to Hittites inhabiting Palestine remain obscure, while those of II Sam. xi, 3 and xxvi, 6 and from the time of Solomon clearly refer to the "late Hittite" Syrian principalities. Our main sources of information are the records of Assyrian and Urartean kings. The principalities mentioned include the Tyanitis in the Taurus mountains, Tabal (biblical Tubal), Kue (Adana [Seyhan] region in Cilicia Campestris), Milid (classical Melitene; modern Malatya), Marqasi (modern Maras), Kummuhi (classical Commagene), Ya'diya-Sam'al (modern Zenjirli or Zincirli Huyuk), Hattina-Unqi, Arpad, Carchemish and Til Barsip (modern Tell Ahmar) on the Euphrates, the old imperial vassaldom of Halpa-Aleppo and, farthest south in Syria, the powerful kingdom of Hamath.

Assyrian expansion westward after Hatti's downfall began *c.* 1100 B.C. with Tiglath-pileser I, who in penetrating all the way to the Mediterranean fought two kingdoms of what he calls "Great Hatti," perhaps Milid and Carchemish. During the following two centuries Assyrian hegemony declined, and the ethnic multiplicity of the area was further compounded by an influx of Semitic Aramaeans who supplanted the late Hittite dynasties of Til Barsip, Arpad and Sam'al. The western warpath was resumed in 876 by Ashurnasirpal of Assyria who imposed heavy tributes on the Syrian principalities. A coalition of Carchemish, Til Barsip, Hattina and Sam'al was subsequently defeated by Shalmaneser III and Carchemish fell to the Assyrians. Hamath and Damascus in alliance with their vassals fought the king successfully at Karkar in 853, averting complete disaster for the time being.

After Hamath had been subjected by Adad-nirari III in 804 Assyrian attention was deflected to the increasingly powerful "late Hurrian" kingdom of Urartu or Haldi in the Armenian mountains around Lake Van. Most of the remaining principalities from Kue to Milid and Carchemish accepted the protection of Urartu under King Argistis I. His successor Sardur III in 742 opposed with armed might a new westward drive by Tiglath-pileser III but was defeated, and Assyria proceeded to incorporate the city-states permanently into the realm. This policy was continued by Shalmaneser V and Sargon II, until by 710 B.C. the last vestiges of "late Hittite" political independence had been obliterated.

III. HITTITE INSTITUTIONS

1. Royalty.—Hittite political power was the creation of a conquering Indo-European elite transplanted within the confines of the near-eastern cultural sphere and imposing its domination on an autochthonous population. The history of Hittite kingship faithfully reflects something extraneous gradually adapting itself to its new surroundings. In accordance with similar traditions among other Indo-European peoples, the king in earliest Hittite times seems to have been the patriarchal head of a dominant clan and the elective chieftain of the nobility as a whole. *De facto* succession within the same family tended to become early practice, leading from designation by the incumbent to an incipient institution of hereditary succession by his chosen offspring, though still subject to the endorsement of the ruling classes. This state of affairs is reflected in the political will of Hattusilis I, where the appointed heir, Mursilis, and the *pankus* and *nakkes* ("conclave" and "grandees") are enjoined to observe each other's prerogatives and privileges. In the apparent absence of any mystical sanction and the integral foundation of governmental supremacy on a traditional social compact lay seeds of political dissension and internal conflict well borne out by the events culminating in the murder of Mursilis I. The codification of hereditary monarchy in the edict of Telipinus was of lasting benefit to the ruling family; yet at the same time it not merely implicitly sanctioned the nobility's previously attested immunity from royal jurisdiction but granted them judiciary power over the dynasty, establishing them as a tribunal in cases of constitutional crimes.

During the obscure interval between the Old and New Kingdoms the increasing seepage of pronouncedly oriental influences into Hatti effected a thoroughgoing metamorphosis of kingship. Nothing more is heard of the *pankus*, and aristocratic government

is replaced by the traditional trappings of near eastern despotic theocracy. While the rulers of the Old Kingdom were content to be known as "Great King, Tabarnas" (a variant of the name Labarnas, a traditional title on the lines of the Roman Caesar), the imperial potentates styled themselves "Tabarnas So-and-so, Great King, King of Hatti, Hero, Beloved of God So-and-so." First-person self-reference was replaced by "My Sun," and a variety of the winged sun-disk common to Egyptian and other contemporary kings made its appearance as the royal emblem. This was accompanied by notions of superhuman qualities infused by divinity (*para handandatar*), and of the sanctity of the royal person which had to be protected against outside pollution by a bodyguard (*meshedi*) and an elaborate court ceremonial. The king was conceived as the earthly deputy (*maniyahhatallas*) of the storm-god; upon his demise he "becomes a god" rather than merely dying and is thereafter worshiped in rituals.

In this web of newfangled preoccupations the religious duties of the king assumed increased significance. He was the indispensable high priest, and his personal attendance to a multitude of cultic functions was essential to the spiritual and indirectly the temporal well-being of the realm, because neglect was sure to provoke divine anger. Sometimes important military enterprises had to be suspended or delegated in order to take care of pressing religious matters. Sculptured representations of royalty habitually depict the king in the act of worship before a deity, wearing a long robe and tight-fitting headdress and carrying a curved staff reminiscent of the lituus of Roman augurs.

More worldly duties of the king included supreme command of the military with the annual summer campaigns and occasional extended stays away from the seat of power, as during Suppiluliumas' war in Syria or Mursilis' Arzawan expedition. With increased international sophistication, penmanship gained on the sword, and the diplomatic tasks assumed added significance. The king was not only lawgiver but also chief judge, especially in cases involving high treason and capital offenses in general.

As a pendant to Tabarnas the official title of the queen was Tawannannas. The position was a lifetime one in its own right; rather than becoming dowager the widowed queen occupied the "throne of queenship" until her death and restricted the new king's wife to being merely that. The irritants inherent in such in-law situations were evidently aggravated by the strong-willed character traits prevalent among Hittite queens. Personalities like Puduhepa, the wife of Hattusilis III, made full use of their constitutional prerogatives of independent action and initiative, conducting their own negotiations with foreign powers also in other than nuptial matters. In Puduhepa's case, where matrimonial harmony prevailed, the results were generally beneficial. But Hattusilis I labels his consort "a snake," and Suppiluliumas banished one wife to Ahhiyawa; his widow proved so troublesome to Mursilis II that the latter evicted her from the palace and with the help of a lengthy bill of particulars succeeded in having her tried and deposed. This remarkable feminine prominence in the midst of an ostensibly patriarchal society is probably a vestige of pre-Indo-European matriarchal culture, multiple traces of which are present elsewhere in the region. Telipinus' regulation that in the absence of a qualified male heir the husband of a daughter of the Tawannannas may inherit the kingship is another residual reminder of matrilinear succession practices comparable to those of pharaonic Egypt.

2. Political Organization.—With the expansion of Hittite power beyond the Cappadocian plateau and its increasing international stature there evolved patterns of imperial government and diplomacy which are best inferred from the rich Bogazkoy yield of political treaties, a type of document conspicuously rare elsewhere in the ancient near east. As exemplified by the Hattusilis-Ramses covenant, a settlement between sovereign dynasts was worked out on a level of scrupulous equality and parallel obligations for both contracting parties. In addition to general vows of brotherhood and peace, mutual help was promised in case of external attack or internal insurrection, assistance was pledged in securing the royal succession in the other's realm and extradition arrangements were made for political refugees. The gods of both parties were invoked as witnesses to the treaty, and among the amenities required were thoughtful exchanges of greetings and gifts.

An outer semblance of equality was affected also in the arrangements regulating such relations as those between Suppiluliumas and the rulers (called *kuirwanas*) of relatively important political units such as Kizzuwatna, Mitanni and Arzawa. Yet in spite of skilled lip service the truth remains that those formerly independent states had in fact become protectorates of Hatti; their kings were obliged to refrain from undesirable international contacts and had to journey to Hattusas annually to pay formal homage. In real fact this differed but little from the station of a vassal whose treaty of allegiance was an explicitly one-sided commitment dictated by his royal liege lord at Hattusas and sworn to by the vassal alone. He was granted protection against foreign and domestic enemies and often the hand of a Hittite princess. In return the vassal had to pay homage and tribute, provide a military contingent for the imperial army, extradite refugees without claim to reciprocity, and generally pledge everlasting fealty. On the other hand, the arrangement expired automatically on his death and was negotiated anew with his successor. Hence the series of treaties in cases such as that of Amurru, where Aziru had originally accepted Suppiluliumas' overlordship but evidently did not qualify for the *kuirwanas* treatment accorded Kizzuwatna's ruler. When an enemy country or rebellious dependency had to be subdued by force, vassaldom status was in order, as after Mursilis II's campaign against Arzawa. In such cases a local "fellow traveler" was generally installed as ruler by formal treaty, unless the area was awarded as a kind of duchy to a prince of the Hittite royal house, as in the cases of Halpa and Carchemish.

During the Old Kingdom it had been common practice to assign districts of Hatti itself as subkingdoms to the monarch's sons and brothers. Such was the position of Hattusilis III at Nerikka and Hakpisa prior to his *coup d'état*. The ancient cult centres probably were practically independent theocratic enclaves controlled by the priesthood, a feature still surviving according to Strabo more than a millennium later at Comana Cataoniae. But the imperial heartland generally was developing into a centralized bureaucratic state. The subkings were replaced by governors (*maniyahhatallas*) holding office during the pleasure of the king; as provincial ruler of the "upper country" Hattusilis III seems to have combined such a position with his ancient role of feudal duke. The functions of the governor involved all areas of civil and religious administration where he could be deputed for the king, and probably resembled the extramilitary duties of the *awariyas ishas* (Akkadian *bel madgalti*), a garrison commander in border areas for whose edification an extant instruction book was issued at Hattusas. In matters of local concern he was to co-operate with the town mayors and elders.

3. Social Structure.—In the essentially feudal Hittite society the nobles, who filled the ranks of court and administrative officialdom, possessed large fiefs as liegemen of the king. At the same time this landed gentry constituted a kind of higher warrior caste and probably provided the armed chariotry which formed the backbone of offensive military might. The bulk of the (largely pre-Indo-European) common people lived in villages and leased their land either directly from the crown or from a temple, paying socage or ground rent (*sahhan;* Akkadian *ilku*). Entailed holdings could in principle change hands only through inheritance (*iwaru*), which led to widespread fictitious legal adoption practices designed to circumvent the law. There are also records of communal land worked by "men of the tool" or "artisans." The lease of this land could be acquired or disposed of through purchase or sale and reverted to the village when the lease lapsed, whereas crown land was repossessed by the palace. In practice the two types, which may correspond historically to the *ktoina ktimena* and *ktoina kekeimena* of Mycenaean Pylos, seem to have ultimately become holdings open to any person willing and able to assume the duties involved.

The "artisans," like most of the populace, were subject to the *corvée* (*luzzi*) and occupied a position halfway between freemen and slaves, like the deportees from conquered lands who were

bound to their assigned places of residence. Concerning the status of slaves the sources are strangely contradictory. Basically slaves were chattels, to be disposed of as the owner pleased; yet they could own property, might marry free women upon payment of the habitual bride price, and were protected by criminal law at half the rate of normal restitution; evidently a period of strenuous social evolution was in progress. Even below the slaves in station were the pariahs referred to as "shepherds" and "drawers of water"; marriage with such a man entailed a freeborn woman's temporary loss of her status.

4. Law.—Tablet fragments from Bogazkoy contain a corpus of 200 laws in two equally divided groups. In these, notable areas of civil law (inheritance, adoption, contracts) are not covered, which raises the probability that the body is incomplete; in fact an identification tag from the royal archives attests to the erstwhile existence of a third tablet. The extant two, mostly mutually exclusive in their content and not explicitly tied together or interrelated, are habitually referred to by their initial words as "If a man" and "If a vine" respectively. The fragments, discovered in different sections of the royal capital, represent hand copies on clay used in various administrative offices or deposited in libraries and archives, comparable to the clay transcripts of the Babylonian code of Hammurabi. On the basis of idiomatic and stylistic archaisms the original text is dated to the late Old Kingdom and plausibly attributed to Telipinus, whose talents as a lawgiver are evidenced by his edict. Preimperial phraseology, such as "father of the king" rather than "father of the sun," points in a similar direction. The discrepancies and inconsistencies of inner arrangement by subject matter have caused some to classify the work as a lawbook rather than a polished code; but logical organization of material is no prime virtue of Hammurabi either. Undeniably Hittite law was not a finished product of codification but evolved according to the changing needs of society. There are at least two different versions, one older and one younger; these show frequent insertions of additional matter, sometimes in inappropriate places, and a general trend of evolution toward more enlightened and humane procedures and penalties. One late fragment belongs to an even later version, where the text has been stripped of past references and restricted to a concise formulation of current law.

In the regrettable absence of Hittite private documents, in contrast to their profusion in Mesopotamia, it is difficult to gauge the practical workings of the legal system. Probably the law was not uniform throughout the realm; in fact the instruction text for garrison commanders enjoins these to follow current local practice in dealing with capital offenses. Its typical formulation in terms of concrete cases is plausibly based on an actual body of precedent from the courts. In the villages the elders served as justices of the peace or people's court; in the code they are explicitly charged only with ruling on the ownership of stray cattle. The king's gubernatorial or military representative dispensed justice in the provinces, in co-operation with local authority. An ultimate appeal to the king was possible, indeed statutory in cases involving the death penalty. Scant remains of court minutes attest to thorough and painstaking methods of inquiry and scrupulous attention to fair procedures; yet in cases of contradictory claims under oath the water ordeal, well known from Hammurabi, was still practised.

There is a general spirit of enlightened respect for human life and dignity, reflected especially in the penal regulation of criminal law. In contrast to the Semitic principle of talion and the general retributive mentality of the Mesopotamian and Mosaic codes, restitution is the dominant means of redress. As in Mesopotamia, premeditated murder is still essentially extrajudicial, to be avenged by blood feud or composed privately at the discretion of the surviving kinsmen; this privilege of the *eshanas ishas* ("lord of blood," corresponding to the *go'el* of Deuteronomy) is explicitly stated in the edict of Telipinus. Other types of killing called for restitution in the form of persons (probably slaves, but also a son in place of a slain child), later replaced by a monetary payment. Killing in anger or in a quarrel and accidental manslaughter are so regulated, as is murder with robbery involving a Hittite merchant; in this last case the rate decreases with increased distance from Hattusas. Justifiable homicide of an adulterous wife and her paramour or of the abductor of a girl goes unpunished. If a slayer escapes the proprietor of the death scene is liable, or the nearest village within a radius of three leagues.

Assault and battery (like theft and property damage) likewise call for indemnification of the victim, payment of medical expenses and the like; here, in accordance with a general principle, a slave's battered head or broken leg rates half the sum for a free person's. Miscarriage resulting from bodily injury is at first evaluated in proportion to the stage of pregnancy, but later compensated for with a uniform fine. Sorcery amounting to black magic counts as bodily injury and is a serious offense; a slave practising it forfeits his life. The Mesopotamian staple punishment of bodily mutilation is seldom applied and is restricted to unfree persons. Otherwise cruel practices are rare. What must at one time have amounted to a ritual killing or human sacrifice is toned down by the substitution of a sheep, though occasional instances of such occurrences are still recorded and evidently tolerated, especially when a prisoner is sacrificed along with a he-goat, a dog and a pig in a cleansing rite after military defeat. The death penalty is used very sparingly but is meted out for defiance of state authority and in this instance includes the wrongdoer's family; therein lingers a primitive notion of collective responsibility. Especially certain sexual offenses rated as capital crimes; *e.g.*, incest with a variety of close relatives, rape "in the mountains" where the woman would have no means of getting help and bestiality with cattle, sheep or pigs but not with horses. The last was a ritual feature of the "horse sacrifice" among ancient Indo-European peoples from India to Ireland. Although in contemporary Hittite religion the horse was not a sacrificial animal (except perhaps at burials), a memory of this practice might explain the discrepancy.

In civil law family organization was patently patriarchal, though traces of pre-Indo-European Anatolian matriarchy may be seen in paragraphs of the code dealing with a mother's right to disown her son and her role in giving a daughter in marriage. In general, however, the *patria potestas* of the husband, who might sell his children and kill an adulterous wife, was as absolute as that of the Roman paterfamilias. Betrothal involved a present by the man to the prospective bride. If the betrothal was broken by the parents, the gift was returned; if the girl eloped with another man, the latter had to indemnify the unsuccessful suitor. A marriage was formally concluded with the payment of a bride price (*kusata*) by the groom to the bride's father; if subsequently the man refused consummation, he was precluded from reclaiming his *kusata*. Conversely, interposition by the wife's parents entailed a twofold reimbursement of the bride price. Normally the wife would move to her husband's residence under a system of community of property, while retaining personal control of her dowry (*iwaru*), but sometimes the groom instead joined his father-in-law's household and was called *antiyants* ("one who enters"; Akkadian *errebu*). Marriage could be dissolved by divorce; the wife was then entitled to one-half of the community property. At her death the latter reverted integrally to the husband, while her dowry was bequeathed to the children. Levirate marriage, known from Mosaic law, is prescribed in the code, with the deceased's brother, father and nephew in this order in line for the hand of the widow. Detailed regulations prohibit sexual relations with one's mother, daughter and son; stepmother during father's lifetime; several sisters and their mother in the same locality; sister-in-law during brother's lifetime; and wife's daughter, sister or mother. There is no injunction against brother-sister marriage in the code, but that such a ban existed in practice is shown by Suppiluliumas' treaty with Hukkanas of Hayasa.

Other regulations of the code, dealing with land tenure, rates of pay and commodity prices, are dealt with under *Social Structure* (above) and *Economic Life* (below).

5. Economic Life.—The central Anatolian high plateau with its windy steppes and seasonal extremes of continental climate was inhospitable to human habitation and vegetation alike. Only river valleys offered adequate irrigation and shelter and doubtless constituted the dominant locale of what according to the code was a basically agrarian society. Economic documents, mostly cadas-

tral inventories and title deeds, complete the evidence derived from the laws. The farms—whether owned by the cultivator or occupied by tenant farmers under lease from the crown, a feudal lord or a theocratically administered cult centre—were composed of plots subdivided into cultivated land, orchards, vineyards, meadows, pasture and woodland. The stock was composed of the usual domestic animals (oxen for plowing, cattle generally, sheep, goats, pigs and mules); beekeeping was prominent and horse breeding specifically for the military chariotry is attested from the days of the Old Kingdom. Barley and emmer wheat were the chief crops, used both for food and for brewing beer. The vine (*wiyana*) was cultivated extensively, but only certain more temperate coastal regions were hospitable to olive trees. Skilled craftsmen, especially smiths, were attached to the estates.

Mineral-rich Anatolia (including Cyprus) was especially blessed with copper, making bronze the staple commercial metal. Iron was an expensive rarity throughout Hittite history; although Anatolia with its intimations of the approaching Iron Age antedated neighbouring regions by centuries, the techniques of ironworking were not fully developed. Such sword blades, tablets and even statues of iron as are mentioned in the texts served the purpose of special favours and honours, especially as royal and religious gifts. The abundant deposits of the Taurus (notably at Bulgarmaden) caused silver to become the standard currency of the realm. Measured by weight in bars or rings, it was counted in units of 60 shekels to 1 mina; this agrees with Babylonian terminology, although the Hittite mina (like that of Carchemish later) was probably a smaller absolute denomination (approximately 10½ oz. compared with the Mesopotamian 18 oz.). In the code list of prices the value of a sheep is established at one shekel, and a sheep thus becomes an alternative fixed unit of monetary reference. Prices of animals, meat, skins, farm products, land, clothing and metals are listed in considerable detail and provide interesting insights into the relative values of goods on the Hittite market.

6. Warfare.—Coherent data on military organization are lacking. A regular standing army was a necessity for the Hittite warrior kingdom, and probably included alien mercenaries, such as the Habiru and Lulahhu known to have served also in neighbouring states. Specific large-scale undertakings called for a more thoroughgoing levy involving added obligations for the nobles and their local dependents throughout the land. The vassaldoms and dependencies were bound by treaties to furnish auxiliary contingents under the personal command of the ruler.

The speedy horse-drawn war chariot, which by the middle of the 2nd millennium replaced the older Mesopotamian heavy cartlike type, had probably been introduced to the near east by the Indo-Iranian overlords of Mitanni. Hippology became a vital area of national defense, and Mitannian specialists in this line were employed at Hattusas, notably Kikkulis whose extant manual on the subject reflects a foreigner's perplexity with the Hittite tongue and abounds in technical jargon of Indo-Iranian and Hurrian origin. Such attention to modern trends in warfare, including the development of a specifically Hittite three-man chariot, accounts for much of the Hittites' military success from Suppiluliumas onward. Cavalry was unknown, and riding on horseback was practised only occasionally by messengers; this agrees on the whole with Homeric Greek tradition. The speedy chariot fighters, armed with spear and bow, relegated infantry to secondary importance in the Syrian plains, where an adversary's best chance usually was to avoid head-on engagement with the Hittite chariotry. Whereas at Kadesh the foot soldier's main function seems to have been the protection of the royal headquarters and the baggage train, he came into his own in the mountain regions of Anatolia proper. Standard armament comprised sword and spear, while dress consisted of a long gown and (beneath it) a short tunic and kilt.

Full-time defensive garrisons had to be maintained against the Gasgas in the north, in the "lower country" on the southwestern frontier, and against the Egyptian and Assyrian menace in Syria. Active campaigning, preceded by the taking of omens and auspices, was restricted to the summer months, while the inclement season was spent in winter quarters. It was in the interests of the Hittites, in view of their military superiority, to surprise the enemy in the field and force a pitched battle, rather than engage in guerrilla warfare in the mountains or in prolonged sieges of fortified strongholds. The tactical skill of Hittite kings, with their feigned withdrawals, encircling movements and surprise sallies, is well attested, especially by Suppiluliumas' Mitanni campaign and Muwatallis' strategy in Kadesh.

Formal declaration of war was customarily preceded by negotiations designed to produce an ostensible pretext, such as a refusal to extradite fugitives, which would justify the ordeal of war. A city conquered by force was sacked, burned and laid under a curse by dedication to the storm-god. In such a case the inhabitants were transported to Hatti and resettled. In case of surrender, submission on the spot was practised and a treaty of allegiance enacted. In either case there is no indication of that deliberate cruelty that disfigures the annals of Assyrian kings.

7. Burial Practices.—Evidence for disposal of the dead is of two kinds: in 1936 fragments of a funeral ritual for royalty were excavated at Bogazkoy; in 1952 the main cemetery area near the capital was uncovered. Royal burial entailed cremation of the body on a pyre on the day or night of the death. On the following day the fire was extinguished with beer and wine, the bones were gathered and dipped into a silver jar containing oil, wrapped in linen and another "fine cloth" and placed on a chair. In the course of elaborate ceremonies lasting a total of 13 days they were subsequently deposited on a funeral couch inside the "stone-house." These usages are curiously reminiscent of the Homeric rites for Patroclus and Hector. In the necropolis for commoners among the rocky outcrops between Bogazkoy and Yazilikaya cremation seems to have predominated from the earliest times, but mere interment is also found. The ashes were deposited in urns and jars; among animal skeletons found with many burials, heads of horses predominate.

IV. LANGUAGE

The general linguistic layout of ancient Anatolia is treated under ANATOLIAN LANGUAGES; for the writing system of the Bogazkoy texts *see* also CUNEIFORM; general characteristics of the Hurrian language remains are described under HURRIANS. This section is devoted wholly to the Hittite language, which constitutes the main extant representative of the Anatolian branch of the Indo-European group. It was the native speech of the northern heartland of Hatti, now called Hittite, but referred to by contemporaries with the adverb *nesili*, "in the language of Nesa," as opposed to *hattili*, designating the aboriginal idiom. Besides being the official language in use at Hattusas in cuneiform documents, it probably also served as the spoken form till the end, although there is some indication of an increased spread of southern vernacular (Luish or Luwian in the widest sense; *cf.* ANATOLIAN LANGUAGES) as the everyday spoken language during the latter part of the Empire period.

Inherent deficiencies of cuneiform writing obscure the exact phonemic make-up of Hittite. Complicated consonant clusters characteristic of Indo-European languages are capable of graphic representation only by the clumsy expedient of including pleonastic vowels not present in actual pronunciation (*e.g., si-pa-an-da-an-za* for probable *spandants*). The Hurrian-Hittite variety of cuneiform is derived directly from the Old Akkadian type and does not make use of discrete sign groups differentiating voiced and voiceless consonant values in later Mesopotamian writing. Instead there is the somewhat inconsistent makeshift expedient of a single: double opposition in denoting medial stop phonemes; *e.g., da-lu-ki-* "long" (*cf.* Old Slavonic *dlūgŭ*), but *lu-uk-ka-at-ta* "it dawned" (*cf.* Lat. *lucescit* "it dawns"). The actual phonetic contrast in Hittite may be one of *lenis:fortis*, but historically at least the former represents the Indo-European voiced simple and aspirated orders and the latter the nonaspirated voiceless variety. In the framework of the *centum:satem* dichotomy in the dialectal reflexes of the postulated Indo-European series of guttural stops, Hittite sides with the mostly western "centum" group (Greek, Italic, Celtic, Germanic, but also Tocharian in Chinese Turkistan). Thus the palatal stops are preserved (*kardi* "to the heart"; *cf.* Lat. *cordi*) and so are the labiovelars (*kuis* "who?"; *cf.* Lat. *quis?*).

Of basic significance for comparative grammar is the pair of phonemes transcribed here by *h(h)*, actually written with syllabic symbols containing a Semitic velar spirant. The erstwhile existence of such phonemes (laryngeals) had been postulated for early Indo-European because of structural considerations prior to the decipherment of Hittite, and received welcome support from the new direct evidence. In the vowel system Indo-European *a* and *o* have been fused prehistorically into *a*, and there is an increasing tendency to lose the distinction of *e* and *i* in historical times. Nothing conclusive is derivable from the texts concerning the nature of accent, but it seems plausible that distinctive vowel quantities were preserved.

Many noun suffixes are of well-attested Indo-European type; *e.g.*, *aniya-t-* "performance"; *cf.* Sanskrit *stu-t-* "praise"; *lu-tsi-* "*corvée*"; *cf.* Gr. *lúsis* < **lu-ti-* "ransom." Particular concordances with Slavic include *-asti-* (*dalug-asti-* "length" : Old Slavonic *dlog-osti*) and *-talla-* (*arsana-talla-* "envier" : Russian *spasitel'* "saviour"). Especially remarkable is the prominence of old Indo-European heteroclitic inflection with its *r* : *n* variation within the paradigms of abstract noun suffixes: *hanne-sar*, genitive *hanne-snas* "judgment"; *akka-tar*, genitive *akka-nnas* < **-tnas* "death"; *es-war* "existence," original genitive *-unas*. The same survives in old inherited words such as *watar* "water," genitive *wetenas*. Most of the old inflectional classes are retained (*-o-*, *-i-*, *-u-* and various consonant stems), but the feminine gender is lost and with it the *-ā* stems. One set of normalized case endings has been standardized in all classes (genitive singular *-as*, dative-locative *-i*, ablative *-(a)z*, instrumental *-(i)t*), but the plural paradigm is curtailed and confused (mostly nominative *-es*, accusative *-us*, genitive *-as* or *-an*, dative-locative *-as*).

The pronominal system contains a variety of old and new forms of eminent comparative interest. In the verb the nonthematic type (*es-mi* "I am") with primitive ablaut (*kuenzi* : *kunanzi* "he kills" : "they kill," Sanskrit *hánti* : *ghnánti*) is prominent, and many old secondary stem suffixes survive (*e.g.*, denominatives in *-iya-* and *-a(y)e-*, factitives in *-ahh-*, causatives in *-nu-*, duratives in *-ske-*).

Beside the ordinary conjugation with first person singular present in *-mi* there is the *-hi* type (*memahhi* "I speak") corresponding in origin essentially to the Indo-European perfect tense. This shift is symptomatic, being part of a general breakdown of old tense and mood categories which resulted in a verbal system that looks almost modern when compared with the intricacies of Greek and Sanskrit. There is only a present and a preterit tense, with no trace of aorist or future; of the moods the subjunctive and optative have disappeared, and only an indicative and imperative are found. Besides the active there survives a medio-passive voice characterized in the present by a somewhat loose *-r(i)* attached to the old middle endings; this has remarkable parallels in Tocharian, Phrygian, Italic and Celtic (*e.g.*, *ki-ta-ri* "he lies"; *cf.* Lat. *lauda-tu-r*, passive, "he is praised," but Gr. *kei-tai* "he lies"). Most of the personal endings are thoroughly paralleled in other Indo-European languages. There is a participle in *-ant-* corresponding in form to the present participle of Sanskrit, Greek and Latin. Periphrastic verbal constructions, literally equivalent to "I have heard" or "I am seen," are making their appearance.

The syntax is of typical old Indo-European character. The copula *es-* "to be" is regularly omitted in the present, and the verb gravitates toward final position in a sentence. Subordinate clauses tend to precede the main clause, but their development out of paratactic juxtaposition with attendant transformation of adverbs into conjunctions is often still discernible. Every sentence is usually introduced by one or several particles, especially *nu*.

In vocabulary the proportion of attested Indo-European inheritance is less impressive. The Hittite shape of many of the most elementary lexical items is consistently hidden by the scribal shorthand of Sumerian ideograms (*cf.* CUNEIFORM). Basic comparisons, besides those quoted above, include, *e.g.*, *genu* "knee" (Lat. *genu*), *pad-* "foot" (Gr. *pod-*), *seszi* or *suptari* "he sleeps" (Sanskrit *sasti*, *svapiti*), *kessar* "hand" (Gr. *kheir*), *pedan* "place" (Gr. *pédon* "field). A large percentage of the vocabulary is of obscure, probably indigenous Anatolian origin, and results from extensive lexical borrowings by the Indo-European speakers in their new surroundings.

V. RELIGION

While in matters of political and legal organization the Hittites retained clear traces of their Indo-European ancestry, they took to different paths in the field of religion and mythology. Elements of Indo-European religion are inferred most plausibly from a confrontation of Indo-Iranian, Old Italic and Germanic data, and with these Hittite religion has little in common. Its roots are to be sought entirely in the near eastern area. There is a profusion of cult data in the Bogazkoy materials; it is no exaggeration to state that numerically the bulk of Hittite texts are concerned with prayers, cult instructions, festive and magical rituals, records of divination practices, and mythological lore of religious significance. Because kingship and political acts at large were permeated and motivated by such conceptions, there is hardly a major text where they are not in evidence. Impressions of chaotic multiplicity and variety are confirmed by contemporary references to the "thousand gods of Hatti." On the other hand this is official material from the capital city and applies less to popular religion in general.

1. Deities.—Basically the Hittite religious attitude may be characterized as a meticulously tolerant polytheism, marked by a spirit of sedulous antiquarianism in preserving the idiosyncrasies of nonnative deities incorporated into the Hittite cults. A foreign god is not an enemy or rival of a jealous established divinity such as the Jewish Yahweh; he is rather a power whose efficacy in its own right is never questioned but put to use.

The core of the official pantheon is constituted by old Anatolian Hattic deities, chief among whom is the sun-goddess of Arinna (a cult centre near Hattusas), called in Hattic Wurusemu, the "queen of Hatti-land," whose prominence as a Great Mother figure is an indication of erstwhile Anatolian matriarchy. Her consort is the storm-god of Hatti (always denoted by the Sumerian ideogram for his Akkadian counterpart, Adad; in Hattic, Taru), a typically Anatolian divinity of whom almost innumerable local and specialized varieties existed at sundry cult sites. Those of Nerikka and Zippalanda were made into sons of the chief divine couple, along with a daughter, Mezullas, and a granddaughter, Zintuhis. The storm-god is sometimes depicted theriomorphically as a bull or as standing on this official cult animal (like his classical survival Jupiter Dolichenus). In imperial times he carries a mace or a club, while his Late Hittite counterpart, Tarhundas (*see* below), is depicted wielding an ax and a thunderbolt. The storm-god figures pre-eminently in mythological lore employed in rituals. The similarly prominent "vanishing god" Telipinus, with his consort Hatepinus, was said to be his son.

There were many other deities of Hattic provenance, such as the goddess Inaras, the war-god Sulinkatte or Wurunkatte ("king of the land"), the god Tauri and especially a male sun-god, Istanus (Hattic, Estan), whose relation to the sun-goddess of Arinna is not entirely clear. He is the "all-seeing judge of mankind" influenced by the Babylonian Shamash, and has beside him even further solar deities, especially a transparently chthonic "sun of the underworld" who seems to be female. Numerous divinities were referred to merely by appellatives (*e.g.*, Kattahhas, Hattic for "queen"; Ishassaras, Hittite for "lady"; Hannahannas, Hittite for "grandmother"; Hattic Kait, Hittite Halkis, "Grain," a chthonic goddess of the Telipinus circle). In addition to such anthropomorphic figures, mountains, rivers and springs were conceived animistically and included among witnessing divinities in state treaties. Also Hattic is Ziparwas, the god appearing most frequently in Palaic texts (*cf.* ANATOLIAN LANGUAGES) from Pala in northern Anatolia (perhaps identifiable with Blaene in classical Paphlagonia).

From Kanesh south of the Halys, where the substratum was no longer purely Hattic, and from Luwian territory are attested other groups of deities. The "singer of Kanesh" in Hittite rituals celebrates notably a healing goddess, Kamrusepas (Hattic Katahzipuri), Pirwas (associated with the horse) and Askasepas ("gate-genius"). Gods of this group are found in theophorous personal names on the Kultepe tablets, just as Luwian deities appear in comparable southern Anatolian anthroponomy down to classical

times. Here the chief figures, worshiped especially in Arzawa and Kizzuwatna, were Armas (moon-god; Hattic Kasku), Yarris (plague-god), Hasamilis (conferring invisibility, associated with the chthonic goddess Lelwanis), Rundas or Uruwandas (a protective god of a type popular all over Anatolia, but usually hidden under a Sumerian ideogram; represented as standing on a stag), Tiwattas (sun-god), Dattas and Tarhundas (storm-gods; the latter especially in hieroglyphic texts, related to Etruscan Tarchu), Santas (classical Sandon) and his consort Kubaba (especially at Carchemish, having the lion as her cult animal and probably related to the classical Great Mother of Anatolia, Cybebe or Cybele).

From Kizzuwatna, which was largely Hurrianized, and from the southeastern provinces generally, the Hurrian pantheon exerted an ever increasing influence on Hatti itself. The chief goddess, Hebat (perhaps surviving in name in the classical Hipta of Orphic hymns), was worshiped notably at the cult centres of Samuha, Kummanni (classical Comana) and Uda (classical Hyde); her consort was Teshub (Teshup), the Hurrian storm-god. Sausga, a goddess identified ideographically with Akkadian Ishtar, was prominent at Samuha and Lawazantiya; like Kubaba and Hebat she is associated with lions. Her miracle-working cult statue at Nineveh in Assyria has already been referred to. Others were Sharruma (the son of the divine couple), Kumarbi (Teshub's father), Shimegi (sun-god), Kushuh (moon-god, associated with the city of Harran), Nubatik (war-god), Ninatta and Kulitta (handmaids of Sausga).

The imperial dynasty, perhaps of southern origin, introduced Hurrian elements into the state cult at Hattusas. This development is especially marked beginning with Hattusilis III, who had Sausga as his patron goddess, and his wife Puduhepa, daughter of a priest from Lawazantiya, whose theophorous name classifies her as a votary of Hebat. As Tawannannas she was officially concerned with the cult of the sun-goddess of Arinna; in one prayer she pronounces an explicit syncretistic identification of the latter with Hebat. Tudhaliyas IV had Sharruma as his patron god and codified the Hurrianized reinterpretation of the official pantheon at the shrine of Yazilikaya. Even without specific syncretism Teshub's bulls Seri and Hurri were assigned to the storm-god of Hatti; the same is true of his holy mountains Namni and Hazzi (Mons Casius on the Syrian coast).

Foreign gods, especially Mesopotamian and occasionally Canaanite, are found in imported rituals and myths; many such are included in state treaties as divine witnesses for the opposite party. The best-known examples are the Indo-Iranian gods Indra, Mitra, Varuna and the two Nasatyas, in the Mattiwaza treaty; they belong to the pantheon worshiped by the Aryan rulers of Mitanni.

2. Cults.—By tradition the worship of every deity had to be conducted in his "native tongue"; largely thanks to this practice, texts in Hattic, Palaic, Luwian and Hurrian have survived at Bogazkoy. Other specific evidence for cult usages is derived partly from the archaeological evaluation of architectural and iconographic remains, but mostly from the abundant textual sources.

There were temples of all sizes and descriptions ranging from the five extensive structures at Bogazkoy to modest rural shrines attended by one priest on a part-time basis. The layout of the vast temple in the "lower city" at Hattusas agrees well with inferences from the texts. Around a central paved court were ranged rows of vestibules, antechambers, sacristies and storerooms, and also the inner sanctum (cella, adyton) containing the cult statue. Numerous descriptions of such statues are found in the texts; they were usually made of precious metal and rare wood and represented the divinity with his customary cult attributes, animals and attendants. At small centres a symbolic relief or aniconic fetish might replace the statue. Of this type was the *huwasi* stone, a much-used cult stele with symbolic carvings, comparable to the *baitylia* and *masseba* elsewhere. Other standard temple furniture comprised the *istananas*, a kind of wooden altar slab comparable to the Canaanite asherah, and vessels named *bibru*, probably theriomorphic *rhyta* (cups) in the shape of the appropriate cult animal.

It seems that the deity was not held to be personally present in the temple at all times. The shrine was rather the best means of attracting him from his heavenly, maritime or mountainous haunts; it served as a kind of "entry port" for the desired theophany. On the other hand the cult statue had to receive daily attention in the form of washing, dressing and feeding. The sacrificial loaves and libations that constituted its daily fare were conceived as a requisite physical necessity if the deity was not to starve. Elaborate regulations safeguarded the outer cleanliness and ritual purity of all such operations. Compulsory taxes and tributes to the gods were enacted on the analogy of a slave's obligation to provide revenues for his master. All imaginable products of cultivation and animal husbandry (except, apparently, horses) were sacrificed at the temples. After the throat of the victim had been slit the blood, heart, liver and other selected parts were offered to the deity, while the rest was consumed by the celebrants at a cultic banquet. (For occasional human sacrifice, *see* under *Law* above.)

Besides such routine activities there were regular seasonal or extraordinary festivals, determined by a religious calendar or proclaimed by the king. The best known of the former, the *purulliyas* festival and that of the *antahsum* plant, took place in the spring. During the winter season the king made a hurried annual grand tour of the main cult centres, accompanied by his Tawannannas and the crown prince. This enterprise, taking in Nerikka and Arinna, was known collectively as the "speedy festival" (*nuntarriyashas*). Countless descriptions have recorded the infinitely pedantic and exasperatingly monotonous proceedings in the minutest detail. What is mostly involved is a ritual meal attended by innumerable prescribed motions and gestures by the presiding royal couple and their attendants, notably repeated handwashing.

On a higher religious level stand the royal prayers to various divinities. Especially famous are the plague prayers of Mursilis II, a moving confession of sins and appeal for mercy addressed to the storm-god. Remarkable qualities of religious feeling are evident also in such texts as Muwatallis' prayer to the sun-god and Puduhepa's vows to the sun-goddess of Arinna, which are less emergency appeals than routine requests for long life, health and general welfare.

3. Divination and Magic.—The will of the gods was manifested in dreams or by the ecstatic utterances of oracular persons "possessed by divinity" (*siumiyants*). An elaborate pseudo science of divination was evolved, to a large extent on Mesopotamian models, which also dominated Hittite astrology and medicine. Questions to be answered by this procedure were formulated on the lines of a "yes, no" dichotomy, and the inquest was continued until the desired result was attained. Extispicy and hepatoscopy (examination of the entrails and liver of a sheep) were typical imports from Babylonia, confirmed by extant copies of omen texts and liver models. Augury (observation of the movements of birds) was also practised, and a sort of lottery oracle was the monopoly of "old women" (Hittite *hasawas*, the standard name for a female soothsayer). Interminable records of such inquiries were found at Bogazkoy.

Through divination the causes of divine displeasure could be ascertained and countermeasures initiated before it was too late. If this prophylaxis failed, therapeutic recourse could be had to magic, another quasi science widely used by the Hittites as by other ancient near eastern peoples. Basically magic implies a subreligious belief in the efficacy of symbolic analogous action to influence a course of events. Detailed rituals on such lines occupied an inordinate amount of tablet space at Hattusas and were performed to a large extent by Kizzuwatnian specialists. Implicit belief in its potential efficacy underlies the legal classification of black magic (*alwanzatar*) as a felony in the code. Hittite magic may be tentatively classified on the one hand through the opposition of cathartic to harmful, and on a different, overlapping level as apotropaic or adductive. The first type is designed to cleanse the beneficiary from pollution of various kinds (*papratar*); *e.g.*, by dispelling disease, restoring impaired sexual functions or alleviating domestic discord. Its opposite half is designed to visit the same on one's enemy, most clearly expressed in such scapegoat rites as "You, Yarris, have afflicted with pestilence this land and its camp; but may this ass carry it off and take it into enemy country." Curses in general belong to this variety, as does black magic.

Apotropaic magic is preventive, designed to avert evil influence, while adductive practices have the converse purpose of attracting or propitiating desirable persons or deities. The Telipinus myth (*see* below) forms part of such a ritual.

VI. LITERATURE AND ART

1. Literature.—The political and religious texts from which much of the preceding evidence is derived are not properly literary compositions, but they contain elements of stylistic and even artistic merit in their own right. This is particularly true of the "Farewell Address" of Hattusilis I, with its grotesque anecdotes setting a pattern for subsequent moral pointers; the "Prayers" and especially the "Annals" of Mursilis II, which have exerted an influence on later near eastern historiography; and the "Autobiography" of Hattusilis III, a prototype of subjective probing and interpretation of personal fortunes. In a more fictional vein there are quasi-historical tales, Akkadian in language but clearly intended for a native audience. Such is the "Siege of Urshu," an amusing story of a king's exasperation at the incompetence of his general staff during a siege in Syria, and a comparable tale connected with the ancestral city of Zalpa on the central Anatolian plateau. Foreign imports in Hittite translation and adaptation are seen in the fragments of the Sumero-Akkadian Gilgamesh epic and the stories connected with the legendary Anatolian expeditions of Sargon and Naramsin of Akkad during the 3rd millennium. Here Hurrian intermediaries are probable, because of the Hurrian Gilgamesh fragments discovered at Bogazkoy and the Hurrian provenance of some of the most meritorious mythical texts in Hittite literature. These comprise notably the myth of "Kingship in Heaven," describing how the successive divine rulers Alalu, Anu, Kumarbi and Teshub wrested supremacy from one another; via Phoenicia this tradition reached Greece and emerged in the guise of Uranus, Cronus and Zeus in the *Theogonia* of Hesiod. Further, the versified myth of the diorite monster Ullikummi, whom Kumarbi begat to be an adversary of his son Teshub, likewise reached the *Theogonia* in the person of Typhon. Other stories of Hurrian origin are the Hedammu myth, the epic of Gurparanzahus and the tales of Appu and Keshi. Even Canaanite tradition is represented at Hattusas in a text describing the attempted unsuccessful seduction of Baal by Astarte and ensuing complications, a motif known to the Pentateuch (Joseph and Potiphar's wife) as well as to Greek legend (Bellerophon, Hippolytus, Peleus).

In contrast to these, native Hattic myths have not severed their connections with religious ritual. The Illuyankas story, recited at the *purulliyas* festival, is a variation on the dragon-slaying theme that constitutes a stock-in-trade of universal mythology. In two divergent versions the storm-god is at first worsted by the dragon but subsequently triumphs through the interposition of a human agent, in one case via the intermediary of the goddess Inaras. The Telipinus myth, its storm-god variant and the third version of the so-called Yozgat tablet are typical tales of divine disappearance and subsequent earthly blight, entirely comparable with the dying god theme associated with Tammuz, Adonis, Attis and Osiris. This myth was employed in the ritual designed to appease divine anger. Both abound in folk-tale motifs amply paralleled elsewhere, from the German *Nibelungenlied* and *Tannhäuser* to the Finnish *Kalevala*.

2. Art.—Plastic relics of preimperial Hittite culture are conspicuously scarce. Polychrome Cappadocian pottery continued in use throughout the Old Kingdom but was gradually replaced by a polished red-washed ware attesting to refined production techniques. The cylinder seals of the colony period are remarkable provincial varieties of imported Mesopotamian glyptic art, while stamp seals reflect true Anatolian tradition. The Empire period produced a somewhat barbarous but powerful style of stone sculpture seen in the ruins of Bogazkoy and Alaca Huyuk, at Yazilikaya and on rock surfaces in various localities of Anatolia. How far this development reflects Hurrian influence is difficult to estimate, for the monumental remains of contemporary Hurrian centres like the Mitannian capital Washshukanni remain to be discovered. During the same period stamp seals and signet rings represent individual accomplishments of native glyptic. The typical royal seal sometimes contains a central image of the king in the embrace of his patron god. More often only the name of the ruler appears there in hieroglyphs, flanked by two royal ideograms and surmounted by the winged sun-disk. The hieroglyphic true name (*e.g.*, Pihame in the case of Suppiluliumas) is matched along the circular edge of the seal by the king's throne name and title in cuneiform script.

The art of the Late Hittite city-states is very different. At Malatya and Zenjirli there are occasional instances of cult scenes resembling those of imperial times, syncretistic images of the storm-god which combine his Anatolian and Syrian attributes or gate lions not unlike those at Bogazkoy. But this composite art is basically Syrian, permeated by ancient Mesopotamian and recent Assyrian influences and revealing occasional elements of Phoenician and Egyptian style. This is true in spite of its traditional connection with Hittite hieroglyphs at such notable sites as Carchemish and Hamath. Mesopotamian cylinder seals predominate. Even the architectural *bit hilani* type must be disconnected from Hittite tradition proper and ascribed to local Syrian origin. It attests to some measure of Syro-Hittite artistic originality, as does the characteristic use of rows of sculptured orthostatic slabs for mural ornamentation.

See LUWIANS; *see* also references under "Hittites" in the Index volume.

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HITTORF, JOHANN WILHELM (1824–1914), German physicist, best known for his work on the migration of ions during electrolysis, was born at Bonn on March 27, 1824. He studied at Bonn and Berlin, and became *Privatdozent* in the academy of Münster. When this institution became the University of Münster, Hittorf became professor of physics and chemistry; in 1879 the physics and chemistry departments were separated, and he became director of the physical laboratories. Hittorf retained this post until 1889 when he had to resign because of ill-health. After a rest his health improved, and he continued his research work. He died at Münster on Nov. 28, 1914.

Hittorf's early investigations were on the allotropy of selenium and phosphorus. His most important work on ion migration during electrolysis appeared in the *Annalen der Physik* between 1853 and 1859. He investigated the changes in concentration in the electrolyte and from this worked out the "transport numbers" for the migrating ions. With his teacher Plücker, Hittorf made investigations on the spectra of gases and vapours. He made a number of investigations on the passage of electricity through gases, he discovered a number of properties of cathode rays and observed the Crookes dark space. Other investigations were on the passivity of metals.

HITTORFF, JACQUES IGNACE (1792–1867), French architect and archaeologist, was born at Cologne on Aug. 20, 1792 and died in Paris on March 25, 1867. After apprenticeship to a mason in Cologne, he went in 1810 to Paris to study at the Acad

emy of Fine Arts under F. J. Belanger, the government architect, whom Hittorff succeeded in his post in 1818. Thereafter he designed many important buildings, both public and private, in Paris and the south of France. His principal work is the basilica of Saint-Vincent de Paul (1830–44). His books are: *Architecture antique de la Sicile* (1826–30 and 1866–67); *Architecture moderne de la Sicile* (1826–30); *Architecture polychrome chez les Grecs* (1830); *Restitution du temple d'Empédocle a Sélinunte* (1851).

HITZIG, FERDINAND (1807–1875), German biblical critic, a Hebrew philologist of high rank, was born on June 23, 1807, at Hauingen, Baden, and studied theology at Heidelberg, Halle, and Göttingen. Returning to Heidelberg he became *Privatdozent* in theology in 1829, and in 1831 published his *Begriff der Kritik am Alten Testamente praktisch erörtert*, in which he explained the critical principles of the grammatico-historical school, and his *Des Propheten Jonas Orakel über Moab*, an exposition of chapters 15 and 16 of Isaiah attributed by Hitzig to the prophet Jonah mentioned in II Kings 14:25. In 1833 he went to Zürich as professor of theology, and in 1861 to Heidelberg, where he died on Jan. 22, 1875.

HIUNG-NU: *see* HSIUNG-NU.

HIVES (URTICARIA): *see* SKIN, DISEASES OF.

HJORRING (officially HJØRRING), an *amt* (county) of Denmark, with a capital of the same name, covers much of the northern, insular part of the peninsula of Jutland and includes Laeso Island to the east. Area 1,106 sq.mi. Pop. (1960) 177,778. The coasts as far north as the Skaw have splendid beaches and such resorts as Lokken, Saeby and Frederikshavn. The latter (pop. [1960] 22,522) is also important for its fishing, shipbuilding and related industries; it has shipping connections with Oslo, Larvik and Fredrikstad in Norway and Göteborg in Sweden.

The ancient town of Hjorring lies 48 km. (30 mi.) N. of Aalborg by road and 50 km. (31 mi.) by rail. Pop. (1960) 15,038. The church of St. Catherine dates from *c.* 1250, St. Hans from *c.* 1230 and St. Olai from *c.* 1200. Local products include condensed milk, biscuits and bacon. (RO. H. T.)

HLINKA, ANDREJ (1864–1938), Slovak autonomist leader, was born at Cernova on Sept. 27, 1864, when Slovakia was still under the Habsburg Hungarian crown. He became priest of the small industrial town of Ruzomberok in 1905 and eagerly supported the Slovak nationalists there in the election of 1906. In Nov. 1906 he was tried for inciting the Slovaks to disloyalty to Hungary and condemned to three and a half years' imprisonment. The Roman Catholic priesthood in Slovakia in general supported the Hungarian authorities, who resented what they regarded as Hlinka's insubordination—the more so since it received much popular support. He was later acquitted by the Roman *curia* from a charge of simony brought against him by the Hungarian ecclesiastical authorities.

On May 24, 1918, when the Slovak National party took up a position against Hungary, it was Hlinka, as leader of the Slovak People's party, who most emphatically declared for union with the Czechs. By Aug. 1922, however, he had drawn up the Zilina memorandum reproaching the Czechs for having robbed the Slovaks of the autonomy which had allegedly been promised to them by Tomas Masaryk in what Hlinka persisted in calling the "treaty" of Pittsburgh—a document signed in May 1918 by Masaryk and regarded by him as a statement of policy which American Czechs and Slovaks were prepared to advocate. Later Hlinka's relations with Prague were patched up to the extent of the participation of his lieutenant, Josef Tiso, in a Czechoslovak government in Jan. 1927. When in 1929 Béla Tuka, a Slovak, was condemned as a Hungarian agent Hlinka did not repudiate him, and Hlinka's party returned to opposition: it thus became associated in the 1930s with the German and Hungarian opposition to the Czechs, which aimed at the destruction of Czechoslovakia. Hlinka was a true Slovak patriot, but failed to see that his by now fanatical hostility to the Czechs was being exploited by Germans and Magyars who felt little benevolence for the Slovak cause. Hlinka died at Ruzomberok on Aug. 16, 1938, less than two months before Slovakia became autonomous. *See* also CZECHOSLOVAKIA: *History*.

See K. Sidor, *Andrej Hlinka* (1934); F. Jehlicka, *Father Hlinka's Struggle for Slovak Freedom* (1938). (E. WI.)

HO, the capital of the Volta region of Ghana and headquarters of the Ho administrative district, is situated 45 mi. N.E. of Akuse on the Volta river. Pop. (1960) 14,519. The town is surrounded by hilly country, mainly forest to the north and savanna to the south. The population, the majority of whom are Ewe (*q.v.*), is for the most part engaged in farming, trade and government service. Ho is an important market centre, mainly for agricultural produce, fish and meat. Palm oil, cotton and cocoa are produced. Apart from government offices, the principal buildings are Mawuli secondary school and the sports stadium. Ho is the centre of a network of roads which link it with Accra, all parts of the Volta region and eastward with Togo. The district chief of Ho has his seat in Dome, a subdivision of Ho district. (A. H. B.)

HO, a tribe concentrated in the Kolhan section of Singhbhum district, Bihar state, India, on the lower Chota Nagpur plateau. Ho population exceeded half a million persons in the 1960s. The Hos speak a language resembling Mundari (*see* MUNDA LANGUAGES), and appear to have moved gradually into their territory from farther north, where some Hos were once in close contact with Mundas. Especially where they mingled with Mundas, they shared many features of Munda social organization, including the institution of girls' and boys' dormitories, an elaborate system of village officers, an indigenous distinction of land tenure between the rights of original settlers and later arrivals, and a territorial organization into quasi-military confederations. The Hos have exogamous patrilineages and permit cross-cousin marriage, favouring marriage with daughters of maternal uncles. Marriage by elopement and by abduction remained common however while concern for economic status often overrode the preference for marriage with a cousin. Hos principally worship spirits held capable of inflicting disease, approaching them through divination and witchcraft.

Joining with the insurgent Mundas, the Hos successfully repelled British forces in 1831, but soon afterward submitted their lands to government regulation. Hunting and shifting agriculture tended to be given up in favour of settled agriculture and grazing. The modern development of local iron mines and of steelworks at such places as nearby Jamshedpur provided important new sources of tribal subsistence.

See D. N. Majumdar, *The Affairs of a Tribe* (1951), *Races and Cultures of India*, 4th ed. (1961). (M. MA.)

HOADLY, BENJAMIN (1676–1761), bishop of Winchester, "the object of whig idolatry and tory abhorrence" as Edward Gibbon described him, was one of the most controversial figures of a fiercely controversial age. He was the foremost clerical champion of whig principles in the state and of latitudinarian ideas in the church. Born at Westerham, Kent, on Nov. 14, 1676, he was educated at Catherine hall, Cambridge. He became lecturer at St. Mildred in the Poultry in 1701, rector of St. Peter-le-Poor, Broad street, in the city of London in 1704 and rector of Streatham in 1710. The establishment of the Hanoverian dynasty in England meant rapid advancement for Hoadly and he became successively bishop of Bangor (1716), of Hereford (1721), of Salisbury (1723) and of Winchester (1734). He died at Chelsea on April 17, 1761.

He was a voluminous writer, though most of his pieces had only a contemporary relevance. In 1703 he published, in reply to Edmund Calamy the younger, *The Reasonableness of Conformity to the Church of England Represented to the Dissenting Ministers*, in which he defended episcopal ordination and adopted a minimizing interpretation of the oaths and subscriptions required of the clergy. His chief polemical works were provoked by the claims of the nonjurors, particularly in the posthumously published writings of George Hickes (*q.v.*), against which Hoadly wrote *A Preservative Against the Principles and Practices of the Non-Jurors Both in Church and State* (1716) and a sermon defending individualism in religion entitled "The Nature of the Kingdom or Church of Christ." The *Preservative* started a controversy concerning the limits of civil obedience; the sermon led to a vehement and prolonged pamphlet war, known as the Bangorian controversy, concerning the nature of ecclesiastical authority and incidentally to the suspension of convocation (1717) for its opposition to Hoadly's views (*see* also BANGORIAN CONTROVERSY).

Among the many replies to this sermon the most important was undoubtedly William Law's *Three Letters to the Bishop of Bangor*. Hoadly was an unwearying defender of the Protestant succession and of individual liberty in both church and state.

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HOAR, EBENEZER ROCKWOOD (1816–1895), U.S. jurist and statesman, was born in Concord, Mass., Feb. 21, 1816, a son of Samuel Hoar (*q.v.*). He graduated from Harvard college in 1835 and the Harvard Law school in 1839. He became associated in cases with Rufus Choate and Daniel Webster. He was elected to the Massachusetts senate where his chance remark that he would rather be a "Conscience Whig" than a "Cotton Whig" gave the former name to the antislavery wing of the Whig party. In 1848 he and his father led in organizing the Free-Soil party in Massachusetts.

In 1859 Hoar was appointed to the supreme court of Massachusetts where he served until Pres. U. S. Grant appointed him attorney general of the United States. When he insisted on filling nine new circuit judgeships with competent judges, patronage-seeking senators were alienated and rejected Grant's appointment of Hoar to the U.S. supreme court.

In 1870 Grant summarily and without warning dismissed Hoar as attorney general, apparently to use the vacancy as patronage in the hope of winning senatorial support of his treaty to annex Santo Domingo. Later Grant appointed Hoar to the joint commission to negotiate the treaty of arbitration that settled the "Alabama" claims against England. In 1873–75 he served a term in the U.S. house of representatives and continued active in Republican national conventions until late in life. He died at Concord, Mass., on Jan. 31, 1895.

See Moorfield Storey and E. W. Emerson, *Ebenezer Rockwood Hoar* (1911); G. F. Hoar, *Autobiography of Seventy Years*, vol. i (1903). (W. E. BY.)

HOAR, GEORGE FRISBIE (1826–1904), U.S. lawyer and statesman, son of Samuel Hoar (*q.v.*), was born in Concord, Mass., Aug. 29, 1826. He graduated from Harvard college in 1846 and Harvard Law school in 1849. He began to practise law in Worcester, Mass., where he made his home for the rest of his life. In 1854 he joined his father and his brother in helping to organize the new Republican party in Massachusetts. In 1852 George Hoar was elected to the house of representatives of Massachusetts and in 1857 to the state senate. In 1869 he was elected to the U.S. house of representatives where he served eight years. He won election to the senate in 1877 and served there until his death 27 years later.

Hoar was a member of the electoral commission that in 1877 decided the outcome of the disputed Hayes-Tilden election. He was the author of the Presidential Succession act (1886) that placed the cabinet members in the line of succession following the vice-president. Following the Spanish-American War he vehemently opposed the annexation of the Philippines. Hoar was a delegate to Republican national conventions in 1876, 1880, 1884 and 1888 and was the presiding officer in 1880. He died at Worcester, Mass., on Sept. 30, 1904.

See G. F. Hoar, *Autobiography of Seventy Years*, 2 vol. (1903); Frederick H. Gillett, *George Frisbie Hoar* (1934). (W. E. BY.)

HOAR, SAMUEL (1778–1856), U.S. lawyer and statesman, a leader in Massachusetts politics for 30 years, was born in Lincoln, Mass., May 18, 1778. In 1802 he graduated from Harvard college and three years later he began the practice of law in Concord, Mass. He became one of the leading lawyers in the state, along with Rufus Choate and Daniel Webster. In 1820 Hoar played a conservative role as a delegate to the convention to revise the constitution of Massachusetts. He served in the Massachusetts senate from 1825 to 1833 and one term (1835–37) in the U.S. house of representatives, where he advocated the abolition of slavery in the District of Columbia. In 1850 he was elected to the Massachusetts house of representatives.

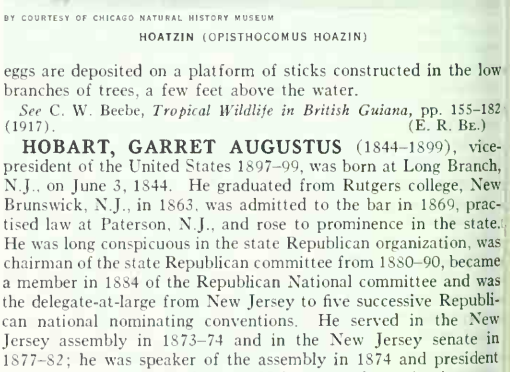
In politics Hoar was a Federalist until that party disappeared after the War of 1812. In the 1830s he became a Whig but in 1848 when that party nominated Zachary Taylor, a slaveholder, for president, he led the movement to organize the Free-Soil party in Massachusetts. When the Republican party was emerging in 1854 Samuel Hoar and his sons were busy organizing the party in Massachusetts. He died at Concord, Mass., on Nov. 2, 1856.

See G. F. Hoar, *Autobiography of Seventy Years*, vol. i (1903). (W. E. BY.)

HOARFROST is ice deposited when the water vapour in the atmosphere solidifies without passing through the liquid state. It has a crystalline appearance, and takes a variety of interesting forms which are particularly striking on windowpanes. Hoarfrost is a hydrometeor (*q.v.*). See FROST.

HOATZIN (HOACTZIN), a relict bird (*Opisthocomus hoazin*), of weak flight, inhabiting wooded river banks of the Atlantic drainage in northern South America. It is remarkable for its flattened keel, very capacious crop and, in young birds, well-developed claws on the first and second fingers of the wing, by means of which they are able to climb; they can also swim. This unusual bird constitutes the family Opisthocomidae and suborder Opisthocomi in the order Galliformes.

About the size of a small pheasant, the hoatzin has a short, laterally compressed, denticulated beak; prominent eyelashes set in a bare space around the eye; and a long, erectile crest. It is brownish-olive above, with bold white streaks; the long neck and under parts are pale buff, becoming chestnut on the belly and thighs. The wings and tail are large and rounded. The hoatzin is gregarious and wholly arboreal, feeding on leaves and fruit, especially of arum. Harsh, hissing sounds and several monotonous notes constitute the voice. The two to three brown-speckled white



BY COURTESY OF CHICAGO NATURAL HISTORY MUSEUM

HOATZIN (OPISTHOCOMUS HOAZIN)

eggs are deposited on a platform of sticks constructed in the low branches of trees, a few feet above the water.

See C. W. Beebe, *Tropical Wildlife in British Guiana*, pp. 155–182 (1917). (E. R. BE.)

HOBART, GARRET AUGUSTUS (1844–1899), vice-president of the United States 1897–99, was born at Long Branch, N.J., on June 3, 1844. He graduated from Rutgers college, New Brunswick, N.J., in 1863, was admitted to the bar in 1869, practised law at Paterson, N.J., and rose to prominence in the state. He was long conspicuous in the state Republican organization, was chairman of the state Republican committee from 1880–90, became a member in 1884 of the Republican National committee and was the delegate-at-large from New Jersey to five successive Republican national nominating conventions. He served in the New Jersey assembly in 1873–74 and in the New Jersey senate in 1877–82; he was speaker of the assembly in 1874 and president of the senate in 1881 and 1882. Hobart was also active in many business concerns. He accepted the nomination as vice-president in 1896, on the ticket with William McKinley, and was elected; but while still in office he died at Paterson, N.J., on Nov. 21, 1899.

See David Magie, *Life of Garret Augustus Hobart* (1910).

HOBART, a seaport and the capital of Tasmania, Austr., is situated on the Derwent estuary, 12 mi. from the sea. Pop. (1961) 115,932 (including suburbs). Hobart was founded in 1804 (taking its name from Lord Hobart, then U.K. secretary of state for

the colonies), proclaimed a city in 1842 and granted municipal government in 1852. It occupies a site of great beauty. At this point the estuary is about two miles wide, and the city ranges along steep foothills, with Mt. Wellington (4,167 ft.), often snow-covered, in the near background. Mean monthly temperatures range from 16.8° C. (62.2° F.) in February to 8.1° C. (46.6° F.) in July; average annual rainfall is 25 in. and daily average sunshine 5.9 hr.

Hobart has two cathedrals, for it is the seat of the Anglican bishop of Tasmania and the Roman Catholic archbishop of Hobart. A number of public and private buildings in stone, brick and even weatherboard attain remarkable grace. Among the outstanding buildings are the parliament house (1834) and the parish churches of St. George and the Holy Trinity. There are many parks (of which the largest is the Queen's Domain), the University of Tasmania (founded 1890), several large hospitals, together with the state library and museum and art gallery. The urban centre is on the western shore, but suburban development has spread across the estuary; a new bridge was to be completed in 1963.

For many years the main reason for the township's development was the fact that the harbour was easy of access, well sheltered and deep. The wharves around Sullivan's cove, where the first settlement arose, are still at the heart of the city. In the mid-19th century whaling in the South Pacific was at its peak, and this contributed greatly to the colony's economy.

BY COURTESY OF THE AGENT GENERAL FOR TASMANIA

AERIAL VIEW OF THE HARBOUR AND CITY OF HOBART, AT THE FOOT OF MT. WELLINGTON

Successive expeditions to the south pole made Hobart their final port of call. There is wharf accommodation for all but the largest ships afloat. Exports include apples, newsprint, hides and skins, timber and wool.

In the 20th century the area's ample supply of water has encouraged hydroelectric projects in the central highlands and a consequent increase in Hobart's industry. Manufactures include electrolytic zinc, sulfuric acid and superphosphate, jam, confections and clothing. Calcium carbide is processed at Electrona and newsprint is produced at Boyer nearby. Hobart is connected with the main towns of Tasmania by road or rail and has an airport at Llanherne to the east. (O. M. R.)

HOBART PASHA (AUGUSTUS CHARLES HOBART-HAMPDEN) (1822–1886), English naval captain and Turkish admiral, 3rd son of the 6th earl of Buckinghamshire, was born in Leicestershire on April 1, 1822. He entered the navy in 1835, and served with distinction until March 1863, when he retired with the rank of captain.

During the American Civil War he took command of a blockade-runner. He ran the blockade frequently, conveying war matériel to Charleston, S.C., and returning with a cargo of cotton. Hobart entered the Turkish service in 1867, and was immediately nominated to the command of the fleet, with the rank of *bahrie livassi* (rear admiral). He helped to suppress the Greek insurrection in Crete, and was rewarded by the sultan with the title of pasha (1869). Hobart, whose name had, on representations made by Greece, been removed from the British navy list, was reinstated in 1874; his restoration did not however last long, for on the outbreak of the Russo-Turkish War in 1877 he again entered Turkish service. In command of the Turkish squadron he completely dominated the Black sea, blockading the ports of south Russia and the mouths of the Danube and paralyzing the action of the Russian fleet. In 1881 he was appointed mushir, or marshal, being the first Christian to hold that office. He died at Milan on June 19, 1886.

HOBBEMA, MEINDERT (1638–1709), one of the foremost Dutch landscape painters of his day, was born at Amsterdam on Oct. 31, 1638, lived there all his life and died there on Dec. 7, 1709. He was a friend, and probably pupil, of Jacob van Ruisdael. The two made sketching tours together and often painted the same views; thus Ruisdael's "Water Mill" at Amsterdam and Hobbema's "Water Mill" in Washington, D.C.; Ruisdael's "Ruins of the Castle of Brederode," formerly in the Northbrook collection, and Hobbema's on the same subject in the Wallace collection, London, and Frick collection, New York. These were painted from 1661 to 1663. In Oct. 1668 Hobbema married the cook of the burgomaster of Amsterdam. This marriage marked the end of his artistic career, for through the position and influence of his wife he received a municipal appointment. He was, however, not able to amass a fortune, for when his wife died in 1704 she was buried as a pauper, and Hobbema was buried in Dec. 1709 in the pauper section of the Westerkerk cemetery at Amsterdam.

Unlike Ruisdael, who liked to paint the sea, the mountain torrent and rocky landscape, Hobbema's favourite motif is the countryside, thickly studded with trees, houses, churches and ruined castles. A peaceful stream with a water mill may enliven the scene, as in "Landscape With Water Mill" (Institute of Art Minneapolis, Minn.).

THE NATIONAL GALLERY, LONDON

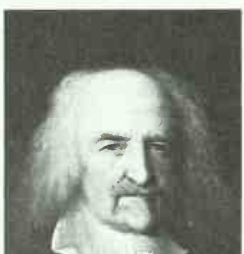
"THE AVENUE MIDDELHARNIS" BY MEINDERT HOBBEMA. IN THE NATIONAL GALLERY, LONDON

His masterpiece is "The Avenue, Middelharnis," in the National gallery, London. "The Avenue" is unique in style among Hobbema's works, and its fine composition bears no resemblance to the somewhat tame and repetitive designs he produced earlier. Hobbema's other masterpieces were painted between 1663 and 1669. Among them is "A Wooded Landscape with Two Cows," in which the cows are painted by Adrian van de Velde. "The Mill" is in the Louvre, and there are examples in most European galleries and in many private collections. From 180 to 200 works by the master are extant. (R. E. W. J.; X.)

HOBBES, THOMAS (1588–1679), English philosopher, perhaps the greatest political thinker of his nation, was born at Westport (now part of Malmesbury), Wiltshire, on April 5, 1588, the second son of Thomas Hobbes, vicar of Westport and Charlton. Reports of the Spanish Armada were filling England with alarm at the time of his birth, and Hobbes afterward attributed his own love of peace to the fact that fear and he were twins. His father was "a choleric man"; in Hobbes's early years he caused a scandal by engaging in a brawl at the church door, and disappeared, leaving his three children to be brought up by his brother, a well-to-do glover in Malmesbury.

At the age of 4 Hobbes was sent to the church school at Westport; then to a private school kept by Robert Latimer; and finally, at 15, to Magdalen hall, Oxford. He took little interest in the scholastic philosophy taught there and devoted most of his time to books of travel and the study of maps and charts.

Studies and Travels, 1608–36.—On graduating (Feb. 5, 1608), Hobbes became private tutor to William Cavendish, afterward 2nd earl of Devonshire, and began a connection with the Cavendish family which lasted, with interruptions during the Civil War, until the end of his life. He grew very fond of his pupil, who was only a little younger than himself, and in 1610 accompanied him on a tour in Europe. Finding that the philosophy taught at Oxford was held in contempt there, he determined to make himself a scholar and, on his return to England, devoted himself to classical studies.



BY COURTESY OF THE NATIONAL PORTRAIT GALLERY

DETAIL FROM A PORTRAIT OF THOMAS HOBBES BY JOSEPH MICHAEL WRIGHT, ABOUT 1625–1700. IN THE NATIONAL PORTRAIT GALLERY

At some time between 1621 and 1625 he came into contact with Francis Bacon; John Aubrey relates that he occasionally acted as Bacon's amanuensis and helped him to render a few of his *Essays* into Latin. But the chief fruit of Hobbes's classical studies was his translation of Thucydides (*English Works*, viii–ix). Its publication in 1629 was inspired by the troubles of the time, for Hobbes saw in the fate of ancient Athens a salutary warning against democracy.

After the death of the 2nd earl of Devonshire (1628) Hobbes remained for a short time in the Cavendish household, but in 1629 he went abroad again as traveling companion to the son of Sir Gervase Clifton. In 1630 he was recalled from Paris to teach the young earl of Devonshire, William Cavendish (1617–84), son of his late patron. He took his pupil to France and Italy in 1634. These last two excursions stimulated Hobbes's interest in science and philosophy by bringing him into contact with the leaders of the new thought in Europe. The turning point in his intellectual history, his discovery of geometry, is described by Aubrey as follows: "Being in a gentleman's library in . . . , Euclid's *Elements* lay open, and 'twas the 47 El. libri I. He read the proposition. 'By G—', said he (he would now and then swear by way of emphasis), 'this is impossible!' So he reads the demonstration of it, which referred him back to such a proposition; which proposition he read. That referred him back to another, which he also read. *Et sic deinceps*, that at last he was demonstratively convinced of that truth. This made him in love with geometry." In his prose autobiography (*Latin Works*, i) Hobbes himself relates how he was in a gathering of learned men when the question was asked, "What is sense?" On consideration it occurred to him that if material things and all their parts were always at rest or in uniform motion there could be no distinction of anything and consequently no perception, and he concluded that the cause of all things must be sought in diversity of motion. He was therefore driven to geometry to gain insight into the principles of motion. Hobbes's awakening to physical science seems to have taken place during his second European journey in 1629–30; on his third journey the new interest became an overpowering passion, and he was able to discuss his ideas with Marin Mersenne's circle in Paris and with Galileo, whom he visited at Florence in 1636. He now determined to embody his doctrines in a philosophical trilogy: *De corpore* was to show that physical phenomena were explicable in terms of motion; *De homine* was to show what specific bodily motions were involved in human cognition and appetition; and *De cive* was to expound the proper organization of men in society.

Political Interests, 1637–40.—But when Hobbes returned home in 1637 he was quickly diverted from abstract speculation about body and motion. Finding the peace of his native land endangered by attacks on the royal prerogative, he set to work to prove that the powers and rights called in question were inseparably annexed to sovereignty, which at that time was admitted to reside in the king; and by 1640 his treatise on *The Elements of Law, Natural and Politic* was being circulated in manuscript.

It already embodies Hobbes's characteristic doctrine that social peace requires the existence of an absolute and undivided sovereign power (*see* ABSOLUTISM, POLITICAL); but it differs from his *Leviathan* (*see* below) by stressing that primary democracy is the first form of commonwealth by institution, monarchy and aristocracy arising when the democratic sovereign created by the social contract between individuals annihilates itself by transferring its power absolutely to one man or a few. Hobbes's views antagonized both parties in the constitutional struggle: the believers in the divine right of kings were irritated by his attempt to base sovereignty on a social contract, the parliamentarians by his advocacy of absolute monarchy.

Exile in Paris, 1640–51.—When strife became acute in 1640 with the impeachment of the earl of Strafford and of Archbishop Laud, Hobbes thought he was a marked man and fled to Paris. Probably his fears were exaggerated. In any case the next 11 years were spent in exile, chiefly in Paris, where he was soon in contact with later fugitives from England. He rejoined the Mersenne circle, and Mersenne showed him the unpublished *Meditations* of Descartes. Hobbes put in writing certain objections to the *Meditations* and also to the *Dioptrique* (*Latin Works*, v); but the self-confident dogmatism of these communications

exasperated Descartes, who finally refused to have anything more to do with "the Englishman." In 1642 *De cive* (*Latin Works*, ii) appeared at Paris, but so few copies were issued that according to Pierre Gassendi they excited rather than satisfied thirst. This work expanded the argument of the second part of *The Elements of Law* and concluded with a section on religion which dealt more fully than the earlier treatise with the relation between church and state. A Christian church and a Christian state were one and the same body; of that body the sovereign was the head; the sovereign had therefore the right to interpret Scripture, to decide religious disputes and to determine the form of public worship. Such, in brief, was Hobbes's remedy for the sectarian controversies then disrupting the peace of so many European states.

Having published the third part of his trilogy first in the hope of averting civil war, Hobbes spent the next four years working on *De corpore;* but in 1646 the young prince of Wales, later to become Charles II, sought refuge in Paris, and Hobbes accepted an invitation to instruct him in mathematics. Contact with exiles from England made it increasingly difficult to concentrate on natural philosophy, and he turned once more to political theory. In 1647 a second edition of *De cive,* augmented by explanatory notes and a "Preface to the Reader," appeared at Amsterdam. In 1650 the manuscript of *The Elements of Law* was published as two separate works, the first entitled *Human Nature,* the second *De corpore politico* (*English Works,* iv).

In 1651 there appeared an English version of *De cive* (*English Works,* ii); and this was followed in the same year by Hobbes's masterpiece, *Leviathan, or the Matter, Form, and Power of a Commonwealth, Ecclesiastical and Civil* (*English Works,* iii). In the first two parts, "Of Man" and "Of Commonwealth," he re-covered the ground already traversed in the earlier treatises; in the last two, "Of a Christian Commonwealth" and "Of the Kingdom of Darkness," he embarked upon a discussion of Scripture and made a vigorous attack on the attempts of papists and presbyterians to challenge the right of the sovereign.

By 1651 Charles I was dead and the royalist cause seemed hopelessly lost; accordingly, in the "Review and Conclusion" at the end of *Leviathan* Hobbes attempted to define the circumstances under which submission to a new sovereign became legitimate. He had always maintained that a subject had the right to abandon a ruler who could no longer protect him and to transfer his allegiance to one who could; but the statement of this view in his "Review and Conclusion" naturally gave serious offense to Prince Charles's advisers, who concluded that Hobbes was trying to curry favour with the new regime in England in order to facilitate his own return. So little was Hobbes himself conscious of any disloyalty that he presented the prince, newly returned to Paris after the defeat at Worcester, with a manuscript copy of *Leviathan,* "engrossed in vellum in a marvellous fair hand" (probably the copy in the British museum, Egerton manuscript 1910). Barred from the exiled court and suspected by the French authorities for his attack on the papacy, Hobbes found his position in Paris becoming daily more intolerable and, at the end of 1651, returned to England. His patron, the earl of Devonshire, had submitted to parliament in 1646 to save the family estates, and now Hobbes too made his peace with the new regime. Instead of joining his patron in the country he settled in London, where he could enjoy the society of men like William Harvey and John Selden.

Later Life and Controversies.—Hobbes was now 63 years of age, but was to retain his vigour for another quarter of a century. For a time he worked quietly on *De corpore,* but in 1654 he became involved in one of the controversies which were to play so large a part in his later life. In 1646 he had discussed the problem of free will with John Bramhall, bishop of Londonderry, at the house of the marquis of Newcastle in Paris. After the discussion Bramhall had put his arguments in writing and sent them to Newcastle; Hobbes had replied; Bramhall had made a rejoinder; and the controversy had then closed. Since Hobbes had requested Newcastle to keep his contribution private the whole correspondence had remained unpublished. But one of the philosopher's admirers had seen and made a copy of Hobbes's answer; and this he now published, without Hobbes's knowledge, under the title *Of Liberty and Necessity* (*English Works,* iv). The publication of this work, under Hobbes's name and with an offensive prefatory epistle, incensed Bramhall, who in 1655 proceeded to issue the whole correspondence, including his own replies to Hobbes, in a work entitled *A Defence of True Liberty From Antecedent and Extrinsical Necessity.* In the following year Hobbes retorted with *The Questions Concerning Liberty, Necessity, and Chance* (*English Works,* v), where he reprinted the correspondence with animadversions on the bishop's replies. In 1658 Bramhall returned to the fray with *Castigations of Mr. Hobbes His Last Animadversions,* which contained for good measure an appendix entitled *The Catching of Leviathan or the Great Whale.* Hobbes took no notice of the *Castigations;* but to the charge of atheism made in *The Catching of Leviathan* he replied ten years later in a work which was not published until 1682, some three years after his death (*English Works,* iv).

Hobbes's argument with Bramhall over free will is still interesting and important; but the same cannot be said of the other controversy which occupied Hobbes's later years. He had made enemies at Oxford by the publication of *Leviathan,* which attacked the university system as being founded originally for the support of the papal against the civil authority and as still working social mischief by adherence to the old learning. Oxford was therefore quick to avail itself of the opportunities for criticism offered by *De corpore* (*Latin Works,* i), which was published at last in 1655. Hobbes's main antagonists were Seth Ward, Savilian professor of astronomy, and John Wallis, author of the great treatise *Arithmetica infinitorum,* both of them much abler mathematicians than Hobbes. He replied to their attacks in *Six Lessons to the Professors of Mathematics in the University of Oxford* (*English Works,* vii), which appeared in 1656 as an appendix to the English translation of *De corpore* (*English Works,* i). After more rough thrusts on both sides Hobbes retired to complete his *De homine* (1658; *Latin Works,* ii). It consisted for the most part of an elaborate theory of vision, and although it contained a brief account of human psychology, it did little to bridge the gap between *De corpore* and *De cive.*

As soon as *De homine* was through the press Hobbes prepared to join battle again. In the spring of 1660 he published an onslaught on the newfangled methods of mathematical analysis in six dialogues entitled *Examinatio et emendatio mathematicae hodiernae qualis explicatur in libris Johannis Wallisii* (*Latin Works,* iv). In *Dialogus physicus, sive De Natura aeris* (1661; *Latin Works,* iv) he fulminated against Robert Boyle and other friends of Wallis who were then forming themselves into a society (incorporated as the Royal society in 1662) for experimental research, in opposition to the deductive method of physical inquiry advocated in *De corpore.* Wallis retorted in the scathing satire *Hobbius heautontimorumenos* (1662). Professing to be roused by the attack on his friend Boyle, when he had scorned to lift a finger in defense of himself against the earlier dialogues, he tore them all to shreds with consummate skill, accusing Hobbes, quite unjustly, of having written *Leviathan* in support of Oliver Cromwell's title and of having deserted his royal master in distress. Hobbes answered these charges in a letter about himself in the third person addressed to Wallis in 1662, under the title *Mr. Hobbes Considered in His Loyalty, Religion, Reputation, and Manners* (*English Works,* iv). In this piece, which is of great biographical value, he told his own and Wallis' "little stories during the time of the late rebellion" so effectively that Wallis wisely attempted no reply.

After a time Hobbes began a third period of controversial activity, which did not end on his side till his 90th year. *De principiis et ratiocinatione geometrarum* (1666; *Latin Works,* iv) was designed to humble the pride of professors of geometry by showing that their works contained as much uncertainty and error as those of writers on physics or ethics. *Quadratura circuli, Cubatio sphaerae, Duplicatio cubi* (1669; *Latin Works,* iv) gave Hobbes's solutions to these famous problems; and although they were promptly refuted by Wallis he worked them up again in later publications. In 1674, at the age of 86, he published *Principia et problemata aliquot geometrica, ante desperata, nunc breviter explicata et demonstrata* (*Latin Works,* v); and in 1678 appeared

his last piece of all, *Decameron physiologicum* (*English Works*, vii), a new set of dialogues on physical questions. By this time Wallis had given up the vain attempt to cure him of his mathematical aberrations.

These controversial writings on mathematics and physics represent only part of Hobbes's activity after the age of 70. From the time of the Restoration he acquired a new prominence. Two or three days after Charles II's arrival in London, Hobbes attracted the notice of his old pupil in the street and was at once received into favour. The king relished his wit (he used to say, "Here comes the bear to be baited!"), and did not like the old man the less because his presence at court scandalized the bishops and the prim virtue of the chancellor Edward Hyde (1st earl of Clarendon). He even granted Hobbes a pension of £100 a year (not always fully or regularly paid) and had his portrait hung in the royal closet. But "Hobbism" was frequently identified with freethinking and even with atheism, for Hobbes's attack on the church was regarded as subversive of all religion. His enemies were many and powerful. His eagerness to defend himself against Wallis' imputation of disloyalty and his apologetic dedication of *Problemata physica* (*Latin Works*, iv) to the king are evidence of the hostility with which he was being pressed by the church party as early as 1662; but it was not till 1666 that he felt himself in serious danger. In that year the house of commons embodied the superstitious fear arising from the calamities of the plague and the Great Fire of London in a bill against atheism and profaneness; and the committee to which the bill was referred was instructed to investigate *Leviathan*. Hobbes, then verging upon 80, burned such of his papers as he thought might compromise him and set himself to inquire into the state of the law of heresy.

The results of his investigations appeared in the three short dialogues which in the Latin version of *Leviathan* (1668; *Latin Works*, iii) replaced the old "Review and Conclusion." In these dialogues, as in the tract entitled *An Historical Narration Concerning Heresy and the Punishment Thereof* (published posthumously in 1680; *English Works*, iv), he maintained that since the abolition of the high court of commission there was no court of heresy to which he was amenable and that in any case nothing was to be declared heresy but what was at variance with the Nicene creed, as the doctrine of *Leviathan* was not.

Although parliament dropped the bill on atheism Hobbes could never afterward get permission to print anything on subjects relating to human conduct. In 1668 his Latin works (2 vol.) came out at Amsterdam, because he could not obtain the censor's licence for their publication in England. Some of his other writings were not printed until after his death—the king apparently having made it the price of his protection that no fresh provocation should be offered to popular sentiment. The most important of the works thus withheld from publication was the spirited dialogue *Behemoth, the History of the Causes of the Civil Wars of England* (*English Works*, vi). This was kept back at the king's express desire, but an unauthorized edition was brought out in 1679, while Hobbes was still alive. *Behemoth* was composed about 1668; to the same period probably belongs the unfinished *Dialogue Between a Philosopher and a Student of the Common Laws of England* (published in 1681; *English Works*, vi), a trenchant criticism of the constitutional theory of English government as upheld by Edward Coke. The Latin elegiacs exposing the methods by which ecclesiastics encroached upon the civil power may also date from this period; they were first published in 1688 under the title *Historia ecclesiastica* (*Latin Works*, v).

For some time, then, Hobbes was not allowed to publish a word in his own defense, and his enemies took every opportunity to discredit him. But no Englishman of the day stood in such high repute abroad, and distinguished foreigners who visited England were always eager to pay their respects to the old man, whose vigour and freshness of intellect no passage of the years seemed able to quench. Among these was the grand duke of Tuscany (Ferdinand II), who took away some works and a portrait to adorn the Medicean library.

In his last years Hobbes amused himself by returning to the classical studies of his youth. The autobiography in Latin verse (*Latin Works*, i), with its playful humour, occasional pathos and sublime self-complacency, was thrown off at the age of 84. In 1673 he produced *The Travels of Ulysses*, a translation of books ix–xii of the *Odyssey* in rugged English rhymes; finding this favourably received, he published in 1675 a rendering of the whole epic, with a lively preface "Concerning the Virtues of an Heroic Poem." A translation of the *Iliad* appeared in the following year (*English Works*, x). As late as Aug. 1679 he was promising his publisher "somewhat to print in English." He died at Hardwick hall in Derbyshire on Dec. 4 of that year and was buried in the neighbouring church of Hault Hucknall.

Personal Character.—Hobbes was tall and erect in figure. Believing that "a beard did not make a philosopher," he had himself shaved close except for a little tuft under his lip. He lived a temperate life. He used to say that he had been drunk about 100 times in all; and after the age of 60 he drank no wine and ate little meat. His favourite sport was tennis, which he still played occasionally even at 75.

Socially he was genial and courteous, though in argument he sometimes lost his temper. Cautious in practical matters, but intellectually bold in the extreme, he claimed to have read little and boasted that he would have known as little as other men if he had read as much. He is said to have had an illegitimate daughter for whom he made generous provision. There is a portrait of him by J. M. Wright in the National Portrait gallery, London, and two others are in the possession of the Royal society.

Hobbes's Place in Philosophy.—Hobbes was so impressed by Galileo's achievements in mechanics that he sought to explain all phenomena, and indeed sense itself, in terms of the motion of bodies. His a priori mathematical approach to natural philosophy separated him decisively from Francis Bacon, who had advocated an experimental inductive method; and the laborious investigations which John Locke was later to make into the powers of the human understanding were alien to his dogmatic and self-confident temper.

Yet Hobbes was not only the architect of a grand metaphysical design, he was also a critical philosopher with a lively interest in language and a keen eye for the snares which it spread for the unwary. Indeed, his account of the sources of absurdity, which provided him with a potent weapon against the scholastics, gives him some title to be regarded as a forerunner of modern logical analysis.

But Hobbes's reputation as a thinker rests mainly on his contributions to the philosophy of man. His egoistic psychology was taken over and elaborated by Spinoza; and in Great Britain it stimulated such thinkers as the 3rd earl of Shaftesbury, Joseph Butler and Francis Hutcheson to seek a more respectable account of human motivation. His contribution to the free-will problem in his controversy with Bramhall had an influence which can be traced not only in Spinoza, Locke, Anthony Collins, David Hume and Jonathan Edwards, but even in modern writers like Moritz Schlick and G. E. Moore. In moral theory he is generally regarded as a pioneer of the utilitarian school. He justified obedience to moral rules as the means to "peaceable, social, and comfortable living"; and, since he was hostile to the political pretensions of ecclesiastics, it obviously suited him to give such rules a purely secular basis. Yet he also said that the laws of nature were God's commands, and it was left to Spinoza to deny that God was a king who laid down laws which men could break. (*See* ETHICS, HISTORY OF: *Modern Ethics.*)

In his political theory he departed from the accepted tradition by making natural right rather than natural law his fundamental concept. The right of nature is essentially a right to self-preservation, and Hobbes maintains that a man has no obligation to act in accordance with the law of nature, and indeed cannot do so, if he thinks such conduct inimical to his own security. Yet peace and its blessings cannot be achieved unless the law of nature is generally observed.

Hobbes's solution is to give everyone a guarantee of the good behaviour of his fellows by creating a power sufficient to keep them in awe. This power will be created if each individual promises every other individual that he will carry out whatever commands some selected person—either one man or an assembly, but pref-

erably one man—shall consider necessary for the peace and defense of all. Such covenants, by convincing each individual that the others will obey the person agreed upon, will inspire him with a belief in the sovereign's power; and a sovereign so established may survive even if all the subjects desire to depose it, provided that they do not communicate their desire to one another. This condition will be satisfied in Hobbes's commonwealth, whose subjects have no source of unity but the sovereign.

The sovereign's right will be as absolute as its power. Insofar as it is responsible at all, it is responsible only to God. It cannot be unjust to its subjects, since these have authorized its actions, and consent precludes violation (*injuria non fit volenti*). Nor is it bound by any covenant with the people, for there is no people apart from the sovereign.

In essence Hobbes's argument is very simple. He first analyzes the conditions necessary for peace and security and then, in his version of the social contract, provides a recipe for constructing an ideal state in which these conditions will be satisfied. Later thinkers, stimulated and influenced though they were by his doctrine, were critical both of his account of the ends of the state and of the means which he advocated to achieve them. Spinoza maintained that peace was not mere absence of war but voluntary co-operation; Locke and Jean Jacques Rousseau rudely compared the peace of Hobbes's state with the peace of a dungeon. As for the means, Spinoza argued that absolute sovereignty was seldom, if ever, possible in practice and explored the limitations which the intractable nature of man imposed upon those in authority; Locke, denying that security could be attained by submission to an absolute ruler "corrupted by flattery and armed with power," recommended that legislative power and executive power should be placed in different hands and that the former should be vested in an assembly whose members would be subject to the laws which they collectively made; and Rousseau, while accepting absolute sovereignty, equated sovereignty with the legislative power which he vested in the people as a whole (he too found some safeguard against oppressive legislation in the fact that the lawmakers were to be subject *qua* individuals to their own laws).

Hobbes's reputation was soon overshadowed by that of Locke; and when the theory of the social contract went out of fashion he suffered a period of neglect in Great Britain. But in the 19th century interest in him was revived by the followers of Jeremy Bentham and in particular by John Austin, who made a modified version of Hobbes's doctrine of sovereignty and law the basis of his jurisprudence; and since Austin's day Hobbes has gradually been accorded recognition as one of the greatest of English political thinkers.

See also references under "Hobbes, Thomas" in the Index volume.

BIBLIOGRAPHY.—The standard edition of Hobbes's complete works is that by Sir William Molesworth, comprising *English Works,* 11 vol. (1839–45), and *Latin Works,* 5 vol. (1839–45); the *Latin Works* include the autobiographies in prose and verse and a supplement entitled *Vitae Hobbianae Auctarium.* Among the numerous modern editions of *Leviathan* that by M. Oakeshott (1946) is noteworthy for its controversial introduction (*cf.* articles in *Political Studies,* i, pp. 53–64, 216–227, and ii, pp. 168–172 [1953]). Other modern editions of separate works include *The Elements of Law* and *Behemoth,* ed. from early manuscripts by F. Tönnies (1889); *Of Liberty and Necessity,* ed. by Baron Cay von Brockdorff (1938); and the English version of *De cive,* ed. by S. P. Lamprecht (1949). For details of original editions *see* H. Macdonald and M. Hargreaves, *Thomas Hobbes: a Bibliography* (1952).

John Aubrey's account of Hobbes (in *Brief Lives,* ed. by A. Clark, vol. i, pp. 321–403 [1898]) gives intimate anecdotes. For further studies *see:* G. C. Robertson, *Hobbes* (1886); F. Tönnies, *Hobbes der Mann und der Denker* (1912); Sir Leslie Stephen, *Hobbes* (1904); R. Hönigswald, *Hobbes und die Staatsphilosophie* (1924); F. Brandt, *Thomas Hobbes' Mechanical Conception of Nature,* Eng. trans. (1928); Z. Lubienski, *Die Grundlagen des ethisch-politischen Systems von Hobbes* (1932); J. Laird, *Hobbes* (1934); J. Vialatoux, *La Cité de Hobbes* (1935); L. Strauss, *The Political Philosophy of Hobbes* (1936); C. Schmitt, *Der Leviathan in der Staatslehre des Thomas Hobbes* (1938); J. Bowle, *Hobbes and His Critics* (1951); R. Polin, *Politique et Philosophie chez Thomas Hobbes* (1953); P. Zagorin, *A History of Political Thought in the English Revolution* (1954); R. Peters, *Hobbes* (1956); Howard Warrender, *The Political Philosophy of Hobbes* (1957).

(A. G. WM.)

HOBBYHORSE, a wooden or cardboard frame draped with cloth, carried by a man who stands inside it and fixed with a horse's head in front and a tail behind. A more primitive form is a real horse skull fixed on a pole, the man being covered with a sheet. The hobbyhorse is a fertility animal disguise that appears at a change of season; midwinter, carnival (*i.e.,* early spring) or midsummer in folk drama or alone. To stimulate renewal of life it chases women and brings "luck" (*i.e.,* fertility) to the houses it visits in exchange for food or money.

South Indian hobbyhorses attend weddings; Javanese horses are of woven basketwork. All Europe possesses examples and in northern Germany a white horse is said to be Wotan's steed. Those of Spain and Provence are ornate and processional. Great Britain boasts the "Old Hoss" at Padstow, Cornwall, appearing on May day to catch women, and the Minehead, Somerset, horse, which catches strangers. The Welsh Mari Lwyd appears on the Gower coast at midwinter; Ireland had a similar skull-type to attend the midsummer fires. Iberian influence took the hobbyhorse to Latin America.

(V. AL.)

HOBHOUSE, EMILY (1860–1926), English humanitarian, called the "Angel of Love" by the Boer women during the South African War, was born on April 9, 1860, and spent the first 35 years of her life at her father's rectory at St. Ive, near Liskeard, Cornwall. After her father's death she took up welfare work in the United States.

On the outbreak of the South African War in 1899 she spoke in public with Lloyd George in opposition to "Joseph Chamberlain's war" and later, on reading of hardship among the Boer women and children, organized a relief fund. She went to South Africa to make investigations, arriving in Cape Town on Dec. 27, 1900. Obtaining permission to visit the concentration camps with some difficulty, she was startled by conditions in them and on her return to England focused public attention on the treatment of women and children in these camps. Conditions were subsequently improved. Miss Hobhouse attempted a second visit in Oct. 1901 but was forbidden to land in Cape Town and was deported, but returned in 1903, spending the next five years in helping the education and rehabilitation of women and girls in the Orange Free State. Ill health forced her to return to England in Oct. 1908.

During World War I she tried to help the destitute and dispossessed in central Europe, even paying a visit to Germany, and continued this work after the war until ill health once more forced her to retire. Miss Hobhouse died in London on June 8, 1926.

See A. R. Fry, *Emily Hobhouse* (1929).

HOBHOUSE, LEONARD TRELAWNEY (1864–1929), British philosopher and sociologist, was born Sept. 8, 1864, at St. Ive, near Liskeard. Educated at Oxford, he taught at Merton and Corpus Christi colleges until 1897. An active Liberal, he served on the editorial staff of the *Manchester Guardian* until 1902, was secretary of the Free Trade union until 1905 and published several political works, notably *The Labour Movement* (1893; 2nd ed., 1898), *Democracy and Reaction* (1904) and *Liberalism* (1911), showing strong sympathy with collectivism which he maintained was consistent with Liberalism. In 1907 he was appointed professor of sociology in the University of London, a position he retained until his death at Alençon, France, on June 21, 1929. His concept of sociology, not as a specialty, nor a synthesis of specialties but as the interpretation of social life as a whole, helps explain the many fields such as philosophy, biology and psychology into which he ventured and made his own.

His principal works are *The Theory of Knowledge* (3rd ed., 1921); *Mind in Evolution* (2nd ed., 1915); *Morals in Evolution* (rev. ed., 1915); *Development and Purpose* (rev. ed., 1927); *Social Evolution and Political Theory* (1911); and, in collaboration with G. C. Wheeler and M. Ginsberg, *The Material Culture and Social Institutions of the Simpler People* (1915). Four works constitute his sociological system and together they are entitled *The Principles of Sociology* (1918–24). The first, *The Metaphysical Theory of the State* (1918), criticizes the Hegelian theory of the state; the second, *The Rational Good* (1921), develops a social philosophy based on individual development and the common good; the third, *Elements of Social Justice* (1922), applies

this philosophy to concrete economic and political problems; the final volume, *Social Development* (1924), examines the actual conditions underlying the life of societies and their bearing on the fulfilment of rational purpose.

See Hugh Seiver Carter, *The Social Theories of L. T. Hobhouse* (1927); M. Ginsberg and J. A. Hobson, *L. T. Hobhouse: His Life and Work* (1931); J. A. Nicholson, *Some Aspects of the Philosophy of L. T. Hobhouse* (1928). (J. Ry.)

HOBOKEN, a town of northern Belgium, province of Antwerp, is situated on the Scheldt river 7 km. (4½ mi.) S.W. of Antwerp by road. Pop. (1961) 30,557. There is a public park, the Sorghvliedt, and new housing estates which have been developed in the grounds of old mansions. Railways and tramlines connect Hoboken with Antwerp. The chief industries are shipbuilding, wool carding, foundry and metal work, metal packing, and the manufacture of telephones. First mentioned in 1135, Hoboken has developed from a village to an important industrial centre.

HOBOKEN, a city of Hudson county, in northeastern New Jersey, U.S., adjoining Jersey City and Union City (*qq.v.*), is located on the Hudson river opposite Manhattan Island, with which it is connected by ferry, tunnel and subway.

In 1630 the Dutch, led by Michael Pauw, purchased the site from the Leni-Lenape Indians, who smoked carved stone pipes and named it Hobocan after *Hobocan Hackingh* (land of the tobacco pipe). In 1784 John Stevens (*q.v.*), the locomotive inventor, after whom the Stevens Institute of Technology is named, bought the site and laid out the town more formally.

During the large-scale migrations to the U.S., around the middle of the 19th century, Germans and Irish came to Hoboken and German traditions dominated. The first brewery in America (1642) was built there by a Dutchman, Aert T. van Putten, and beer (which is no longer produced) was later brewed in great quantities by the Germans, who established many beer halls and gardens. The New York Knickerbockers, early baseball team, made the Elysian Fields their home field for the 1846 season (*see* BASEBALL: *History of Baseball*).

During World War I Hoboken was the main port of embarkation of U.S. forces to continental Europe. Under the terms of a 1952 agreement the Port of New York authority leased Port Hoboken for operation as an integral part of the Port of New York. Hoboken's industries include shipbuilding, processing machinery, textiles, food processing, chemicals, furniture, electronic equipment, paints and precision instruments. The modern type ferry slip and the application of steam power to ships and locomotives was closely associated with Hoboken through Stevens' inventions and their later development. For comparative population figures *see* table in NEW JERSEY: *Population.* (D. N. A.; M. P. M.)

HOBY, SIR THOMAS (1530–1566), English diplomat and translator of Castiglione's *Cortegiano,* was born in 1530. He entered St. John's college, Cambridge, in 1545, but in 1547 went to Strasbourg. Thereafter he traveled extensively on the continent, spending a short time at Augsburg with his half brother, Sir Philip Hoby (1505–58), then ambassador at the emperor's court. By 1552 Thomas was engaged on his translation, *The Courtyer of Count Baldesser Castilio,* printed in 1561. The *Cortegiano,* which Samuel Johnson called "the best book that ever was written upon good breeding," exercised an immense influence on the standards of manners throughout Europe and was the recognized authority for the education of a nobleman. Hoby was knighted by Elizabeth I in 1566, and was sent to France as English ambassador. He died in Paris on July 13 of the same year. His other works include a translation of a Latin work by Martin Bucer as *Gratulation . . . Unto the Church of England* and an autobiography, *A Booke of the Travaile and Lief of Me, Thomas Hoby,* edited by E. Powell for the Camden Miscellany, vol. x (1902).

HOCCLEVE (OCCLEVE), **THOMAS** (*c.* 1368–1426), English poet, one of the group often referred to as the English Chaucerians, was born probably in 1368/69. What is known of Hoccleve's life has to be gathered mainly from his works. At 18 or 19 he obtained a clerkship in the privy seal office, which he retained on and off, in spite of much grumbling, for about 35 years. In 1399 he received a small annuity, which was not always paid as regularly as he would have wished. "The Letter of Cupid," his first poem to which a date can be assigned, was translated from *L'Epistre au Dieu d'Amours* of Christine de Pisan (*q.v.*) in 1402, evidently as a sort of antidote to the moral of Chaucer's *Troilus and Criseyde,* to some manuscripts of which it is attached. About 1410 he settled down to married life, and the composition of moral and religious poems. His longest work, *The Regement of Princes* or *De Regimine Principum,* written for Henry, prince of Wales, shortly before his accession as Henry V, is a tedious homily on the virtues and vices, imitated from Aegidius de Colonna's work of the same name, from the supposititious epistle of Aristotle known as the *Secreta secretorum,* and from the work of Jacques de Cessoles (*fl.* 1300) rendered into English later by Caxton as *The Game and Playe of the Chesse.*

On the accession of Henry, Hoccleve turned his muse to the service of orthodoxy and the church, and one of his poems is a remonstrance addressed to Sir John Oldcastle, calling upon him to "rise up, a manly knight, out of the slough of heresy." Then a long illness was followed for a time, as he tells us, by insanity. His "Dialog With a Friend," written after his recovery, gives a naïve and pathetic picture of the poor poet, now 53, with sight and mind impaired, but with hopes still left of writing a tale which he owes his good patron, Humphrey of Gloucester, and of translating a small Latin treatise, *Scite Mori,* before he dies. His hopes were fulfilled in his moralized tales of "Jereslaus' Wife" and of "Jonathas," both from the *Gesta Romanorum* (*q.v.*), which, with his "Learn to Die," belong to his old age. After finally retiring from his privy seal clerkship, he was granted, in 1424, sustenance for life in the priory of Southwick, Hampshire. This corody was granted to another holder in his place on May 8, 1426, so that he must have died earlier in that year.

Hoccleve claimed Chaucer as his master, and had his portrait painted in the manuscript of *The Regement of Princes;* but his work falls far short of his aspirations. His most interesting work for the modern reader is *La Male Regle* (1406), which contains some lively realistic description of London life. Otherwise he is generally pedestrian and diffuse, and his technique is not skilful enough to make up for the lack of distinction in his thought.

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HOCHE, LAZARE (1768–1797), French general of the Revolutionary wars, chiefly memorable for his pacification of the Vendée, was born at Versailles on June 25, 1768. Eight years in the French guards and self-education won him a commission in Sept. 1792. After eight months with the army of the Ardennes he was appointed staff colonel by the committee of public safety and entrusted with the defense of Dunkerque (Aug. 1793). He then won recognition from Lazare Carnot and, on Oct. 23, 1793, was appointed to command the army of the Moselle; many years later Marshal Soult recalled the wave of confidence which his bearing and competence produced in the troops. His immediate offensive northward against the Prussians had to be called off with loss, after the defeat of Kaiserslautern (Nov. 28–30), but he turned east against the Austrians in the Vosges. Putting his most active officers, regardless of rank, at the head of his columns, he forced the lines of Woerth and Wissembourg and relieved Landau (Dec. 14–28). Two of the *représentants en mission* placed Charles Pichegru's army of the Rhine also under Hoche's orders, but their colleague Antoine de Saint-Just and the minister of war, J. B. N. Bouchotte, supported Pichegru, with the result that Hoche was transferred to Italy (March 1794) and arrested on the orders of the committee of public safety when he reached Nice. Imprisoned for four months in Paris, he was very near death.

After Saint-Just's death at the *coup d'état* of 9th Thermidor, Hoche commanded the army of Cherbourg in Aug. 1794 and then that of Brest. Seeing that the republican armies in the west were

no better armed or disciplined than their opponents, the Vendéans and the Chouans, he made a real army out of his 70,000 men. He overwhelmed the *émigrés* landed by the English fleet at Quiberon (1795) and caught the guerrilla leaders. In July 1796 the pacification of the west could be proclaimed. Hoche's area of command, extending from La Rochelle to Caen, made him one of the most powerful men in France. (*See* VENDÉE, WARS OF THE.)

Carnot appointed Hoche in July 1796 to organize revolution in Ireland, but in December gales dispersed the expedition and Hoche's own frigate was blown so far away that he never saw the rest of the fleet. He next held command of one of the armies on the Rhine in the place of J. B. Jourdan, forced a passage of the Rhine, defeated the Austrians at Neuwied on April 18, 1797, and ended the war in Germany. After the royalist successes in the elections of the summer, his troops marched toward Paris, and he was himself appointed minister of war in July. Refusing this appointment (partly because he was too young), he was given the chief command of the new French army of Germany. There he died, perhaps of pneumonia, in his headquarters at Wetzlar on Sept. 19, 1797. (I. D. E.)

HO CHI MINH (originally NGUYEN TAT TAN) (1890–), founder and first president of the Democratic Republic of Vietnam (North Vietnam), was born on May 19, 1890, in a village of Annam. After participating in Tongkingese revolutionary activities, he went to France in 1919 as a dock hand, changing his original name to Nguyen Ai Quoc ("Friend of the People") and, in 1920, joining the French Communist party. He then went to Moscow (1924), whence in 1925 he was sent to Canton to join the staff of Borodin (Mikhail Markovich Grusenberg), the Soviet consul there. Arrested by the Chinese government in 1927 but soon released, he returned for a time to Moscow but was next sent to Thailand to prepare an insurrection in French Indochina. His Vietnam Workers' party (Dan Lao Dong Viet Nam) was banned by the French after riots in Tongking (1931). Moving to Hong Kong, Ho continued to organize Communist activity in Tongking and Thailand from there. In 1941, with the new name of Ho Chi Minh ("Brilliant One"), he appeared in the southern Chinese province of Yünnan as leader of the Vietnam League for Independence (Viet Nam Doc Lap Dong Minh Hoi). After the Japanese surrender at the end of World War II he proclaimed the People's Republic of Vietnam at Hué on Sept. 2, 1945, with himself as president. Invited to Paris by the French government for negotiations, he signed the Fontainebleau agreement of Sept. 1946 to make Vietnam an independent unit in an Indochinese federation, but fighting broke out between the French and his forces in the following December. The ensuing war continued until the Geneva armistice of July 1954, which partitioned Vietnam between a northern Communist state and a southern national one. *See* also VIETNAM.

HOCK: *see* WINE: *Regional Classifications of Wine: Germany.*

HOCKET, probably derived from the French word *hoquet* ("hiccup") or the Arabic *iqa'at* ("rhythm"), is a musical technique as well as a musical form based on this technique. It is a peculiar form of syncopation by which (a) one part sings or plays on the beat while another comes in off the beat after rests, or (b) a single line is divided between two voices so that while one sings the other rests. The technique, which may be used in music written in two to four or more parts, flourished from the beginning of the 13th to the early 15th century, while the form appeared at the end of the 13th century for a short time. (G. RE.)

HOCKEY, an outdoor game played on a closely cut grass or hard dirt surface with a ball by two opposing teams of 11 players on each side, using hooked or bent sticks with which each side attempts to drive the ball into the other's goal. The game is also called field hockey to distinguish it from ice hockey (*q.v.*).

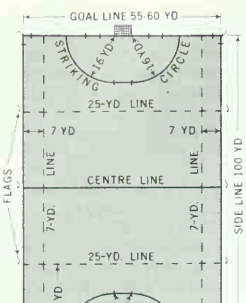
A crude form of a stick game was played by the ancient Persians, from whom it was acquired by the Greeks, who in turn passed it on to the Romans. A discovery made at Athens in 1922 gives reason to believe that a form of stick game came from the east. This was a bas-relief found in the wall built by Themistocles (*c.* 514–449 B.C.), which depicts six youths taking part in a game resembling hockey, and shows what is termed a face-off or bully in the modern game, but with the hooked sticks pointing downward instead of upward. The opinion has been expressed that the game depicted is an early form of lacrosse, but this seems very doubtful. Traces of a sort of stick game played by the Aztec Indians have also been found and evidence shows that probably most of the American Indian tribes played a rough stick game for several thousand years. But neither these nor the "London Balle Playe" mentioned by William Fitzstephen in 1175 bear much general resemblance to modern hockey.

Modern Hockey.—About 1875 a game resembling modern hockey began to be played in England. No goal could be scored if hit from a distance of more than 15 yd. from the nearest goal post, but players did not for a time realize the need of a definite, marked-out striking circle. A landmark in the progress of the game was the formation of the famous Wimbledon club in 1883. The members at first used a string ball and light ash sticks. A few more clubs soon came into being in the London area and the game spread to the midlands, west and north of England. The real birthday of modern hockey was, however, Jan. 18, 1886, the date of the formation of the Hockey association and of the adoption of the striking circle. In 1895 the first international match was played between England and Ireland, resulting in a win for the former by 5 goals to 0. About 1900 the need for an international committee to frame and amend the rules of the game was realized, and the governing bodies of Ireland and Wales were each asked to send two representatives to meet three from the Hockey association. Later this body was called the International Hockey board, its membership being increased by two on the formation of the Scottish Hockey association in 1902. The game grew rapidly throughout the British Isles and is played there by hundreds of clubs as well as by schools and universities and the various armed services.

The Game Throughout the World.—Although not played to the same extent as association football (soccer), the game is popular in many countries throughout the world. The national associations of these countries, including those making up the rest of the British Commonwealth and also the United States, became members of the Fédération Internationale de Hockey (F.I.H.). From 1908 hockey was included in the program of the Olympic games. Great Britain, after an absence of several years, again competed in hockey in the Olympic games held in London in 1948, and a close working arrangement was instituted at that time between the International Hockey board and the F.I.H. whereby observance of the same playing rules by all countries was assured. The leading countries in this sport in the second half of the 20th century were India, the Netherlands, Great Britain, Germany and Pakistan. Australia, New Zealand, Spain and a number of African countries, however, developed great proficiency in the game and, with interest in hockey increasing all over the world including the western hemisphere, the standard of play rose and international matches tended to be more closely contested. Along with cricket, hockey gained the distinction of being the national game of India, which dominated Olympic competition until 1960 when Pakistan won the championship. Sports writers covering the games of 1932 at Los Angeles, Calif., voted the performance of the Indian team the outstanding exhibition of skill in any sport. The Indian type of play features short, controlled passes as opposed to the European type in which the tendency is to hit the ball about the field more. Furthermore, the players in India and Pakistan use sticks with a short toe. By using these sticks and employing a left-handed grip well behind the stick they are able to reverse the stick (*i.e.*, play the ball with the toe of the stick pointing downward) without changing the grip and thus attain remarkable ball control. The conventional long-toed stick will strike the ground and fail to contact the ball properly if it is reversed in this manner. European players gradually adopted the short-toed stick. United States players attempt to follow the Indian type of play as closely as possible, although they also use some of the European technique.

A version of the game to be played indoors has been devised, utilizing special rules and a limited number of players.

The Game.—The game is played by two teams of 11 players on a rectangular ground, 100 yd. long and not more than 60 yd. nor less than 55 yd. wide, marked with white lines indicating the side



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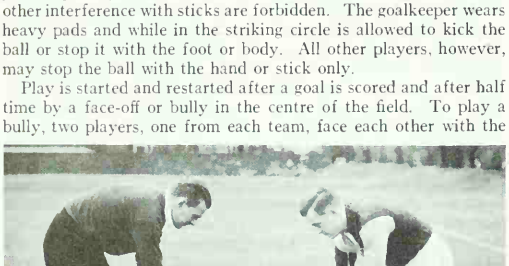
FIELD HOCKEY PLAYING FIELD

lines, the goal lines and the centre line. Broken or dotted lines indicate the 7-yd. lines, parallel to the side lines, and the 25-yd. lines. Flags are placed at each corner and 1 yd. from either end of the centre line and the 25-yd. lines. The goals are 4 yd. wide and 7 ft. high, with nets attached to the posts, crossbar and the ground. In front of each goal there is a white line, 4 yd. long, parallel to and 16 yd. from the goal line. This line is continued each way to meet the goal line by quarter circles having the goal posts as centres. The space thus enclosed is called the striking circle. For a goal (which counts 1 point) to be scored the ball must pass over the goal line between the goal posts and under the crossbar and while within the striking circle must have been touched by the stick of an attacker.

The ball originally was a cricket ball but plastic balls are also approved. The ball weighs $5\frac{1}{2}$ to $5\frac{3}{4}$ oz. and is $8\frac{1}{16}$ to $9\frac{1}{4}$ in. in circumference. The stick usually is 36 to 38 in. long and weighs 18 to 22 oz. The diameter must not exceed 2 in. nor the weight 28 oz. The striking surface is flat on the left side only and only the flat surface may be used. The usual composition of a team is five forwards, three halfbacks, two fullbacks and a goalkeeper. A game consists of two halves of 35 minutes each with a 5 minute half-time interval. Under international rules, no substitutions are allowed. In the United States, Bermuda and some other countries, however, substitution is permitted by agreement between the competing teams. A time-out is called only in case of injury.

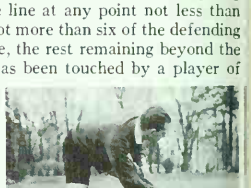
Strategy in field hockey is generally similar to strategy in association football. A big difference, however, is that a player is not permitted to obstruct an opponent by putting his stick or any part of his body between the opponent and the ball or by running between the opponent and the ball. When striking at or approaching the ball no part of the stick may be raised above the shoulder, either at the beginning or at the end of a stroke, in such a way as to be dangerous, intimidating or hampering an opponent; and a player who raises his stick in a way likely to lead to these offenses is subject to penalty. Undercutting the ball and hooking, holding or other interference with sticks are forbidden. The goalkeeper wears heavy pads and while in the striking circle is allowed to kick the ball or stop it with the foot or body. All other players, however, may stop the ball with the hand or stick only.

Play is started and restarted after a goal is scored and after half time by a face-off or bully in the centre of the field. To play a bully, two players, one from each team, face each other with the ball on the ground between them. Each player taps the ground between the ball and his own goal line and then his opponent's stick three times alternately before trying to strike the ball, thus putting it into play. Until the ball is in play all other players must be on side. In the play a player is off side if he is across the centre line unless there are at least three opponents nearer the goal line or the striker, or roller-in (*see* below), is nearer the goal line. If the ball goes out of bounds over a side line, it is rolled back into play from the point it crossed the line by an opponent of the player who last touched it, all other players remaining behind the 7-yd. line. If the ball is hit over the goal line by an attacking player or unintentionally by a defending player outside the 25-yd. line, the game is restarted by a free hit taken by a player of the defending team 16 yd. from the goal line at a place opposite the place where the ball crossed the line. If the ball is unintentionally hit over the goal line by a defending player inside the 25-yd. line, a corner is awarded. This gives the attacking team a free hit from the goal line or side line within 3 yd. of the nearest corner flag, with the defending players behind the goal line and the attacking players outside the striking circle. No shot at goal may be made from a corner hit unless the ball first is stopped (not necessarily motionless) on the ground by a player of the attacking team or touches the stick or person of a defender. If the ball is intentionally hit over the goal line by a defender, a penalty corner is awarded, giving the opponents a free hit from the line at any point not less than 10 yd. from either goal post, and not more than six of the defending team shall be behind their goal line, the rest remaining beyond the nearer 25-yd. line until the ball has been touched by a player of either side other than the one making the corner hit or until the ball has gone out of the circle. A penalty corner may also be awarded for a foul by the defending team within the circle. In the case of a deliberate foul by the defense inside the circle, or any foul within the circle which prevents a goal being scored, a penalty bully is awarded. A penalty bully is played from a spot 3 yd. in front of the centre of the goal by the offender and a player of the attacking team, with all other players of both teams behind the 25-yd line. Other fouls may be penalized by giving the opposition a free hit from the point of infraction. An umpire—there is one umpire for each half of the ground—may decline to enforce any penalty if enforcing it would give an advantage to the offending team. Minor infractions, where, in the opinion of the umpire, no advantage results to the offender, are not penalized.



BY COURTESY OF HENRY KIRK GREER

FACE-OFF OR BULLY SHOWING: (LEFT) "SQUARE" FOOT POSITION WITH FLAT SIDE OF STICK READY TO STRIKE BALL; (RIGHT) INCORRECT STANCE WITH STICK TILTED



BY COURTESY OF HENRY KIRK GREER

FLICK STROKE: HEAD OF STICK IS LAID BACK SLIGHTLY WITH BALL AT ITS HEEL. PLAYER HAS LEFT FOOT FORWARD, KNEES BENT AND WEIGHT LOW

Women's Hockey.—The foregoing comments apply particularly to the game as played by men. Hockey is also played extensively in many countries by women. Although women do not compete in this sport in the Olympic games, they do engage in international competition. The international governing body, the International Federation of Women's Hockey Associations, was formed in 1927. Teams representing England dominated international competition. The game was introduced in the United States in 1901 by Constance M. K. Applebee, a member of the British College of Physical Education, and thereafter became the most popular outdoor team sport among women in the United States. It is played in schools and colleges and sectional and national tournaments are held.

The rules used by women are similar to those used by men, the following being the more important exceptions: the striking circle measurement is 15 yd.; the dotted lines are 5 yd. from the side lines; the foot may be used to stop the ball provided there is no rebound; the position of the defenders on a corner is the same as on a penalty corner; and playing time does not exceed two 30-minute halves.

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Fison and R. L. Hollands, *Hockey* (1951); Norman Borrett and Peggy Lodge, *Hockey for Men and Women* (1955); *Official Field Hockey Guide for Women and Girls* (annually; includes rules of the game, articles for coaches and players, notes on umpiring, and bibliography); International Hockey Board, *Rules of the Game of Hockey* (annually); Frank G. Menke (ed.), *The Encyclopedia of Sports*, rev. ed. (1960). An exhaustive bibliography of hockey has been prepared by W. A. Malherbe, Kroonstad, S.Af. (H. G.)

HODDESDON, a market town (since 1253) and urban district (which includes Broxbourne, Wormley and Rye Park) of Hertfordshire, Eng., lies in the Lea valley 20 mi. N. of London. Pop. (1961) 17,908. Rawdon house (1622) stands in the High street near Rathmore house, noted for its fine Georgian doorway (1746). Old inns include the Bull inn (*c.* 1550). Also of interest are the Monson almshouses (1728) and the Priest's house (*c.* 1590) at Broxbourne and the Old Manor house at Wormley (*c.* 1580). John Loudon McAdam (*q.v.*) lived in Hoddesdon from 1825 to 1836.

Nursery produce (cucumbers, tomatoes, flowers), with a large area of greenhouses (about 150 ac.), forms the biggest single industry. There are boat-building and printing works; and precast concrete, Nissen buildings, insulated and copper wire, pharmaceutical products, cardboard boxes and glassware are made. The Rye House power station was opened in 1953. (E. W. Pk.)

HODGE, CHARLES (1797–1878), U.S. Presbyterian theologian, the major figure in the "Princeton school" of Reformed (Calvinist) orthodoxy, was born Dec. 27, 1797, in Philadelphia, Pa., but moved at age 14 to Princeton, N.J., his home for 68 years. He graduated from Princeton college, then from the seminary, where, in 1822 he became professor of biblical literature. Traveling abroad (1826–28), he met leading continental theologians in Paris, Halle and Berlin, but firmly resisted all the newer trends of thought, significantly forming a lasting friendship with the learned and conservative Friedrich August Tholuck of Halle. Adding systematic theology to exegetical work, Hodge became, after 1840, professor of exegetical, didactic and polemic theology until his retirement in 1877, thereby contributing to the training of about 3,000 ministers. Active as a churchman, he was moderator of the "Old School" Presbyterian Church in 1846. Having founded the *Biblical Repertory and Princeton Review* in 1825, he remained an editor for 46 years, contributing nearly 150 articles. Among his books are biblical commentaries on the Roman, Ephesian and Corinthian epistles and his magnum opus, the influential *Systematic Theology*, 3 vol. (1871–73).

Hodge emphasized exegesis of a verbally infallible Bible as the base of all theology and recognized as his intellectual antecedents the church confessions and scholastic systems of 17th-century Calvinism, pre-eminently the thought of François Turretini (d. 1687) of Geneva. He adopted a method described by himself simply as induction and deduction from biblical "facts." By defending his tradition with learned and detailed reference to the history of theology, to Roman Catholic teaching and to the contemporary streams of religious, scientific and philosophic thought, he mediated to United States religious life both a broad learning and an unruffled resistance to innovation. He died June 19, 1878.

See A. A. Hodge, *The Life of Charles Hodge* (1880). (E. A. Dy.)

HODGKIN, ALAN LLOYD (1914–), British physiologist who shared the 1963 Nobel prize for physiology and medicine with Andrew Fielding Huxley and Sir John Carew Eccles (*qq.v.*) was born in Banbury, Oxfordshire, on Feb. 5, 1914. Hodgkin was educated at Gresham's school, Holt, and at Trinity college, Cambridge, of which he became a fellow in 1936. He was lecturer and assistant research director in the Cambridge university department of physiology (1945–52) and in 1952 became Foulerton research professor of the Royal society. He was elected a fellow of the Royal society in 1948.

The 1963 Nobel award for medicine and physiology was granted for researches on "the ionic mechanisms involved in excitation and inhibition in the peripheral and central portions of the nerve cell membrane." Hodgkin and Huxley collaborated in studying the electrochemical basis of the excitatory process in peripheral nerve fibres and its wavelike conduction from point to point as a nervous "impulse." They showed, beginning in 1952, that this conducted excitation involves, at each point, an ionic interchange between the sodium-rich medium outside the fibre and its potassium-rich core, the latter being a long extension from the protoplasm of a cell in the central nervous system or in a peripheral ganglion. They also showed that the restoration of the ionic contrast of the resting condition requires the expenditure of metabolic energy by a procedure, unknown in detail, that is called the "sodium pump." The measurements and observations required to establish the details of these microphysiological phenomena involved the use of the "giant" nerve fibres—with diameters up to 1 mm.—found in the nerves of cuttlefish. A great stride toward the complete interpretation, in terms of physics and chemistry, of the physiology of excitation was thus made. (H. H. Da.)

HODGKIN, DOROTHY MARY (*née* Crowfoot) (1910–), British chemist and X-ray crystallographer awarded the 1964 Nobel Prize for chemistry for the determination of the structure of biochemical compounds of primary importance, was born in Cairo, Egy., on May 12, 1910. She studied in England at the Sir John Leman School and at Somerville College, Oxford. In 1933, she and J. D. Bernal, at the crystallographic laboratory at Cambridge, took the first X-ray diffraction photograph of a protein, pepsin. Later she made an extensive structural survey of the sterols. She returned to Somerville College as tutor in chemistry in 1934, and in 1937 married the writer and lecturer Thomas Hodgkin. Her subsequent work included crystal structure analyses of complex substances, most notably of penicillin and vitamin B_{12}. The latter molecule, with the formula $C_{63}\,H_{90}\,O_{14}\,N_{14}\,PCo$, is one of the most complex nonprotein compounds with known structure; normal chemical methods had revealed little of the structure of the central part of the molecule, at the heart of which is the cobalt atom. Using the minute quantities necessary for X-ray diffraction techniques, Mrs. Hodgkin and her colleagues completely determined its atomic arrangement.

Mrs. Hodgkin became a fellow of the Royal Society in 1947, a Royal Medallist in 1957, the first Wolfson Research Professor of the Royal Society in the University of Oxford in 1960, and a member of the Order of Merit in 1965. In the 1960s she spent much time at the University of Ghana in Accra, where her husband was director of the Institute of African Studies. (K. Lo.)

HODGKIN'S DISEASE is a rare disease of man, of unknown cause, resembling both inflammation and cancer, usually causing at first enlarged lymph nodes in some region, external or internal. Tending to spread eventually to other nodes, it may affect any living tissue of the body, directly or indirectly. Among many synonyms are lymphogranulomatosis, lymphadenoma and malignant granuloma. Thomas Hodgkin of London described in 1832 seven fatal cases, of which three fit modern criteria for the disease. Apparent modes of onset vary greatly. Painless enlargement of lymph nodes in the neck is a common first indication. Routine chest X-rays in some cases disclose enlarged nodes in front between the lungs, before symptoms appear. Low-grade febrile illness without localized symptoms, or a stormy course with high fever and obscure findings, should be suspect. Common symptoms as Hodgkin's disease progresses are fever, sweating, anemia, wasting, itching and pain. Fortunately usually some feature such as enlarged nodes in neck, armpit or groin permits early diagnosis by biopsy (removal of specimen of diseased tissue), showing microscopically a complex of cells including the characteristic Sternberg-Reed cell.

No blood test, chemical test or X-ray examination proves Hodgkin's disease. Common mimicry of or by other serious diseases makes diagnostic proof imperative to permit selection of proper treatment. Occasionally early biopsies may not be diagnostic. In such cases repetition should be permitted.

The total duration may be from a few weeks or months to 30 years or more. In the course of advancing Hodgkin's disease, skin, lungs, gastrointestinal tract, liver, spleen, kidneys, adrenals, spinal cord, brain or bones can be invaded or affected. With the multiplicity of parts that may be affected, and the frequency of bacterial, fungal or viral infections in those debilitated by the disease, recurring diagnostic problems of complications often arise.

Although no treatment is assuredly curative, and no features permit foretelling the outlook, it seems theoretically possible that

some early cases may be curable. Surgical removal of a single early localized lesion may be justifiable in selected cases. The treatment of greatest over-all usefulness is irradiation applied externally to various lesions, as by X-rays or gamma rays of cobalt 60. The so-called polyfunctional alkylating chemicals, such as nitrogen mustard, triethylene melamine and chlorambucil, are valuable palliative agents. In certain advanced cases appropriate hormones (adrenal corticosteroids or ACTH) may produce symptomatic benefits. Anemia may necessitate blood transfusions. Judicious treatment may cause more or less complete remissions, sometimes with great prolongation of life, or distinctly worthwhile palliation. Five-year survivals run from about 25% for all cases to 50% or even 75% for favourable cases.

See also LYMPH AND LYMPHATIC SYSTEM: *Diseases of the Lymphatic System.* (L. F. CR.)

HODGSON, BRIAN HOUGHTON (1800–1894), English administrator and orientalist noted for his studies of the literature, language and religion of Nepal, was born at Prestbury, Cheshire, on Feb. 1, 1800. He joined the civil service in India in 1818 and was posted to Katmandu in 1820, where apart from one year's absence in 1823, he served continuously from 1820 to 1833 as assistant resident, and from 1833 to 1843 as resident. In 1843 he was recalled by the governor general, Lord Ellenborough, and retired from service. From 1845 to 1858 he lived in Darjeeling, and then he returned to England to live in studious seclusion until his death in London on May 23, 1894.

Few men have so successfully combined the roles of administrator and scholar, and achieved such eminence in both. Hodgson's official conduct was guided by a deep understanding of the character of the Nepalese, their history and languages, religions and political ambition. He loved the Nepalese, and his policy was consistently directed to winning their friendship. The great increase in Indo-Nepalese trade in the 19th century can be ascribed to his importunate advice and to the commercial statistics and commodity lists he compiled. He urged the demarcation of Nepal's southern boundary, which was a constant source of irritation. He was less immediately successful in persuading the governor general to employ Gurkha troops in the British army. His advice was not heeded until 1857. The last ten years of Hodgson's service in Nepal were particularly turbulent. War between Nepal and India was near on several occasions, but when Hodgson left the country the foundation of Anglo-Nepalese friendship had been laid.

Hodgson's reputation as a scholar is beyond question. His researches were conducted in many fields: language, history, ethnology, physical geography, zoology, ornithology, botany and philosophy. He collected, copied and annotated hundreds of manuscripts, Sanskrit Buddhist texts, Tibetan scriptures, Newari chronicles and *vamsavalis*, which he presented to the Asiatic societies of India and Great Britain, the British museum, the India Office library and the Société Asiatique de Paris. To the British museum also he presented 10,000 specimens of birds, mammals and reptiles. He contributed nearly 200 monographs to 15 scholarly journals.

His collected works were published as *Essays on the Languages, Literature, and Religion of Nepal and Tibet, Together With Further Papers on the Geography, Ethnology and Commerce of Those Countries* (1874); and *Miscellaneous Essays Relating to Indian Subjects*, 2 vol. (1880).

See W. W. Hunter, *Life of Brian Houghton Hodgson* (1896). (T. W. CL.)

HODLER, FERDINAND (1853–1918), Swiss painter and sculptor whose work is transitional between Expressionism and Symbolism, was born on March 14, 1853, at Bern. He studied first at Thun under F. Sommer, who painted landscapes for tourists, but after 1872 he worked in a more congenial atmosphere under B. Menn at Geneva. In 1878 he visited Madrid, but his study of Velázquez was already apparent in works like "Der Student" (1874). By 1879, when Hodler settled in Geneva, he was producing massive, simplified portraits owing something to Courbet and landscapes showing an Impressionist tonal key ("Landschaft bei Madrid," 1879). By the mid-1880s, however, a tendency to self-conscious linear stylization is visible in his subject pictures, which deal increasingly with the symbolism of youth and age, solitude and contemplation (*e.g.*, "Die Reformatoren," Geneva, 1889). From this time his work can be divided between the naturalistic and the symbolic, the latter being the mood of his murals in the town hall at Hanover and at Jena university.

Hodler died at Geneva on May 20, 1918.

See A. Loosli, *Ferdinand Hodler*, 5 vol. (1918–21); H. Mühlestein, *Ferdinand Hodler* (1942). (D. C. T. T.)

HÓDMEZŐVÁSÁRHELY, the chief town of Csongrad *megye* (county) in southeastern Hungary, is one of four main towns of the Great Alföld, lying east of the Tisza river on the shore of Hód lake. Pop. (1960) 53,505 (mun.). The site is on the edge of the alluvial strip bordering the Tisza and is liable to flooding, and the city is protected by a great dike. The surrounding countryside is highly fertile, especially for grain, sugar beet and vine cultivation; there is a tradition of poultry and egg production and marketing, and of the breeding of cattle and horses. Majolica is made and light industries were introduced after World War II. The town is a focal point for secondary road and rail communications. For centuries the management of the surrounding countryside was municipal and Hódmezővásárhely had the appearance of a traditional village-town. It was formerly notable for a number of Calvinist churches and for its minorities of Roman Catholics, Uniates, Baptists and Jews. (H. G. S.)

HODOGRAPH. When vectors are drawn from any point O to show changes in the velocity of a moving particle, the ends of these vectors define a curve called the hodograph of the particle. (*See* VECTOR ANALYSIS and TENSOR ANALYSIS; also compare this definition with that given for radial curve under CURVES, SPECIAL.) Any point on the hodograph represents the magnitude and direction of the particle's acceleration at a specific time. The hodograph of the orbit of a planet or a comet, considered as in a Newtonian field, is always a circle. The pole O is inside, on or outside the circle, depending on whether the orbit is elliptical, parabolic or hyperbolic. The idea of the hodograph originated with A. F. Möbius (1843) and, independently, with Sir William Rowan Hamilton (1846), to whom the name and certain original developments of the theory are attributed. In fluid dynamics hodograph methods are used to simplify complicated equations of motion. The properties of a fluid element are expressed in this case through its velocity components rather than with the more usual coordinates which represent its position. The methods were invented by P. Molenbroek (1890) and S. A. Chaplygin (1904). (R. C. A.; J. A. SE.)

HODSON, WILLIAM STEPHEN RAIKES (1821–1858), the "Hodson of Hodson's Horse," a noted leader of light cavalry, was born on March 19, 1821, at Maisemore Court near Gloucester, Eng., the son of a clergyman. A boy notable for arrogance, rashness and domineering temper, he was educated at Rugby, under Thomas Arnold, and at Cambridge. At the age of 23 he joined the Indian army and served through the First Sikh War (1845–46) in the Bengal grenadiers, but later joined the 1st European fusiliers.

In 1846 he won the favour of Henry Lawrence, who secured for him the adjutancy of the Guides, with which corps he played an active role during the Second Sikh War (1848–49). He was rewarded by appointment as assistant to the commissioner at Lahore. In 1852 he was appointed as commandant of the Guides, an early promotion which created much jealousy. Hodson, though brilliant in action, by his superior aloofness and tactless self-reliance antagonized his officers; by 1854 the adjutant accused him of fraud. The charge was unfounded, but a hostile court of inquiry found the regimental accounts disturbingly irregular. Since he had also been censured for the arbitrary arrest of a Pathan chief he was dismissed from the Guides in 1855. Though his successor, reexamining the accounts, cleared Hodson of any dishonesty, the government refused to reopen the case.

In 1857, however, the new commander in chief took Hodson on his staff and, the Indian mutiny breaking out, appointed him assistant quartermaster general and head of intelligence. He was also empowered to raise a regiment of 2,000 irregular horse, which became famous as Hodson's Horse. He played a vital part in the siege of Delhi. His cool daring was shown in the arrest of the emperor Bahadur Shah II and the princes six miles outside Delhi, but his shooting of the princes caused a revulsion of feeling, and seem-

ingly unfounded accusations of looting were made. He was wounded on March 11, 1858, in the attack on the Begam Koti at Lucknow and died there the next day.

See B. J. Cork, *Rider on a Grey Horse* (1958). (J. B. HA.)

HOE, RICHARD MARCH (1812–1886), U.S. inventor of the rotary printing press, was born in New York city, Sept. 12, 1812. He was the son of Robert Hoe (1784–1833), an English-born U.S. mechanic, who with his brothers-in-law Peter and Mathew Smith had established in New York city a manufactory of printing presses. Educated in public schools, Richard entered Robert Hoe and Co. in 1827 and on his father's death became head. He had considerable inventive genius and the application of his ideas revolutionized printing processes. He discarded the old flat-bed press, placing the type on a revolving cylinder, a model later developed into the Hoe rotary or "lightning" press, patented in 1846, and first used by the Philadelphia *Public Ledger* in 1847. It was further improved under the name of the Hoe web perfecting press. His press enabled publishers to satisfy the increasing circulation demands of the rapidly growing U.S. population.

Hoe died in Florence, Italy, June 7, 1886.

See Robert Hoe, *Short History of the Printing Press* (1902). (R. P. P.)

HOEFNAGEL, JORIS (GEORG HUFNAGEL) (1542–1600), Dutch painter and illustrator, noted for his miniatures, was born at Antwerp. He was a pupil of Jan Bol. He traveled abroad often in the company of the famous geographer Abraham Ortelius, studying and making drawings of the people, their costumes and customs in France, Spain, England and Italy. He was afterward patronized by the elector of Bavaria at Munich, where he stayed eight years, and by the emperor Rudolph II at Prague. He is famous for his miniature work, especially on a missal in the Imperial library at Vienna; he painted animals and plants to illustrate works on natural history; and his illustrations (especially for Braun's *Civitates orbis terrarum,* 1572), give him a place among early topographical draftsmen.

HOF, the most northeasterly town of the *Land* (state) of Bavaria, Germany, which after partition of the nation following World War II became part of the Federal Republic of Germany, lies at the northeastern edge of the Fichtelgebirge and the Frankenwald, in the valley of the upper Saale, near the borders of Thuringia, Saxony and Czechoslovakia. Pop. (1961) 57,129.

The art treasures in the old churches of Hof are interesting, as is the municipal museum. The Therienstein municipal park, in the middle of which is the botanic garden, stretches to the north of the town unbroken as far as the Labyrinthberg, with an artificial ruin and a tower. To the south is the Rosenbühl park with a granite lookout tower named after Bismarck.

Provision is made for the cultural needs of the population through the Städtebundtheater, the Hof Symphony orchestra and a choir for sacred music. There are numerous educational establishments, a modernized hospital, two indoor swimming baths and an assembly hall which can seat 6,000 persons.

Hof was formerly an important railway junction through which the lines from Stuttgart and Munich to Berlin, Leipzig and Breslau were routed, but from 1945 traffic north and east was almost completely cut off. Traffic on the main roads is also chiefly westward and southward. There is an airfield for sailplanes.

The textile and associated industries predominate and make the town an industrial and commercial centre of northern Upper Franconia. Other industries include the manufacture of machinery, chemicals, beer and liqueurs, electrical equipment, and chocolate and meat products. Hof is the shopping centre of northern Bavaria.

The town was founded in the 13th century, being first recorded in documents in 1214. The area round the Regnitz was originally in the possession of the dukes of Meranien and came in 1373 into the possession of the burgraves of Nürnberg. In 1385 Hof became one of the four capital towns of the duchy. In 1791 it fell to Prussia and in 1806 was put under French administration. Since 1810 Hof has belonged to Bavaria.

The town has several times suffered from war damage and twice, severely, from fire. (H. Ho.)

HOFBAUER, SAINT CLEMENT MARY (KLEMENS MARIA) (1751–1820), Roman Catholic priest, the "Apostle of Vienna," was born on Dec. 26, 1751, in the Moravian village of Tasswitz, of a poor family. He ardently desired to become a priest, but encountered many obstacles, particularly the anti-Catholic spirit prevalent in the educational institutions of Austria. In 1784, while on a pilgrimage to Rome, he entered the Congregation of the Most Holy Redeemer (the Redemptorists). He was ordained to the priesthood in 1785, and authorized by his superiors to establish Redemptorist monasteries in northern Europe. In 1788 he took up residence in Warsaw, and for 20 years exercised a zealous apostolate and at the same time recruited a large number of members for his congregation. In 1808, by the order of Napoleon, the Redemptorist community at Warsaw was disbanded and the members exiled. Hofbauer spent the remainder of his life in Vienna, where he exerted a wide influence on the intellectuals and contributed much toward the revival of Catholic life. He was particularly popular with the students of the University of Vienna. He continued to seek governmental approbation for Redemptorist monasteries, which was granted shortly after his death (March 15, 1820). He was canonized by Pope Pius X in 1909, and his feast day is March 15. *See* also REDEMPTORISTS.

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HO-FEI, since 1949 the capital of Anhwei province, China, is a very ancient city, Luchow being an alternate name periodically used. Pop. (1953) 183,600. Near a low saddle on the drainage divide between the Huai and Yangtze river systems, Ho-fei was a trade-transport centre on the north-south routes in earlier centuries. The completion of a branch railway from Pengpu, on the Huai river, to Wu-hu, on the Yangtze, originally started to tap the Huainan coal fields, restored the position of Ho-fei. Under the Communists, it became an important rice and cotton growing centre, as well as an administrative centre, and was developed for agricultural processing and trade. (J. E. SR.)

HOFER, ANDREAS (1767–1810), Tirolese popular hero, was born on Nov. 22, 1767, in the inn "Am Sand" near St. Leonhard in the Passeier valley (South Tirol). He was an innkeeper and a cattle dealer and also, from 1797, the captain of a Passeier militia company. When the Tirol was ceded to Bavaria in 1805 (*see* NAPOLEONIC WARS), Hofer joined the party which worked for the return of his country to Austria by means of a rebellion; he did so for religious and patriotic reasons, being an enemy of the Enlightenment and strongly pro-Austrian. Hofer went to Vienna in Jan. 1809 to negotiate with the archduke John and Joseph von Hormayr, another Tirolese patriot, for Austrian troops to aid the Tirolese. Hofer defeated a small Bavarian troop at Sterzing on April 11, 1809, and fought as commander of the South Tirolese sharp-shooter companies against the Italo-French troops in Trentino. The Austrian troops, however, were defeated in the Tirol in May, whereupon most of them left the country. Hofer then rose to be commander in chief of the whole Tirolese militia. Helped by a small Austrian contingent, he defeated the Bavarians at Bergisel near Innsbruck on May 29, 1809. Yet when Hormayr returned as civil administrator to Innsbruck, he confirmed Hofer only as commander of the sharp-shooters of South Tirol.

Austria had again to give up the Tirol at the truce of Znaim on July 12, 1809, and the remainder of the Austrian army withdrew; but Hofer won another victory at Sterzing (Aug. 6–9) and then the second great battle at Bergisel (Aug. 13), with the Tirolese militia alone, and forced the Bavarians to leave the country. As there was no Austrian administration, Hofer undertook the regency of the Tirol from Aug. 15 to the end of November. The Austrian emperor Francis I sent him a chain of honour on Sept. 29; but made the peace of Vienna on Oct. 14, 1809, by which the Tirol was surrendered to Napoleon. This was Hofer's most unhappy period: sometimes he fancied that the news of the peace was untrue and gave the order to continue resistance; at other times he accepted the peace and ordered the cessation of resistance. Those Tirolese who continued the resistance lost their right to amnesty.

Hofer was taken prisoner on the Pfandler Alm in the Passeier

on Jan. 28, 1810, and brought to Mantua. As Napoleon sent an order that he was to be executed within 24 hours, his trial in Mantua (Feb. 19) was a mere farce and he was shot on Feb. 20. His bones were reburied in the Franciscan church at Innsbruck in 1823. The "Andreas-Hofer-Lied," by Julius Mosen, is the anthem of the Tirol.

See H. Kramer, *Andreas Hofer,* 7th ed. (1963); K. Paulin, *Das Leben A. Hofers,* 3rd ed. (1959). (HA. K.)

HÖFFDING, HARALD (1843–1931), Danish philosopher who is remembered chiefly as a historian of philosophy, was born in Copenhagen on March 11, 1843. He was professor of philosophy there from 1883 to 1915. He died on July 2, 1931, in the same city. Höffding's major work is *Den nyere Filosofis Historie,* 2 vol. (1894–95; Eng. trans., *A History of Modern Philosophy,* 1900). His own philosophy is notable for his psychological voluntarism and for his view of religion, which he held to be the reaction of mind to the sense of value and which he made the basis of his ethical system.

His writings include *Den engelske Philosophi i vor Tid* (1874); *Psykologi i Omrids paa Grundlag af Erfaring* (1882); *Etik* (1887); *Kontinuiteten i Kants filosofiske Udviklingsgang* (1893); *Rousseau og hans Filosofi* (1896; Eng. trans., *Jean Jacques Rousseau and His Philosophy,* 1930); *Det psykologiske Grundlag for logiske Domme* (1899); *Mindre Arbejder* (1899); *Religionsfilosofi* (1901; Eng. trans., 1906); *Udvalgte Skrifter,* 7 vol. (1902–09); *Moderne Filosofer* (1904; Eng. trans., 1915); *Danske Filosofer* (1909); *Oplevelse og Tydning* (1918); *Spinoza's Ethica* (1918); *Begrebet Analogi* (1923); and *Erkendelsesteori og Livsopfattelse* (1925).

HOFFMAN, MALVINA (1887–), U.S. sculptor, most famous for her bronze representations of ethnic types, was born in New York city on June 15, 1887. She studied in New York with Herbert Adams and Gutzon Borglum. In 1910 Miss Hoffman went to Paris, where until World War I she worked intermittently under Auguste Rodin. On his advice she studied anatomical drawing and dissecting at the College of Physicians and Surgeons, New York. Rodin's sculpture influenced her work in many ways—in erotic subject matter ("Offrande," 1919), in impressionistic technique ("Lovers' Prayer," 1923), in fleeting movement ("Bacchanale," 1917), and in vivid realism ("The Coal Man," 1928). In 1930 the Field museum (later Chicago Natural History museum) commissioned her to execute a series portraying the various "Races of Man." To make studies for the 101 bronzes, which bear such titles as "Blackfoot American Indian," "Hawaiian Surf-board Rider," and "Family Group of South African Kalahari Bushmen," she traveled around the world.

She also did a number of portraits, marked by unaffected characterization. Among these are three heads of Paderewski, showing him as the Friend, the Statesman, and the Artist (1920), and a bust of Wendell L. Willkie (1944). A war memorial, entitled "The Sacrifice" (1920), in Memorial chapel, Harvard university, is considered the finest of her ideal compositions. After 1911, when her "Russian Bacchanale" won first prize at the Paris Salon, Miss Hoffman received many awards and honorary degrees.

Her autobiography, *Heads and Tales,* appeared in 1936 and *Sculpture Inside and Out* in 1939. (M. I. B.)

HOFFMAN (HOFMANN), **MELCHIOR** (c. 1495–1543/4), German Anabaptist, was born at Schwäbisch-Hall. He was a furrier by trade, and worked as a Lutheran lay missionary in Livonia, Sweden and Lower Germany. Frederick I of Denmark appointed him a preacher at Kiel, in Holstein. The Zwinglian view of the Eucharist that he developed alarmed Martin Luther, and after the colloquy in Flensburg (1529), when he disputed with J. Bugenhagen, Hoffman was banished from Denmark. He went to Strasbourg, where he was converted to Anabaptism (*see* ANABAPTISTS) and became a proponent of the doctrine of the celestial flesh of Christ. Journeying to East Frisia (1530), he became the apostle of Anabaptism in the Netherlands, where his followers were known as Melchiorites. Elaborating his eschatological convictions, he returned in 1533 to Strasbourg, which was to be the seat of the New Jerusalem to await the Last Day. He was arrested there, and imprisoned. The last notice of his continued imprisonment is Nov. 19, 1543. Some of his ideas survived among the Mennonites.

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HOFFMANN, AUGUST HEINRICH (1798–1874), known as HOFFMANN VON FALLERSLEBEN, German patriotic poet, philologist, literary historian, whose "Deutschland über alles" was adopted as the German national anthem after World War I, was born at Fallersleben, near Brunswick, April 2, 1798. Having studied at the universities of Göttingen and Bonn, he was custodian of the university library at Breslau (1823–38), became extraordinary professor of German language and literature there in 1830 and ordinary professor in 1835. Removed by the Prussian authorities in 1842 for his *Unpolitische Lieder* (1840–41), he was allowed to return after the revolution of 1848. In 1860 he was appointed librarian to the duke of Ratibor at Corvey castle, where he died on Jan. 19, 1874.

Hoffmann was among the earliest and most effective of the poets who prepared the way for the revolutionary movement of 1848. He also composed political melodies for many of his songs, which were sung throughout Germany. His "Deutschland über alles," written in 1841, is typical in its expression of popular feeling—the wish for national unity felt by German liberals of the period. In the first line the word "Deutschland" was repeated to fit Haydn's tune, adopted from the Austrian national hymn. As a student of ancient Teutonic literature Hoffmann ranks among the most persevering and cultivated of German scholars. *Die deutsche Philologie im Grundriss* (1836) valuably contributed to philological research, and *Geschichte des deutschen Kirchenlieds bis auf Luthers Zeit* (1832; 3rd ed., 1861), *Unsere Volkstümlichen Lieder* (3rd ed., 1869) and *Die deutschen Gesellschaftslieder des 16 und 17 Jahrh.* (2nd ed., 1860) were also important.

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HOFFMANN, ERNST THEODOR WILHELM (1776–1822), German writer, composer, music critic, painter and lawyer, the most important storyteller of the German romantic period. In homage to Mozart he changed his name from Wilhelm to Amadeus about 1813. Hoffmann was born at Königsberg, East Prussia, on Jan. 24, 1776. After studying law at Königsberg university, he finished his legal training in Glogau and Berlin and in 1800 was appointed to the Prussian courts of law for the Polish provinces. His first post was in Posen, where he married in 1802; but in the same year his indulgence in a number of indiscreetly impudent caricatures resulted in his transfer to Plozk. In 1804 he managed to move to Warsaw, where he met the romantic dramatist Zacharias Werner and through Heinrich Loest and J. E. Hitzig became acquainted with the works of Calderon and the German romantics Novalis, Ludwig Tieck, Clemens Brentano and Wilhelm Wackenroder. He wrote music for Brentano's *Die lustigen Musikanten* (1804) and for Werner's *Kreuz an der Ostsee* (1804–05) and also composed the Symphony in E flat major (1806), an opera, *Liebe und Eifersucht* (1807; based on Calderón's drama *La Banda y la flor*) and the Quintet in C minor (the harp quintet). After the French invasion of 1806 the Prussian government in Poland was dissolved and Hoffmann lost his position. The uncertain and restless life that followed lasted until 1814. He left Warsaw in 1807 and tried without success for an appointment in Berlin. In Sept. 1808 he went to Bamberg as conductor, musical director and theatrical designer and his years there, and especially his passion for the young Julia Marc, were a turning point in his creative work. There he composed sacred music and the operas *Aurora* (1812) and *Undine* (1814; libretto by F. de la M. Fouqué); and wrote for the *Allgemeine Musikalische Zeitung* not only music criticism but stories which, collected in *Phantasiestücke in Callot's Manier* (4 vol., 1814–15, preface by J. P. F. Richter), were to make him famous as a storyteller. The best of these sketches were *Ritter Gluck* (1809), *Johannes Kreislers, des Kapellmeisters musikalische Leiden* (1810) and *Don Juan* (1813).

In April 1813 Hoffmann left Bamberg and, after some months with an opera group at Dresden and Leipzig, in Oct. 1814 took up a position at the court of appeal in Berlin. Hoffmann was an excellent lawyer and a conscientious official; though he steadily pursued his artistic aims he had, in his own phrase, "too much reality" to devote himself solely to art. In 1816 his opera *Undine* was performed and well received; but because the theatre was damaged by fire it was only given 14 performances and later fell into undeserved oblivion. In Berlin Hoffmann took up old friendships and formed new ones, and K. W. Contessa, D. F. Koreff and Hitzig were among those with whom he spent literary evenings, called first *Seraphinenabende* and after 1818 *Serapionsabende*. He made friends with the actor Ludwig Devrient and became a regular visitor to Lutter and Wegner's famous wineshop. It was in Berlin that he wrote many of his best stories, collecting some of them in *Die Serapionsbrüder* (4 vol., 1819–21) and *Die Lebensansichten des Katers Murr* (2 vol., 1820–22). Toward the end of his life Hoffmann acted as a commissioner of inquiry during the so-called "Demagogue" trials. He behaved with courage and integrity, though contrary to the intentions of his superiors; but his satirical use of the affair in *Meister Floh* (1822) was to have involved him in disciplinary action. He fell ill, however, and died in Berlin on June 25, 1822.

Hoffmann's stories are of several distinct types and his work displays a triple chain of development rather than a single line. Psychological theories and belief in the fixed destiny of the individual dominate the demonic tales; *e.g.*, *Elixiere des Teufels* (written in 1814–15 and inspired to some extent by M. G. Lewis's *The Monk*) and *Nachtstücke* (1817). In his great fairy tales, *Der Goldene Topf* (1814), *Klein Zaches, genannt Zinnober* (1819), *Prinzessin Brambilla* (1821) and *Meister Floh*, as well as in the minor pieces *Nussknacker und Mausekönig* and *Das fremde Kind* (1816–17), he confronts the supernatural with everyday reality. *Die Serapionsbrüder* excel in their use of literary sources and in the effectiveness of their style. Though his humour is more reminiscent of Laurence Sterne and Jean Paul than of the irony of the romantics, Hoffmann is the most important narrative writer of the German romantic period. The gruesome figures of his maniacs, spectres, *Doppelgänger* and automata form only one part of his imaginative faculty and his success is largely due to his highly suggestive but realistic narrative art. His most directly autobiographical works are the Kreisler tales, from the *Phantasiestücke* to *Kater Murr*.

As a composer Hoffmann stands between the classical and romantic periods and between the strictly contrapuntal and the lyrically melodic styles. His reviews, particularly of Beethoven, Bach and Gluck, introduced a new epoch in musical criticism which was developed by Schumann (whose *Kreisleriana* was inspired by Hoffmann's autobiographical creation, the *Kapellmeister Kreisler*).

At first Hoffmann's literary influence was greater in France, England and America than in Germany, as can be seen from the work of Gérard de Nerval, Alfred de Musset, Theophile Gautier, Charles Baudelaire, Walter Scott, Edgar Allan Poe, George Meredith and others. His writings made an impression too in Russia, Poland, Denmark and Sweden. His fantasies have kept their hold on the stage in Jacques Offenbach's *Tales of Hoffmann* (1881), Léo Delibes' ballet *Coppélia* (1870), F. Busoni's *Brautwahl* (1912) and Paul Hindemith's *Cardillac* (1926). His influence is also evident in the style of the Expressionist theatre (as in the performances of *Prinzessin Brambilla*, 1920, and *Signor Formica*, 1922, by the Moscow *Kamernogo teatra*) and in such films as *Die Puppe* (1919) and *Dr. Caligari* (1923).

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Numerous English translations of Hoffmann's tales have been published. Of these may be mentioned: *The Golden Pot*, trans. by T. Carlyle in *German Romances* (1827); *The Serapion Brethren*, trans. by A. Ewing (1886–92); and selected tales, trans. by various hands (1943), by C. Lazare (1946) and by J. M. Cohen (1952). (K. KA.)

HOFFMANN, MAX (1869–1927), German general and staff officer in World War I, was born at Homberg on Jan. 25, 1869. Much of his military service was spent in the eastern provinces of Posen and East Prussia. He spoke Russian fluently and was an attaché with the Japanese during the Russo-Japanese War. When World War I broke out in 1914 he was appointed to the staff of the 8th army, which was responsible for the defense of the eastern frontier; and he participated in the planning of the early operations against Russia, including the battle of Tannenberg (*q.v.*). In Aug. 1916 he succeeded Erich Ludendorff as chief of staff for the eastern front. In Dec. 1917, after the collapse of Russian resistance, he conducted negotiations with the Russians at Brest-Litovsk; and, in Feb. 1918, he signed a treaty with Ukraine.

After the war Hoffmann took up literary work. Together with Arnold Rechberg (a prominent industrialist) and others, he promoted Franco-German understanding and worked for the restoration of the Hohenzollern monarchy. His literary work included *Der Krieg der versäumten Gelegenheiten* (1923; Eng. trans., *The War of Lost Opportunities*, 1924); an anti-Bolshevik work, *An allen Enden Moskau* (1925); and *Tannenberg wie es wirklich war* (1927), in which he discounts the popular belief that Hindenburg and Ludendorff were responsible for the strategic moves which resulted in the victory at Tannenberg and maintains that the plans were initiated before they arrived in the theatre of operations. Hoffmann's writing reveals him as a quick-witted man, much more a staff officer than a commander and perhaps more inclined to be insubordinate and less hardworking than most German officers of his generation. He died at Bad Reichenhall on July 8, 1927.

(C. N. B.)

HOFMANN, AUGUST WILHELM VON (1818–1892), German chemist whose research on aniline, with that of Sir William H. Perkin (*q.v.*), helped lay the basis of the aniline dye industry, was born at Giessen in western Germany on April 8, 1818. He first read law and philosophy at Giessen and then studied chemistry under Justus von Liebig. He acted for a short time as *Privatdozent* at Bonn and then, in 1845, accepted the invitation, made at the suggestion of Prince Albert, to become the first director of the new Royal College of Chemistry, London. Many of the leaders of British chemistry were trained there under him. In 1864 he returned to Bonn, but before he moved into the laboratory there, which had been built under his direction, he succeeded (1865) Eilhardt Mitscherlich as professor of chemistry and director of the laboratory in the University of Berlin. He continued his excellent work there as teacher and researcher until his unexpected death on May 5, 1892.

In 1868 Hofmann founded the German Chemical society and he was for many years its president. Its home in Berlin was opened in 1900, and was named the Hofmann Haus in his memory. He also served as president of the British Chemical society. He was ennobled on his 70th birthday.

Hofmann's work covered a wide range of organic chemistry. His first research, carried out in Liebig's laboratory at Giessen, was on coal tar, and his investigation of organic bases established the nature of aniline. In 1845 he developed a method of preparing aniline from benzene. His perception of the analogy between it and ammonia led to his famous work on the amines and organic ammonium bases and the allied phosphorus compounds, while his researches on rosaniline, which he first prepared in 1858, formed the first of a series of investigations on colouring matters which

culminated in the discovery of quinoline red in 1887. Hofmann is also known for his discovery of allyl alcohol (with Auguste Cahours), of formaldehyde, hydrazobenzene and the isonitriles. He discovered a method of converting an amide into an amine containing one carbon atom less, and this important reaction is now known by his name. Hofmann's method for determining molecular weight of liquids by means of vapour densities was an important contribution to chemistry.

In addition to the investigations for which he was responsible, he exercised considerable influence on chemical progress through the valuable work of his pupils, among whom were Perkin, discoverer of mauve, Peter Griess, the discoverer of diazo compounds, and Sir William Crookes. Almost 1,000 papers came from his laboratory and nearly 300 of these represent his own work. Among his scientific publications were *Handbook of Organic Analysis* (1853) and *Einleitung in die moderne Chemie* (6th ed., 1877). After Liebig's death (1873) he succeeded to the editorship of the *Annalen der Chemie*. He was the possessor of a clear and graceful, if somewhat florid, style which showed to special advantage in his numerous obituary notices or encomiums (collected and published in three volumes, *Zur Erinnerung an vorangegangene Freunde*, 1888). He delivered speeches in four languages. His other historical works were *Berliner Alchemisten und Chemiker: Ein Jahrhundert chemischen Forschung unter dem Schirm der Hohenzollern*. The two volumes of the letters of Liebig and Friedrich Wöhler (1888) were issued under his guidance.

As a teacher, besides the power of accurately gauging the character and capabilities of those who studied under him, he had the faculty of infecting them with his own enthusiasm and thus of stimulating them to put forward their best efforts. In the lecture room he laid great stress on the importance of experimental demonstrations, paying particular attention to their selection and arrangement, though since he himself was a somewhat clumsy manipulator, their actual exhibition was generally entrusted to his assistants. Many of the standard lecture demonstrations were invented by Hofmann.

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(R. E. O.; X.)

HOFMANN, JOSEF CASIMIR (1876–1957), Polish-U.S. composer and one of the greatest pianists of his time, was born at Podgorze near Cracow, Jan. 20, 1876. He gave his first concert at the age of six and began to tour the U.S. at eleven. He studied later with Moritz Moszkowski in Berlin and in 1892 with Anton Rubinstein in Dresden. He resumed his public career in 1894 and from 1898 lived mainly in the U.S. He became a U.S. citizen in 1926 and in the same year was appointed director of the Curtis Institute of Music, Philadelphia, Pa. He resigned the position in 1938. His technical prowess was the more remarkable because his hands were small. His playing was noble and poetic, free of any eccentricity and never routine. His compositions included a symphony, five piano concertos and a quantity of solo piano music, some of it published under the pseudonym of Michel Dvorsky. Hofmann was also the author of three books on piano playing. He died in Los Angeles, Calif., on Feb. 16, 1957. (WI. S. M.)

HOFMANNSTHAL, HUGO VON (1874–1929), Austrian dramatist, poet and essayist, leader of the Austrian neoromantic school and librettist of Richard Strauss, was born in Vienna, Feb. 1, 1874. When still at school, he published his first writings under the name of Loris. Through their perfection of form and maturity of thought, these caused a literary sensation. Besides poems and essays, he evolved a kind of short lyrical play, *e.g.*, *Gestern* (1891), *Der Tod des Tizian* (1892; Eng. trans., *The Death of Titian*, 1913–15), *Der Tor und der Tod* (1893; Eng. trans., *Death and the Fool*, 1913), *Der weisse Fächer* and *Die Frau im Fenster* (both 1897). This he developed gradually into full-length poetic drama, as in *Der Abenteurer und die Sängerin* (1899; Eng. trans., *The Adventurer and the Singer*, 1917–18), *Die Hochzeit der Sobeide* (1899; Eng. trans., *The Marriage of Sobeide*, 1913–15), and *Oedipus und die Sphinx* (1905). Some of his works were based on old plays: *Das gerettete Venedig* (1904) on Thomas Otway's *Venice Preserved;* *Elektra* (1903) on Sophocles' tragedy; and *Jedermann* (1911) on the English morality *Everyman*. He was greatly attracted by the Spanish drama of Calderón, two of whose plays he remolded into dramas of his own: *Das Salzburger Grosse Welttheater* (1922) and *Der Turm* (1925; *The Tower*, 1961).

Hofmannsthal's international fame is mainly based on the librettos he wrote for Richard Strauss. These include, besides *Elektra*, *Der Rosenkavalier* (1911), *Ariadne auf Naxos* (1912), *Die Frau ohne Schatten* (1919), *Die ägyptische Helena* (1928), and *Arobella* (1933). He also turned to comedy in the Austrian tradition with *Cristinas Heimreise* (1910; Eng. trans., *Christina's Journey Home*, 1917), *Der Schwierige* (1921), and *Der Unbestechliche* (1923). Throughout his life he wrote a great variety of essays, mainly on literary subjects, in which he revealed his genius for penetrating into the spirit of his own and of other nations.

Hofmannsthal was acclaimed as the leading figure of a generation which set its ideals of beauty and spiritual refinement against the realism and materialism of the time. After World War I he founded with Max Reinhardt the Salzburg festival, centred on the annual performances of his own religious play, *Jedermann*. He died at Rodaun, near Vienna, July 15, 1929.

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(H. F. GN.)

HOFMANN VON HOFMANNSWALDAU, CHRISTIAN (1617–1679), a leading German poet of the "second Silesian school," was born at Breslau on Dec. 25, 1617, and educated at Breslau, Danzig (where he fell under the influence of Martin Opitz) and Leiden. Hofmannswaldau traveled widely before returning to Breslau, where he occupied a leading administrative post until his death there on April 18, 1679. The German counterpart to Luis de Góngora and Giambattista Marino (*qq.v.*), Hofmannswaldau wrote a considerable quantity of verse, both secular and religious, distinguished for its sensual, erotic sentiments and the exaggerated, high-flown way they are expressed. He wrote verse in a variety of genres—*Grabschriften* (1643), *Heldenbriefe* (1663), *Deutsche Übersetzungen und Gedichte* (1673)—and his translated works into German include G. B. Guarini's *Pastor Fido* (1673). Behind the wild emotions there is a coolly calculating intellect that often gives an impression of ironical insincerity to his verse, the lascivious character of much of which stands in no relation to the blameless life of the much esteemed Breslau civil servant.

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(D. G. D.)

HOFMEISTER, WILHELM (FRIEDRICH BENEDICT) (1824–1877), German botanist and pioneer investigator of the comparative embryology of plants who greatly influenced botanical research, was born at Leipzig on May 18, 1824. He entered his father's publishing and bookselling business in 1841. Meanwhile his interest in botany was developing. Entirely self-taught, he published his first paper, on investigations concerning the process of fertilization of the evening primrose (*Oenothera*), in 1847. His next studies concerned sexuality and origin of the embryo of seed plants. His short but decisive paper, "Embryology of Flowering Plants" (1849), settled the question of the origin of the embryo from an ovum, as against the then prevalent pollen-tube theory of M. J. Schleiden. Hofmeister also studied the embryology of bryophytes and pteridophytes. His important work *On the Germination, Development and Fructification of the Higher Cryptogamia* (1851; Eng. trans., 1862) demonstrated the life story of liverworts, mosses, ferns, horsetails, club mosses and even gymnosperms, and the analogy between these higher cryptogams and the conifers. He clearly established that there is an alternation of generations in plants as had recently been shown in animals.

Hofmeister remained in the publishing business until 1863, then was appointed professor of botany and director of the botanical garden at Heidelberg. He became professor at Tübingen in 1872. He died at Lindenau, near Leipzig, on Jan. 12, 1877.

See K. E. von Goebel, *Wilhelm Hofmeister* (1924, Eng. trans., 1926).

HOFMEYR, JAN HENDRIK (1845–1909), South African statesman, for many years leader of the Afrikander Bond in the Cape Colony, was born in Cape Town on July 4, 1845, and educated at the South African college. He entered public life through journalism, as editor of the *Volksvriend* (1861–71) and of the united *Zuid Afrikaan* and *Volksvriend* (1871–83). He also founded a literary periodical, *Zuid Afrikaansche Tijdschrift*, in 1878. Though an admirer of English culture, "Onze Jan," as he later came to be called, worked successfully to revive the waning Dutch culture of the Cape, more especially the Dutch language (which he always preferred to the spoken Afrikaans); and his efforts, with the help of many others, led by the end of the century to the recognition of Dutch as an official language for most purposes.

The son of a wine farmer, Hofmeyr established a Boeren Beschermings Vereeniging (Farmers' Protection association) in 1878, with the long-term object of making the Afrikaner Boer as politically conscious as his English-speaking counterpart. In 1879 he entered parliament as member for Stellenbosch at the head of a small, loosely knit party. The establishment of the Afrikander Bond in 1879 faced Hofmeyr with a difficult problem, for he did not share the hostility toward things English which this rival political movement then manifested. By astute maneuvering, however, he secured the amalgamation of the Bond and his own association in 1883, retaining the parliamentary leadership of the united body; he strengthened his hold still more in 1889, when he became chairman of the organization's new disciplinary committee, Commissie van Toezicht op Electies.

As leader of the only organized party in the Cape parliament, Hofmeyr commanded enough votes to make and unmake ministries and secure the passage of measures agreeable to the Bondsmen. His refusal to form a government was a constant theme of attack by his opponents, though it may be doubted if it was ever in fact possible for him to form a stable administration. He held cabinet rank only for a few unhappy months in 1881, and retired from parliament in 1895, though his political influence was hardly diminished thereby. To some extent, Hofmeyr was affected by the anti-imperial spirit of the early 1880s, opposing the restoration of British rule in Basutoland or its establishment in Bechuanaland. Native policy, he considered, was a matter not for the British, but for South African governments working in co-operation. He was slow to grasp the need for South African economic federation until after the discovery of gold on the Rand (1886), and even then continued to back for a while the isolationist railway policy of the Transvaal. By degrees, however, his political horizon broadened, as shown by the constructive part he played in the imperial conferences of 1887 and 1894. By 1890 he had moved far enough to support Cecil Rhodes's schemes for the opening up of the north as a Cape colonial venture.

His alliance with Rhodes during the latter's premiership (1890–95) was of advantage to both parties. Rhodes obtained a secure basis of power in the colony; the Bondsmen obtained agricultural, labour and railway policies to their liking, and their membership rose markedly. The Jameson raid, however, led to a complete breach between Hofmeyr and Rhodes, and the dark night of Hofmeyr's political career began. His masterly statesmanship during the raid crisis, designed not only to expose the guilty but also to reconcile the imperial and Transvaal authorities, was matched by his responsible handling of the 1899 crisis. But his efforts to maintain peace were ineffective, partly because, though he persuaded Paul Kruger to give a little ground, he was not correspondingly successful with Sir Alfred Milner. He retired to Europe during the South African War, a sick and disillusioned man.

Returning to the Cape in 1902, Hofmeyr resumed effective leadership of the Bond, which supported a policy of reconciliation between Boer and Briton. In the movement toward union, he was a lively supporter of Dutch language rights and of the Cape nonwhite franchise and, unlike most leaders outside Natal, advocated a federal rather than a unitary constitution. He went to London, however, in the delegation which presented the draft Act of Union to the British government, and died there on Oct. 16, 1909.

See J. H. Hofmeyr, *The Life of Jan Hendrik Hofmeyr* (1913).
(T. R. H. D.)

HOFSTADTER, ROBERT (1915–), U.S. physicist awarded the 1961 Nobel prize for physics, jointly with Rudolph Mössbauer, for his investigations of the structure of atomic nuclei and nucleons, was born in New York city on Feb. 5, 1915. He received his undergraduate education at City College of New York and attended Princeton university, where he obtained the degree of doctor of philosophy in 1938. During World War II he worked on military equipment at the national bureau of standards and the Norden Corp., returning to Princeton in 1946. Up to the time he left there to join the faculty of Stanford university in 1950, his principal scientific work dealt with infrared spectroscopy, photoconductivity, and crystal and scintillation counters. At Stanford, he first used the high-voltage linear electron accelerator to explore the structure of atomic nuclei by means of electron scattering. Using the same equipment, he also made quantitative measurements of the sizes and shapes of nucleons (protons and neutrons), considered the building blocks of nuclei. (L. I. S.)

HOG: *see* PIG.

HOGARTH, DAVID GEORGE (1862–1927), British archaeologist, remarkable both for the range and quality of his scholarship, and for the diplomatic and administrative abilities that gave him a leading part in Arab affairs during World War I. Born at Barton-on-Humber, Lincolnshire, on May 23, 1862, he was educated at Winchester and Magdalen college, Oxford. At Oxford he was tutor from 1886 until 1893, when he was elected a research fellow to undertake archaeological studies in the near east. He excavated some notable sites in Egypt and Asia Minor, working at Phylakopi on Melos in 1898, and excavating in Crete with Arthur (later Sir Arthur) J. Evans (*q.v.*) whom he succeeded as keeper of the Ashmolean museum, Oxford, in 1909. Hogarth's excavations at Ephesus are particularly well known, and were published as *The Archaic Artemisia of Ephesus* (1908). He was director of the British School of Archaeology at Athens from 1897 until 1900. Later (1911) Hogarth turned to the Hittite civilization, excavating Carchemish, a capital of the Hittites, and preparing a report, the first part of which was published in 1914. He also wrote *Hittite Seals* (1920) and *Kings of the Hittites* (1926).

In 1915 the British government sent Hogarth to Cairo, Egy., on the delicate mission of organizing an Arab revolt that was intended to challenge Turkish rule. His versatility was invaluable when he became director of the Arab bureau in Cairo, which drew to its service such exceptional individuals as T. E. Lawrence, Gertrude Bell and Mark Sykes. After the war he continued to work on Arab problems, and in 1919 was British commissioner at the Middle-East commission of the Paris Peace conference. He was president of the Royal Geographical society from 1925 until he died, at Oxford, on Nov. 6, 1927. Hogarth's publications include *A Wandering Scholar in the Levant* (1896), *Philip and Alexander of Macedon* (1897) and *The Penetration of Arabia* (1904).
(J. M. Wi.)

HOGARTH, WILLIAM (1697–1764), the first great English-born painter and engraver, who was especially popular on account of his moral and satirical paintings, was born in the City of London on Nov. 10, 1697. His father was Richard Hogarth, a schoolmaster who had come to London from Westmorland to obtain literary work, but failed to make more than a meagre living. The son was from childhood fond of drawing and this interest led to his being apprenticed to an engraver of arms on silver plate near Leicester Fields, where he came in touch with the Huguenot community who brought over prints from France. The end of his apprenticeship, together with the death of his father in 1718, left Hogarth free to follow his own devices. Heraldry did not appeal to him and by 1720 he had set up for himself in the same neighbourhood as an engraver on copper. Beginning with shop bills, he proceeded in 1723 to book illustrations, the best of which are those for Samuel Butler's *Hudibras* (1726). He also designed satiric prints on the fashions of the day, such as "Masquerades and Operas" (1724). These had a brief popularity, but were soon pirated.

In 1720 Hogarth had become a not very diligent student at Cheron and Vanderbank's academy in St. Martin's lane in order

to study from the model, and he may also have attended the free school opened by Sir James Thornhill. However, he disapproved of copying as an exercise and preferred to rely on his own method of training the memory by close observation of persons and scenes noticed in the course of his amusements until he could reproduce their characteristics. He took naturally to the use of oils, a fluid medium which lent itself to the free expression of his ideas. In 1727, he painted a design called "The Element of Earth" for a tapestry maker, who rejected it on the grounds that he had since learned that Hogarth was an engraver and not a painter; but in the ensuing litigation Hogarth was able to produce evidence of his ability and won his suit. The following year he produced his first painting of a scene from *The Beggar's Opera* then running in London, and this proved so popular that he was called upon for repetitions (one in the Tate gallery, London).

In 1729 Hogarth eloped with Sir James Thornhill's daughter Jane, an event which affected the subsequent course of his work. Being now under an obligation to provide for a family, he took to painting small portrait groups of the type known as conversation pieces. Those done during the next three years include "The Wedding" (New York), "The Assembly at Wanstead House" (Philadelphia), "The Wollaston Family," "The Conquest of Mexico," "The Cholmondeley Family," and two unfinished sketches of the royal family (one at Dublin). Some of these have great charm and vivacity, which has made them among the most popular of his works. In fact, though it was only a short time since he had been dependent on his engravings, Hogarth was now at the height of his fame as a painter, and George Vertue could write of him in 1729, "happy are they who can get a picture of his painting." Unfortunately the labour was immense in relation to the remuneration (in one instance the number of likenesses to be included were 25), so that this only proved another form of drudgery.

Meanwhile, Hogarth had been following his natural bent for social satire in such works as "The Denunciation" (Dublin). By 1731, he had completed the six pictures entitled "A Harlot's Progress" (destroyed by fire in 1755), the first of the great sets of works arranged like acts in a play, on which his fame as an original artist most securely rests. "Subjects," he wrote, "I considered as writers do. My picture was my stage and men and women my actors who were by means of certain actions and expressions to exhibit a dumb show." He engraved the "Harlot's Progress" himself, and when the prints were published the next year they had an instantaneous success, which was enhanced by the fact that gossip could identify some of the figures with well-known people. So many were sold that Hogarth could henceforth look upon the proceeds of his printing press as the revenues of an estate, and in 1733 he bought himself a large house in Leicester square, which he occupied for the rest of his life. The eight pictures of "A Rake's Progress" (Sir John Soane's museum, London) soon followed; but he still suffered from piracy and publication of the engravings was held up until 1735, when he secured the passing of a statute, still known as "Hogarth's act," to protect the copyright of original artists in their own designs. Other popular prints from paintings appearing during 1733–38 were "A Midnight Modern Conversation," "Sarah Malcolm," "Southwark Fair," "The Distressed Poet," "Four Times of the Day," and "Strolling Actresses Dressing in a Barn"; but these had no such moral purpose as the "progresses," being intended simply for entertainment.

Thus assured of a regular income, Hogarth could afford to divert his energies to less remunerative work. A major influence on his determination to become an artist had been Thornhill's frescoes for St. Paul's cathedral, and "history painting," as it was then called, was regarded as the highest form of art. In 1735, having been elected a governor of St. Bartholomew's hospital, he announced his intention of adorning the staircase with large mural paintings at his own expense and carried out his offer in the next year or so with "The Pool of Bethesda" and "The Good Samaritan," the first of his scriptural subjects. The experiment, however, met with little response.

On Thornhill's death in 1734 his art school in St. Martin's lane had passed to Hogarth, who turned it into a sort of club, where many of the leading artists came to study and hold lively debates on the state of British art, still overshadowed by that of the continent. Hogarth refused to accept the defeatist attitude of his colleagues, and the opening in 1739 of the Foundling hospital, London, in which he was actively interested, gave him a chance of displaying his own prowess by presenting it with a large portrait of the founder, his friend Capt. Thomas Coram. Ambitious to succeed in the most profitable branch of his profession, he painted a number of portraits during the next few years, notably "The Graham Children" in 1742 and "Mrs. Salter" in 1744 (both in the Tate gallery, London). But his reputation as a satirist was against him and though he had a few staunch supporters and received the highest fee yet paid in England for his "Garrick as Richard III" (Liverpool), he did not meet with the success for which he had hoped.

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"HEADS OF SIX OF HOGARTH'S SERVANTS" BY WILLIAM HOGARTH, IN THE NATIONAL GALLERY, LONDON

In 1743 he announced the forthcoming publication of his most famous set of works, "Marriage à la Mode" (Tate gallery), in which the disastrous results of a union contrived from mercenary motives are displayed. Having no high opinion of his own powers as an engraver where fine work was required, he decided to have the paintings engraved by other hands, and his visit to Paris in the same year may have been for this purpose. The six plates appeared in 1745 and added to his laurels in this field. His reputation as a painter, however, was falling in inverse proportion to the popularity of his prints. As a result of a feud with the art dealers, whom he held responsible for foisting bogus old masters on the public, he conducted a sale by auction of his best-known pictures in 1745. The prices bid were ridiculously low and the originals of "Marriage à la Mode" remained on his hands, to be sold six years later for 20 guineas apiece. This may explain why the series of paintings to be known as "The Happy Marriage" remained unfinished, though "The Dance" (Camberwell, London), with its effect of flickering light, ranks among his finest efforts, along with other oil sketches, such as "The Shrimp Girl" (National gallery, London).

In 1746 Hogarth renewed his attempt to encourage British artists by organizing a permanent exhibition of their works at the Foundling hospital, the first exhibition of its kind in England, his own contribution being "Moses Brought to Pharaoh's Daughter." The so-called "March to Finchley" (Foundling hospital), a return to satirical subjects, is of the same period. The didactic prints of "Industry and Idleness," done from drawings, came out in 1747, to be followed four years later by "The Four Stages of Cruelty," "Gin Lane" and "Beer Street," which were intended to reform rather than amuse. In 1748 Hogarth painted "Paul Before Felix" for Lincoln's Inn and went over to France again, only to be turned back at Calais on suspicion of spying while sketching

the fortifications, as seen in "Calais Gate" (Tate gallery).

Having acquired a summer villa at Chiswick in 1749, and discouraged by the reception of his paintings, Hogarth went into seclusion for the next few years to compose his *Analysis of Beauty*, "written with a view to fixing the fluctuating Ideas of Taste" and published in 1753. The notion had long been simmering in his mind and the serpentine "Line of Beauty," shown on the palette in his self-portrait of 1745 (Tate gallery), had raised inquiries as to its meaning, which he now sought to satisfy by demonstrating that it was the underlying principle of enjoyment of beauty in life as well as in art. The line, it should be noted, was three-dimensional, his doctrine being based on seeing things in the round. The book had some success abroad, but only served to harden opinion against him in England as an arrogant ignoramus.

He returned to painting with the "Election" series of 1754 (Soane's museum), a large altarpiece for Bristol in 1756, and a few more portraits. In spite of his appointment as serjeant-painter to the king in 1757, in the closing years of his life Hogarth was frustrated and unhappy. After painting "The Lady's Last Stake" (Fine Arts academy, Buffalo, N.Y.) in 1759 by way of a farewell to his brush, he was persuaded to take it up once more and produced his ambitious "Sigismonda" (Tate gallery), which provoked a storm of ridicule. As the result of a political quarrel in 1762, when he was in ill-health, he was savagely attacked by John Wilkes and his friend Charles Churchill and retaliated with biting caricatures of both men. He died suddenly at his house in Leicester square on Oct. 26, 1764, and was buried at Chiswick.

Although he was the first English-born artist of international status and innumerable feeble imitations of his prints were made, Hogarth can hardly be said to have had any great influence on the art of his time, except possibly through his conversation pieces. His prints passed rapidly abroad and it is impossible to estimate the effect of his works on later generations of artists. The incisive quality of his engravings was well suited to their purpose of inculcating a moral, while his merits as a painter have come to be more and more appreciated since the first exhibition of his paintings in 1814. He played an important part in the emancipation of British art by means of his own academy and exhibitions of contemporary works.

Bibliography.—Hogarth's own autobiographical notes will be found in J. Burke's edition of his *Analysis of Beauty* (1955). *See* also P. Quennell, *Hogarth's Progress* (1955). The best collection of the prints is in the British museum, catalogued by F. G. Stephens. For drawings *see* A. P. Oppé, *The Drawings of William Hogarth* (1948). Notable collections include those of the British museum, the royal collection, the Pierpont Morgan library, and the marquess of Exeter. For paintings *see* R. B. Beckett, *Hogarth* (1949). (R. B. Bt.)

HOG CHOLERA: *see* Swine Fever.

HOGG, JAMES (1770–1835), Scottish poet, known as "the Ettrick shepherd," was baptized at Ettrick, Selkirkshire, on Dec. 9, 1770. He spent most of his youth and early manhood as a shepherd, and was almost entirely self-educated. After unsuccessful attempts at farming and literary journalism he was provided by the duke of Buccleuch with a small farm at Altrive, Yarrow, in 1817. He died at Altrive on Nov. 21, 1835.

Of Hogg's prolific poetic output only a few narrative poems and ballads have proved of lasting value, but in "Kilmeny" and "The Witch of Fife" he shows a real imaginative force; many of his songs have a folk vigour and raciness; and *The Poetic Mirror* (1816) was a volume of masterly parodies of such contemporaries as Scott, Wordsworth and Coleridge. Hogg also wrote many stories and sketches, of which the *Private Memoirs and Confessions of a Justified Sinner* (1824) is the most memorable: it is a striking study of Calvinist extremism in which Hogg's interests in Scottish history and the supernatural were powerfully combined.

Bibliography.—*The Works of the Ettrick Shepherd*, ed. by T. Thomson, 2 vol. (1865), containing Hogg's *Autobiography; Selected Poems*, ed. by J. W. Oliver (1940); *Private Memoirs and Confessions of a Justified Sinner*, ed. with introduction by T. E. Welby (1924), ed. with introduction by A. Gide (1947); *The Poetic Mirror*, ed. with introduction by T. E. Welby (1929); H. T. Stephenson, *The Ettrick Shepherd: a Biography* (1922); E. C. Batho, *The Ettrick Shepherd* (1927); A. L. Strout, *The Life and Letters of James Hogg, the Ettrick Shepherd*, vol. i, 1770–1825 (1946); L. Simpson, *James Hogg* (1962).
(E. G. M.)

HOGG, QUINTIN (1845–1903). English philanthropist and originator of the Polytechnic, was born in London Feb. 14, 1845, and educated at Eton. He chose mercantile work in London and became associated with Lord Kinnaird and his philanthropic "ragged schools," intended to educate destitute children and "save them from vagrancy and crime." Hogg's interest in education began with a reading lesson given to a couple of crossing sweepers. He opened a ragged school in "Of Alley," now York place, Charing Cross, and in 1868 it was moved to Castle street. Ten years later a Working Lads' institute was set up at Long Acre and in 1881 Hogg acquired the building known as the Polytechnic in Regent street. This had previously been a place of popular entertainment. Hogg carried on the work of the Polytechnic without the aid of public funds until 1889, when it received money through a redistribution of the city parochial charities and came under the supervision of the London County council. The Polytechnic developed a large number of activities, social, recreational and educational, and the parent institution gave rise to similar education centres elsewhere (*see* Technical Education). Hogg died in London on Jan. 17, 1903.

Hogg's remarkable success with boys sprang from his understanding of them, his sincerity and his convinced belief in Christianity, which he put into practice.

See E. M. Hogg (afterward Wood), *The Polytechnic and Its Founder, Quintin Hogg* (1932). (S. J. C.)

HOGG, THOMAS JEFFERSON (1792–1862). English writer, the friend and biographer of Shelley, was born on May 24, 1792, at Norton, Durham. He was educated at Durham grammar school and entered University college, Oxford, in 1810. There he met Shelley and was expelled with him in 1811 for his part in the authorship of the pamphlet *The Necessity for Atheism*. He studied law at York and was joined there by Shelley and his young bride Harriet. Hogg's dishonourable advances to Harriet while Shelley was absent on business, though probably exaggerated by the romantic imagination of Harriet's sister Eliza, led to the temporary estrangement of the two friends, but late in 1812, at Shelley's instigation, they were reconciled. Shelley had already favourably reviewed Hogg's *The Memoirs of Alexy Haimatoff* (1813), a series of amorous adventures recounted by an old man describing his youthful search for happiness. After studying at the Middle Temple Hogg was called to the bar in 1817 and he rose to become a revising barrister for Northumberland and Berwick. After Shelley's death in 1822 he was asked by the poet's family to write a biography and in 1858 the first two of the proposed four volumes of *The Life of Shelley* were published. They describe Shelley's early years up to 1814 in a lively and at times ironic narrative style which throws light on Shelley's character by the use of anecdotes and letters, and contains much relating to Hogg himself. Shelley's family objected to this autobiographical material and refused Hogg access to sources necessary for the completion of the *Life*. He began a third volume, but it was never published. He died in London on Aug. 27, 1862. Hogg also wrote *Two Hundred and Nine Days* (1827), a series of impressions from his wide continental travels, and many articles for magazines. He contributed the articles "Alphabet" and "Antiquities" to the eighth edition of *Encyclopædia Britannica*.

See W. Scott, *Jefferson Hogg* (1951).

HOGMANAY, the name in Scotland and parts of the north of England for New Year's Eve, as also for the dole of bread, cake or sweets then given to the children that go from house to house soliciting it with traditional rhymes, one of which concludes with "Rise up and gie's our Hogmanay." On this evening also it is traditional for parties of masked children or young men to visit houses as guisers or mummers. Of local customs formerly observed at Hogmanay, the "burning of the clavie" (a bonfire of split casks, in which a nail plays a part) still flourishes at Burghead in Moray. The derivation of the term is doubtful. For various theories *see* R. Chambers (ed.), *The Book of Days* (1864; reprinted 1914). (Ja. F.)

HOHENLIMBURG, a town of Germany which after partition of the nation following World War II was located in the *Land* (state) of North Rhine-Westphalia, Federal Republic of

Germany. It lies on the lower Lenne 26 km. (16 mi.) S.S.E. of Dortmund by road. Pop. (1961) 26,504. The hilly town is dominated by a castle. Notable buildings include the Protestant church (1748–51), with rococo carvings, and the town hall (1956). Hohenlimburg is both holiday resort and industrial town; parks and woods are a feature. Industries include cold and hot rolling mills, ironworks, wire drawing and textile finishing; chalk and glass are produced. The town is on the railway from Hagen to Iserlohn. The district was settled in very early days, but the building of the castle in 1230 by Count Friedrich I marks the town's beginning. The town was successively owned by the Isenburg, von Neuenahr and von Bentheim families; the latter still own the castle. Lymburg (with Nahmer and Oege) received civil rights in 1709. In 1879 it was renamed Hohenlimburg to distinguish it from Limburg an der Lahn.

HOHENLINDEN, BATTLE OF, a battle of the Napoleonic Wars (*q.v.*), fought on Dec. 3, 1800, about 19 mi. E. of Munich in Bavaria between the French commanded by J. V. Moreau and the Austrians under the archduke John. The armistice of Parsdorf (July 15) ended on Nov. 28, when both commanders assumed the offensive—John from the Inn river, Moreau toward its higher reaches. Difficult conditions soon caused the Austrians to direct their march toward Ampfing, whither Moreau had sent his left wing and where two of his divisions were surprised on Dec. 1. The Austrians did not exploit their advantage fully, and on Dec. 2 their inaction allowed Moreau to concentrate sufficient forces to offer battle next day. He withdrew through the forest of Hohenlinden and established his main line before the village. By early morning on Dec. 3 Moreau had assembled 56,000 of the 100,000 under his command to meet the 60,000 available of John's 129,000. The archduke, however, imagining the French to be still retreating, advanced toward Anzing in four principal columns; their unpreparedness, the denseness of the forest and the distances between them enhanced the strength of Moreau's position and his skilful direction of the battle. The Austrian columns came up successively and were contained in front. Meanwhile, Antoine Richepanse's and C. M. I. Decaen's divisions marched to attack the flank of the main Austrian force. Leaving Decaen to repel a column that appeared on his rear, Richepanse delivered his assault, disorganizing his opponents as Moreau launched a general offensive along the main front. Determined resistance by the Austrians who continued to come up could not prevent their army's rout. The Austrians lost 80 guns, 4,780 killed and wounded and 9,000 prisoners, the French, 1,800 killed, wounded and captured. The French soon crossed the Inn, and on Dec. 25 concluded the armistice of Steyr, preliminary to the peace of Lunéville.

(J. H. N.)

HOHENLOHE, a German princely family which took its name from the district of Hohenlohe in Franconia. First mentioned in the 12th century as possessing the castle of Hohenloch or Hohenlohe, near Uffenheim, the family soon extended its influence over several of the Franconian valleys, including those of the Kocher, the Jagst and the Tauber. Henry I (d. 1183) was the first to take the title of count of Hohenlohe, and in 1230 his grandsons Gottfried and Conrad, supporters of the emperor Frederick II, founded the lines of Hohenlohe—Hohenlohe and Hohenlohe-Brauneck. The latter became extinct in 1390, while the former was divided into several branches, only two of which, Hohenlohe-Weikersheim and Hohenlohe-Uffenheim-Speckfeld (extinct in 1412), need be mentioned here. Hohenlohe-Weikersheim, descended from Count Kraft I (d. 1313), also underwent several divisions, the most important being that between the two sons of Count Georg I (1488–1551), namely Ludwig Kasimir (1517–68) and Eberhard (1535–70), founders of the lines of Hohenlohe-Neuenstein and Hohenlohe-Waldenburg respectively. Both these lines were mediatized in 1806.

The line of Hohenlohe-Neuenstein, which became Protestant during the Reformation, did not receive the rank of princes of the Holy Roman empire till 1764. Meanwhile it had divided itself into several branches: (1) the first Öhringen branch, extinct in 1805; (2) the first Langenburg branch, extinct in 1590; (3) the second Langenburg branch, descended from Albrecht Wolfgang (1659–1715); (4) the Ingelfingen branch, descended from Albrecht Wolfgang's brother Christian Kraft (1668–1743); and (5) the Kirchberg branch, extinct in 1861. The Ingelfingen branch in turn subdivided itself between the brothers August (1784–1853) and Adolf (1797–1873), to form the second Öhringen and the junior Ingelfingen branches.

The line of Hohenlohe-Waldenburg, which remained Catholic, attained princely rank in 1744. It comprises the houses of Bartenstein-Jagstberg and of Waldenburg-Schillingsfürst, descended respectively from the brothers Christian (1627–75) and Ludwig Gustav (1634–97). The latter house is likewise subdivided to form two branches, Waldenburg and Schillingsfürst, descended from the brothers Karl Albrecht III (1776–1843) and Franz Joseph (1787–1841). Franz Joseph's eldest son Viktor (1818–93) inherited the duchy of Ratibor in Silesia and the principality of Corvey in Lower Saxony in 1840. The German imperial chancellor, Chlodwig, Prince von Hohenlohe-Schillingsfürst (*q.v.*), was Viktor's brother.

See C. Belschner, *Die Linien und Zweige des Hauses Hohenlohe* (1926).

HOHENLOHE-INGELFINGEN, FRIEDRICH LUDWIG, PRINCE OF (1746–1818), Prussian general, entered the Prussian service in 1768, and fought in the campaign on the Rhine in 1794. In 1806 Hohenlohe commanded the left wing of the army of the Prussian forces opposing Napoleon, having under him Prince Louis Ferdinand of Prussia. Disputes soon broke out between Hohenlohe and the commander in chief, the duke of Brunswick; the armies marched hither and thither without effective results, and finally Hohenlohe's army was almost destroyed by Napoleon at Jena (*see* NAPOLEONIC WARS). Hohenlohe surrendered the remnant of his army at Prenzlau on Oct. 28, a fortnight after Jena and three weeks after the beginning of hostilities. After two years spent as a prisoner of war in France, he retired just before the outbreak of the Austrian war in 1809, and resigned the principality to his eldest son.

HOHENLOHE-INGELFINGEN, KRAFT, PRINCE OF (1827–1892), soldier and military writer, son of Prince Adolf of Hohenlohe-Ingelfingen, was born at Koschentin in Upper Silesia. He joined the Prussian Guard artillery in 1845.

In the bold advance of the Guard corps on the Austrian right wing at Königgrätz in 1866 (*see* SEVEN WEEKS' WAR), Hohenlohe led the Guard reserve artillery with great success, and after the war ended he turned his energies to improving the tactical training of the Prussian artillery. In 1868 he was made a major general and assigned to command the Guard artillery brigade. In this capacity he served in the Franco-German War, distinguishing himself at Gravelotte and Sedan; he was in control of the artillery attack on the fortifications of Paris. He retired in 1879 and died near Dresden on Jan. 16, 1892.

See his memoirs, *Aus meinem Leben*, ed. by W. von Bremen, 4 vol., (1897–1907), new ed., 1 vol. (1915).

HOHENLOHE-SCHILLINGSFÜRST, CHLODWIG KARL VICTOR, PRINCE VON (1819–1901), German statesman, the third chancellor of the second *Reich*, was born on March 31, 1819, at Schillingsfürst in Bavaria, of a mediatized princely house (*see* HOHENLOHE). His father was a Roman Catholic but his mother was a Protestant. He served for a short time in the Prussian civil service before returning in 1846 to Schillingsfürst as heir to the principality. As a great nobleman he knew himself to be of equal rank with the dynasties of Europe, and this feeling of independence was strengthened by his marriage in 1847 to the princess Marie von Sayn-Wittgenstein-Berleburg, who brought him extensive property in Russia as well as connections with St. Petersburg and London. Hence he followed unperturbed his moderately liberal inclinations, first as a member of the Bavarian upper chamber and, in 1848, as a diplomat in the service of the provisional German government in Frankfurt (*see* GERMANY: *History*). Throughout his life he remained a moderate advocate of German unification and a Roman Catholic of tolerant, nonauthoritarian outlook.

Because of these views Hohenlohe was accepted after Bavaria's defeat in the Seven Weeks' War (*q.v.*) as minister president, on

Richard Wagner's recommendation (Dec. 1866). He tried to form the South German confederation permitted by the treaty of Prague, but Württemberg and Baden prevented it. At the time of the Luxembourg crisis (1867), when Napoleon III's proposal to buy the grand duchy created tension between Germany and France, Hohenlohe attempted without success to support Bismarck's efforts for a reconciliation with Austria. He adhered to the alliances with the North German confederation and promoted the renewal of the Zollverein and the establishment of the Zollverein's parliament, of which he became a member. But growing opposition by the Bavarian particularists, the Patriot party, led to his fall from office in Feb. 1870. The particularists' hostility was sharpened by Hohenlohe's attitude to the Vatican council. Under the influence of Ignaz von Döllinger and of his brother Gustav Cardinal von Hohenlohe, he opposed acceptance of the dogma of papal infallibility, which he wished to prevent by a common intervention of the European powers. Bismarck, however, refused to support him.

In 1871 Hohenlohe advocated the acceptance by Bavaria of the treaty embodying the constitution of the German empire; and in the following years he sat as a Free Conservative (for the Deutsche Reichspartei) in the *Reichstag*, of which he was vice-president, and also as Bavarian representative in the federal council or *Bundesrat*. At the beginning of the *Kulturkampf* (the conflict between the new state and the Roman Catholic Church) Hohenlohe moved the bill for the so-called "pulpit clause," aimed at preventing the abuse of the pulpit as a political platform; he also defended the law expelling the Jesuit order from the empire.

In 1874 Hohenlohe went as German ambassador to France. His skeptical but conciliatory manner rendered valuable service in Paris, and these gifts stood him likewise in good stead at the congress of Berlin (1878) and during a short period in 1880 when he deputized for Bismarck at the foreign office. When he became governor of Alsace-Lorraine in 1885, his tactful and considerate handling of the people there proved very successful.

Hohenlohe seemed the providential mediator in the difficult situation created by the fall of the chancellor Caprivi in Oct. 1894. Though he was almost 75 years of age and his powers were declining rapidly, his intellect remained tough and resilient, and Philipp Eulenburg advised the emperor William II to appoint him chancellor of the *Reich* and Prussian premier because he seemed to be "neither conservative nor liberal, neither ultramontane nor progressive, neither devout nor an atheist." As chancellor he was to be overshadowed by the stronger figures of Johannes Miquel, Alfred von Tirpitz, Adolf Marschall von Bieberstein and Bernhard von Bülow. The good relations which the emperor established with "Uncle Chlodwig" hid much resignation on Hohenlohe's part, as well as his incessant labour as moderator and conciliator. He refused to countenance an open revolt of the ministers against the emperor's changing moods, but was able to impose his views on particular questions; *e.g.*, on that of allowing publicity for the proceedings of military tribunals. On the whole, however, he failed to restrain his imperial master. He did not agree with William's repeated attempts to revive, in harsher form, the attacks against the Social Democratic party, but lent himself to the passing of the law against subversion (1894) and of the Prussian law against the Socialists (1897). The bill which proposed prison sentences for picketing and threatening blacklegs was a severe defeat for him, as the *Reichstag* would not even give it a second reading (1899).

It was the same with regard to foreign policy. Often Hohenlohe tried to moderate William's impulsive actions, such as the sending of the telegram to Paul Kruger in Jan. 1896, congratulating him on the repulse of the Jameson raid in the Transvaal, but he never prevented these actions, since he refused to rule as "victor over a vanquished emperor." This resigned attitude did not prevent the Prussian ministry from following an increasingly conservative policy, and Hohenlohe was forced to agree in 1897 to the dismissal of Henrich von Bötticher and Marschall von Bieberstein, his closest collaborators in the imperial government. The slow return to a more positive social policy and the improvement of relations with the Centre party were in line with his policy. Yet it was not he but Miquel, vice-president of the Prussian ministry, who in 1897 began to reconstruct the Bismarckian alignment of parties in the so-called *Kartell*, comprising the Conservatives, the Centre party and the National Liberals. This prepared the transition to Bülow's tariff policy of 1902, which raised both agrarian and industrial protective duties. Hohenlohe supported the building of a German navy by the laws of 1898 and 1900, but the transition to "world policy" was already directed by Bülow, foreign secretary from 1897.

Hohenlohe turned more and more into a "helpless old man" who viewed with detachment the struggle between Miquel and Bülow for his succession, the opposition of the Prussian Conservatives to the building of the Mittelland canal, the defeat of the government on this issue and further concessions with regard to the protective tariffs. Thus the end of his long career showed a decline from the heights around 1870 when he had been, after Bismarck, "the most powerful man in Germany." Taken all in all, his period as chancellor was one of missed opportunities.

Hohenlohe resigned in Oct. 1900 and died on July 6, 1901, at Ragaz, Switz. The first two volumes of his *Denkwürdigkeiten* appeared in 1906–07, edited by F. Curtius, the third volume in 1931, edited by K. A. von Müller.

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HOHENSTAUFEN (more accurately STAUFEN), a dynasty which ruled in Germany from 1138 to 1208 and from 1212 to 1254. Its founder was the count Frederick (d. 1105), who built the castle of Staufen in the Swabian Jura mountains. This Frederick, a faithful adherent of the German king Henry IV, was made duke of Swabia as Frederick I in 1079 and subsequently married Henry's daughter Agnes. After his death his elder son Frederick II the One-Eyed (d. 1147) succeeded to Swabia, while the younger, Conrad, received the county of Rothenburg. The brothers were the only heirs of their uncle Henry V, the last Salian king, who died in 1125; but the papal party saw to it that Frederick's claims were overlooked and secured the election of the duke of Saxony to the German kingship as Lothair III (*see* LOTHAIR II, Holy Roman emperor). The Staufen family then rebelled against Lothair, and on his death (1137) Conrad of Rothenburg was elected German king (1138; *see* CONRAD [German kings]: *Conrad III*). Conrad III had to suppress the revolt of the Welf Henry the Proud, Lothair's son-in-law and duke of Bavaria. Before his death in 1152 Conrad, whose own son Frederick IV of Swabia (1145–67) was still very young, recommended to the electors his nephew Frederick III of Swabia, the son of Frederick the One-Eyed; and this nephew, nicknamed Barbarossa, consequently became German king and, in 1155, emperor as Frederick I (*q.v.*). Barbarossa's half brother Conrad (d. 1195) became count of the Rhenish Palatinate in 1156, but this Conrad's only son Frederick died before him (1189).

Frederick Barbarossa restored royal authority in Germany; upheld the rights of the empire against papal claims; and led the third crusade to Asia Minor, where he was accidentally drowned (1190). Of his sons, the eldest, Frederick V or VI of Swabia, died in 1191; the second succeeded Barbarossa in the German kingship and empire as Henry VI (*see* HENRY, German kings); the third, Otto, became count of Burgundy (*see* FRANCHE-COMTÉ); the fourth, Conrad (d. 1196), succeeded his eldest brother as duke of Swabia; and the youngest was Philip of Swabia (*see* below; and PHILIP, German king). King Henry VI, who had been married to Constance, heiress of Sicily, in 1186, was crowned king of Sicily in 1194, but died in 1197. His widow was able to assert the claims of their young son Frederick Roger to Sicily, but in Germany two claimants now disputed the royal crown: Henry VI's brother Philip of Swabia and Henry the Proud's grandson Otto of Brunswick (*see* OTTO IV). After the assassination of Philip (1208), Otto temporarily prevailed; but in 1212, with papal help, Frederick Roger was elected German king as Frederick II (*q.v.*). Having finally defeated Otto, Frederick was crowned emperor in 1220, but subsequently came into collision with the papacy because of his Italian policy, notwithstanding the crusade (1228–29) in which he was crowned king of Jerusalem. His eldest legitimate son Henry (VII),

who had rebelled against him, died in 1242, leaving two sons who were both dead by the end of 1251. Then on Frederick II's death (1250) his second legitimate son was elected German king as Conrad IV; but Conrad IV died in 1254, and his son Conradin (*q.v.*) was executed in 1268. Frederick II's other legitimate son, also called Henry, had died in 1253 or 1254, and the bastards Frederick of Antioch and Manfred (*q.v.*) had died in 1256 and 1266 respectively. With the eldest of Frederick II's bastards, Enzio (*q.v.*), the male line of the Hohenstaufen became extinct in 1272. *See* further GERMANY: *History;* ITALY: *History.*

See E. Maschke, *Das Geschlecht der Staufer* (1943). (C.-E. P.)

HOHENZOLLERN, one of the formerly sovereign dynasties of central Europe whose history is inextricable from that of Germany. It takes its name from a castle in Swabia first mentioned as Zolorin or Zolre (the modern Hohenzollern, south of Tübingen, in the *Land* Baden-Württemberg). Burchard I, the first recorded ancestor of the dynasty, was count of Zollern in the 11th century. In the third and fourth generation from him two lines were formed; that of Zollern-Hohenberg, extinct in all its branches by 1486; and that of the burgraves of Nürnberg, from which all the branches surviving into modern times derive (*see* Table I).

Frederick III of Zollern, husband of the heiress of the former burgraves of Nürnberg, himself became burgrave in 1192. Between his two sons the first dynastic division of lasting consequence took place: that between the line later known as Franconian (burgraves of Nürnberg, later electors of Brandenburg, kings in Prussia, kings of Prussia, German emperors) and the Swabian line (counts of Zollern, of Hohenzollern, of Zollern-Schalksburg, of Haigerloch, etc.; princes of Hohenzollern-Hechingen, princes of Hohenzollern-Sigmaringen, princes of Hohenzollern, princes and then kings of Rumania). There is some doubt about the seniority of the Franconian and of the Swabian lines: was Conrad I, burgrave of Nürnberg, the elder brother, or was Frederick IV of Zollern? (*See* again Table I.)

The Franconian acquisitions of the burgraves of Nürnberg began when Frederick III got possession of Bayreuth. Frederick IV got Ansbach, John II got Kulmbach. For a long time this group of territories was more important to the dynasty than Brandenburg, of which John II and, from 1411, his grandson Frederick VI. both acted as governors. Then Frederick VI was appointed margrave of Brandenburg in 1411 and elector, as Frederick I, in 1415.

For the history of the rise of the Brandenburg Hohenzollerns (who became Lutheran at the Reformation but turned to Calvinism in 1613), including the account of their considerable acquisitions of territory in the 15th, 16th and 17th centuries, *see* BRANDENBURG. One of the most significant acquisitions was made by a

TABLE I.—*Zollern, Hohenberg and Nürnberg, to 1440*

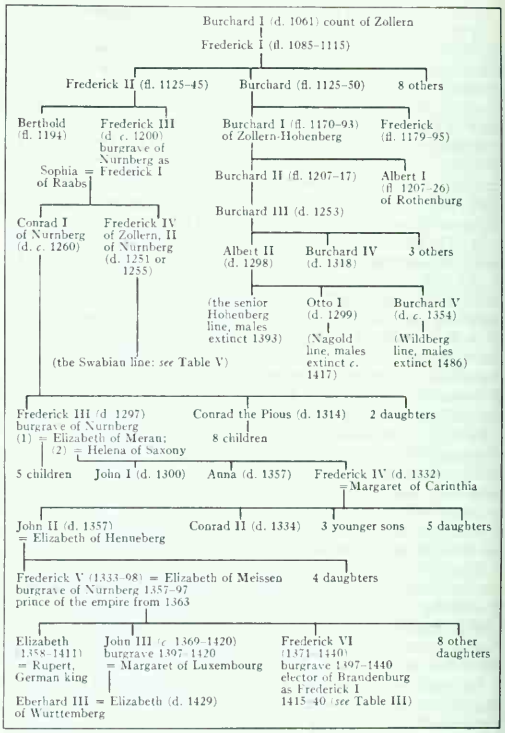


TABLE II.—*Margraves of Bayreuth and of Ansbach, 1603–1791*

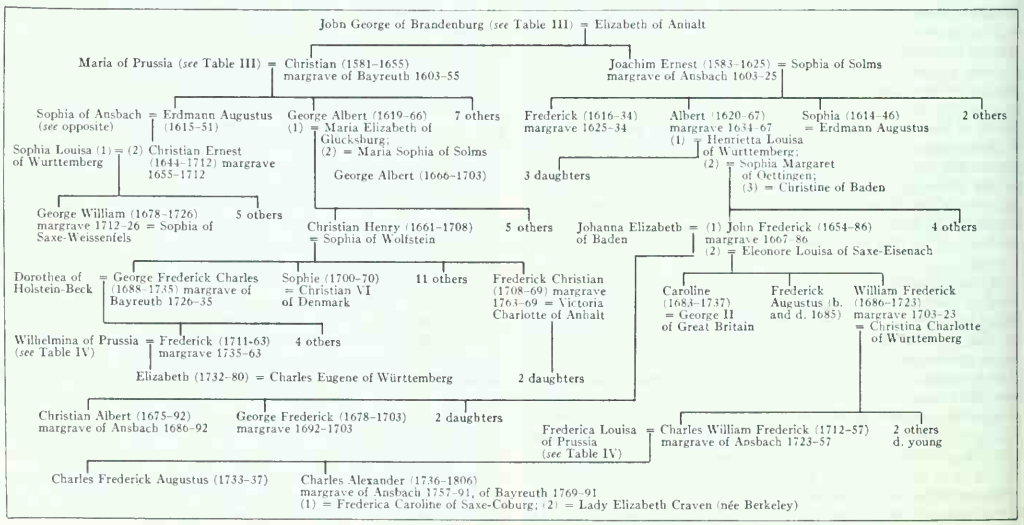


TABLE III.—*The Brandenburg Line, to 1701*

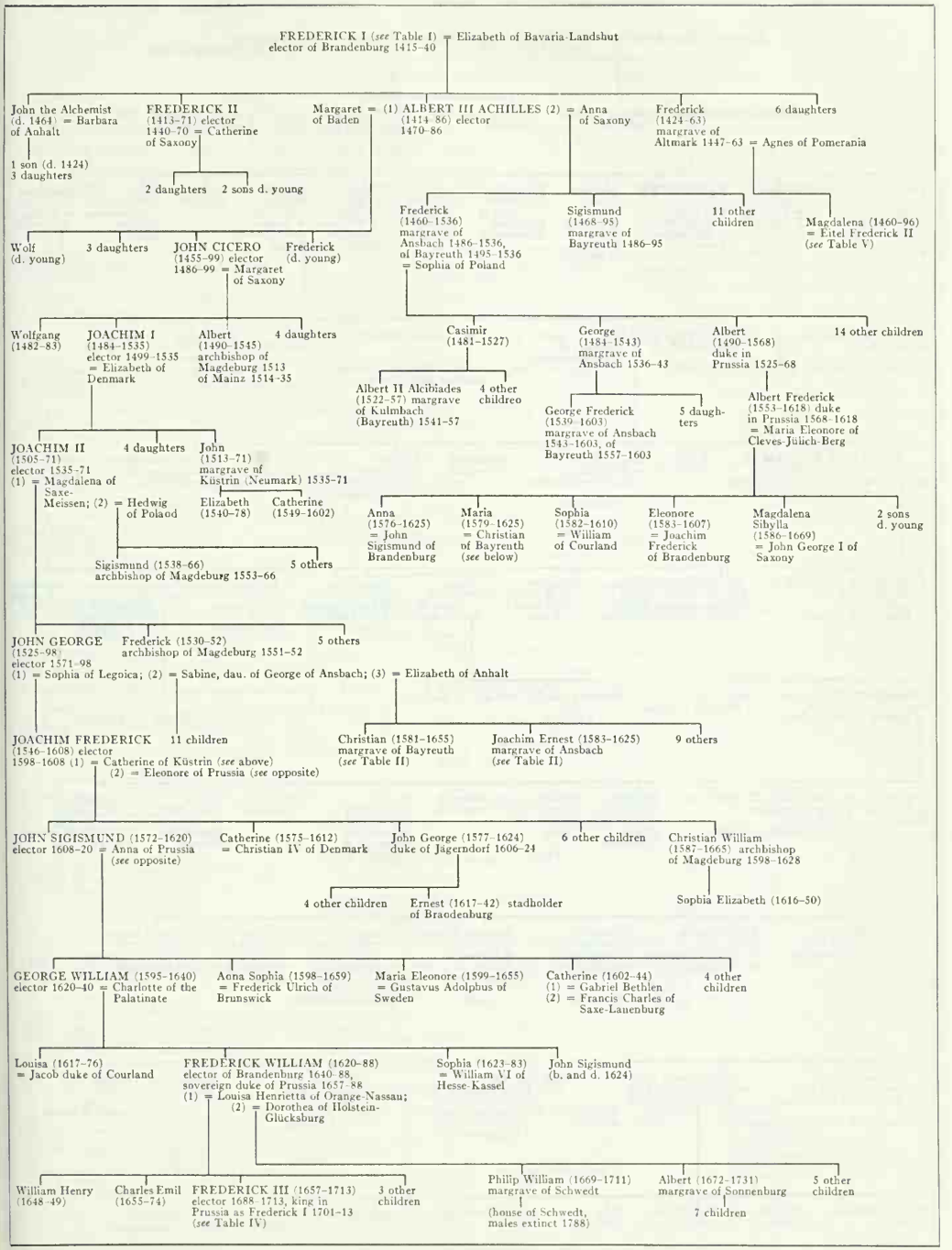


TABLE IV.—*Kings in or of Prussia and German Emperors*

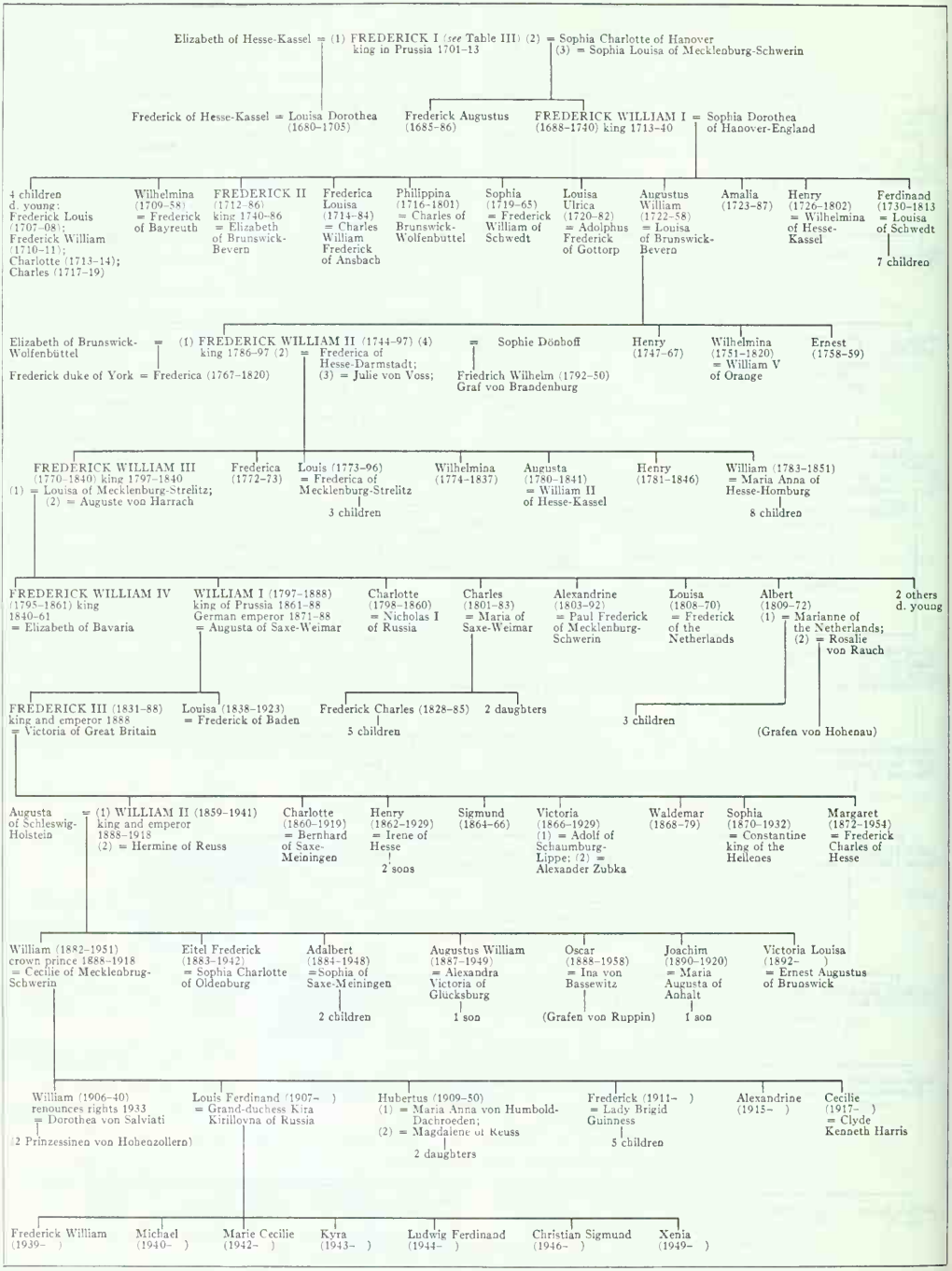
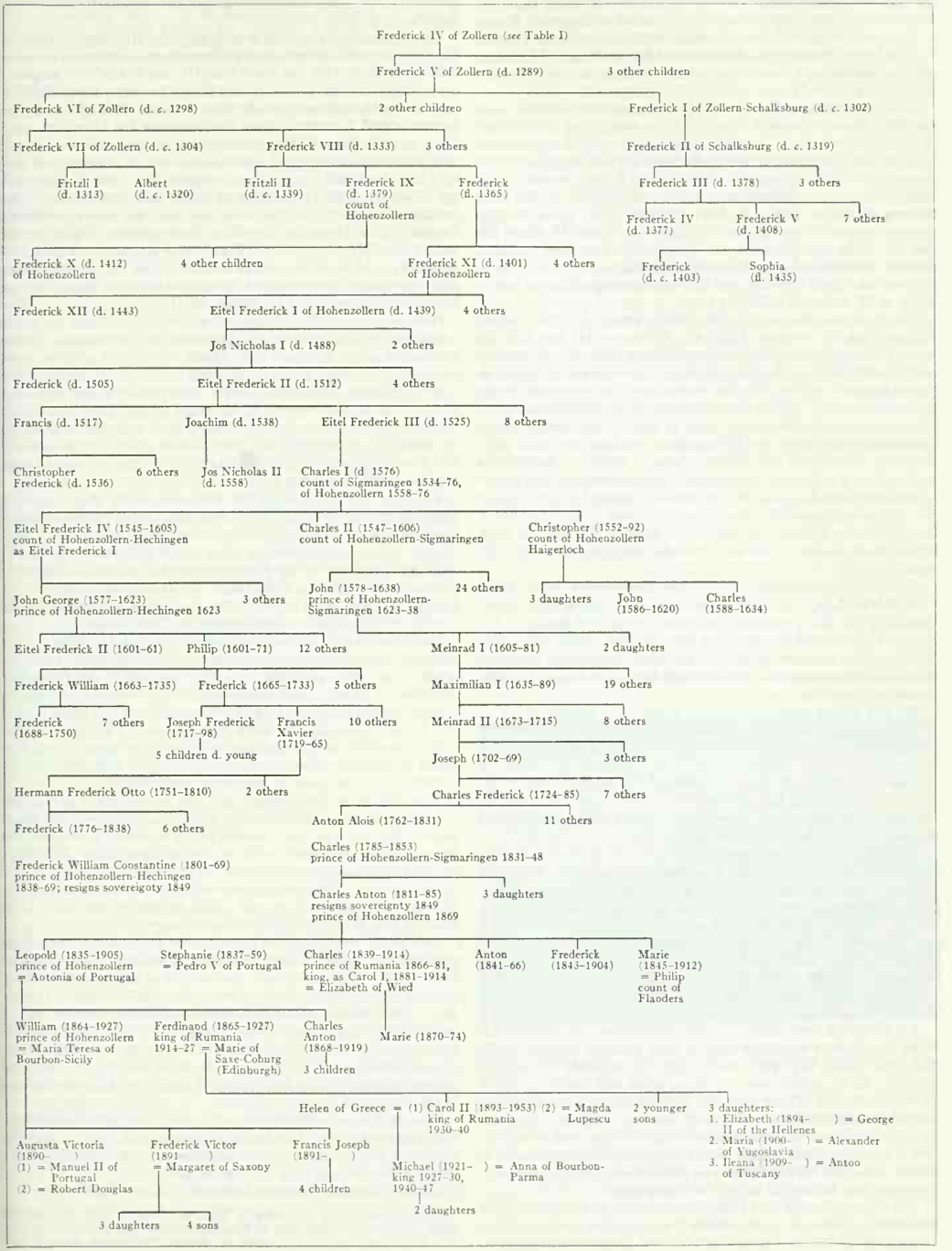


TABLE V.—*The Swabian Line*



junior member of the house in 1525; viz., the duchy of Prussia (*see* PRUSSIA). Table III shows the Hohenzollern electors of Brandenburg down to 1701, with the earlier branches of Bayreuth-Kulmbach, Ansbach and Küstrin, together with the dukes in Prussia. For the latter Hohenzollern margraves of Bayreuth and of Ansbach, which remained as distinct principalities till their cession to Prussia in 1791, *see* Table II.

In 1701 the elector Frederick III of Brandenburg secured from the Holy Roman emperor Leopold I the title "king in Prussia." The change to "king of Prussia" was not formally recognized till 1772, when Frederick the Great obtained it (*see* PRUSSIA for the history of the royal dynasty). The kings of Prussia retained their title of electors of Brandenburg till the dissolution of the Holy Roman empire in 1806. In 1871 William I of Prussia became German emperor (*see* GERMANY: *History*). Table IV shows the descent of the royal Prussian and imperial German lines (*see* further the biographical articles on the individual sovereigns shown in that table). Both Prussian and German sovereignties were lost in 1918, at the end of World War I.

The descent of the Swabian line, which remained Catholic at the Reformation, is shown in Table V. It was in this line that the name Hohenzollern, as distinct from Zollern, first came into use—with Frederick IX. The Hechingen and Sigmaringen branches attained princely rank in 1623, but surrendered their sovereign status to Prussia in 1849. With the extinction of the Hechingen branch 20 years later, Charles Anton, head of the Sigmaringen, received the style prince (*Fürst*) von Hohenzollern, without territorial qualification. His second son, Charles, became prince of Rumania in 1866 and king as Carol I (*q.v.*) in 1881; meanwhile the candidature of the elder son, Leopold, for the Spanish throne had been one of the immediate causes of the Franco-German War of 1870–71. Leopold's son, however, succeeded his uncle in Rumania in 1914, where his descendants, who were brought up in the Orthodox faith, ruled till 1947.

See J. Grossmann, *Genealogie des Gesamthauses Hohenzollern* (1905).

HOHOKAM, the name of an American Indian tribe which lived long ago in the semiarid region of central and southern Arizona. The word Hohokam is of Pima Indian origin and means "the people who have gone." It has been adopted as the name of this old tribe whose accomplishments have been brought to light through archaeology.

No one knows exactly when the Hohokam's history began or what their origin was, but there are reasons for believing that they were descendants of early hunters and food gatherers who lived in the southwestern United States before the time of Christ. A village way of life was firmly established by the beginning of the Christian era. From this time on for at least 1,500 years the history of the tribe has been painstakingly traced and pieced together through excavations in its villages.

Hohokam history was sharply influenced by the desert environment in which it developed. The heartland, along the broad flat valleys of the Gila and Salt rivers, was hot and low in rainfall, but the ground was incredibly fertile and the rivers ran permanently, fed by mountain water from the east. The combination of living water in shallow stream channels, nearby flat and rich lands and an enterprising people resulted in the development of agriculture by canal irrigation. It was this achievement in large-scale systematic irrigation, unsurpassed in North America, that brought fame to the Hohokam as engineers and farmers.

By about A.D. 700 canal systems were in use, and before A.D. 1400 the network of canals reached their greatest extent. In the Salt river valley, aggregate canal length was probably in excess of 150 mi. Ditch widths were 30 ft. or more and depths to 10 ft. have been noted. These were dug by hand because the Hohokam had no mechanical earth movers or beasts of burden. This was truly a monumental accomplishment in planning and execution, and it hints that these Indians were strongly organized politically to create what may be regarded as an intervillage public waterworks program long before the arrival of Europeans.

The principal crops were corn, beans, squash and cotton. These foodstuffs, produced in abundance and supplemented by game, blessed the Hohokam during most of their history with comparative economic security. Through the centuries their villages grew in size, their material arts flourished and Hohokam influence among neighbouring tribes increased.

The archaeological record reveals that the Hohokam developed their unique achievements slowly through many centuries of time. Scholars have divided the history of this people into four stages—the pioneer, colonial, sedentary and classic periods—which broadly express, by the names applied, the transitions through which the society passed. Although from the beginning the Hohokam were living in pit houses, making pottery and growing corn, it was not until about A.D. 1000 that the culture reached its pinnacle. It was then that the tribe's greatest artistic expression is seen in the weaving of cotton cloth, the carving of stone, shell and bone and the making of pottery. At that time too, and for several centuries thereafter, the Hohokam developed their greatest ability to extract a livelihood from the soil and were strongest socially and politically. After about 1400 Hohokam society declined, the large populous centres broke up and the record becomes dim. No one knows certainly why this happened.

Hohokam architecture consisted of flimsy structures of wood, brush and clay built over a shallow pit dug into the ground. These are known as pit houses. Each house was an independent unit, probably sheltering a single family, and because the buildings were widely scattered, Hohokam villages were rambling and exhibited little or no plan. Changes in the shape of the floor and in the method of roofing through the centuries have been determined, but the principle of lowering the floors below ground level was adhered to throughout Hohokam prehistory. Formal religious architecture evidently did not exist.

The dead were cremated, and the ashes of the deceased were placed in pits in the ground or in jars which were buried. Mortuary offerings of pottery, ornately carved stone objects and shell jewelry often accompanied the ashes. This custom of burning the dead destroyed most of the evidence needed to determine the physical appearance of the Hohokam. An exceptional discovery of Hohokam mummies in Ventana cave in Arizona revealed that they closely resembled the modern Papago and Pima Indians.

An interesting and significant sidelight of the Hohokam is the fact that they were in communication with the Indians far to the south in the Mexican highlands. This resulted in the direct importation of objects, such as copper bells and mosaic plaques or mirrors, and in the borrowing of ideas, such as a ball game played in a large oval court with earth embankments. A ball of native rubber, possibly used in this game, dating from about 1100, was found in Arizona. The time of strong Mexican influence broadly coincides with the peak of Hohokam achievement.

They left no written records and had no system of noting the passage of time—at least not any which has survived. For these reasons the dating of their remains has to be done by the standard archaeological procedures of stratigraphy, comparison with other cultures of known age and through the presence of trade goods, also of known age. The most famous village was Snaketown, on the Gila river southeast of Phoenix, Ariz., in which more than 1,000 years of Hohokam history have been recovered.

Not all of the Hohokam lived in the fortunate surroundings provided by the fertile and well-watered valleys of the Gila and Salt rivers. There were some who settled in the harsher environment of what is now the Papago Indian reservation west of Tucson, Ariz. Little surface water and arable land forced them to depend more heavily upon natural plant foods than on the yield of cultivated products, and as a consequence there were no large villages or concentrations of population. In most respects the level of cultural attainment was below that of their river kinsmen because of the rigours of the environment.

What happened to the Hohokam has long puzzled archaeologists. The answer that best fits the facts known about them is that the Pima and Papago Indians, who inhabit southern Arizona, are the living descendants of this famous culture.

See also INDIAN, NORTH AMERICAN: *Culture Provinces.*

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HŌJŌ, the name of an illustrious family of medieval Japan, established by Tokimasa (1138–1215) of the Taira clan. In the 12th century he adopted the new family name of Hōjō, derived from his domain in eastern Japan. The Hōjō political career was launched when Minamoto Yoritomo (*q.v.*) was arrested by the Taira and placed under the guardianship of Tokimasa. But an alliance of the Hōjō and Minamoto, achieved through the marriage of Yoritomo and Tokimasa's daughter, laid the basis for a successful revolt against Taira power (1180–85). The Hōjō then assisted Yoritomo in setting up the Kamakura *bakufu* (*q.v.*), or military government. In 1205 Tokimasa assumed the position of regent for the shogun, an office which was held until 1333 by nine successive members of the Hōjō family. The descendants of Tokimasa, by dominating the military regime at Kamakura, were also able thereby to control the imperial government and court at Kyōto for more than a century. The Hōjō regents were usually able administrators and contributed greatly to the extension of feudal power in 13th-century Japan. Though the Hōjō ascendancy was finally destroyed, together with the Kamakura *bakufu*, in 1333, the family endured as a leading military house for several centuries afterward. *See* also JAPAN: *History: The Development of Feudalism.* (HN. KN.)

HOKAN, a family of North American Indian languages first proposed by R. B. Dixon and A. L. Kroeber in 1913. It then included eight small subfamilies in California: Shasta, Achomawai, Karok, Chimariko, Pomo, Yana, Esselen and Yuman. Later (1915) Kroeber added Salinan and Chumash (California), Washo (Nevada), and Seri and Tequistlatecan (Mexico). Edward Sapir (1917) linked Hokan to the Coahuilteco and Karankawa and to the Subtiaba-Tlappanec languages of Nicaragua. This large family, which he named Hokan-Coahuiltecan, was then said (by Sapir) to be related to Siouan and Caddoan (of the Plains) and Muskogean and Iroquoian (of the eastern woodlands) in the greater Hokan-Siouan stock (*see* CENTRAL AND NORTH AMERICAN LANGUAGES; AMERICAN ABORIGINAL LANGUAGES).

Kroeber's Hokan and Sapir's Hokan-Coahuiltecan have gained wide acceptance among linguists, even though the published evidence is far from complete. The evidence for the greater Hokan-Siouan grouping is small, and much research will be required before the hypothesis can be fully evaluated.

See Harry Hoijer *et al.*, *Linguistic Structures of Native America*, Viking Fund Publications in Anthropology no. 6, pp. 16–21 (1946). (H. HR.)

HOKE, MICHAEL (1874–1944), U.S. orthopedic surgeon, was born at Lincolnton, N.C., on June 28, 1874. He took his medical degree from the University of Virginia, Charlottesville, in 1895, and practised at Atlanta, Ga., after 1897. Hoke soon became one of the leading orthopedic surgeons in the world, among his contributions being new operative methods of straightening twisted bones. He was one of the founders of the Shriners' hospitals and was chief surgeon of the Scottish Rite hospital in Atlanta from its foundation in 1915. He became chief surgeon at the Warm Springs, Ga., Infantile Paralysis foundation in 1931, serving there five years before he resigned to resume private practice. He retired in 1937. Much of Hoke's outstanding work in orthopedic surgery was done without charge for thousands of crippled children throughout the United States. He died at Beaufort, S.C., on Sept. 24, 1944.

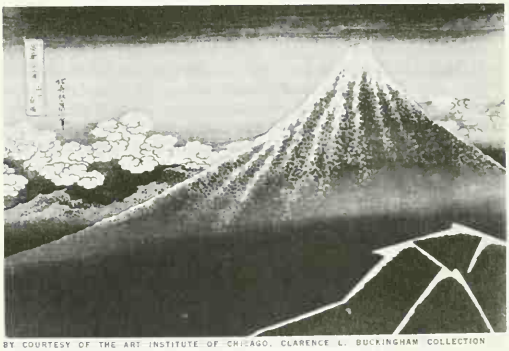
HOKKAIDO, the name of a group of islands (one large island and a few small adjacent islands) in northern Japan. Hokkaido constitutes an autonomous administrative division (*do*), with an area of 30,077 sq.mi., comprising 21% of Japan's land territory. The population of 5,039,206 (1960) was but 5.4% of the national total. The administrative centre is Sapporo (*q.v.*). Hokkaido is characterized by a microthermal (cool) climate and recent land settlement. Long the domain of the Ainu (*q.v.*), except for fishing populations on the southern coasts, serious Japanese settlement did not begin until 1869, when the division, then called Yezo, was renamed Hokkaido. Prior to 1945 the Hokkaido government administered some of the Kuril Islands (*q.v.*), which were ceded to the U.S.S.R. under the terms of the Yalta agreement.

The present economic development includes agriculture, mining and fisheries. The agrarian population accounts for 40% of the total. Rice is the first crop. Soy and kidney beans, oats, barley, hay and white potatoes are important. Thirty per cent of Japan's coal is mined there. *See* JAPAN. (R. B. H.)

HOKUSAI, KATSUSHIKA (1760–1849), Japanese painter, one of the greatest masters of the popular school (*Ukiyo-e*), was born in Edo (Tokyo). He was adopted into an artisan family and apprenticed at an early age to a wood engraver. At 18 he entered the studio of Katsukawa Shunshō, considered one of the foremost artists of the day, to learn the art of designing woodcuts. He was given the art name of Katsukawa Shunrō, but Hokusai was an eccentric, and a quarrel with his master resulted in his changing his name and launching out on a career for himself. Then began a period of intensive study, for Hokusai, a man of great vitality and a terrific worker with an insatiable curiosity, allowed nothing to escape his searching eyes: no scene was too small or too sublime to escape his brush. He lived in poverty most of his life, and in his later years proudly called himself the "peasant of Katsushika."

During his lifetime Hokusai used more than 30 different names and is said to have lived in more than 90 houses, moving only when the place was too dirty to clean or the landlord would no longer extend credit.

Hokusai illustrated large numbers of books, and his famous *Manga*, sketches and caricatures from life, appeared in 15 volumes during the years from 1812 to 1875. Outstanding among his colour prints, the "Thirty-six Views of Fuji" is generally considered the culmination of Hokusai's art. The set contains 46 prints in all and was published between 1823 and 1829. Other series issued around this time were "Views of Famous Bridges," "Waterfalls of the Provinces" and "Pictures of Flowers and Birds." A set, designed in upright format, commonly called the "Imagery of the Poets" is among his masterpieces. These designs are executed in the great landscape tradition and are full of a poignant beauty. Hokusai also designed some superb large sheets published separately, and his *surimono* (greeting card) prints are unequaled for delicacy. When Hokusai was in his 70s his finest book, the *Hundred Views of Fuji*, was published in monochrome; the designs are full of extraordinary originality.



BY COURTESY OF THE ART INSTITUTE OF CHICAGO, CLARENCE L. BUCKINGHAM COLLECTION

"VIEW OF FUJI IN STORM" BY KATSUSHIKA HOKUSAI FROM HIS SERIES "THIRTY-SIX VIEWS OF FUJI" (1823–29). IN THE ART INSTITUTE OF CHICAGO

Hokusai possessed great powers of observation and characterization, a singular technical skill and untiring industry. He was an eager student to the end of his life and at the age of 75 wrote *Once Hokusai, Today the Old Man Mad About Drawing.*

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HOLBACH, PAUL HENRI THIRY, BARON D' (1723–1789), French philosopher and man of letters, celebrated for his outspoken atheism and materialism, was born at Edesheim, near Landau in the Palatinate, in Dec. 1723, and baptized as a Roman Catholic. His family, German in origin, was French in its loyalties, and his uncle F. A. d'Holbach, to whom he owed his fortune and whose surname he added to that of Thiry, was a naturalized French subject. After spending some time in Paris, Paul Henri completed his education at the University of Leiden, where he made the acquaintance of Mark Akenside and John Wilkes. He returned to France and was naturalized in 1749. His intellectual interests were first displayed in the field of geology, mineralogy and metallurgy. For Diderot's *Encyclopédie*, starting with the second volume, published early in 1752, D'Holbach wrote articles on diverse scientific subjects, eventually publishing 376 in all. He became a prominent figure in French intellectual society, facilitated in this by his considerable fortune, which enabled him to make his table a meeting place of the philosophes, notably of Diderot, D'Alembert, Helvétius, Raynal, Grimm, Buffon, Marmontel and, for a time, J. J. Rousseau. He became before long the most advanced and outspoken of their number. In 1761 he published, under the name of his then deceased friend Nicolas Antoine Boulanger, *Le Christianisme dévoilé* (reprinted 1766 and 1767), an open and sustained attack on Christianity as contrary to reason and nature. Nine years later, over the name of J. B. Mirabaud (the late secretary of the Académie Française), he published his *Système de la nature* (1770), the most celebrated 18th-century exposition of atheism, materialism and determinism. Here he unambiguously asserts doctrines which his predecessors had hinted at: all causal relationships are simply relationships of motion; man is entirely a machine; the soul is a false notion; free will is nonexistent; the arguments for the existence of God, whether proposed by Christians or deists, are totally false; religion is harmful as well as untrue. The wise man's course is to accept necessity and to follow nature. The *non sequiturs* and inconsistencies which abound in the work did not prevent it from being sensational in its impact on public opinion. It provoked replies and challenges, notably from Voltaire, whose deistic position now appeared conservative, and had a great influence on Goethe and later on Shelley. Of D'Holbach's other works the most significant is his *Système social* (1773), in which he outlines principles of morality and politics on a utilitarian basis.

See W. H. Wickwar, *Baron d'Holbach: a Prelude to the French Revolution* (1935); P. Naville, *Paul Thiry d'Holbach* (1943).
(RT. S.)

HOLBAEK, a town and *amt* (county) in northwest Zealand (Sjaelland), Den. The *amt* boundary extends in an arc across moraine land from Isefjord to Musholm bay. The coast is noted for its tonguelike peninsulas (*e.g.*, Sjaellands Odde) and islands (*e.g.*, Sejerö and Samsö). Area 676 sq.mi. Pop. (1960) 127,747. The fertile clay loams raise fine crops of barley, wheat, and fodder- and sugar-beet. Dairying and pig raising are traditional. The principal settlements are Holbaek, the county town (pop. 15,475 in 1960 including suburbs), Kalundborg (9,763) and Nyköbing (4,803), each a historic town, fishing port and resort. Holbaek has a bacon factory, fish cannery, grain mill and iron foundries. The town museum has farmsteads, workshops and merchants' houses of former times. (HA. T.)

HOLBEIN, HANS, THE ELDER (*c.* 1465–1524), was the senior member of a family of painters that included also his brother Sigismund and his sons Ambrosius (*c.* 1494–1519/20) and the famous Hans Holbein the Younger (*q.v.*). Nothing is known of his early life and training, but he was married and established as a painter in his native Augsburg by about 1493. His early works, which include the Weingarten altar (1493, Augsburg cathedral), the St. Afra altar (1495, parts in the bishop's palace at Eichstätt and in the Basel museum), the picture called the "Basilica of St. Mary" (1499, Augsburg) and a Passion series in 12 scenes (Donaueschingen), are characterized by deep, rich colouring and by balanced compositions of figures moving slowly and deliberately on a narrow stage. They show a knowledge of the art of Rogier van der Weyden which has led some authorities to suppose that Holbein had visited the Netherlands, but ignorance of his Augsburg predecessors precludes any real evaluation of the immediate sources of his style.

A visit in 1501 to Frankfurt am Main, where, with the assistance of Sigismund Holbein and Leonhard Beck, he painted the high altar of the Dominican monastery (Frankfurt, Städelsches Institut), initiated a new stylistic phase which includes also the Kaisheim altar (1502, Munich) and the "Basilica of St. Paul" (1502, Augsburg). These paintings have much greater depth than before, with a freer grouping of highly individualized figures —often portraits—in rather lively movement. It has been suggested that this new manner was perhaps inspired by a contact with the early work of Mathias Grünewald in Frankfurt.

In a third and last phase, after 1510, including the St. Catherine altar (1512, Augsburg), the St. Sebastian altar (1516, Munich) and the "Fountain of Life" (1519, Lisbon), Holbein began to use Italianate ornament and evolved a compromise between the late Gothic and Renaissance styles similar to that of Gerard David in Bruges. But he then found himself overshadowed by masters whose grasp of the Italian idiom was sounder than his own. In 1517, having fallen into financial difficulties, he withdrew from Augsburg to Isenheim, where he died.

Holbein's honesty and insight as a portraitist are best seen in his many silverpoint drawings (Basel, Berlin; self-portrait in this medium at Chantilly); it is clear that the incomparable portraiture of his more famous son must have owed much to his teaching. He also made designs for glass painting, and windows were designed by him in Eichstätt cathedral (1502) and in the churches of St. Ulrich at Augsburg and St. James at Straubing.

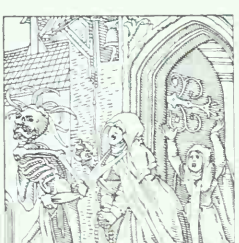
See C. Glaser, *Hans Holbein der Ältere* (1908). (D. KG.)

HOLBEIN, HANS, THE YOUNGER (1497?–1543), German painter and designer for printers and craftsmen, best known for his portraits and historical scenes, was born at Augsburg in 1497 or 1498. He was the son of the painter Hans Holbein the elder, the nephew of the painter Sigismund Holbein and the younger brother of the painter Ambrosius Holbein.

Holbein the elder sent both his sons on their travels about 1513–14 and their first stopping place is thought to have been Constance. In 1515, Hans Holbein the younger was in Basel and there both brothers entered the workshop of the painter Hans Herbster.

In the spring of 1517, commissions from the magistrate Jacob von Hertenstein took Hans Holbein to Lucerne. His first journey to Italy (Lombardy) for study purposes was taken about 1518–19. He was evidently influenced there not only by works by Mantegna and other north Italian engravers but also by Lombard building styles and by the paintings of Leonardo da Vinci and his circle.

In Sept. 1519, the young artist was received as master into the painters' guild in Basel, and a year later he became a citizen of the town and married the widow Elsbeth Schmid. In 1522 he worked for the municipality of Solothurn. In Sept. 1523 he spent some time around Lake Constance; and in the early summer of 1524 went to Lyons and probably also Avignon, in France.



ONE OF THE WOODCUTS DESIGNED BY HANS HOLBEIN, THE YOUNGER, FOR THE "DANCE OF DEATH"

Furnished with letters of recommendation from Erasmus, Holbein wandered, in the autumn of 1526, through the Netherlands and visited Antwerp. In October he crossed to England, where he found a friendly patron in Sir Thomas More, who took him into his home in Chelsea.

In the summer of 1528, Holbein returned to Basel and acquired a house in St. Johann. In 1528–29 he experienced the fury of the iconoclasts. About 1529, Holbein was apparently in Milan for the second time. In 1531 the artist bought another house in Basel.

A payment was made to Holbein in Basel in Oct. 1531, but the next document, dated Sept. 1532, shows him to have been once more in London, where he first worked chiefly for the German merchants of the Steelyard. About 1536, he seems to have entered court service. In March 1538, he was in Brussels, on a commission from Henry VIII; in June he was in Le Havre and in August in Nancy and Joinville. He spent September to October of that year in Basel, where the city council offered him a pension. The same autumn, however, he returned to London by way of Paris. In July and Aug. 1539, he was once more on the continent and, commissioned by Henry VIII, painted a portrait of Anne of Cleves at Schloss Düren, near Aachen.

Between Oct. 7 and Nov. 29, 1543, Holbein died in London during a plague epidemic. He left two illegitimate children there. His legitimate sons Jacob and Philipp were both goldsmiths. Descendants called Holbein, mostly goldsmiths, were long to be found in England, France, Italy and Portugal.

One would expect to find the artistic influence of his father in Holbein's early work, and this is in fact present in a small Madonna with a Mantegnesque frame of *putti* (children) in Basel (1514) and in the portrait of the painter H. Herbster, which is also in Basel (1516). It is disputed, however, whether these two pictures are the work of Hans the Younger or his brother Ambrosius. It is with the imaginatively painted table for Hans Baer in Zürich (1515) and the free marginal drawings in a copy of Erasmus's *Laus Stultitiae* (1515, Basel) that Holbein the younger first appears as a definite artistic personality. A "Christ Carrying the Cross" (hitherto ascribed to Herbster) with a "Crowning With Thorns" on the back (1515, Basel) and the 1516 portrait of the Burgomaster Meyer and his wife (Basel) show the young artist as a disciple of the conventional early Renaissance. At the same time, he had naturalistic tendencies, these showing themselves most freely in the two genre scenes on a double-sided schoolmaster's sign (1516, Basel). About 1516–17 he also began to work in woodcut for book decoration and to design paintings on glass.

GIRAUDON

"ERASMUS" BY HANS HOLBEIN, THE YOUNGER. IN THE LOUVRE, PARIS

Toward the end of the second decade of the century, Holbein was drawn into the international mannerist stream. This is already suggested in a small "Fall of Man" of 1517 (Basel). The five dramatically impetuous scenes of a Basel Passion altarpiece and the 1519 sketch for a "Christ Crucified" (Berlin) are extreme examples of this mannerist tendency. The two leaves of the Oberried altarpiece (Freiburg) also incline in this direction. The 1517 portrait of the youthful Benedikt von Hertenstein (New York) indicates that this extreme mannerism was overcome. Only fragments and copies remain of the façade paintings for the Hertenstein house in Lucerne. There Holbein returned to a quieter and more constrained composition and style, under the influence of Mantegna ("Triumph of Caesar"). The eight scenes of another Basel Passion altarpiece represent a classicism in which reminiscences of Mantegna and Dürer combine with Holbein's own striving toward simplicity and breadth of style. Leonardo's "Last Supper" inspired Holbein to a picture on the same subject, pared down, in Basel. Holbein was preserved from the dangers of eclecticism at that time by the clearsighted realism that is illustrated in the "Christ in the Tomb" of 1521 (Basel).

The portrait of Johannes Xilotectus of 1520 (Nürnberg), that of Bonifacius Amerbach of 1519 (Basel) and the full-face portrait of Erasmus of 1523 (Longford castle, Wiltshire) are shot through with the humanistic spirit and are connected in style with the Hertenstein portrait of 1517. In the contemporary profiles of Erasmus, Holbein goes back to the simplest portrait type of the early Italian Renaissance. The "Solothurn Madonna" (1522) and the "Burgomaster Meyer's Madonna" in Darmstadt, Ger., (preliminary sketch in Basel, repetition in Dresden) are classical compositions of almost symmetrical balance. Two half-length pictures in Basel dating from 1526, the "Venus" and the "Lais of Corinth," again show reminiscences of Leonardo. Connected with them in conception and style is the portrait of a musician in Berlin.

Between 1519 and 1526, Holbein gave more time to book and craft design. At this period he was probably already busy with plans for the two series of woodcuts, the "Dance of Death" (41 pictures) and the Old Testament illustrations (92 pictures), neither of which were brought out until 1538, by K. and M. Trechsel in Lyons. In addition, he designed numerous title pages, initials, etc., for Basel printers.

Two types are to be distinguished, at this period, in Holbein's decorative painting for buildings. In the ornament of the wall decorations for the house "Zum Tanz" (Basel, 1520–22; destroyed) Holbein, remembering Lombard prototypes in antique style, exploited all the possibilities of a playful fantastic illusionism, which breaks up the architectural planes with rich imagination. On the other hand, in the interior frescoes for the walls of the great council chamber in Basel (first payment made in June 1522), Holbein concentrated on the serene, closely organized design of classical fresco; some original fragments, sketches and numerous copies still bear witness to the work. The painting on the organ in Basel cathedral (1523–24) shows similar characteristics.

During his first stay in England (1526–28), Holbein painted a number of portraits which follow the severely objective lines of the Erasmus pictures, but which show a greater degree of detachment and calm. Outstanding examples of this new style of portraiture are the half-length Thomas More (New York city), William Warham (London; variant in Paris) and Henry Guildford with his wife (Windsor castle; copy in New York), all from the year 1527. There are coloured drawings for most of these and for the portraits enumerated below (largest collection in Windsor castle), marvelous in the soft distinctness of their contours, the economy of their modeling and their passionate objectivity.

In the portrait of the astronomer Niklas Kratzer (1528; Paris), Holbein attempts a certain "interior" mood by including the scholar's study and his instruments, the intention being to bring out the characteristic features of the subject. The double portrait of Thomas Godsalve and his son (1528; Dresden) displays an expressive kind of rhythmical grouping.

Everything which Holbein there tried out separately is brought together in the Thomas More family group, which consists of ten figures in an interior. Unfortunately, it exists no longer, but an outline drawing (1527 or 1528; Basel), seven portrait studies (Windsor) and several copies still give an idea of its appearance. In 1527 Holbein was in charge of the festal decoration of a hall in Greenwich, London, and also painted a battle scene.

To the beginning of Holbein's third stay in Basel belong portraits of a more intimate, private character: the "Holbein Family" (copies in Glarus, Switz., and Lille, Fr.), which is broadly painted on paper, the unfinished half-length picture of a woman with her hair loose (Basel) and the portrait of a burgher's wife (copy? The Hague). Some miniatures and various craftsmen's designs may be assigned to the same period; the most important of them is the glass design with ten scenes from the Passion (before 1528). Holbein's chief concern, however, was the completion of the frescoes in the great council chamber, Basel.

The portrait of Georg Gisze, (1532; Berlin) must have been painted soon after Holbein's return to England. This is allied in style to the 1528 interior portrait of the astronomer, and he extended the method to the double portrait in the monumental interior of the "Ambassadors" (1533; London). He also painted a great number of half-length portraits, which show a constant advance in simplicity and objectivity: Hans von Antwerpen (1532; Windsor), Dietrich Born (1533; Windsor), two members of the Wedigh family (1532, Chicago; 1533, Berlin), Robert Cheseman (1533; The Hague), Charles de Solier (Dresden), Cyriacus Kale (1533; Brunswick), Dirk Berck (1536; New York city), and

Richard Southwell (1536; Florence). Many of Holbein's most beautiful drawings and miniatures are among his portraits.

For the Steelyard, Holbein did frescoes and decorative work. The two *grisaille* frescoes, "The Triumphs of Wealth and Poverty," are lost, but they have come down to us through a preliminary sketch in the Louvre and later copies by Federico Zuccaro and others. There, Holbein apparently turned to account reminiscences of Mantegna's "Triumphal Procession of Caesar" and Dürer's "Triumphal Car of Maximilian." For the entry of Anne Boleyn, Holbein ornamented the Steelyard with a figurative festal decoration representing the Parnassus (preliminary drawing of 1533 in Berlin). His most mature religious work, the Venetian-inspired "Noli me tangere," in Hampton court, Eng., probably dates from the same period.

Most of Holbein's last works were commissioned by Henry VIII. Half-length court portraits predominate, and for these the artist had developed a formula of great vitality: Jane Seymour (1536, Vienna). Henry VIII (1537, Althorp), Thomas Howard (Windsor). Anton the Good of Lorraine (Berlin), Anne of Cleves (1539, Paris). Henry VIII (Rome). John Chambers (Vienna).

A number of miniatures (the king's wives, Charles and Henry Brandon, etc., in London, Windsor, Munich, etc.) also date from about 1540. Besides these official portraits, there are others of a more intimate character: Simon George of Quocoute (Frankfurt am Main), the prince of Wales (New York city, Basel) and the full-length Christine of Denmark (1538, London).

In this last period, Holbein also created monumental group pictures—besides a rather dry mass scene, "Henry VIII Confers a Charter on the London Barber Surgeons' Guild" (1541?; London, Barbers' hall; much damaged), and the lost group portrait of Henry VIII with Jane Seymour and his parents, which was one of the wall paintings commissioned for the palace of Whitehall (part of 1537 sketch at Chatsworth, and copies).

See also references under "Holbein, Hans" (the younger) in the Index volume.

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HOLBERG, LUDVIG HOLBERG, BARON (1684–1754), who may be called the founder of Danish literature, was born at Bergen, Nor., on Dec. 3, 1684. Both his parents died in his childhood, and in 1695 the boy was taken into the house of his uncle, who sent him to the Latin school and prepared him for the profession of a soldier, but he was soon adopted by his cousin and went to live with him up in the mountains. His great desire for instruction, however, led to his being sent back to Bergen. There he remained, eagerly studying, until the destruction of the city by fire in 1702, when he was sent to the University of Copenhagen. But he soon exhausted his resources and, having nothing to live upon, went back to Norway, where he accepted the position of tutor at Voss. As soon as possible he returned to Copenhagen where, in 1704, he took his degree and worked hard at French, English and Italian. But he had to earn his living and became a tutor once more, with the vice-bishop of Bergen. The vice-bishop had traveled extensively, and the reading of his itineraries and notebooks awakened such a longing for travel in the young Holberg that at the close of 1704, having scraped together 60 thaler, he boarded a ship for Holland. At Aachen he fell ill and, suffering greatly from weakness and poverty, had to make his way back to Norway on foot. Ashamed to be seen so soon in Bergen he stopped at Kristiansand, where he lived through the winter, supporting himself by giving lessons in French. In the spring of 1706 he journeyed through London to Oxford, where he studied for two years, gaining his livelihood by giving lessons on the violin and flute. He mentions, with gratitude, the valuable libraries of Oxford, and said it was while he was there that it first occurred to him "how splendid and glorious a thing it would be to take a place among the authors."

Through London and Elsinore he reached Copenhagen again and began to lecture at the university; his lectures were attended but he received no money. He was asked in 1709 to conduct a rich young gentleman to Dresden, and on his return journey he lectured at Leipzig, Halle and Hamburg.

Once more in Copenhagen, he undertook to teach the children of Admiral Gedde. In 1710 he took a post at Borch college where he wrote his first work, *Introduction til de fornemste europoeiske Rigers Historie* (1711). This, and two essays presented to King Frederick IV, led to his receiving the title of professor and the Rosenkrantz grant, the holder of which was expected to travel. Holberg accordingly started in 1714 and visited, chiefly on foot, many of the great cities of Europe. From Amsterdam he walked through Rotterdam to Antwerp, took a boat to Brussels and on foot again reached Paris. Walking and skating, he proceeded in the depth of winter to Marseilles, and on by sea to Genoa. On this voyage he fell ill and nearly died. On his recovery, he pushed on to Civitavecchia and Rome. When the spring had come, being still poor and in feeble health, he started homeward on foot by Florence, across the Apennines, through Bologna, Parma, Piacenza, Turin, over the Alps, through Savoy and Dauphiné to Lyons, and finally to Paris.

After a month in Paris he walked on to Amsterdam, took sail to Hamburg and so returned to Denmark in 1716, there publishing his *Introduction til Natur-og Folkeretten*. At last, in 1717, his talents were recognized by his appointment as professor of metaphysics at the University of Copenhagen, and in 1720 he was promoted to the lucrative chair of public eloquence, which gave him a seat in the consistory. His pecuniary troubles were at an end.

Hitherto he had written only on law, history and philology, although in a Latin controversy with the jurist Andreas Hojer of Flensburg, his satirical genius had flashed out. But now, and until 1728, he created an entirely new class of humorous literature under the pseudonym of Hans Mikkelsen. The seriocomic epic of *Peder Paars*, the earliest of the great classics of the Danish language, appeared in 1719. This poem was a brilliant satire on contemporary manners and enjoyed an extraordinary success. But the author had offended in it several powerful persons who threatened his life, and, if Count Danneskjold had not personally interested the king in him, Holberg's career might have had an untimely close. During the next two years he published five shorter satires. In 1722 Holberg became associated with the first Danish theatre in Grönnegade, Copenhagen, where, in Sept. 1722, a Danish translation of *L'Avare* was produced. For 100 years few plays had been acted in Denmark except in French and German, but Holberg now determined to use his talent in writing Danish comedy. The first of his original pieces performed was *Den politiske Kandestöber* ("The Pewterer Turned Politician"); and before the end of 1722 he produced *Den Vaegelsindede* ("The Waverer"), *Jean de France*, *Jeppe paa Bjerget* and *Mester Gert Westphaler*. Of these five plays, four are masterpieces. Holberg took no rest, and before the end of the next year *Barselstuen* and *Den ellefte Junii* had been added to the new theatre's repertory, followed during the next four years by 13 more, including *Jakob von Thyboe*, *Den Stundeslöse* ("The Fidget"), *Erasmus Montanus*, *Henrik og Pernille*, *Ulysses von Ithacia* and *Melampe*. But in spite of this unprecedented blaze of dramatic genius the theatre had to be closed for lack of money, Holberg composing for the last night's performance, in Feb. 1727, a "Funeral of Danish Comedy."

This excessive labour for the stage had undermined the poet's health, and in 1725 he had determined to take the baths at Aachen; but instead wandered through Belgium to Paris and spent the winter in that city. In the spring he returned to Copenhagen with recovered health and spirits, and worked quietly at his protean literary labours until the great fire of 1728.

In the period of national poverty and depression that followed this event a puritanical spirit, which was little in sympathy with Holberg's dramatic or satiric genius, predominated. He therefore closed his career as a dramatic poet by completing in 1731 the publication of his acted comedies, with the addition of five which he had had no opportunity of putting on the stage. He adopted the serious tone of the new age and busied himself for the next 20 years with historical, philosophical and statistical writings. During this period he published his poetical satire called *Metamorphosis* (1726) and his *Epistola ad virum perillustrem* (1728); a description of Denmark and Norway (1729); a history of Denmark (1732–35); a universal church history; a collection of biographical essays; a description of Bergen (1737); a history of the Jews; a book of essays, *Moralske Tanker* (1744; critical edition by F. J. Billeskov Jansen, 1943); and other learned and laborious compilations mainly in Latin. The only imaginative work he published at this time was the famous *Nicolai Klimii iter subterraneum* (1741).

When Christian VI died in 1746 pietism lost its sway; the theatre was reopened and Holberg was appointed director, but he soon resigned this arduous post. The six comedies he wrote in his old age did not add to his reputation. His last published work was his *Epistler* (1754; critical edition by F. J. Billeskov Jansen, 1944–54; English translation of *Selected Essays* by P. M. Mitchell, 1955). In 1747, in return for endowing Sorö college, Sorö, Den., he was created by the new king baron of Holberg. He died a bachelor at Copenhagen on Jan. 28, 1754, and was buried at Sorö.

Holberg was not only a great Danish author but he was, with the exception of Voltaire, the first writer in Europe during his own generation. Neither Pope nor Swift, who perhaps excelled him in particular branches of literary production, approached him in range of genius or in encyclopaedic versatility. Holberg found Denmark provided with no books, and he wrote a library for it. When he arrived in the country, the Danish language was never heard in a gentleman's house. Polite Danes were wont to say that a man wrote Latin to his friends, talked French to the ladies, called his dogs in German and only used Danish to swear at his servants. The single genius of Holberg revolutionized this system.

He wrote poems of all kinds in a language hitherto employed only for ballads and hymns; he instituted a theatre and composed a rich collection of comedies for it; he filled the shelves of the citizens with works in their own tongue on history, law, politics, science, philology and philosophy, all written in a true and manly style and representing the extreme attainment of European culture at the moment. Perhaps no author who ever lived had so vast and lasting an influence over his countrymen. (E. G.; B. W. D.)

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HOLBORN, a metropolitan borough of London, Eng., which under the London Government Act 1963 was to be amalgamated on April 1, 1965, with Hampstead and St. Pancras to form the new London borough of Camden (*see* LONDON). Holborn with St. Pancras South is a parliamentary division. The metropolitan borough (1900) is bounded by Finsbury, St. Pancras, St. Marylebone, Westminster, the City of London. Pop. (1961) 21,596. Area 0.6 sq.mi. It is a legal centre with Gray's Inn and Lincoln's Inn (two of the four Inns of Court), solicitors' offices, insurance firms, architects, estate agents, office equipment suppliers, government offices, patent and trade-mark agents. The original name, Holebourne, "the stream in the hollow," is an allusion to the Fleet river. The fall and rise of the road across the valley before the construction of the viaduct (1869) was abrupt and inconvenient. The site of Holborn bars, where tolls were levied at the entrance to the City, is $\frac{1}{4}$ mi. W. of the viaduct. The residential district is mainly within the parish of St. George, Bloomsbury (derived from William Blemund, a lord of the manor in the 13th century), though many of its 18th-century houses, built round squares, are used as offices. Succeeding the nobility in Bloomsbury came the medical profession, followed in the 19th century by writers. From the 17th century until the building of New Oxford street in 1847 the district of St. Giles, which includes Seven Dials, was notorious as a home of crime and poverty, and in the Rookery of St. Giles were some of the most dangerous of London's alleys. Many of Charles Dickens' characters lived and moved there and in other parts of Holborn. Hatton Garden, leading north from Holborn circus, is a centre of the diamond, gold and silver trades.

Ely place takes its name from a palace of the bishops of Ely. The property was acquired by Sir Christopher Hatton, lord chancellor under Elizabeth I. The chapel of St. Etheldreda (Roman Catholic) is the only remnant of the palace and was built in the 13th century with a vaulted crypt. The parish church of St. Giles-in-the-Fields, between Shaftesbury avenue and New Oxford street, dates from 1734 and is the successor to the chapel of a lepers' hospital founded there in 1101 by Matilda, wife of Henry I. St. George's church (1720–31), Bloomsbury way, by North Hawksmoor, has a statue of George I on a stepped spire. The Tudor gateway of Lincoln's Inn opens (east) upon Chancery lane while west lies the square called Lincoln's Inn Fields, with the Sir John Soane's museum. Gray's Inn is between High Holborn and Theobald's road. Of the former Inns of Chancery attached to these Inns of Court the most noteworthy building remaining in Holborn is Staple Inn, with its unique timbered and gabled Elizabethan front, in High Holborn, a prolongation of New Oxford street once attached to Gray's Inn. (*See* INNS OF COURT AND CHANCERY.)

The British museum stands north of New Oxford street, and also in Bloomsbury are the Senate house and library of the University of London, Birkbeck college and other institutions belonging to the university and the Royal Academy of Dramatic Art. Holborn also contains the Hospital for Sick Children in Great Ormond street, Moorfield's Eye hospital and other hospitals; the Central School of Arts and Crafts, the City Literary institute; the London Central Y.M.C.A., the Y.W.C.A. central club and the headquarters of the Trades Union congress (1956), all in Great Russell street; the Freemasons' hall, Africa house, the Winter Garden and six other theatres. Many great blocks of offices were built on areas bombed in World War II.

HOLBORNE, ANTHONY (? –1602) and **WILLIAM** (*c.* 1575– ?), English brothers and composers, both probably lutenists and cittern players. In 1597 Peter Short published *The Citharn Schoole* by "Antony Holborne, Gentleman," which contained 33 pieces for solo cittern (a small flat-backed, fretted instrument with plucked metal strings), 23 for cittern and bass (viol) and 2 for either cittern or three melody instruments. This publication also included "Sixe short Aers" by William Holborne. It is the description of these as "the first fruits of composition done by him" that has suggested the probable date of William's birth. Anthony Holborne states that he was induced to publish the airs because of the circulation of pirated versions. In 1599 appeared *Pavans, Galliards, Almains and other short Aeirs . . . in five parts for Viols, Violins or other Musicall Winde Instruments*—Anthony Holborne's most important work—consisting of 65 pieces. His music also appears in other contemporary collections: Füllsack and Hildebrand's 1607 publication (Hamburg) and Robert Dowland's *Musical Banquet* (1610) and *Varietie of Lute Lessons* (1610). The latter describes him as gentleman usher to Queen Elizabeth. He wrote commendatory verses to Thomas Morley's *Plain and Easie Introduction* (1595) and to Giles Farnaby's *Canzonets* (1598). (A. D. F.)

HOLBROOKE, JOSEPH (JOSEF) **CHARLES** (1878–1958), English composer whose works were popular at the beginning of the 20th century. He was born at Croydon, Surrey, July 5, 1878, and became a pupil of Frederick Corder at the Royal Academy of Music, London. His symphonic poem *The Raven*, inspired by the poem by Edgar Allan Poe, was performed in 1900, and was followed by a series of over 20 orchestral and chamber works also based on Poe, including *Ulalume, The Bells,* a dramatic choral

symphony, and *The Masque of the Red Death*. His operas, which were of Wagnerian proportions, include the trilogy *The Cauldron of Annwyn*, based on Welsh legends and consisting of *The Children of Don* (1912), *Dylan* (1914) and *Bronwen* (1929). A prolific composer, Holbrooke wrote in all forms. His orchestral variations "Three Blind Mice" best succeeded in retaining a hold on the public. He died in London, Aug. 5, 1958.

HOLCROFT, THOMAS (1745–1809), English dramatist whose melodrama *The Road to Ruin* (1791) has often been revived, was born in London, Dec. 10, 1745. His father, a cobbler who turned peddler, was so poor that Thomas had sometimes to beg his bread; but he taught him the uncompromising honesty which won admiration later. His life was a struggle against adversity. After working as a Newmarket stableboy, a cobbler and a teacher, meanwhile teaching himself languages and music, he secured in 1778 a minor position at Drury Lane theatre, where his first play, *The Crisis*, had one performance. *Duplicity* (1781) was more successful. While in Paris as *Morning Herald* correspondent in 1782 he saw Beaumarchais' *Le Mariage de Figaro* every night until he knew it by heart, and his translation, *The Follies of a Day* (1784), enjoyed great success. He himself acted Figaro. Meanwhile he was writing novels, verse, translations and articles. Holcroft supported the French Revolution and joined the Society for Constitutional Information; in 1794 he was indicted for high treason and imprisoned, but was released two months later. He then tried to found a journal in Hamburg; later, after two years in Paris, he started a printing-press in London (1803) which failed dismally. He died there on March 23, 1809.

Holcroft's friends included Coleridge, Lamb, William Godwin and William Hazlitt, who in 1816 edited his *Memoirs, Written by Himself and Continued Down to the Time of His Death, From His Diary, Notes and Other Papers*. This vivid autobiography shows the gentleness and humour of a man who often appeared harsh. It was re-edited by E. Colby (1925), who also published a bibliography of Holcroft's works (1922).

HOLDER, ALFRED THEOPHIL (1840–1916), Austrian philologist of astonishing productivity in the fields of ancient and medieval Latin, Germanic and Celtic, was born in Vienna on April 4, 1840. After an interlude as schoolmaster, in 1867 he joined, and in 1870 became chief librarian of, the Court and National library at Karlsruhe, Ger., where he died on Jan. 12, 1916.

Holder's work, almost entirely in the form of text editions and manuscript catalogues, embraced four main fields: (1) the editions of Horace (1864–69, in collaboration with Otto Keller) and of the ancient commentaries on Horace (1894), of Tacitus (1882), Caesar (1882, 1898), Avienus (1887) and of works by Cicero, Cato, Seneca and later Latin writers; (2) the extensive study of medieval Latin from which resulted his catalogue *Die Reichenauer Handschriften* (3 vol., 1906–18); (3) in the field of Germanic antiquities, besides producing part 2 of his teacher Holtzmann's *Altdeutsche Grammatik* (1870–75) and *Germanische Alterthümer* (1873), he edited texts of Ekkehard (1874), *Beowulf* (1882–84), Bede (1890), Einhard, Nithard and Jordanes (1882), Saxo Grammaticus (1886) and a Dutch Passion (1877); (4) his *Altceltischer Sprachschatz* (1891–1913), a monumental compilation of Celtic names culled from antiquity.

See K. Preisendanz, *Biographisches Jahrbuch für Altertumskunde* (Bursian's *Jahresbericht*) 47:54–93 (1927). (E. P. H.)

HÖLDERLIN, JOHANN CHRISTIAN FRIEDRICH (1770–1843), one of the greatest German poets, was born on March 20, 1770, at Lauffen on the Neckar. He was destined for the church and studied theology at Tübingen. He was already writing poetry and had begun to sketch his novel *Hyperion* when he was introduced to Schiller, who published some of his early writings in his periodicals *Die neue Thalia* and *Die Horen*. Schiller also obtained for Hölderlin the post of tutor to the son of Charlotte von Kalb. A year later Hölderlin moved to Jena to attend J. G. Fichte's lectures and to be near Schiller; but in 1796 he was forced by poverty to accept another post as tutor to the family of the banker J. F. Gontard in Frankfurt am Main. He fell deeply in love with Susette, Gontard's beautiful and gifted wife, the "Diotima" of *Hyperion* and some of the poems, and she returned his affection. Gontard's jealousy was aroused and the poet was obliged to leave Frankfurt. Physically and mentally shaken, he nevertheless completed the second volume of *Hyperion*, which appeared in 1799, the first having been published in 1797. He also began a tragedy, *Der Tod des Empedokles*, of which the first version was nearly completed; a magnificent fragment written for a second version has survived. Symptoms of great nervous irritability alarmed his family and friends, who persuaded him to go to Switzerland as tutor to a family in Hauptwyl. He wrote several fine poems during this period, among them "Der blinde Sänger," "An die Hoffnung" and "Dichtermut." His employer, however, found himself obliged to make other arrangements and Hölderlin returned home in 1801.

After vainly attempting to obtain a lectureship in Greek literature at Jena through the influence of Schiller, who ignored his appeal, he once more accepted a post as tutor, at Bordeaux. Susette Gontard died a year later in June, and the news is supposed to have reached Hölderlin shortly afterward; for in the following month he suddenly left Bordeaux and traveled homeward on foot through France, arriving at Nürtingen completely destitute and mentally deranged, in an advanced stage of schizophrenia. He seemed to recover somewhat as a result of the kind and gentle treatment he received at home; and in his lucid intervals he continued to write magnificent poetry, most of it published by friends after he had lost his reason. He also completed verse translations of Sophocles' *Antigone* and *Oedipus Tyrannus*, published in 1804. In this year Hölderlin's devoted friend Isaac von Sinclair obtained for him the sinecure post of librarian to the landgrave Frederick V of Hesse-Homburg. Sinclair provided the modest emoluments himself, and Hölderlin improved noticeably under his care and companionship. But unfortunately Sinclair (who refused to believe that Hölderlin was insane) was shortly afterward arrested on a charge of high treason and imprisoned for many months. By the time he was released, Hölderlin had succumbed irretrievably, and, after a spell in a clinic in Tübingen, was moved to a carpenter's house in that town, where he died on June 7, 1843.

Hölderlin ranks as one of the greatest of German poets. Strongly influenced by Friedrich Klopstock and Schiller in his early youth, he was emancipated from the latter's overpowering personality by the inspiration of "Diotima," and abandoned rhymed metres for classical hexameters and free rhythms. His ardent love of ancient Greece and its deities fused with his pantheistic conception of nature into a prophetic and visionary whole which forms the background of his work. *Hyperion, oder der Eremit in Griechenland* (1797–99), in spite of the beauty of the language and the inspiring enthusiasm for Greece, cannot compare with the great hymns and odes of Hölderlin's latter period in which the classical inspiration met and mingled with Christian conceptions and the worship of Christ. Among these *Der Archipelagus*, *Brot und Wein*, *Der Rhein*, "Germanien," "Der Einzige" and "Patmos" are perhaps the most famous; *Der Tod des Empedokles* and the fragmentary *Empedokles auf dem Aetna* have an almost Aeschylean grandeur, and the translations from Sophocles are unparalleled in any language.

Hölderlin is to all intents and purposes a discovery of the 20th century, largely because of Norbert von Hellingrath's beautiful edition, which caught the eye of such poets as Rainer Maria Rilke and Stefan George and established his reputation in Europe. The definitive edition of his collected works was edited by F. Beissner (1943). Previous collected editions were those by N. von Hellingrath, F. Seebass and L. von Pigenot, 6 vol., 2nd ed. (1923); by F. Zinkernagel, 5 vol. (1914–26); and by W. R. Böhm, 5 vol., 4th ed. (1924). *Selected Poems* were translated by J. B. Leishman (1944). The collected letters were edited by E. Bertram (1936).

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und seine Götter (1935); R. Peacock, *Hölderlin* (1938); *Hölderlin Jahrbuch*, 9th issue (1955–56); W. Hoi, *Hölderlins Stil als Ausdruck seiner geistigen Welt* (1956). (E. M. Br.)

HOLDHEIM, SAMUEL (1806–1860), Jewish rabbi, a founder and leader of Reform Judaism in Germany, was born in Posen. He officiated at Frankfurt an der Oder (1836–40), Mecklenburg-Schwerin (1840–46) and Berlin (1847–60). Holdheim was one of the dominant personalities in the rabbinical conferences of 1844–46, which elaborated the ideology of Reform. He advocated changing the language of prayer in the synagogue from Hebrew to the vernacular. In general he favoured the elimination of all nationalistic elements, particularly the hope for the return to Zion, from the prayer book. In his later years he advocated the observance of Sunday as the Sabbath. Holdheim died at Berlin on Aug. 22, 1860.

Holdheim's writings form part of the classical literature of Reform, though his ideas are not generally accepted within the movement. They include, besides numerous contributions to periodicals and essays, *Gottesdienstliche Vörtrage* (1839); *Geschichte der Entstehung und Entwicklung der jüdischen Reformgemeinde in Berlin* (1857); and three volumes of sermons.

See E. G. Hirsch, "Holdheim" in *The Jewish Encyclopedia*, vol. vi.

HOLGUÍN, a city in Oriente province, Cuba, about 65 mi. N.W. of Santiago de Cuba. It is located on the rolling northeastern plains of the island and is the most important communication and trading centre of northern Oriente. Due to excellent climate and surrounding fertile soils, the city has grown rapidly (pop. [1953] 57,573). Sugar cane and tobacco are the chief products of the region, though cattle are important. The city is on the Central highway and is served by railroads and airlines. Its port, Gibara, is 19 mi. north.

Holguín was founded in the first half of the 16th century by a group of families under Garcia Holguín, a veteran of the Spanish conquest of Mexico. The town was an insurgent centre and suffered intensely the effects of the Ten Years' War (1868–78) and the 1895–98 revolution for Cuban independence. (D. R. D.)

HOLIDAY, a term that was originally written "holyday," signifying a day of dedication to religious observance, has become applicable to days of secular as well as religious commemoration. Still more broadly, it has become customary to speak of vacation periods and individual days of exemption from work as holidays. In the United States, for example, Saturday was commonly referred to as a half-holiday in the early 20th century and as a holiday after 1933. (*See* Hours of Labour.)

Many holidays of the major world religions tend to occur at the approximate dates of more ancient pagan festivals. In the case of Christianity this is sometimes due to the policy of the early church of scheduling Christian observances at dates when they would eclipse pagan ones—a practice that proved more efficacious than merely prohibiting the earlier celebrations. In other cases, the similarity of date is due to the tendency to celebrate turning points of the seasons, or to a combination of the two factors.

Christian festivals are described in the article Church Year; Jewish festivals in Jewish Holidays. Other relevant articles, in addition to those on individual days, are Holy Days of Obligation; Sabbath and Sunday. The religious holidays of antiquity and of the other major faiths of the modern world are discussed in Feast and Festival.

The article Calendar contains additional information on the relation between many holidays and the particular calendars of various peoples.

Among articles on individual holidays of ancient Greece are Dionysia; Panathenaea; Thargelia; Thesmophoria. Articles discussing holidays of ancient Rome include Bacchanalia; Flora; Lupercalia; Saturn.

In many countries secular holidays are based on commemoration of historic events and the birthdays of national heroes; *e.g.*, Independence day (*q.v.*) and Washington's birthday in the U.S., and Bastille day (July 14) in France. In the U.S., federal jurisdiction over holidays is limited to the District of Columbia, and the states each year individually implement the presidential proclamation of Thanksgiving day (*q.v.*). Other holidays observed in all states include Veterans day, New Year's day and Christmas (*qq.v.*). (*See* also Labour Day.)

Observance of secular holidays ranges from display of the flag to exemption of public employees from work, setting a precedent generally followed by business organizations. Two holidays of the United States that have spread to other parts of the Americas and parts of Europe and Asia are Mother's day (the second Sunday in May—first observed in Philadelphia, Pa., in 1908) and Father's day (the third Sunday in June—first observed in Spokane, Wash., in 1910). These days are widely observed in the U.S. by family reunions and the sending of greeting cards and gifts.

Bank holidays (*q.v.*) established by statute in the United Kingdom are Easter Monday, Whitmonday, the first Monday in August, and the first weekday after Christmas. Christmas and Good Friday are observed as bank holidays under common law.

See also references under "Holiday" in the Index volume.

HOLINSHED, RAPHAEL (d. *c.* 1580), English chronicler, is remembered chiefly because his *Chronicles* enjoyed great popularity and became a quarry for many Elizabethan dramatists, especially Shakespeare, who found in the second edition material for *Macbeth*, *King Lear*, *Cymbeline* and many of his historical plays. Holinshed probably belonged to a Cheshire family and may possibly be identified with the Holinshed who matriculated from Christ's college, Cambridge, in 1544; he was in London from about 1560. His will, dated Oct. 1, 1578, describes him as steward to Thomas Burdet, of Bramcote, Warwickshire, and was proved, April 24, 1582.

In London he was employed as a translator by Reginald Wolfe, who was preparing a universal history; but after Wolfe's death (1573), the scope of the work was abridged and it appeared, with many illustrations, as the *Chronicles of England, Scotland, and Ireland* (2 vol.; dated 1577), although not licensed for publication until July 1578. Holinshed received valuable assistance from William Harrison (*q.v.*) and others, and from John Leland's manuscripts. The part dealing with the history of Scotland is mainly a translation from Hector Boece's *Scotorum historiae* (1527).

The *Chronicles* is a work of largely uncritical compilation from many sources of varying degrees of trustworthiness. The texts of the first and second (1587) editions were expurgated by order of the privy council, and the excisions from the second edition were published separately in 1723. An edition of the complete text of 1587 was published in six volumes (1807–08). A selection, *Holinshed's Chronicle as used in Shakespeare's Plays*, was edited by A. and J. Nicoll (1927).

HOLKAR, the family name of the Maratha rulers of Indore (*q.v.*) which was adopted as a dynastic title. The family was of peasant origin and of shepherd caste and said to have migrated from the Mathura district to the village of Hol or Hal some 40 mi. from Poona in the Deccan. The name of this village coupled with the Maratha terminal *kar* (an inhabitant of) provided a surname used by all members of the family.

The Holkar family had a stormy history. The founder, Malhar Rao Holkar (1694–1766), rose from peasant origins by his own ability. In 1724 the peshwa at Poona gave him command of 500 horse and thereafter he became the peshwa's chief general in Malwa with headquarters at Maheshwar and Indore. He and his successors gradually became virtually independent of the peshwa, the districts they ruled becoming the territories of a separate state. At his death he was the virtual ruler of Malwa. From 1767 to 1795 his son's widow, Ahalya Bai, ruled the state with great skill and understanding. Indore was an island of prosperity in a sea of violence, and her rule became proverbial for justice and wisdom. The commander of her forces was Tukoji Holkar, of the same clan but no near relation. On his death in 1797 power was seized by Tukoji's illegitimate son, Jaswant Rao, a brilliant but wayward guerrilla leader. After the defeat of Sindhia in 1803 he opposed the British, defeated Col. William Monson and besieged Delhi, but was defeated by Gen. Gerard (later Lord) Lake at Dig and Farrukhabad in Nov. 1804, and compelled to make peace a year later. Soon after he became insane, dying in 1811.

The Holkar family continued a troubled story marked by dis-

putes and abdications down to the end of the state as a separate entity after Indian independence in 1947.

See *Imperial Gazetteer of India*, "Indore State" (1908).

(T. G. P. S.)

HOLL, KARL (1866–1926), German theologian, remembered chiefly for his historic contribution to the interpretation of Luther, was born at Tübingen, May 15, 1866. He studied at Tübingen, Berlin, Giessen and Marburg, becoming professor of church history at Tübingen in 1900 and at Berlin in 1906. He died at Charlottenburg, Berlin, May 23, 1926.

Holl's interests ranged from the early church to urgent contemporary problems, but his chief work was divided between the Greek Church and the Reformation. He was a paleographer, a textual critic and a conscientious scholar, and these gifts find expression in such works as *Die Sacra Parallela des Johannes Damascenus* (1897), *Enthusiasmus und Bussgewalt beim griechischen Mönchtum* (1898) and *Amphilochius in seinem Verhältnis zu den grossen Kappadozien* (1904), which contains a history of the doctrine of the Trinity in the 4th century.

His highly erudite study of Luther's doctrine, forming vol. i of his *Gesammelte Aufsätze zur Kirchengeschichte* (3 vol., 1923–28; 7th ed. of vol. i, 1948), was the fruit of his passionate interest in theology as the study of man's meeting with God and shows his profound knowledge of his period. The work's remarkable impact, however, was due mainly to Holl's insight into Luther's personality, and to his understanding of Luther's experience of God and the confrontation of God and the conscience. With this, and his handling of the doctrine of justification, Holl made his most telling contribution to Luther studies. The book's effect was all the greater for being published in the period of uncertainty and moral crisis after World War I. It gave a new direction to Luther interpretation and remains a classic work on the subject.

See A. von Harnack and H. Lietzmann, *Karl Holl. Zwei Gedächtnisreden* (1926); and H. Bornkamm "Karl Holl" in *Evangelisches Kirchenlexicon* (1958).

HOLLAND, CLIFFORD MILBURN (1883–1924), U.S. engineer, directed the design and construction of the Hudson river tunnel connecting New York and Jersey City, officially named the Holland tunnel in his honour. He was born at Somerset, Mass., on March 13, 1883.

He graduated from Harvard university in 1906 and was soon appointed assistant engineer of the Battery-Joralemon street tunnel, New York city. On the completion of this work in 1908, he was in charge of a portion of the Fourth avenue subway in Brooklyn. In 1914 he took direct charge of the Old Slip-Clark street and Whitehall-Montague street tunnels and, later, of the Willoughby, 14th and 60th street tunnels in New York city, all, like the Battery-Joralemon street tunnel, connecting Manhattan and Long Island.

On July 1, 1919, he became chief engineer of the New York and New Jersey interstate bridge and tunnel commissions for the construction of a vehicular tunnel under the Hudson river. He died on Oct. 27, 1924, at Battle Creek, Mich., before the project was completed.

HOLLAND, SIR (THOMAS) ERSKINE (1835–1926), English international jurist and outstanding professor of international law and diplomacy at Oxford, was born at Brighton, Sussex, on July 17, 1835. He was educated at Brighton college and Balliol and Magdalen colleges, Oxford. He studied Greek philosophy and in 1859 was elected fellow of Exeter college. In 1875 he was elected fellow of All Souls.

In 1863 he was called to the bar by Lincoln's Inn, and joined the home circuit. In 1874 he was appointed Vinerian reader in English law at Oxford and later in the same year, on the resignation of M. Bernard, Chichele professor of international law and diplomacy, a post which he held for 36 years.

In 1875 Holland became associate (and later member) of the Institut de Droit International, which held a meeting in Oxford on his invitation in 1880. The Naval Prize act, 1894, was drafted by him, and also the Admiralty Manual of Naval Prize law (1888). He was particularly interested in law in its scientific and literary aspects, and in 1894 gained the Swiney prize for his *Elements of Jurisprudence*, which went through numerous editions. The war office made use of his services in drafting orders for troops in the field; these were subsequently co-ordinated and published under the title of *Laws of War on Land* (1904). In 1903–05 Holland served on the Royal Commission on the Supply of Food and Raw Material in Time of War and attended the Geneva conference (1906) as plenipotentiary. In 1917 he was knighted. He died at Oxford on May 24, 1926.

SIR ROBERT ERSKINE HOLLAND (1873–), the distinguished civil servant, was his son.

HOLLAND, HENRY (1745–1806), British architect, who designed the original Brighton pavilion, was born on July 20, 1745. He became the assistant and, later, partner of the well-known landscape gardener, Lancelot Brown. Holland carried out extensive alterations and additions at Carlton house, the London home of the Prince of Wales; he was also architect of the Brighton Marine pavilion, which was later buried under the "Hindu" accretions of John Nash. His principal surviving works are Brooks's club in London, Althorp in Northamptonshire, parts of Woburn abbey in Bedfordshire and Southill in the same county. All show a quality of restrained elegance that was felt by contemporaries to be a welcome change after the more lavish interiors of Robert Adam. The last three also show a large degree of French influence, which had first appeared in Carlton house. He died on June 17, 1806, in Chelsea.

See Dorothy Stroud, *Henry Holland* (1951); *Capability Brown* (1951).

(Ms. W.)

HOLLAND, HENRY EDMUND (1868–1933), Australian and New Zealand labour leader, was born on June 10, 1868, at Ginninderra, New South Wales, Austr. He served an apprenticeship in the printing trade, reading widely in the literature of social reform and accumulating some literary culture. Subsequently he went to Sydney, where he plunged into trade-union organization and led a successful strike of tailoresses in 1901. His writings and speeches brought him imprisonment in 1896 and 1909. Ill health took him to New Zealand in 1912. There his radical views and force of mind rapidly, and justly, brought him great influence in the labour movement: he was a trenchant journalist and editor, fought hard and uncompromisingly for the unity of the movement in both the industrial and the political spheres, and against conscription during World War I. Another prison term (1913–14) only served to consolidate his opinions and his popularity with labour; in 1918 he was elected to parliament, and in the following year became leader of the parliamentary Labour party. A convinced and unwavering socialist on Marxist lines, Holland led his party through some of its weakest years in parliament, making it clear both there and in the country that the real alternatives in government did not lie between the older parties, but between some "Conservative" consolidation and Labour. An incisive, critical and sometimes bitter speaker, and an industrious pamphleteer, his great service to his party was in opposition, and he would not have been a good leader of a government. Nevertheless the party that came into power in 1935 owed an enormous debt to him. He died on Oct. 8, 1933, at Waihi.

See B. Brown, *The Rise of New Zealand Labour* (1962).

(J. C. Be.)

HOLLAND, HENRY FOX, 1ST BARON (1705–1774), English politician, notable chiefly for the success with which he exploited public office for private gain, second son of Sir Stephen Fox, was born on Sept. 28, 1705. Inheriting a large share of the riches which his father had accumulated, he squandered it soon after attaining his majority and went to the continent to escape from his creditors. He contracted a wealthy marriage which enabled him to enter parliament in 1735 as member for Hindon, Wiltshire. He became the favourite pupil and devoted supporter of Sir Robert Walpole. He was surveyor general of works from 1737 to 1742, was member for Windsor from 1741 to 1761, lord of the treasury in 1743, secretary at war and member of the privy council in 1746 and became leader of the house of commons and secretary of state under the duke of Newcastle in 1755. In 1757, in the rearrangements of the government, Fox was ultimately

excluded from the cabinet and became paymaster of the forces.

During the Seven Years' War Fox devoted himself mainly to accumulating a vast fortune. He again became leader of the house, with a seat in the cabinet, under the earl of Bute in 1762 and exercised his skill in cajolery and corruption to induce the house of commons to countenance the treaty of Paris of 1763; as a recompense, he was raised to the house of lords with the title of Baron Holland of Foxley, Wiltshire.

In 1765 he was forced to resign the paymaster generalship, and four years later a petition of the livery of the City of London against the ministers referred to him as "the public defaulter of unaccounted millions." The proceedings brought against him in the court of exchequer were stayed by a royal warrant and he justified the delays by appealing to custom. He died at Holland house, Kensington, on July 1, 1774. One of his four sons was the Whig leader Charles James Fox (*q.v.*).

HOLLAND, HENRY RICH, 1ST EARL OF (1590–1649), English politician, owed his fortune to the favour of James I and his downfall to some remarkable changes of loyalty during the Civil War. The second son of Robert, 1st earl of Warwick, and of Penelope, daughter of Walter Devereux, 1st earl of Essex, he was baptized on Aug. 19, 1590, educated at Emmanual college, Cambridge, knighted in 1610 and returned to parliament for Leicester in 1610 and 1614. In 1610 he was present at the siege of Juliers. Favours were showered upon him by James I. He was made gentleman of the bedchamber to Charles, prince of Wales, and captain of the yeomen of the guard; and in 1623 he was raised to the peerage as Baron Kensington. In 1624 he was sent to Paris to negotiate the marriage treaty between Charles and Henrietta Maria.

He was created earl of Holland in Sept. 1624, and was sent in 1625 on two further missions, first to Paris to arrange a treaty between Louis XIII and the Huguenots, and later to the Netherlands with the duke of Buckingham. He held various places under Charles I, but deserted his cause in 1641. He was chosen by the parliament in March and July 1642 to communicate its votes to Charles, who received him with studied coldness. He was appointed one of the committee of safety in July, and joined Essex' army at Twickenham, where, it is said, he persuaded him to avoid a battle. In 1643 he appeared as a peacemaker, and after failing to bring over Essex, he returned to the king. His reception, however, was not cordial and after the first battle of Newbury he once more returned to the parliament. However, after endeavouring to promote the negotiations for peace in 1645 and 1647, he took up arms against parliament in the second phase of the Civil War, received a commission as general and put himself at the head of 600 men at Kingston. He was defeated on July 7, 1648, captured at St. Neots shortly afterward, and imprisoned at Warwick castle. He was sentenced to death and was executed on March 9, 1649.

HOLLAND, HENRY RICHARD VASSALL FOX, 3RD BARON (1773–1840), one of the leading members of the Whig party as refounded by Charles Grey, and a disciple of Charles James Fox, was the son of Stephen Fox (1745–74), 2nd Lord Holland, and Lady Mary Fitzpatrick, daughter of John, earl of Upper Ossory. He was born at Winterslow house, Wiltshire, on Nov. 21, 1773, and was soon orphaned, his father dying in 1774, his mother in 1778. While in Italy in 1796 he fell in love with the young wife of Sir Godfrey Webster, who divorced her in 1797 after she had given birth to a son by her lover. Lord Holland then married her, and she bore him four legitimate children.

After the death of his uncle, Charles James Fox, in Sept. 1806, Holland became lord privy seal in the Grenville ministry, with a seat in the cabinet of the ministry of "all the talents," until it was dismissed in March 1807. Lord Grey in vain urged him to take over the leadership of the Whig opposition in 1812. As Fox's nephew he would have been particularly acceptable to Fox's friends, and the prince regent had no dislike for him as he had for Grey; an important consideration whenever there was a possibility of forming a Whig administration. The Whigs who joined the Canning and Goderich ministries in 1827 would have liked to strengthen their own position by securing the foreign secretaryship for Holland, but George IV could not stomach a further infusion of Whiggism into the cabinet. Holland therefore remained out of office from 1807 to Nov. 1830 when he was appointed chancellor of the duchy of Lancaster in Lord Grey's reform ministry (1830–34), after refusing an offer of the foreign secretaryship as too arduous a post, since he had for years suffered from gout. This cabinet office Holland retained under Lord Melbourne from 1834 (except for the brief interlude of the Peel ministry, Dec. 1834–April 1835) until his death on Oct. 22, 1840. In the house of lords he was the recognized exponent of the political ideas of his uncle; Lady Holland made their London home, Holland house, the most celebrated of the Whig *salons*. His *Memoirs of the Whig Party*, 2 vol., ed. by the 4th Lord Holland (1852), and *Further Memoirs of the Whig Party, 1807–1821*, ed. by Lord Stavordale (1905), enshrine the Whig creed and vividly portray the contemporary literary and social world.

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HOLLAND, HENRY SCOTT (1847–1918), one of the most brilliant preachers and writers in the Church of England of his day, was born at Ledbury, Herefordshire, Jan. 27, 1847. Educated at Eton and Balliol college, Oxford, where he was a pupil of the philosopher T. H. Green, he was ordained in 1872 after a period studying with B. F. Westcott at Cambridge. In 1884, on Gladstone's recommendation, he became a canon of St. Paul's, and remained there until 1911, when he became regius professor of divinity at Oxford. He died in Oxford on March 17, 1918.

Scott Holland was a leading figure in the High Church group which produced the series of religious studies called *Lux mundi* in 1889. His writings include *Logic and Life* (1882), *God's City* (1894), a biography of Westcott (1910) and *Creeds and Critics* (1918). He had great influence as a preacher, as a philosophical theologian and as one of the founders of the Christian Social union (1889).

See S. Paget, *Henry Scott Holland* (1921); A. M. Ramsey, *From Gore to Temple* (1959); B. M. G. Reardon (ed.), *A Selection From H. S. Holland's Writings* (1962). (A. MACD. A.)

HOLLAND, JOHN PHILIP (1841–1914), U.S. inventor and developer of the modern submarine, designed and built the first submarine accepted by the U.S. navy.

Holland was born at Liscannor, County Clare, Ire., on Feb. 24, 1841, and received his primary education at Limerick. His real interest was in ships, but because of his poor eyesight, he decided to become a schoolteacher. He taught in Ireland until 1872, then went to the United States, where he taught in Paterson, N.J., until 1879.

He drew plans of submarines and, in 1879, with funds from Irish associates, built a small submarine which successfully operated submerged. He formed a company in 1895 and was awarded a contract to build a submarine for the U.S. navy. His first boat was a failure but his second, the "Holland," passed navy tests. This boat had a gasoline engine for surface propulsion and an electric motor fed by storage batteries for power when submerged. The arrangement of tanks to be flooded to submerge this boat was similar to that in modern submarines. It was purchased by the navy on April 18, 1900.

Holland died at Newark, N.J., on Aug. 12, 1914. (M. R. D.)

HOLLAND, JOSIAH GILBERT (pen name TIMOTHY TITCOMB) (1819–1881), U.S. journalist and editor, wrote a number of sentimental, didactic books which were popular during his lifetime. He was born in Belchertown, Mass., on July 24, 1819, into a family of straitened circumstances. He worked at various occupations and for a brief period attended secondary school. After graduation from a medical college at Pittsfield, Mass., he practised medicine in Massachusetts from 1844 and made an unsuccessful attempt with Charles Robinson (1818–94), later first governor of the state of Kansas, to establish a hospital for women. He abandoned medicine, however, and in 1848 was superintendent of schools in Vicksburg, Miss. He also taught for a short period of time in Richmond, Va.

In 1849 he returned to Massachusetts, where he became assistant

editor under Samuel Bowles, and later one of the owners, of the *Springfield Republican*. Under Holland, who contributed items of human interest, and Bowles, who was primarily responsible for news of public affairs, the newspaper prospered and earned a high reputation. Holland first won prominence with a series of "letters" in the paper satirically pointing up differences between life in urban and rural areas. In 1870, in New York city, he helped establish and became editor of *Scribner's Monthly*. The title was changed in 1881 to *The Century*. He remained editor of the magazine until his death on Oct. 12, 1881.

His writings fall into four classes: (1) history and biography, represented by a *History of Western Massachusetts* (1855) and a *Life of Abraham Lincoln* (1866); (2) fiction, of which *Miss Gilbert's Career* (1860) and *Sevenoaks* (1875) were pictures of village life in the eastern United States; (3) poetry, of which *Bitter-Sweet* (1859) and *Kathrina, Her Life and Mine* (1867) were widely read; and (4) a series of homely essays on the art of living, of which the most characteristic were *Titcomb's Letters to Young People, Single and Married* (1858), *Gold Foil, Hammered From Popular Proverbs* (1859), *Letters to the Joneses* (1863) and *Every-Day Topics* (two series, 1876 and 1882).

See Harry Houston Peckham, *Josiah Gilbert Holland in Relation to His Times* (1940).

HOLLAND, PHILEMON (1552–1637), English scholar called by Thomas Fuller "the translator general in his age," was born at Chelmsford, Essex, in 1552. He studied under John Whitgift at Trinity college, Cambridge, 1566–74, was elected fellow in 1573, and became an M.D. in 1597. He had been incorporated M.A. at Oxford in 1585. About 1595 he settled at Coventry, Warwickshire, practising medicine and teaching, but his main work was translating. He died there on Feb. 9, 1637.

Holland's version of Livy appeared in 1600. His translation of Pliny's *Natural History* was finished in 1601, and was followed by Plutarch's *Morals* (1603), Suetonius (1606), Ammianus Marcellinus (1609) and Xenophon's *Cyropaedia* (1632). In 1610 he completed an English version (with additions) of his friend William Camden's *Britannia*.

Holland translated not so many books as big books. His prose is marked by clarity and colloquial ease. His Suetonius (probably his masterpiece) is spirited, and more accurate than any other English translation.

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HOLLAND, RICHARD (RICHARD DE HOLANDE) (fl. 1450), Scottish poet, author of the *Buke of the Howlat* ("owl"), a bird allegory of a type made familiar by Chaucer's *Parlement of Fowles*, telling of the downfall of the bird with borrowed plumes. All that is known of its author is that in 1450 he was secretary or chaplain to the earl of Moray and rector of Halkirk near Thurso, and that he later became a public notary and rector of Abbreochy, Moray. He was an ardent partisan of the Douglases in their struggle with James II of Scotland. On their overthrow (1455) he retired to Orkney and later to Shetland, perhaps going to England to join the exiled Douglases. He was employed by Edward IV of England in his attempt to enlist the support of the western islanders through the agency of another branch of the family during his war with Scotland, and in 1482 was excluded from the general amnesty granted by James III to those who would renounce their fealty to the Douglas family.

The *Buke of the Howlat*, written *c.* 1450, is dedicated to the wife of a Douglas, and shows his devotion to the family

> On ilk beugh till embrace
> Writtin in a bill was
> O Dowglass, O Dowglass,
> Tender and trewe!

but early theories of its being a political allegory in their favour are discredited. It contains wearisome descriptions of heraldic arms, especially of the Douglases, but shows some humour and inventiveness in its description of the birds and their disputes and in its handling of the irregular alliterative rhymed stanza.

The poem is preserved in two manuscripts, the Asloan (*c.* 1515) and the Bannatyne (1568). Fragments of an early 16th-century black letter edition are reproduced in the *Adversaria* of the Bannatyne club (1867). There are editions from the Asloan manuscript by D. Laing (1823) and by F. J. Amours, in *Scottish Alliterative Poems* (1897), of which *see* also introduction, pp. xx–xxxiv; and from the Bannatyne manuscript by A. Diebler (1893) and W. T. Ritchie (1930).

HOLLAND, SIR SIDNEY GEORGE (1893–1961), prime minister of New Zealand from 1949 to 1957, was born at Greendale, N.Z., on Oct. 18, 1893, and educated at West Christchurch high school. He started work at 18 in a hardware store, but at 19 joined his father's rural haulage and mobile threshing firm. After service in World War I he founded with his brother a successful engineering firm in Christchurch, and at the age of 42 succeeded to his father's seat in parliament. Party maneuvering made him leader of the National party in 1940, and stout opposition to Labour policy at every opportunity strengthened his hold on his followers through the war years and after. The 1949 election made him prime minister, when he set out to remove controls over the country's economy and to adopt a "strong" policy toward industrial unrest, at that time concentrated in water-front work. He broke a serious strike (1951), capitalizing on this with a snap election, which gave him an increased majority. Holland combined great force as leader of a cabinet with a certain naïveté in his pronouncements on matters of both internal and external concern to the country; his popularity waned and his government was defeated in 1957. Bad health had already forced him to resign the premiership earlier in the year, and he did not stand again for parliament. On ceasing to be premier he was knighted. He died at Wellington, N.Z., on Aug. 5, 1961. (J. C. BE.)

HOLLAND, the name originally of the county and province of Holland (*q.v.*) which, because of that province's hegemony among the United Provinces after the successful revolt of the Dutch against Spain, came to be applied loosely to the whole of the Dutch republic and later, after the short-lived kingdom of Holland, to the kingdom of the Netherlands. *See* also NETHERLANDS, THE; NORTH HOLLAND; SOUTH HOLLAND.

HOLLAND, COUNTY AND PROVINCE OF. The origins of the county of Holland in the Netherlands may be traced to the 9th century A.D., though the name Holland (perhaps derived from Holtland, a property near Leiden) came into use only at the beginning of the 12th. After the destruction of a short-lived Viking rule (885) in which Gerulf, one of the minor Frisian counts (*see* FRISIANS), may well have assisted, the coastal area that later grew into the county of Holland came once more under Frankish rule. Gerulf became a vassal of the Carolingians, and he left part of his fief to his son Dirk I (d. *c.* 939?), who is considered the ancestor of the house of Holland.

First Line of Counts.—Dirk I ruled as count over Kinhem (Kennemerland), which now is the name of the area between Haarlem and Alkmaar but which then probably comprised the whole coastal belt, extending beyond Leiden and possibly even farther. Only this coastal area was inhabitable; the interior consisted mainly of swamps and lakes and so separated the coastal belt from the diocese of Utrecht. From this nucleus Dirk's successors were to extend their dominion northward, eastward and southward, favoured by family connections and by their remote situation on the fringe of the Holy Roman empire, of which the county formed part. Dirk's son Dirk II (d. 988) was married to Hildegardis, daughter of Arnulf I of Flanders; one of his sons, Arnulf (d. 993), succeeded him as count, while another, Egbert (d. 1008), was archbishop of Trier. The aspirations of the counts of Holland in a northerly direction brought them into conflict with the Frisians of the later West Frisia (east of Alkmaar), who were not separated from Middle Frisia by the growing Zuider Zee until the 13th century.

Expansion eastward and southward involved the counts in a series of wars with the bishops of Utrecht and with Germany. A sharp conflict arose during the reign of Arnulf's son Dirk III (d. 1039), who after acquiring the Rijn district penetrated as far as the mouth of the Meuse and there built a fortification, Vlaardingen, for the purpose of levying a toll. Adelbold, bishop of Utrecht, though supported by an imperial army under Godfrey of Lorraine,

could not oust the count, so that Vlaardingen and its vicinity stayed in the latter's hands. Less fortunate was his son Dirk IV (d. 1049), who was forced by the emperor Henry III to abandon his conquests to the diocese of Utrecht. He probably only managed to get a firm foothold in the region of Dordrecht. Dirk V (d. 1091), who succeeded his father, Floris I, in 1061, likewise attacked the diocese of Utrecht, supported by his stepfather, Robert the Frisian (*see* FLANDERS, COUNTY OF), but without much result. Dirk V, however, and his successor Floris II (d. 1122), who was married to Petronella, sister of the emperor Lothair II, and who was the first of the dynasty to be recognized specifically as count of Holland (in a charter of 1101 from Burchard of Utrecht), did achieve some consolidation of their countship. Under Dirk VI (d. 1157) and Floris III (d. 1190) further attempts at expansion had little success. Floris III was forced to recognize the Flemish rights on Zeeland (1167) but on the other hand his brother Baldwin, having been elected bishop of Utrecht, gave him the opportunity to extend the influence of Holland into that diocese.

The counts of Holland repeatedly came into conflict with the counts of Gelre (*see* GELDERLAND) over the election to the see of Utrecht. Dirk VII (d. 1203) and his brother and successor William I (d. 1222) were furthermore involved in the contemporary struggle for the German kingship and repeatedly changed sides.

William I had difficult times. He had to wrest the countship from his niece Ada, who was married to Louis of Loon; and he subsequently fought several unsuccessful wars with his neighbours. He is important, however, for having started granting privileges to the towns (Middelburg and Utrecht) and for having inaugurated land reclamation and the maintenance of waterways and dikes.

William II, count from 1234 to 1256, the son and successor of Floris IV, extended his grandfather William I's internal policy, promoting municipal development in Middelburg, Delft, Haarlem and Alkmaar, towns which during the 13th century acquired some importance as trading centres. Externally he co-operated with Brabant. Moreover, in 1247 he was elected German king in opposition to the emperor Frederick II. As king he enjoyed the support of the papacy and of the German towns and thus acquired a position of prominence among the rulers of the Low Countries. He was killed at Hoogwoud in 1256 in battle against the West Frisians, whose independence he was trying to suppress (*see* WILLIAM).

With William II's death and the beginning of the Great Interregnum in Germany the ties between Holland and the empire were loosened considerably; the Netherlands—and Holland especially—went their own way. Under Floris V, count from 1256 to 1296, who succeeded his father when he was less than two years old and did not come of age till 1266, the territorial development of Holland was of major importance. The county was enlarged by the final subjugation of the West Frisians in 1289 and by the acquisition of Waterland (the area between Hoorn and Amsterdam). West Frisia, fertile and protected by castles, made a valuable addition to the revenues of the counts, but efforts to penetrate into Middle Frisia failed. Floris V had further success in the diocese of Utrecht, exploiting the weakness of the bishop-elect, John of Nassau, and forcing several feudal lords in the borderlands to recognize him as their overlord (Amstel, Woerden). When the Gooi area had also been acquired, the county was more or less coextensive with the later provinces of North and South Holland. Careful maintenance of waterways and dikes increased the agrarian importance of the country. Before his successes on his frontiers, Floris V had had to suppress a revolt of the peasants in the north of Holland (1273–74). The grant of a land charter re-established peace.

It was in Floris V's reign that Holland became involved in Anglo-French quarrels. Edward I of England, seeking allies on the continent, won his support; but Floris in 1296 transferred his alliance to Philip IV of France, probably at the prompting of his cousin John of Avesnes, count of Hainaut, since John and Philip were both hostile to the count of Flanders, Guy of Dampierre, who was also Floris' adversary. This tergiversation was the cause of Floris V's death; discontented nobles, encouraged by the English king, took him prisoner and, when the peasantry prevented them from taking him to England, killed him (1296).

House of Avesnes and Wittelsbachs.—John of Avesnes then acted as the governor of Holland till the death of Floris V's son John I (1299), last of the old house of the counts of Holland. Then John of Avesnes himself became count of Holland as John II, when English interference had been repelled and an adverse faction of the nobility suppressed. Holland and Hainaut were now united under one count. Interference by the German king Albert I was rejected, and Holland and Hainaut became closely linked to French policy. Holland's influence in Utrecht was strengthened by the election of Guy of Avesnes to the bishopric.

An invasion by the Flemings, who had beaten the French at the battle of Courtrai (Kortrijk) in 1302, threatened the position of the house of Avesnes in Utrecht, where a rebellion brought the guilds into the government of the town; but help from France enabled John II and, after his death in 1304, his son William III (d. 1337) to overcome their difficulties. In 1323 William III made Flanders waive its claims to Zeeland, which thus fell at last to the counts of Holland.

Economic prosperity was promoted by extensive land reclamation. The towns also profited by growing trade. William III played an important role in the affairs of western Europe. He exploited the Anglo-French dissensions leading up to the Hundred Years' War in order to increase his power and prestige. His prominence is shown by the marriages of his daughters: Margaret married the Wittelsbach German king and future emperor Louis IV the Bavarian; Philippa married Edward III of England. Toward the end of his reign William III was head of the anti-French coalition in the Low Countries. In the diocese of Utrecht he acquired great influence; its southern part eventually came under his jurisdiction.

William III's successor, William IV (d. 1345), tried to establish his authority in Middle Frisia but fell in the ill-fated battle of Warns, which put an end to this venture. His death without male issue brought about great disorder and party strife between the factions of "Hooks" (Hoeken) and "Cods" (Kabeljauwen) because his sister Margaret—who had been enfeoffed with Holland, Zeeland and Hainaut by her husband, Louis IV—and her son William V could not agree about their status. The Cods, mainly bourgeois, supported William; the Hooks, mainly nobles, appealed to Margaret. A final settlement was reached only in 1354, under the pressure of a part of the nobility and the rising towns; William V was acknowledged as count of Holland and Zeeland and shortly afterward also of Hainaut. In this way the house of Wittelsbach entered into the Low Countries. As William became insane, his brother Albert ruled as regent from 1358 till William's death in 1389, after which he was himself count till his death in 1404.

Albert strove to end the quarrels between Hooks and Cods but was only partly successful. Renewed efforts to conquer Middle Frisia also were without permanent result (1396–1402). In several towns of Holland during Albert's reign a patrician government was established. His son and successor William VI, count from 1404 to 1417, sought a *rapprochement* with France and Burgundy. His only daughter, Jacoba, was married first, in 1415, to John of Touraine, second son of Charles VI of France; but John died in April 1417 and William VI himself in May. Though Jacoba's rights had been recognized by the estates of Holland and Zeeland in 1416, difficulties now arose about the succession, and Jacoba had to face opposition not only at home but also from her uncle John of Bavaria. Neither her second nor her third marriages—to her cousin John IV of Brabant and to Humphrey, duke of Gloucester—served to secure her inheritance. (*See* JACOBA.) (W. J. AL.)

Burgundian Dynasty.—John of Bavaria, who died in 1425, left his rights in Holland to Philip (*q.v.*) the Good, duke of Burgundy, who was also a cousin of Jacoba and of John IV of Brabant; and John IV of Brabant also ceded his rights to Philip. Jacoba resisted as long as possible, but under the treaty of Delft (1428) was forced to hand over the actual government of her provinces to Philip, who finally himself acquired the title of count of Holland, as Philip I, in 1433, because Jacoba, in contravention of the treaty, had made a fourth marriage. Under the Burgundian line of counts Holland's material prosperity increased continually

thanks to the thriving herring fishery and the development of the carrying trade. Under Philip's son Charles (*q.v.*) the Bold, count of Holland as Charles I from 1467 to 1477, the Hollanders suffered much from excessive taxation; they also felt outraged at Charles's attempt to establish a more centralized government in the Burgundian Netherlands. They took advantage of the collapse of the central government in 1477—when Charles, killed in the battle of Nancy, was succeeded by his young daughter Mary (*q.v.*)—to recapture their ancient rights and liberties. A high court of justice was established for Holland, Zeeland and Friesland and the use of the Dutch language was made official.

Habsburgs and House of Orange.—On the sudden death of Mary in 1482 her possessions, including Holland, passed to her infant son Philip the Fair (Philip II of Holland) under the guardianship of his father, the Austrian archduke Maximilian (*see* MAXIMILIAN I). Thus the Burgundian dynasty was succeeded by that of Habsburg. The regency of Maximilian was a time of troubles. The Hooks caused new disturbances but were finally overthrown, and the "Bread and Cheese War," a blind revolt of peasants in northern Holland, was proof of the misery caused by civil discords and oppressive taxation.

In 1494 Philip was declared of age. During his effective reign Holland enjoyed rest, and its fisheries benefited from a commercial treaty with England. On his sudden death in 1506 his elder son, the future Holy Roman emperor Charles V (*q.v.*), became count as Charles II; for his reign *see* NETHERLANDS, THE: *History*.

When Charles abdicated the Netherlands in 1555, his son, the future Philip II of Spain, became Philip III of Holland; in 1559 he appointed William I (*q.v.*) of Orange as stadholder of Holland, Zeeland and Utrecht. In 1572 Holland and Zeeland became under William's leadership the centre of the revolt of the Netherlands against Spanish rule. After the estates-general, meeting at The Hague, had abjured Philip II in 1581, Holland and Zeeland were about to offer the now vacant countship to William of Orange, but before the matter was finally decided he was assassinated (1584); in 1585 they appointed his son Maurice (*q.v.*) only to the position of stadholder. Then the earl of Leicester exercised some measure of sovereignty in the seven northern provinces of the old Burgundian state, but left the country at the close of 1587. Thenceforward Holland was one of the sovereign republics of the seven United Provinces.

Holland was the most influential of the Dutch republics, thanks to its rapidly increasing wealth (it paid more than half of the federal taxes) and to the concentration of power and talent in its cities, especially Amsterdam. Hence the importance attached to Holland's vote in the assembly of the estates-general. Yet the authority of Holland did not remain unchallenged. It was in the first place counterbalanced by the influence of the stadholders, the princes of Orange, who, since they held the stadholdership of various provinces at the same time and were generals of the federal army, were sometimes prepared to protect the interests of the other provinces and those of the federal government against Holland's highhanded ways. Sometimes, however, it was not the defense of the federal principle but the furthering of their personal foreign policy which brought the princes of Orange, basing themselves on the majority of the smaller provinces in the estates-general, into conflict with Holland. Moreover, the very fact of Holland's preponderance and overriding influence gave some unity to the all too loosely constructed federal government. In any case, the chief crises in the internal history of the Dutch republic are to be found in the struggles for supremacy between Holland and the princes of Orange. In the 1780s the conflict led to a state of latent civil war. The "Patriot" opponents of William V of Orange, originally sprung from the *staatsgezinden* (*i.e.*, the anti-Orangist Holland magistracies led by Amsterdam), developed democratic tendencies. When in 1795 the old republic was overthrown they welcomed the French as deliverers, not only in order to do away with the stadholdership and the oligarchic system which the princes of Orange had in the 18th century come to accept as an ally but also in order to realize that unitary state which neither of the old parties had been able to conceive.

The province of Holland during the 17th and 18th centuries was governed by the estates, of which the full title was *De Edele Groot Mogende Heeren Staaten van Holland en Westfriesland* (the Noble Great Mighty Lords Estates of Holland and West Frisia). After 1608 this assembly consisted of 19 "members" (delegations), 1 representing the nobility and 18 the towns. The "member" for the nobles gave its opinion first, followed by a spokesman for each town in a fixed order of precedence. The grand pensionary (*see* PENSIONARY), acting as chairman, had in the end to embody the sense of the assembly, as apparent from the 19 opinions, in a "resolution." The interests of the country districts were the peculiar charge of the member for the nobles. The nobles also retained the right of appointing representatives to sit in the college of deputed councilors, in certain colleges of the admiralty and on the board of directors of the Dutch East India company and to various public offices. Each town (as did the nobles) sent as many representatives as it pleased, but the 19 "members" had only one vote each. Each town's deputation was headed by its pensionary, who often acted as spokesman on behalf of the representatives. Certain questions such as peace and war, the voting of subsidies, the imposition of taxation, changes in the mode of government, etc., required unanimity. The estates of Holland sat at The Hague in the months of March, July, September and November. During the periods of prorogation the continuous supervision of the business and interests of the province was confided to the college of deputed councilors (*gecommitteerde raaden*), which was itself divided into two sections, one for the southern quarter, another for the northern. The grand pensionary presided over the meetings of the college, which had the general charge of the whole provincial administration, especially finance; the carrying out of the resolutions of the estates; the maintenance of defenses; and the upholding of the privileges and liberties of the land.

French Regime and Kingdom of the Netherlands.—In the period of the French Revolutionary and Napoleonic Wars, Holland shared the fate of the rest of the Netherlands. The province was divided into several parts in 1798, but was restored to its old form in 1801. In 1806 it was again divided, now into a northern and a southern part; and from 1810 to 1813 the northern part was united with Utrecht. In 1814, however, when the kingdom of the Netherlands was set up on the fall of Napoleon, the old province was once again restored, though it lost some territory to Brabant. In 1840 it was divided, this time for good, into North Holland and South Holland (*qq.v.*). It still had two colleges of deputed councilors, and from 1814 it had had two governors. The provincial estates met in turn at Haarlem and The Hague; they were composed of 14 representatives of the nobility, 49 of the towns and 27 of the countryside. They were, however, no longer sovereigns but an administrative body in a centralized monarchy.

(E. H. K.)

HOLLAND, a harbour city on Lake Macatawa, an inlet of Lake Michigan, in Ottawa county, Mich., U.S., 25 mi. S.W. of Grand Rapids. Advantages of the site for water transport attracted Rev. A. C. Van Raalte and his small band of Dutch settlers in 1847. Subsequently, this outpost became the destination of many Dutch immigrants who colonized western Michigan. Shingle making, tanning and woodworking were early industries. The city has industrial diversity including pharmaceuticals, furniture, metal crafts and machinery. It is renowned as a resort centre and is the hub of a fruit-growing, poultry and farming area. Holland State park is nearby, and the annual Tulip festival in May features Dutch provincial costumes, pageantry, wooden-shoe dances, and miles of streets and parks bordered by tulips. The Netherlands museum has exhibits of local history and Dutch folklore. Hope college (1866) and Western Theological seminary (1869) are institutions of the Reformed Church in America. Holland was incorporated in 1867 and the council-manager government, adopted in 1950, operates its own utilities, a community hospital and a civic centre. For comparative population figures *see* table in MICHIGAN: *Population*.

(W. C. W.)

HOLLAND, a term used for several kinds of cloth, including, in a broad sense, all linens imported from the continent of Europe. More specifically it refers to an unbleached or dull-finish linen

made chiefly in the Netherlands and used as furniture covering; or a cotton fabric that is made more or less opaque by a glazed or unglazed finish (called the Holland finish), consisting of oil and a filling material. It is used for window shades, labels and tags, sign cloth and the like. (G. E. L.)

HOLLAR, WENCESLAUS (WENZEL; in Czech, VÁCLAV HOLAR) (1607–1677), Bohemian etcher, whose work has always had great charm for connoisseurs; for mastery in working directly on the etched plate he had few—if any—peers. He was born in Prague on July 13, 1607. The earliest of his extant works are small plates dated 1625 and 1626. In 1627 he was working under Matthäus Merian in Frankfurt, later moving to Strasbourg and then to Cologne in 1633. There he attracted the attention of the collector Thomas, earl of Arundel, who was on an embassy to the imperial court; and with him Hollar traveled to Vienna and Prague, arriving at last in England in 1637.

Though he lived in the household of the earl of Arundel he seems to have worked not exclusively for him, but to have begun that slavery to the publishers which was the normal condition of his life. During his first years in England he produced his view of Greenwich, nearly a yard long, receiving 30 shillings for the plate. The earl of Arundel left England in 1642 and Hollar passed into the service of the duke of York. With other royalist artists he stood the long siege of Basing house and there are about a hundred plates by him dated during the years 1643 and 1644. Taken prisoner, he escaped or was released and joined the earl of Arundel at Antwerp, remaining eight years, the prime of his working life, and produced the finest of his plates: his noble views, his miraculous muffs and shells, the superb portrait of the duke of York. In 1652 he returned to London and lived for a time with the engraver William Faithorne.

He illustrated many books, among them Sir William Dugdale's *Monasticon* (part i, 1655), *Warwickshire* (1656) and *St. Paul's* (1658). After the Great Fire he produced some of his famous "Views of London" and it may have been the success of these which induced the king to send him to Tangier in 1668 to draw the town and forts. During his return trip to England occurred the desperate and successful engagement fought by his ship the "Mary Rose" against seven Algerian men-of-war, an affair which Hollar etched for Ogilby's *Africa*.

Hollar lived eight years after his return, still working for the booksellers and retaining to the end his wonderful powers. He died in London on March 28, 1677, in extreme poverty, his last recorded words being a request to the bailiffs that they would not carry away the bed on which he was dying.

Two catalogues of his etchings have been made, one in 1745 (2nd ed., 1759) by George Vertue and a definitive one (1853) by Gustav Parthey.

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HOLLES, DENZIL HOLLES, BARON (1599–1680), English statesman, a leading but moderate opponent of Charles I, was born on Oct. 31, 1599, at Houghton, Nottinghamshire, the second son of John Holles, 1st earl of Clare. Denzil's father, a rich, ambitious and quarrelsome man who bought a barony for £10,000 and his earldom for another £5,000, was a critic of Charles I's favourite, the duke of Buckingham, and was in consequence dismissed from his court offices. It was therefore natural that in the early parliaments of the reign Denzil Holles, who sat for St. Michael in Cornwall in 1624 and subsequently for Dorchester, should be a member of the "opposition." His second cousin Gervase Holles, the antiquarian, stated that his education was of the best and beyond that of most nobility: he took his M.A. in 1616 at Christ's college, Cambridge, and then studied at Gray's Inn. A close friend of Sir John Eliot (*q.v.*), he first distinguished himself in the parliament of 1628–29 when, after the king ordered the adjournment, he was one of three members who held down the speaker in the chair while three resolutions critical of royal policies were carried. For that action of dubious legality Holles was arrested along with Eliot and others and committed to the Tower of London. He was refused a writ of habeas corpus, was fined 1,000 marks and was ordered to be imprisoned during the king's pleasure. However, in 1630, he paid his fine and gave the securities demanded for his good behaviour; then in his own words he "lived a banished man . . . for . . . seven or eight years." Nevertheless he continued to oppose the crown: he refused to pay ship money and encouraged his mother-in-law, Lady Ashley, to resist payment. He had married (1626) Dorothy Ashley (d. 1646), the first of three wives; by her he had a son Francis (1627–90), who succeeded him.

Holles was friendly with a number of Puritans and soon became a leader of the commons in the parliaments of 1640. At first he differed from John Pym and other parliamentarian leaders only in that he tried to save the life of his brother-in-law, the earl of Strafford, apparently suggesting that Charles I should agree to the abolition of the bishops as the price. He was throughout a keen supporter of the "root-and-branch" bill for abolishing the bishops, and spoke in favour of the Grand Remonstrance of 1641. The king recognized Holles' importance in naming him one of the five members whom he vainly tried to arrest and impeach in Jan. 1642. But Holles escaped and returned in triumph to parliament on Jan. 11. He advocated a bill enabling parliament to control the militia; in July he became a member of the committee of safety; and when the Civil War began he raised his own regiment of foot. In 1642 he fought at the battles of Edgehill and Brentford, but next year he urged peace and from then on became a consistent supporter of a negotiated peace if the king would accept stringent constitutional reforms and a Presbyterian form of church government.

Though Holles became famous as a leader of the parliamentary Presbyterians, he was not a fanatic in the same sense as the Scottish covenanters. He favoured the retention of the parochial system and the introduction of a directory of worship. He did not want the covenanting army which entered England in 1644 to stay once the war was won, and was anxious to persuade the king to accept a settlement, whereby the parliamentarian army would be disbanded and a reformed monarchy set up. In Nov. 1644 and again in Jan. 1645 he was concerned in peace negotiations with the king. His eagerness to disband the New Model army brought him into conflict with Oliver Cromwell and his son-in-law, Henry Ireton, and at one time Holles challenged Ireton to a duel. On June 15, 1647, he and ten other "Presbyterian" members of parliament were impeached by the army and he was compelled to flee from Westminster when the New Model army entered London to enforce its will in Aug. 1647. Though "disabled," he resumed his seat in the commons during the second phase of the Civil War in Aug. 1648 and reopened negotiations with Charles I in the Isle of Wight. The army leaders demanded his arrest and punishment. He escaped to France and was offered a secretaryship of state by the future Charles II in 1651. Cromwell permitted his return to England, but he appears to have been imprisoned, for his release was ordered by the republican council of state on Sept. 2, 1659.

Holles took a leading part in the Restoration. He became a member of the council of state and advocated the summoning of a convention to invite the king home. He was admitted to the privy council in April 1661 and was created Baron Holles of Ifield in June. He served as English ambassador in Paris from July 1663 to May 1666 and was one of the negotiators in 1667 of the treaty of Breda which ended the second Dutch War. He was a supporter of the earl of Clarendon and bravely protested against his banishment. But on the whole his policy was one of moderation. He hoped that the restored king would agree to a settlement with the Presbyterians; he opposed the Test acts, which excluded Roman Catholics from office; he attacked the Tory leader, Danby, and was friendly with the Whig leader, Shaftesbury, but was against the bill to exclude James, duke of York, the king's Roman Catholic brother, from succession to the throne. He died on Feb. 17, 1680, and was buried at St. Peter's church, Dorchester.

Bishop Burnet wrote of Holles that "he was well versed on the records of parliament: and argued well, but too vehemently: for he could not bear contradiction. He had the soul of an old stubborn Roman in him." His temper may be gauged from his *Memoirs* covering the years 1641–48. He was a sincerely religious

man and a patriot according to his fashion.

BIBLIOGRAPHY.—There is no life of Holles, but there exists an excellent article by Sir Charles Firth in the *Dictionary of National Biography*. Additional facts about him will be found in Mary Frear Keeler, *The Long Parliament* (1954) and C. V. Wedgwood, *Great Rebellion*, vol. ii, *The King's War* (1958). For family background *see* Gervase Holles, *Memorials of the Holles Family, 1493–1656*, ed. by A. C. Wood (1937). (M. P. A.)

HOLLOWAY, THOMAS (1800–1883), English patent-medicine merchant and philanthropist, was born at Devonport on Sept. 22, 1800. He began to sell an ointment in 1837 and it carried his name over the world. He soon added the sale of pills to his business. Advertising played a large part in making his business efforts successful. He endowed two institutions, a sanatorium for the mentally afflicted of the lower middle class, which was opened in 1885, and a college for women, which was opened at Egham in 1886. He attended carefully to the arrangements for establishment of these institutions prior to his death at Tittenhurst on Dec. 26, 1883. (H. J. Sg.)

HOLLOW WARE: *see* PORCELAIN ENAMELING.

HOLLY, the common name for a large genus (*Ilex*) of trees and shrubs of the family Aquifoliaceae (*q.v.*), containing about 300 species, many of which are popular though expensive garden subjects grown for their decorative fruit and foliage. The genus finds its chief development in Central and South America and is well developed in parts of Asia but has few species in Europe, Africa and Australia. In Europe, where *I. aquifolium* is the sole surviving species, the genus was richly represented in earlier geologic times. The leaves are generally leathery and evergreen and are alternate and stalked; the flowers, commonly dioecious (male and female borne on different plants), are in axillary clusters and have a persistent four- to five-lobed calyx, a white, rotate four- or rarely five- or six-cleft corolla, with the four or five stamens adherent to its base in the male, and a two- to six-celled ovary, seldom more; the fruit is a globose, usually red drupe, containing two to eight one-seeded stones.

ROCHE

EUROPEAN HOLLY (ILEX AQUIFOLIUM)

The wood of the holly is even grained and hard, especially when from the heartwood of large trees, and almost as white as ivory, except near the centre of old trunks where it is brownish. It is employed in inlaying and turning and, since it stains well, in the place of ebony, as for teapot handles. When dry it weighs about 47½ lb. per cubic foot. From the bark of the holly birdlime is manufactured. The leaves are eaten by sheep and deer and in parts of France serve as a winter fodder for cattle. The berries provoke in man violent vomiting and purging, but are eaten with impunity by birds.

The custom of employing holly and other plants for decorative purposes at Christmas is one of considerable antiquity and has been regarded as a survival of the usages of the Roman Saturnalia, or of an old Teutonic practice of hanging the interior of dwellings with evergreens as a refuge for sylvan spirits from the inclemency of winter. Several popular superstitions exist with respect to holly. In the county of Rutland, Eng., it is deemed unlucky to introduce it into a house before Christmas Eve. In some English rural districts the prickly and nonprickly kinds are distinguished as "he" and "she" holly; and in Derbyshire the tradition obtains that according as the holly brought at Christmas into a house is smooth or rough, the wife or the husband will be master.

In North America about 15 native species occur, found chiefly in the southeastern United States. The American holly (*I. opaca*), very similar in appearance and uses to the European holly, is a slow-growing tree, sometimes 40 or 50 ft. high, with a trunk 3 ft. or more in diameter. It grows in moist woods, mostly near the coast, from Massachusetts to Florida, westward to Texas and northward in the Mississippi valley to Missouri and Indiana. Like the old-world holly, it is much used for Christmas decoration. The dahoon holly (*I. cassine*), a shrub or small tree, sometimes 25 ft. high, with oblong, spineless and mostly toothless evergreen leaves, is found from Virginia to Florida and westward to Arkansas and Texas, and also in Cuba and the Bahamas.

ROCHE

AMERICAN HOLLY (ILEX OPACA)

The emetic holly (*I. vomitoria*), called also yaupon, cassena, Carolina tea and Indian black drink, because of its use by the Indians as an emetic and purgative, has nearly the same geographic range as the dahoon. It usually grows 10 to 15 ft. high and has small, minutely wavy-toothed leaves, about one inch long, and small scarlet fruits. Several North American species have deciduous leaves. Of these the best known is the Virginia winterberry, dogberry or black alder (*I. verticillata*), a shrub, 6 to 15 ft. high, native to swamps from Connecticut to Wisconsin and south to Florida and Missouri. The foliage turns black and falls off in autumn, leaving bright-red persistent fruits which are used for winter decoration. Other deciduous species are the smooth winterberry or hoopwood (*I. laevigata*), native to swamps from Maine to Pennsylvania and Georgia; the deciduous holly or possum haw (*I. decidua*), widely distributed in the southeastern states; and the mountain holly (*I. montana*) of the Allegheny mountain region.

The common European holly or hulver (*I. aquifolium*) is an evergreen shrub or low tree having smooth, ash-coloured bark and wavy, pointed, smooth and glossy leaves, two to three inches long, with a spinous margin. The flowers, which appear in May, are ordinarily dioecious, as in all the best of the cultivated varieties in nurseries. Darwin says of the holly: "During several years I have examined many plants, but have never found one that was really hermaphrodite." Shirley Hibberd, however, in 1877 mentioned the occurrence of "flowers bearing globose anthers well furnished with pollen, and also perfect ovaries." The holly occurs in Great Britain, northeast Scotland excepted, and in western and southern Europe, from as high as latitude 62° N. in Norway to Turkey and the Caucasus and in western Asia. It is found generally in forest glades or in hedges and does not flourish under the shade of other trees. In England it is usually small, but it may attain to 60 or 80 ft. in height. Some of the trees on Bleak hill, Shropshire, are said to be 14 ft. in girth at some distance from the ground. *I. aquifolium* is abundant in France, especially in Brittany.

There are numerous varieties of *I. aquifolium*. Some trees have yellow and others white or even black berries. In the fruitless variety *laurifolia*, "the most floriferous of all hollies" (Hibberd), the flowers are highly fragrant; the form known as *femina* is, on the other hand, remarkable for the number of its berries. The leaves in the unarmed varieties *aureo-marginata* and *albo-marginata* are of great beauty, and in *ferox* they are studded with sharp prickles.

The evergreen hollies will grow in almost any soil not absolutely wet, but flourish best in slightly acid, rich sandy loam. They are propagated by means of seeds, which do not normally germinate until their second year; by whip grafting and budding; and by cuttings from the matured summer shoots. Transplanting should be performed in damp weather. *I. aquifolium* is rarely injured by frosts in Great Britain; in the U.S. it grows best in the Pacific northwest but is generally hardy in the southern states.

See also INKBERRY; MATE; WINTERBERRY.

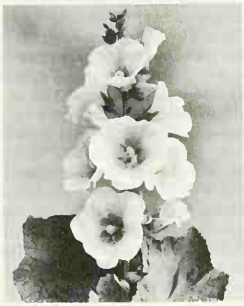
See American Horticultural Society, *Handbook of Hollies* (1957).

HOLLYHOCK (*Althaea rosea*), a perennial plant of the mallow family (Malvaceae; *q.v.*). A native of China, it is widely grown in North America and in Great Britain. The ordinary hollyhock is single blossomed, but the florists' varieties have all double

flowers, of white, yellow, rose, purple, violet and other tints, some being almost black. The plant is in its prime in late summer, but by careful management samples may be obtained in blossom from July to autumn.

Hollyhocks are easily propagated from seed or by division of the root; also single eyes from wood shoots or cuttings from outgrowths of the old stock or of the lateral offsets of the spike may be started in rich sandy soil, in a close frame, with a gentle bottom heat. The seed may be sown in autumn under cover, the plants obtained being potted and kept under glass until the following spring. Or, if the seed is late-gathered, it may be planted in the open ground in early summer, the plants being transplanted in the autumn or the following spring. In many gardens, when the plants are not disturbed, self-sown seedlings come up in abundance in late spring. Seedlings may also be raised in February or March by the aid of gentle heat in a light and rich moist soil. They should not be watered till they have made their second leaves and, when large enough for handling, should be pricked off in a cold frame, from which they are subsequently transferred to the flower bed. Hollyhocks thrive best in a well-trenched and manured sandy loam. The forms now grown are the results of the careful selection and crossing of varieties. The most diverse varieties may be raised from plants growing near together.

The young shoots of the hollyhock are susceptible to the attacks of slugs and to a disease called hollyhock rust, caused by a fungus, *Puccinia malvacearum*. The fungus, a native of Chile, reached Europe in 1869 and the United States in 1886; it attacks not only hollyhocks but also wild mallows, destroying the soft parts of the leaves, leaving only the veins. It is especially harmful to the plant in dry seasons. The disease appears on the leaves as minute, hard, pale-brown pustules filled with spores that germinate without a resting period but that, when produced late in the season, may last as resting spores until the next spring. Sulfur spray is useful in preventing rust, but the disease, once established, is difficult to control. In hot dry seasons, red spider (a mite) may be very injurious to the foliage but may be kept at bay by spraying the plants frequently with water. Hollyhock is also susceptible to anthracnose, caused by the fungus *Colletotrichum malvarum*.



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HOLLYHOCK (ALTHAEA ROSEA)

HOLLYWOOD, Calif., the principal seat of the U.S. motion-picture and television film industries, is situated about 8 mi. N.W. of the centre of Los Angeles (*q.v.*), to which it was annexed in 1910. Its district boundaries are Hyperion avenue and Riverside drive on the east, Beverly boulevard on the south, the foothills of the Santa Monica mountains on the north and the city of Beverly Hills (*q.v.*) on the west. Spanish annals referred to an unimportant way station on El Camino Real and the Cahuenga pass, the principal route between southern and northern California and back door to modern Hollywood. The first home, an adobe, in the area was built by Don Tomás Urquidez in 1853. It was not until the early farmers or homesteaders settled there in the 1870s that there arose an appreciation of the unique combinations of geography that influenced an unusually pleasant climate. The nearby Pacific ocean conditioned the temperature to a comfortable medium, while the desert stretching to the east helped to keep the atmosphere dry and clear. During the 1880s one of the settlers, Mrs. Horace H. Wilcox from Topeka, Kan., gave the community the name Hollywood, which was derived from the summer residence of a friend in Chicago. By 1903 the colony had developed a pride in local achievements and a desire to control its destiny, and on Nov. 14 voted 88 to 77 to incorporate as the city of Hollywood. Because of its arid location, the new city's water supply was inadequate. To solve the problem, Hollywood (pop. then about 4,000) voted in 1910 to become a district of Los Angeles.

The pioneers of the motion-picture industry found southern California extremely well suited to their needs of maximum sunshine, mild temperatures, varied terrain and a labour market. In 1908 one of the first "story" moving pictures, *The Count of Monte Cristo,* begun in Chicago by William N. Selig, was finished in the Hollywood area by Francis Boggs. About this time the Motion Picture Patents company ("Movie trust") was formed in New York by producers licensed by Thomas Alva Edison to use his kinetoscope. A group of independent producers and exhibitors, using French cameras for which patent priority was claimed, threatened the trust's monopoly, resulting in a series of suits, injunctions and even street fights. The independents eventually moved to southern California. The trust companies followed, and studios, independent and trust alike, became centred at Edendale. Resultant overcrowding caused some producers to move a few miles westward into Hollywood. In 1911 David Horsley leased the northwest corner of Gower street and Sunset boulevard for his Nestor film company studio, the first actually in Hollywood. Before the end of the year 15 companies had located close by, to be followed by many others. The trust companies dwindled; the independents eventually dominated the industry.

In 1913 Cecil B. deMille, Jesse Lasky and Samuel Goldwyn combined to produce *The Squaw Man* in a barn just a block from the intersection of Hollywood boulevard and Vine street. The barn was subsequently moved to Paramount Studios and dedicated as a historical monument by the state of California. D. W. Griffith helped give Hollywood a start in the race for supremacy in motion pictures. Early films such as *The Birth of a Nation* (1915) helped set a standard of showmanship. Early stars included Mary Pickford, Douglas Fairbanks, Charlie Chaplin (*qq.v.*), Gloria Swanson, Rudolph Valentino, Harold Lloyd, Francis X. Bushman, William S. Hart, Lillian Gish and Tom Mix. Great studios arose under leaders such as Adolph Zukor, William Fox, Samuel Goldwyn and Louis B. Mayer. The 1920s saw Hollywood as the centre of a movie industry with a world-wide market. Real estate boomed, riches were extravagantly displayed and headline scandals periodically occurred. Censorship bureaus in many cities ordered the suppression of pictures or the deletion of suggestive lines and scenes. The producers responded by forming an organization that became known as the Hays office—a bureau for self-censorship, headed by Will Hays, former postmaster general, under the aegis of the Motion Picture Producers and Distributors of America, Inc.

The advent of the talking picture had a marked effect on the careers of many. Famous stars of the silent screen were forced into retirement. There was a demand for more resourceful directors and screen writers and for technicians with more varied skills to cope with the new sound medium. Film technicians, writers, directors and actors organized into guilds that acquired the status of trade unions.

The effect of television as a competitor to the movie industry began to be felt after the prosperous years of World War II. The Hollywood counteraction was a rash of new techniques involving new lenses, wider screens and stereophonic sound. Nevertheless, thousands of theatres stayed closed and millions of former movie patrons preferred the home television screen. An additional blow was a series of court decisions holding that the control of theatre chains by major producing companies constituted combinations in restraint of trade, which must be broken up. The major Hollywood studios joined their rival, selling great backlogs of films for televiewing and selling and leasing their facilities for television production requirements. The RKO studio was taken over by television producers. In the early 1960s about 80% of the three main television networks' evening programming originated from Hollywood. The financial structure of movie making underwent a radical change. The old studio giants were largely replaced by a conglomerate alliance of independent producers, profit-sharing stars, bankers, agents and investment counselors. The blocking of foreign currency and capital gains and income tax factors provided incentive for production of an increasing number of films overseas, and the cheap supply of extras and other help encouraged this trend. However, thousands of technically skilled artisans who

have made Hollywood and its environs their home have to some extent been absorbed into the television industry, with an equally vast inventory of equipment. The entertainment industry is so firmly anchored that it will hardly be uprooted. The Central Casting office maintains a file of thousands of bit players and extras.

Radio in Hollywood was a natural outgrowth of its supply of talent, and in pretelevision days Hollywood rivaled New York as radio centre for nation-wide programs. Columbia square, the Mutual Don Lee Broadcasting system studios and the National Broadcasting company studios stand as monuments to radio. The recording of songs written for movies, of radio and television programs and of other popular music is a thriving industry.

In 1919 the Hollywood Bowl, a 50-ac. natural amphitheatre owned by Los Angeles county, became a reality. The pool of artists who moved to the area in the ensuing years made possible the array of talent that attracts record-breaking crowds to the outdoor series of summer concerts known as "Symphonies Under the Stars." Other main points of interest are the outdoor Pilgrimage Play amphitheatre and Greek theatre, the Californian Art club and Barnsdall park.

Hollywood has grown from a country village concerned with the quality of its citrus fruits to a thriving community of more than 200,000, most of whom live in apartments. It has many churches. It is known for the manufacture of cosmetics and is among the leaders in the creation of styles in both men's and women's clothes. In the 1960s a redevelopment program was under way.

See also MOTION PICTURES.

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(E. D. BR.)

HOLLYWOOD, a city of Broward county, in southeastern Florida, U.S., on the Atlantic ocean, 18 mi. N. of Miami. Until 1921 it was palmetto jungle with a few pineapple and tomato farms. Joseph W. Young, a developer from California (hence the name Hollywood), starting with 1,700 ac. in the present downtown section, made a geometrically precise layout for the town, which was to be bisected by a broad avenue (Hollywood boulevard) with three circular 10-ac. parks at regular intervals and a hotel at the east end. The city was incorporated in 1926, but was hit hard by the hurricane and the real estate collapse of that year and grew but little until the 1950s when the population doubled. It shares ownership and benefits of Port Everglades with nearby Dania and Fort Lauderdale. Tourism and some industry, principally electronics, furniture, cement and shipping, with a winter vegetable-growing hinterland make up the economy. It adopted a council-manager form of government in 1926. For comparative population figures *see* table in FLORIDA: *Population.*

(C. W. TE.)

HOLMES, OLIVER WENDELL (1809–1894), U.S. physician, poet and humorist, was born in Cambridge, Mass., on Aug. 29, 1809. His father was Abiel Holmes, a minister in Cambridge and author of a creditable historical work, *The Annals of America* (1809). A childless widower upon his settlement in Cambridge, Abiel Holmes had chosen as his second wife Sarah Wendell, daughter of the well-to-do Oliver Wendell. Sarah Holmes was a good-humoured, sociable woman, beloved by her children, to whom she bequeathed the wit that leavened the sobriety of a Calvinist home. She lived to be 93; perhaps it was she who taught her son that "life is a fatal complaint, and an eminently contagious one."

Early Life.—Educated first at local schools, Holmes was sent to Phillips academy (Andover) for a year before entering Harvard in 1825. Andover, the seat of a Calvinist theological seminary, was to Holmes a "dove's nest of Puritan faith" and very different from "our heretic college," as he described Harvard, which had become the centre of New England Unitarianism. The battle between the New England Calvinists and Unitarians would soon lead to a skirmish in his father's church. While Holmes, in his junior year, was making a reputation as student, poet and convivial club man, the town of Cambridge became embroiled in the schism in its principal parish. The two-year battle between the orthodox and liberal groups ended a month before Holmes's graduation with the ousting of his father from the pulpit. For Holmes the blame rested not upon his mild-tempered father nor upon the liberals, but upon the Calvinists who had forced matters to a head. The quarrel left him with an ineradicable impression of "Machiavellian" deacons and contributed greatly to his later compulsion to attack Calvinist doctrines.

Outwardly, young Holmes was unaffected by the quarrel. His talents were recognized by his fellow students, who chose him as class poet, and by the faculty, which awarded him a commencement part. Although his ability was thus acknowledged, Holmes was too sensible to consider a literary career; his choice lay between law and medicine. Acting upon the American conviction that law was the field for a gifted young man, he enrolled at the Harvard law school but, finding the work dull, he sought relief in writing verses. He was encouraged by five undergraduates who printed his verses in their periodical, *The Collegian* (Feb.–July 1830). These poems, of which the best known is "The Height of the Ridiculous," were reprinted and praised in the newspapers. Having tasted "the intoxicating pleasure of authorship," Holmes later confessed that "there is no form of lead-poisoning which more rapidly and thoroughly pervades the blood and bones and marrow than that which reaches the young author through mental contact with type metal." He was never able to cure the infection, although he tried to when he sought to become established in the profession of his final choice, medicine. Holmes began to study medicine in the fall of 1830, but he published "Old Ironsides" in September; he worked hard under James Jackson, but he published "The Last Leaf" (1831). Following Jackson's cases until he knew more of them than anyone else, he wrote "September Gale" and other well-wrought comic verses. Still scribbling, he nevertheless pursued assiduously the courses at the Harvard medical school and those given by a group of Boston physicians. In these two years he showed what Jackson called the "true zeal" and persuaded his parents that he deserved an additional two years' training in Paris. In France, Holmes forsook poetry and followed the teaching of Charles Pierre Alexandre Louis and others of the school of French clinicians known as therapeutic nihilists for their skepticism about the efficacy of the drugs then employed.

Medical Teacher and Author.—Returning home in Dec. 1835 and taking his medical degree at Harvard, Holmes was qualified to practise medicine, but from the first he desired to secure a professorship. Although he practised medicine for ten years, he also taught, becoming associated in 1838 with other physicians in founding the Tremont Medical School. Holmes's modest practice and two years as professor of anatomy at Dartmouth college, Hanover, N.H., did not interfere with his work at the Tremont school. Practice and teaching provided the income necessary for marriage, and in 1840 Holmes married Amelia Lee Jackson, daughter of Charles Jackson, justice of the supreme judicial court of Massachusetts. The first child, Oliver Wendell Holmes, Jr., who was to become a justice of the supreme court of the United States, was born in 1841; a daughter Amelia (1843) and a son Edward Jackson (1846) completed the family.

The professorship Holmes really sought came his way in 1847 when he became the Parkman professor of anatomy and physiology at Harvard; this post he held until his retirement in 1882. As a teacher he was distinguished for introducing the use of the microscope and for his ability to make his lectures amusing. At Harvard, during his 36 years of service, he was always assigned the one o'clock lecture hour, the last in the students' long morning, because he could keep attention with his lucidity, wit and delight in the subject. Charles William Eliot, reforming president of Harvard, said of Holmes: "I never heard any mortal man exhibit such enthusiasm over an elegant dissection." Although Holmes did not wholly favour Eliot's reforms of the medical school, he helpfully led the older members of the faculty to accept them. Upon one matter of policy, Holmes was in advance of his colleagues, old or young; he always voted for the admission of women to the medical school.

Although in his medical writings Holmes offered no original discoveries, he employed his talent and knowledge in good causes. In his first medical essay, "Direct Exploration," which won the

Boylston medical prize in 1836, he argued for a more frequent use of the stethoscope, which was then not extensively used in America. In the following year he won both Boylston prizes with an essay on neuralgia, competent but not important, and with a study of "Intermittent Fever in New England," described by an authority as the best regional study of malaria. The subject led Holmes into the deserts of Puritan theology, which he described as "more likely to cause a fever than to mention one." With his eyes on a professorship, Holmes published all three essays in 1837, dedicating the volume to C. P. A. Louis, who had taught him the techniques of medical scholarship.

In 1848 Holmes provoked controversy with a *Report on Medical Literature* (prepared for the American Medical association); here he urged his countrymen to produce original work instead of merely annotating English books, not sparing himself from censure for having similarly edited (with Jacob Bigelow) a work by Marshall Hall. Before 1848, however, Holmes had produced his most distinguished medical work, the essay on *The Contagiousness of Puerperal Fever*, 1843. Written at white heat in 21 days, the essay was evoked by discussions in the Boston Society for Medical Improvement. Persuaded by these discussions and by investigation of the literature that the disease was contagious and was transmitted from patient to patient by the obstetricians, Holmes directed all his talents to marshaling the evidence. His article met vigorous opposition from the leading American obstetricians. Although he did not suffer the martyrdom of the Hungarian Ignaz Semmelweis who published similar conclusions in 1847, Holmes was roundly abused, until in 1855 he was urged to reprint his essay with additional and even more eloquent pleas that the facts be acknowledged, as shortly they were. Holmes's other medical writings, witty and intelligent though less important, show their author as scornful of quackery of all kinds (*Homoeopathy and Its Kindred Delusions*, 1842), insistent upon scientifically tested therapeutic practices (*Currents and Counter-Currents in Medical Science*, 1860), eager to see psychology recognized both in morals and medicine (*Mechanism in Thought and Morals*, 1871) and bold in defense of freedom of investigation (address, *The New Century and the New Building of the Harvard Medical School*, 1884). Holmes never devoted himself to pure science; he had not the mind for it: "I like nine-tenths of any matter I study but I do not like to lick the plate. If I did I suppose I should be more a man of science. . . ."

Poet, Essayist, Novelist.—His regrets for not having trained himself "to the exhaustive treatment of some limited subject" may be taken with a grain of salt. Distracting him was his delight in the flattering praise his countrymen lavished upon the man of letters, praise they were not disposed to give the labouring scholar. In the same year in which he won the first Boylston prize, Holmes published his first volume of verse (*Poems*, 1836); here he gathered his fugitive early pieces together with "Poetry, a Metrical Essay." In his preface, Holmes bowed himself off the literary stage, and for a time he held with some show of firmness to this "retirement," but he was easily persuaded to make public appearances, poem in hand, for the pleasure of Harvard classmates, fellow citizens, medical colleagues and innumerable visiting celebrities. He early became the unofficial laureate of Boston. As Ralph Waldo Emerson observed: "Holmes is the best example I have seen of a man of as much genius, who had entire control of his powers, so that he could always write or speak *to order:* partly from the abundance of the stream, which can fill indifferently any provided channel."

Holmes was also before the public as a popular lecturer; appearing sporadically on the platform in the 1840s, he became a regular performer in the 1850s. His firecracker wit delighted his audiences, provided he eschewed the slavery question. There his conservative views provoked the wrath of the abolitionists, upon whom he retaliated by diagnosing their complaint as "inflammation of the conscience" and treating them with the corrosive satire of "The Moral Bully." By 1857 Holmes's comic poems and witty lectures had made him famous in his own country and known also to English celebrities like Thackeray, who declared Holmes the best thing he'd seen in America.

In 1857 the literary group in Boston founded a new magazine; James Russell Lowell made his acceptance of the editorship contingent upon the publishers' securing Holmes as a contributor. It was Holmes who gave the magazine its name, *The Atlantic Monthly*, and according to William Dean Howells, its third editor, "he not only named but made it." Page 47 of the first number made the magazine notorious overnight, for it carried Emerson's provoking poem "Brahma" and the tantalizing opening lines of Holmes's *The Autocrat of the Breakfast-Table:* "I was just going to say when I was interrupted." The interruption had occurred 25 years before, when Holmes, after two numbers, abandoned the Autocrat papers published in *The New-England Magazine* (1831, 1832). *The Atlantic Monthly*, founded in the midst of an economic depression, owed its survival chiefly to Holmes's essays, and Holmes appears to have been regarded by successive editors as a good-luck piece, for each in his turn anxiously sought assurance that he would have the doctor's contributions. Many of his poems, all three of the Breakfast-Table books, *Our Hundred Days in Europe*, *Over the Teacups* and the three novels were there serialized before book publication. *The Autocrat* of 1858 was followed by his alter ego *The Professor* in 1859. The second was less popular than the first because, under fire from the religious press, Holmes became insistent on attacking Calvinism. His revulsion from Calvinism provided the theme for the novel *Elsie Venner* (1861). Serialized as *The Professor's Story* it brought down upon Holmes's unbowed head the accusation of "moral parricide" and the charge that he was no fit company for Harriet Beecher Stowe, also an *Atlantic* contributor. In writing the novel, Holmes had succumbed to what he astutely recognized as "the flattery of abuse."

A different kind of flattery, that of the *Atlantic's* second editor, James T. Fields, tempted him to try a second novel, *The Guardian Angel* (1867). Somewhat more plausible a story than *Elsie Venner*, *The Guardian Angel* has the same intention, that of demonstrating the limits of the human will and persuading readers to judge human behaviour from the standpoint of psychology rather than religion. Holmes's third novel, *A Mortal Antipathy* (1885), has a bold psychological theme, but it is ill-conceived and poorly executed; Holmes had undertaken to write it before recovering from the effort of composing a biography of Emerson (1885). In love with his own planet, Holmes was not prepared to follow Emerson on his metaphysical flights. The best chapter in the biography is that on Emerson's poetry; it particularly pleased readers of the Civil War generation, for it helped them to understand the reverential regard given Emerson before the war. Holmes's other venture into full-length biography, *John Lothrop Motley* (1879), is more affectionately loyal than informative.

Appraisal.—A mediocre biographer and novelist, Holmes was at his best in the Breakfast-Table chatter, which allowed free play to his wit. As a talker Holmes had his peers in Boston, but no superior. At the monthly meetings of the Saturday club, Holmes delighted in the rapid fire of talk in which his friends Motley and Lowell readily engaged him. According to a less loquacious member of this club of distinguished men, these three wits could all talk at once at high speed without losing the thread of the argument or repeating themselves or each other. While it was said that Holmes talked too much, it was never said that his talk was dull. The conversational form of the Breakfast-Table books, used also in *Over the Teacups*, was for Holmes the ideal medium of expression. Not so sparkling as *The Autocrat* nor so argumentative as *The Professor*, *The Poet* (1872) is the least pleasing of the four books because it is overweighted with too much serious blank verse instead of being garnished, as the others are, with a variety of poetic forms and moods. *Over the Teacups* (1891), written when Holmes was 80, shows no diminution in wit and no flagging of spirit. In it, the poem "The Broomstick Train" matched "The Deacon's Masterpiece" (in *The Autocrat*) and prompted Lowell to write Holmes that it was "a serious thing to have 'eclipsed the gayety of nations.'" Spontaneous and personal, these four books express Holmes's volatile personality in which, with characteristic candour, he admitted to being "intensely interested." Then too, they provide a record of their author's times, for Holmes's catholic mind touches lightly upon all subjects of current talk, and upon all subjects he flashed the lightning of his wit.

Closely attached to his native ground, Holmes lived all his life in Boston, spending even his summers in Massachusetts, first at Pittsfield and later at Beverly Farms. He contentedly admitted to being as provincial as any Bostonian who contemplated his own reflection in the Frog Pond. He maintained, however, correspondence with many English friends and was finally, in 1886, persuaded to make his second trip abroad. He spent a triumphant 100 days chiefly in England, where he suffered the delights of a London season; received honorary degrees from Oxford, Cambridge and Edinburgh; and studied with interest Tennyson and Gladstone, who born in 1809 were his exact contemporaries. He managed a flying trip to Paris to make sentimental visits to the cafés he had frequented more than 50 years earlier and to pay a respectful call on Louis Pasteur. The book evoked by the trip is an extended thank-you letter to his hosts.

Surviving all those who had made New England the literary centre of the United States, Holmes fulfilled the expectation of the poem "The Last Leaf." He died on Oct. 7, 1894, and was buried from King's chapel, Boston, in Mt. Auburn cemetery in Cambridge.

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HOLMES, OLIVER WENDELL (1841–1935), justice of the U.S. supreme court, is the only American jurist who competes with John Marshall for the superlative. He was born, a "child of fortune," in Boston, on March 8, 1841. His father was the famed poet-physician, Oliver Wendell Holmes; his mother, the daughter of Justice Charles Jackson of the Massachusetts supreme judicial court. The Olivers, the Wendells, the Jacksons and the Holmeses all played a part in the development of New England, whose intellectual life was being brought to flower during Holmes's youth. He was thus born an aristocrat in the only sense in which the United States has ever had an aristocracy. He was heir, not to great wealth, though he hardly represented the Horatio Alger tradition; nor to distinction, for he had to earn his own place in the firmament; but to an environment of thought in which his mind could be brought to full flower under the most favourable circumstances. His father's intimates included Emerson, Agassiz, Lowell, Longfellow, Prescott, Whittier and Hawthorne. Among his own companions were Charles Francis, Henry and Brooks Adams and Henry and William James.

Holmes's schooling was that of his time and circumstances: a dame's school, followed by a boys' school conducted by a Unitarian minister, then preparation for Harvard college at a Latin school conducted by his future father-in-law, Epes Sargent Dixwell. Harvard college was—in the image of Oxford and Cambridge—a citadel of orthodoxy into which Holmes did not fit. His education was advanced despite his professors, not because of them. Philosophy was his first love and Emerson was his true mentor. Art was a second love, and this appreciation was intuitive; his college essay on Albrecht Dürer remains unsurpassed. Writing and good talk were his avocations, and here his father was his master from whom these arts were well learned. Indeed there was a great intellectual debt due from son to father.

Religious orthodoxy, which was then the foundation of Harvard's curriculum, was anathema to Holmes. Dr. Holmes had deserted the strict tenets of his minister-father's Calvinism. His son would not tolerate even the unconfining doctrines of the Unitarian Church. The philosophic skepticism which Holmes developed as a young man and carried through his life was even preceded by a religious skepticism which he apparently got at his mother's knee. For him there were no answers except tentative ones.

The Civil War erupted during Holmes's senior year. Though he was not active in the abolitionist cause—he was never active in any cause—he enlisted immediately. When his battalion was not called up, he returned to Harvard to take his degree. He then secured a commission in the Massachusetts 20th Volunteers, a regiment which participated in the bloodiest battles of the war. Holmes was thrice wounded and three times returned to his regiment, seldom far from the immediate scenes of conflict. He returned to Cambridge when his commission expired before the end of the war, physically and morally exhausted.

At the Harvard law school, which he attended at his father's instance, Holmes once again met with orthodoxy, this time the orthodoxy of the common law as the perfect legal system. Holmes was less openly rebellious at law school than he had been at college, but no less unwilling to accept the dogmas proffered to him. After flirting once again with philosophy, he finally determined upon law as a career, but withdrew from law school before completing the course. After a short time in the offices of Robert Morse and John C. Ropes, Holmes set off on the first of many visits to England, which became for him his home away from home.

Europe, and especially England and Scotland, proved most congenial. In England he visited with the great: Gladstone, Roundell Palmer, Lord Houghton, Chancellor Cranworth, Jowett, Mill, Baron Parke, and the duke of Argyll. On this visit as on later visits he made fast and lasting friendships, some of which, as in the case of Frederick Pollock, were recorded in a remarkable series of letters.

When he returned to Boston, Holmes entered the offices of Chandler, Shattuck and Thayer. Of his intellectual debt to Shattuck, one of Boston's great trial lawyers, Holmes said: "I owe more to Mr. Shattuck than I ever owed to anyone else in the world." In Thayer he found a kindred spirit who was to express academically the same doctrines for which Holmes was to become famous as a jurist. Holmes continued to woo philosophy, with Charles Peirce and William James among others, but only as a sideline; he was now fully dedicated to the law. He was admitted to the bar on March 4, 1867, and became a contributor to the *American Law Review* and its co-editor in 1870. In 1869 he undertook the extensive job of producing the 12th edition of Kent's *Commentaries*, which was published in 1873. Holmes's official biographer, Mark Howe, has attributed this total immersion in the law to "a Puritan's feeling that no moment should be wasted" (*Justice Oliver Wendell Holmes*, vol. i, Harvard University Press, Cambridge, Mass., 1957). Holmes's less charitable contemporaries regarded the spur as regard for place, for there were in Holmes strong traits of ambition and vanity.

In 1872 he married Fanny Bowditch Dixwell, a marriage which provided a remarkable man with a remarkable wife. Howe has written: "When New England breeds a woman of intelligence and reserve, it occasionally brightens those qualities with a dash of wit, and humor, and ashamed to admit it, softens them with sentiment . . . Cambridge had bred such a girl in Fanny Dixwell. . . ." (*Justice Oliver Wendell Holmes*). When she died, Holmes wrote to Pollock: "We have had our share. For sixty years she made life poetry for me." (Mark De Wolfe Howe [ed.], *Holmes-Pollock Letters*, 2 vol., Harvard University Press, Cambridge, Mass., 1941.)

The early fugitive writings of Holmes were systematized in his most important contribution to legal thinking, *The Common Law*, which was published in 1881 after first being delivered as a series of lectures at the Lowell institute. As Justice Frankfurter has said: "The book is a classic in the sense that its stock of ideas has been absorbed and become part of common juristic thought. . . . they placed law in a perspective which legal scholarship ever since has merely confirmed." (*Of Law and Men*, Harcourt, Brace and Co., Inc., New York, 1956.) Its opening words set its theme much as do the opening notes of Beethoven's Fifth Symphony: "The life of the law has not been logic; it has been experience." (Little, Brown & Co., Boston, 1938).

The publication of this book led Harvard to offer Holmes the Weld chair at the law school, which he accepted on condition that he be free to take a judicial post were one to be opened to him. For him the ivory tower could only be a second choice: "The final test . . . is battle in some form. . . . It is one thing to utter a

happy phrase from a protected cloister; another to think under fire—to think for action upon which great interests depend." (*Mind and Faith of Justice Holmes*, ed. by Max Lerner, Little, Brown & Co., Boston, 1943.) Less than a year later he was a judge. Holmes served on the supreme judicial court of Massachusetts from 1883 until 1902, the last three years as chief justice.

In 1902 Pres. Theodore Roosevelt, looking for a "liberal" of his own pattern and mistakenly believing he had found him, appointed Holmes to the supreme court of the United States. On the Massachusetts court Holmes had written about 1,300 opinions, most of them resolving controversies between individuals. On the national court he had a different function to perform. But it was in this new arena, which called upon the actors to define the boundaries of governmental power, that Holmes established himself as a peer of Marshall. Unlike Marshall, however, Holmes espoused a doctrine of judicial restraint. And however important his many individual opinions may be, his view of the judicial function is more important: "While the courts must exercise judgment of their own, it by no means is true that every law is void which may seem to the judges who pass upon it excessive, unsuited to its ostensible end, or based upon conceptions of morality with which they disagree. Considerable latitude must be allowed for differences of view as well as for possible peculiar conditions which this court can know but imperfectly, if at all. Otherwise a constitution, instead of embodying only relatively fundamental rules of right, as generally understood by all English-speaking communities, would become the partisan of a particular set of ethical or economical opinions, which by no means are held *semper ubique et ab omnibus*." (*Otis v. Parker*, 187 U.S. 606, 608 [1903].)

Short of his 92nd year by only a few months, Holmes resigned on Jan. 12, 1932, writing "the time has come and I bow to the inevitable." He died on March 6, 1935, leaving the bulk of his estate to the United States of America. In a message to congress suggesting that these funds be put to an appropriate use, Pres. Franklin Delano Roosevelt said of Holmes that "for him law was an instrument of just relations between man and man. With an insight into its history that no American scholar has surpassed; with a capacity to mold ancient principles to present needs, unique in range and remarkable in prophetic power; with a grasp of its significance as the basis upon which the purposes of men are shaped, Mr. Justice Holmes sought to make the jurisprudence of the United States fulfill the great ends our nation was established to accomplish." The bequest was ultimately used to finance a history of the supreme court, an appropriate use and a fitting tribute to its great donor.

BIBLIOGRAPHY.—The literature on Holmes is extensive. *See* vol. 1 of his authorized biography by Mark De Wolfe Howe, *Justice Oliver Wendell Holmes: the Shaping Years, 1841–67* (1957); other biographies are Silas Bent, *Justice Oliver Wendell Holmes* (1932); Francis Biddle, *Mr. Justice Holmes* (1942); Catherine Drinker Bowen, *Yankee From Olympus* (1943). *See* also Samuel J. Konefsky, *The Legacy of Holmes and Brandeis* (1956); Max Lerner (ed.), *The Mind and Faith of Mr. Justice Holmes* (1943); Felix Frankfurter, *Mr. Justice Holmes and the Supreme Court* (1939), (ed.), *Mr. Justice Holmes* (1931). For some of Holmes's own writing, see *The Common Law* (1881–1938); *Speeches* (1891, 1913, 1938); Mark De Wolfe Howe (ed.), *Holmes-Pollock Letters* (1941) and *Holmes-Laski Letters* (1953); Harold Laski (ed.), *Collected Legal Papers* (1920); A. Lief (ed.), *Dissenting Opinions of Mr. Justice Holmes* (1929), *Representative Opinions of Mr. Justice Holmes* (1931); Harry C. Shriver (ed.), *Justice Oliver Wendell Holmes: His Book Notices and Uncollected Letters and Papers* (1936).
(P. B. K.)

HOLMES, WILLIAM HENRY (1846–1933), helped transform 19th-century curiosity about western hemisphere prehistory into the beginnings of professional archaeology in the U.S. Born in Harrison county, O., Dec. 1, 1846, he graduated from McNeely Normal college (Ohio) in 1870. In 1872 he joined F. V. Hayden's survey of the Rocky mountain area as an artist, but soon became interested in geology. His geological explorations of ancient cliff dwellings in southeastern Utah (1875) stimulated his interest in archaeology. Although appointed geologist with the U.S. geological survey, he became increasingly involved with archaeological research. During this period his early studies of aboriginal art were published by the Bureau of American Ethnology, which he joined in 1889 and of which he became chief in 1902. He made an important survey of the ruined cities of southern Mexico while curator of anthropology at the Chicago Natural History museum (1894–97). He served as head curator of anthropology at the U.S. National museum (1897–1902, 1910–20) and, with Ales Hrdlicka, physical anthropologist at the museum, Holmes critically appraised claims for the antiquity of man in America and demonstrated the fallacy of the widespread belief that there was a period in new world prehistory comparable to that of Paleolithic Europe. He died April 20, 1933, at Royal Oak, Mich.

His books include *Art in Shell of the Ancient Americans* (1883); *Archaeological Studies Among the Ancient Cities of Mexico* (1895–97); *Aboriginal Pottery of the Eastern United States* (1903); *Handbook of Aboriginal American Antiquities* (1919).

For a complete bibliography of his writings, see *American Anthropologist*, 35:755–764 (1933). (R. H. TH.)

HOLMIUM, a silvery metallic element, one of the rarest of the rare-earth group. The metal and its compounds are used for research purposes and their limited applications are based largely upon distinctive electronic and magnetic properties. Holmium has been used as a component of some electronic devices, the trivalent ion as a catalyst for ortho-para hydrogen conversion (*see* HYDROGEN) and the oxide as a special refractory.

Holmium was discovered by J. L. Soret in 1878 and independently by P. T. Cleve in 1879. Cleve named the element from the latinized word (Holmia) for Stockholm, his native city. The element occurs associated with other rare earths in the minerals gadolinite, euxenite, xenotime, samarskite and others; it also occurs in the products of atomic fission. The classical methods of separation and purification of holmium were fractional crystallization and precipitation. Ion-exchange technology, which was developed during World War II and in subsequent years, later yielded kilogram or greater quantities of highly pure holmium oxide.

The metal is produced by the thermoreduction of the anhydrous fluoride HoF_3 with calcium. It is reactive and is slowly attacked by oxygen and water. The melting point of the metal is 1,461° C. and its density is 8.803 g. per cubic centimetre for the hexagonal, closely packed structure. Below −187° C. the metal is ferromagnetic. The symbol for holmium is Ho, atomic number 67, atomic weight 164.93. There is only one naturally occurring stable isotope, Ho^{165}.

Holmium behaves as a typical trivalent rare earth and forms a series of yellow-brown salts, many of which are obtained in solution by dissolving the oxide, Ho_2O_3, in the appropriate acid. The solutions are also yellow and have discrete sharp absorption bands in the ultraviolet and visible regions of the spectrum that are used for quantitative analyses. The Ho^{3+} ion has a radius of 0.894 Å and is strongly paramagnetic because of the presence of unpaired electrons; along with disprosium oxide, holmium oxide is the most paramagnetic substance known. *See* RARE EARTHS.
(LD. B. A.)

HOLROYD, SIR CHARLES (1861–1917), English artist noted for the technical excellence of his etchings, was born at Leeds on April 9, 1861. It was intended that he should become a mining engineer, but after a false start at the Yorkshire College of Science, Leeds, he received an art education under Alphonse Legros at the Slade school, University college, London.

After obtaining a traveling scholarship he studied for two years (1889–91) in Italy. Except for that interval, he was assistant master at the Slade school from 1885 to 1893. He was an occasional portraitist and landscape painter, and for Aveley church, Essex, he painted a triptych altarpiece.

Holroyd was chiefly distinguished as an etcher possessed of profound technical knowledge. Among the best-known plates are the "Monte Oliveto," "Icarus," "Monte Subasio" and "Eve" series, together with "The Flight Into Egypt," "The Prodigal Son," "A Barn on Tadworth Common" and "The Storm." Holroyd was the first keeper of the National Gallery of British Art (Tate gallery), 1897–1906, and director of the National gallery, 1906–16. He was responsible for the acquisition for the National gallery of the Layard pictures, and for the proper display at the Tate of works by Alfred Stevens and Turner that lay neglected in store. He was

knighted in 1903. He died at Weybridge on Nov. 17, 1917.

HOLST, GUSTAV THEODORE (1874–1934), English composer and music teacher. The son of a Swedish father and English mother, he was born at Cheltenham on Sept. 21, 1874. From 1893 to 1898, he studied at the Royal College of Music, where he joined Sir Charles Stanford's composition class in 1894. His solo instrument was the trombone and for some years after leaving the college he made his living as a trombone player in the Carl Rosa opera company and in various orchestras. He became music master at St. Paul's girls' school in 1905 and director of music at Morley college in 1907. These were the most important of his teaching posts and he retained both of them until the end of his life. He died in London on May 25, 1934.

Holst's pioneering methods, which entailed a rediscovery of the English vocal and choral tradition (folk song, madrigals and church music), were still influential in musical education in many English schools in the mid-20th century. Many of Holst's smaller choral works, folk song arrangements and instrumental pieces, *e.g.*, the *St. Paul's Suite* for strings (1913), reflect the musical interests he sought to promote as a teacher. In this part of his creative output he shares much common ground with Ralph Vaughan Williams, his friend and contemporary. Holst's stubbornly independent, exploring mind had need, however, of a musical language less limited and more flexible than that offered by the English folk song school. He found fresh creative stimuli in the "new" European music, *e.g.*, the innovations of Stravinsky, whose impact Holst registered in his orchestral suite *The Planets* (1918), and also in Hindu literature, which gave rise to his so-called "Sanskrit" period when the opera *Savitri* and four sets of choral hymns from the Rigveda were composed during the years 1908–12. It is the cosmopolitanism of Holst's style, rare in English music of his period, that lends him a special historical significance. In works like *Egdon Heath* for orchestra (1927), the *Choral Fantasia* (1930), and the *Fugal Concerto* for flute, oboe and string orchestra (1923), he anticipated many of the trends associated with a later generation of English composers who were to turn away from the self-consciously "national" style bred by the folk song revival.

Holst's works include the opera *Sitra*, composed during 1899–1906; the *Hymn of Jesus*, for chorus and orchestra (1917); *Ode to Death*, for chorus and orchestra (1919); *The Perfect Fool*, an opera (1923); *Choral Symphony* (1923–24); the opera *At the Boar's Head* (1925); Double Concerto, for two violins and orchestra (1929); and *Hammersmith*, for orchestra (1930).

See Imogen Holst, *Gustav Holst* (1938), *The Music of Gustav Holst* (1951). (D. C. P. M.)

HOLSTEIN, FRIEDRICH VON (1837–1909), the most influential maker of German foreign policy in the emperor William II's reign, was born at Schwedt on April 24, 1837, of an ancient noble family from Mecklenburg. The fact that his parents died early may account for his solitary and self-willed nature. Educated at Berlin, he entered the Prussian diplomatic service in 1860 and was sent as attaché to the embassy in St. Petersburg, where he met Bismarck and his family. Despite early reservations about his character, Bismarck came to value his penetrating intelligence. After a first mission to the United States in 1865, Holstein was in Washington again in 1867, but was recalled in four months' time (scandal alleged that he had paid indiscreet attentions to Charles Sumner's wife). He then tried to enter the world of business and exchange speculation. Even so, Bismarck made him one of his closest collaborators at headquarters during the Franco-German War of 1870–71 and subsequently sent him to Paris. Then, when Harry von Arnim became German ambassador to France, Bismarck used Holstein to spy on him; and eventually Holstein was obliged to testify in the proceedings against Arnim, who was charged with purloining state papers. Holstein was thus exposed as having spied on his chief, with the result that his social position was compromised forever. This exposure seems to have been the cause of the resentment that later estranged him from Bismarck. Yet he remained in close touch with the Bismarcks, especially with Herbert Bismarck, till the 1880s. At the foreign office in Berlin uninterruptedly from 1876 onward, he sent them reports on the situation there during their frequent absences at Friedrichsruh. He was promoted to be assistant undersecretary (*vortragender Rat*) for his excellent work in connection with the congress of Berlin (1878), but he refused further promotion as he disliked working in the glare of publicity and preferred the substance of power to its trappings.

Already in the 1880s Holstein fell out with Bismarck, to whom he owed not only his career but equally the stain on his reputation. He thought Bismarck's Russian policy mistaken and agreed with Alfred Waldersee that war was inevitable and that preventive war was necessary. Accordingly he recommended closer relations with Austria-Hungary and with Great Britain. His secret correspondence during the years 1886–90 shows that he pursued without scruple a policy diametrically opposed to that of the chancellor who was responsible for foreign affairs; and he was deeply involved in the intrigues which prepared and accompanied Bismarck's fall in 1890. Immediately afterward he took advantage of the new chancellor's lack of knowledge to turn down the renewal of the Reinsurance treaty with Russia; he had worked for this for some time and thus bears the chief responsibility for this decisive change of direction in German foreign policy.

From 1890 to 1906 Holstein was the key figure in the foreign office while chancellors (Caprivi, Hohenlohe and Bülow) and secretaries of state (Adolf Marschall von Bieberstein and Bülow) followed one another. He maintained this position by his perfect knowledge of all documents and files, as well as by his assiduity and his penetrating intelligence—which, however, often led him to construe artificial combinations that did not correspond to reality. His influence was strengthened by his wide personal correspondence with German representatives abroad; but in this too his tendency to intrigue and to preconceived judgments can be discerned. Despite his inveterate hostility to Bismarck, he was considered the heir to the Bismarckian tradition.

It speaks well for Holstein's sense of responsibility that he soon perceived William II's weaknesses. After 1894 he tried hard but in vain to get the emperor's senior advisers—Hohenlohe, Eulenburg and Bülow—to co-operate in holding William back. No-one else tried seriously to do this until the incident of the *Daily Telegraph* interview (1908), in which William made statements on Anglo-German relations that aroused widespread criticism.

Holstein embodied fully the errors of the diplomacy of William II's "new course." He broke the link with St. Petersburg—and wished to repair it when it was too late—without achieving that alliance with Great Britain which he had planned as a substitute but which in fact he hardly pursued seriously as he was unwilling to make the requisite concessions. He hesitated between the British alliance and a continental alliance with France and Russia, the possibility of which he often regarded far too optimistically. The Anglo-German talks of 1898–1901 failed probably—almost certainly—because Holstein insisted on the inclusion of Austria-Hungary and the triple alliance in the proposed agreement and on ratification by the British parliament. Regardless of warnings, he believed that the British could never come to terms either with the French (because of conflicts in Africa) or with the Russians (because of differences in Asia); but Great Britain's entente with France (1904) and agreement with Russia (1907) proved him wrong. Thus he bears a large part of the responsibility for the isolation of Germany in the decade before World War I.

Holstein, however, was not in full command of all vital decisions determining German foreign policy. He tried to prevent William II from sending his telegram of good wishes to Paul Kruger in 1896 on the occasion of the Jameson raid in the Transvaal, as this gesture would strain Anglo-German relations; and he also had doubts about the plan for a Berlin-Baghdad railway and the speeding-up of the naval program. His fall came about when he used the first Moroccan crisis (1905–06) as a trial of strength with the Anglo-French entente. Willing to push to the brink of war even though he did not wish the preventive war to happen then, he refused all the offers of the French premier Maurice Rouvier and, after the resignation of Théophile Delcassé from the French foreign ministry, forced the calling of the Algeciras conference. At the height of the crisis, however, the emperor and Bülow abandoned Holstein's policy, as they preferred a compromise to the risk

of war. With Bülow's connivance William dismissed Holstein on April 16, 1906; the last of Holstein's successive letters of resignation supplied an ostensible pretext.

After his dismissal Holstein entered into relations with Maximilian Harden, to whom he may perhaps have given material for his attacks on the emperor's entourage. He was still asked for advice by Bülow, whom he encouraged to oppose Alfred von Tirpitz' naval program. In the crisis following Austria-Hungary's annexation of Bosnia-Hercegovina (1908), he advised a firm attitude toward Russia. Convinced that the annexation was a success against that encirclement of Germany which he had been trying to break in 1906, Holstein died in Berlin on May 8, 1909. His papers are edited by N. Rich and M. H. Fisher (1956–).

See further GERMANY: *History;* and biographical articles on the chancellors mentioned above.

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HOLSTEIN (medieval Lat. HOLSATIA), the southern part of the modern *Land* of Schleswig-Holstein (*q.v.*) in the Federal Republic of Germany, omitting the former free city of Lübeck. The three districts of Holstein, Stormarn (the northern hinterland of Hamburg) and Dithmarschen (*q.v.*) were probably already united in the 10th century A.D., but Dithmarschen obtained a special position in the 13th century under the overlordship of the archbishops of Bremen. The Elbe marches and Wagria (the eastern area) were only later considered part of Holstein.

Holstein in the 11th century was ruled by counts enfeoffed by the Billung dukes of Saxony. The Billungs' successor, Lothair of Supplinburg, the future emperor Lothair II, invested Adolf of Schauenburg (Schaumburg) with the countship in 1111. Adolf I (d. 1130) maintained himself against both the Danes and the Wends; and though during the struggle between the German king Conrad III and Henry the Proud of Bavaria and Saxony the Schauenburgs lost their county temporarily, it was given back to Adolf II (d. 1164) by Henry's son Henry the Lion in 1143.

The expulsion of Adolf II had meant a setback for the Christian missionary activity in Holstein and in Wagria, with which St. Vicelin, the "apostle of Holstein," had been entrusted from 1127; but during the winter of 1138–39 the Slavs were conquered and Wagria was incorporated in Holstein. There followed a period of colonization, in part by Frisians and Netherlanders. Adolf III (d. 1225) allowed the Danes to establish themselves in Holstein, and after the battle of Stellau (1201) they occupied the whole area north of the Elbe; but Adolf IV ended Danish rule at the battle of Bornhöved (1227) and reconquered his patrimony. The conquest and colonization of eastern Holstein led to the growth of a local nobility, and this social change had its effect on old Holstein. Adolf IV also founded towns: Itzehoe, Kiel, Lütjenburg, Oldenburg, Plön, Rendsburg and Segeberg.

The Schauenburg dynasty split into several branches after Adolf IV's death. Of these, the Rendsburg line was most important, especially under Gerhard III the Great, count from 1304, who obtained from Denmark the grant of the duchy of Schleswig as a hereditary fief and extended his power to north Jutland. Though Gerhard III was assassinated in Randers in 1340, his sons upheld their claim to the duchy, and in 1386 his grandson Gerhard VI was invested with it. This grant was confirmed by the German king Albert II in 1439 and by the Danish council of the realm in 1440.

From 1432 Adolf VIII ruled as count over Holstein and as duke over Schleswig. He strengthened the connection between the two countries, especially by the transfer of German peasants and artisans from Holstein to Schleswig. He died without direct heirs, however, in 1459, and on his desire the estates of both countries elected his nephew Christian I of Denmark as his successor (the Schauenburg count of the Pinneberg branch was given compensation). In 1474 the counties of Holstein, Wagria and Dithmarschen were raised to the rank of a duchy of the Holy Roman empire. For later history *see* SCHLESWIG-HOLSTEIN QUESTION. (O. KE.)

HOLSTENIUS (HOLSTE), **LUCAS** (1596–1661), German classical scholar and Vatican librarian, best known for his geographical work, was born at Hamburg on Sept. 27, 1596. While he was a student at Leiden a journey (1617–18) with P. Clüver to collect materials for the latter's *Italia antiqua* aroused an interest which sent him for two years to England copying geographical manuscripts. In 1625 he met Cardinal Francesco Barberini in Paris and was invited to Rome. There he was received into the Roman Catholic Church. Appointed apostolic protonotary in 1629 and Vatican librarian in 1641, he remained in Rome until his death on Feb. 2, 1661. His work, in which the humanist, theological, historical and scientific disciplines interpenetrated, typifies the intellectual activity of his period. Some theological pamphlets apart, his publications consisted of editions, of which the most valuable are some minor writings of *Porphyry* (1630), Arrian's *Cynegetica* (1644) and a collection of early monastic rules (1661). But he left multitudinous notes, some of which, including his criticisms of Caesar Baronius's Roman martyrology and an annotated collection of papal documents, were posthumously printed. His chief geographical works, which were based on personal observation, measurement and a full knowledge of the existing literature, are his revisions of E. Danti's maps of Italy in the Vatican gallery and his corrections (1663) of Clüver's *Italia antiqua*. Of his projected edition of the minor Greek geographers, the *Ethnica* of Stephanus Byzantinus (1684) was the only volume published.

See R. Almagia, *L'opera geografica di Luca Holstenio* (1942). (R. R. Bo.)

HOLT, SIR JOHN (1642–1710), lord chief justice of England, remembered for the firmness with which he upheld his prerogatives in opposition to the authority of the houses of parliament, was born at Thame, Oxfordshire, on Dec. 30, 1642. He studied at Oriel college, Oxford, and at Gray's Inn, London. He was called to the bar in 1663. An ardent supporter of civil and religious liberty, he defended accused persons in many state trials. In 1685–86 he was appointed recorder of London. He was dismissed from this office about a year later after refusing to pass sentence of death on a soldier for desertion. He doubted whether the soldier's conviction in peacetime was good in law. As a legal assessor to the peers in the convention Holt took a leading part in the Glorious Revolution, and after the accession of William III was appointed lord chief justice of the king's bench. In judicial fairness, legal knowledge and ability, clearness of statement and unbending integrity he had few superiors on the English bench. In 1700 Holt was offered the great seal, but declined it. He died in London on March 5, 1710. (R. G. M. B.)

HOLTEI, KARL VON (1798–1880), German poet, playwright, novelist and actor who achieved success by his "vaudevilles" or ballad operas and by his recitations, was born at Breslau, Jan. 24, 1798. After studying law, in 1821 he married the actress Luise Rogée (1800–25) and was made official poet at the Breslau theatre. He soon went to Berlin where his two popular ballad operas, *Die Wiener in Berlin* and *Die Berliner in Wien*, were produced in 1824, and where he also wrote a number of plays for the Königsstadter theatre, notably *Lenore* and *Der alte Feldherr* (both 1829). In 1830 he married the actress Julie Holzbecher (1809–39) and with her toured Germany and Austria. In Vienna in 1833 he created a sensation by his brilliant recitations, especially of Shakespeare, and was appointed manager of the Josefstädter theatre, where he remained until 1836. From 1837 to 1839 he was manager of the theatre at Riga, and then led a wandering life until 1847, when he settled at Graz, where he wrote several novels. The last years of his life were spent at Breslau, where he died, Feb. 12, 1880. As a dramatist his chief importance was that he introduced the "vaudeville" into Germany; as a poet, he was particularly successful in the Silesian dialect; as a reciter, he was unequaled, especially in his interpretation of speeches from Shakespeare. His lively autobiography, *Vierzig Jahre*, was published in six volumes, 1843–50, with two supplementary volumes, *Noch ein Jahr in Schlesien* (1864); his plays appeared in six volumes in 1867, and his collected works in 39 volumes (1861–66).

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HÖLTY, LUDWIG HEINRICH CHRISTOPH (1748–1776), German poet, the most gifted lyric poet of the Göttingen circle, was born Dec. 21, 1748, at Mariensee, Hanover. In 1769 he went to Göttingen to study theology and became a close friend of J. M. Miller, J. H. Voss, H. Boie, the brothers Stolberg and others, with whom he founded (1772) the *Göttinger Dichterbund* or *Hain*, a group of young poets, mostly of peasant background, whose work drew inspiration from folk song and ballad. His poems appeared in the society's *Musenalmanach* and other collections. He died of tuberculosis at Mariensee, Sept. 1, 1776. His *Gedichte* were published by Friedrich Leopold zu Stolberg and Voss, 2 vol. (1782–84); an enlarged edition by Voss (1815) included a biography. There was a critical edition by W. Michael, 2 vol. (1914–18).

Hölty was influenced by J. P. Uz and by Klopstock, but his love for the *Volkslied* and his real delight in nature preserved him from the artificiality of the one and the cloudiness of the other. A strain of natural melancholy, tempered by sincere religious faith, runs through his lyrics. His ballads are the pioneers of the rich ballad literature which, influenced by English models made available by the publication of Percy's *Reliques* (1765), sprang up in Germany in the late 18th century. He also translated from Anacreon, Ariosto, Tasso and the English poets.

See H. Ruete, *Hölty, sein Leben und Dichten* (1883); W. Kayser, *Geschichte der deutschen Ballade* (1936).

HOLUB, EMIL (1847–1902), Austrian naturalist and traveler in south-central Africa, who made valuable scientific collections, was born at Holice (Holitz) in Czechoslovakia on Oct. 7, 1847. In 1872 he went to South Africa where he practised as a surgeon at the Kimberley diamond fields. He undertook expeditions to the northern Transvaal, Mashonaland and through Bechuanaland to the Victoria falls, making extensive natural history collections. In 1886 he explored the then almost unknown region between the Zambesi and its tributary the Kafue. When Holub was north of the Kafue the Mashukulumbwe attacked his camp and he was forced to retire. He returned to Austria in 1887 with a great collection of considerable scientific interest, now in various museums. He died in Vienna on Feb. 21, 1902. His chief works are *Eine Culturskizze des Marutse-Mambunda-Reiches* (1879), *Sieben Jahre in Südafrika, 1872–79* (1880–81; Eng. trans. E. E. Frewer, 1881), *Von der Capstadt ins Land der Maschukulumbe; Reisen, 1883–87* (1890). (R. L. HL.)

HOLY ALLIANCE, the name given to a 19th-century organization of collective security for Europe after the French Revolutionary and Napoleonic Wars. The outcome not of a comprehensive general agreement but of a series of diplomatic acts and proceedings, it took its name from a treaty between Alexander I of Russia, Francis I of Austria and Frederick William III of Prussia. This treaty was signed in Paris on Sept. 26, 1815, while the members of the Quadruple alliance, namely Russia, Austria, Prussia and Great Britain, were negotiating a new peace treaty with France after the Hundred Days.

This treaty was supposed to inaugurate a community of the Christian nations of the world, without regard to the question of victory or defeat in the preceding wars. Though Great Britain steadfastly refused to accede to it, France was secretly admitted to the Holy alliance on Nov. 19, 1815, just before the signing of the second treaty of Paris between the allies and the restored Bourbon kingdom of France and the public renewal of the quadruple alliance (Nov. 20). France's accession to the Holy alliance was made public at the congress of Aix-la-Chapelle (*q.v.*) in 1818.

For a long time historians regarded the treaty concluded on Sept. 26, 1815, as a sort of mystical union which the influence of the baroness von Krüdener (*q.v.*) had brought Alexander to sponsor. It seems, however, that Alexander was less preoccupied by evangelical exaltation than by a political design to create an international concert through which Russia could counterbalance the sea power of Great Britain by that of other maritime nations, such as the Netherlands, France, Spain (which all acceded to the treaty) and the United States (which however declined the invitation to accede). Such a concert would indeed have had an effect opposite to that of the quadruple alliance, through which Viscount Castlereagh hoped to maintain a continental European balance of power favouring British interests. All the powers, however, were at one in wanting to avoid another war and to continue that system of conferences and congresses which had preserved allied unity in the negotiations with France. Consequently at the congress of Aix-la-Chapelle in 1818 the Austrian minister Metternich was able to achieve some compromise between divergent aspirations of the participant powers. The general system that emerged from the compromise was manifested in the subsequent congresses of Troppau, of Laibach and of Verona (*qq.v.*) in 1820, 1821 and 1822.

Another consequence of the common desire to avoid a major war was that the powers sought to maintain the existing state of affairs. This concern explains the Austrian intervention in Naples and in Piedmont (1821) and the French intervention in Spain (1823); and it also explains to some extent the pressure brought by the other powers to prevent Russian intervention against Turkey over Greece (1821–23).

Castlereagh's diplomacy meanwhile succeeded in excluding from the series of congresses the maritime powers, such as Spain and the United States, which Alexander I would have liked to invite. The result was that the system of the Holy alliance was confined to Europe. Though both France and Russia tried to extend its operation to Latin America, the British minister George Canning and the U.S. president James Monroe together succeeded in limiting it to the North Atlantic seaboard; and France, authorized to intervene in Spain by Russia, Austria and Prussia at the congress of Verona, was deterred from carrying this intervention to South America, where the Spanish colonies were in revolt. Thereafter the French government, in order to protect its economic interests in America, had to seek a *rapprochement* with the liberally disposed nations of the Atlantic world.

With France's virtual secession, the general system fell to pieces. Thenceforward the Holy alliance was nothing more than the coalition of Russia, Austria and Prussia for the maintenance of the existing order in eastern Europe. Among the Atlantic powers the free-trade policy advocated from 1822 by the British board of trade became the basis of peaceful relations. For further discussion of British foreign policy during this period *see* the biography of Castlereagh under LONDONDERRY, ROBERT STEWART, 2ND MARQUESS OF. For U.S. policy *see* MONROE DOCTRINE, THE.

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HOLY CHILD JESUS, SOCIETY OF THE (S.H.C.J.), a teaching order of women religious founded in England in 1846 by Cornelia Connelly (*q.v.*). The general mother house is at Rome, and members number around 800. *See* WOMEN'S RELIGIOUS ORDERS: *Since the French Revolution.*

HOLY CROSS, CONGREGATION OF (CONGREGATIO A SANCTA CRUCE; C.S.C.), a Roman Catholic institute of religious, was formed in 1837 by Basil Moreau by uniting the Auxiliary Priests (founded by him in 1835) and the Brothers of St. Joseph (founded by James Dujarie in 1820) at Sainte Croix, Le Mans, France. In 1841 the Marianite Sisters of Holy Cross were founded by Moreau. There are a priests' society and a teaching brothers' society, both having nonteaching brothers, the same constitutions and top administration, but each is otherwise autonomous at the provincial level. More than 3,000 Holy Cross priests and brothers in 11 provinces are stationed in Haiti, Brazil, Chile, Ireland, France, Spain, Italy, Ghana, Liberia, Uganda, Pakistan, India, Canada and the United States. The generalate is in Rome, Italy. Best known of Holy Cross operations are St. Joseph's shrine, Montreal; the Family Rosary crusade; and the University of Notre Dame, founded in 1842 near South Bend, Ind., by E. F. Sorin.

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HOLY DAYS OF OBLIGATION are religious feast days on which Roman Catholics are bound to attend Mass and refrain from unnecessary work. Although all Sundays are sanctified in

this way, the term "holy days" usually refers to other feasts that must be observed in the same manner as Sunday. The number of such days has varied greatly, since until the 17th century bishops had the right to institute new feasts for their dioceses. At that time Pope Urban VIII limited the number of holy days throughout the church to 36. In 1918, taking into account the difficulty of observing religious feasts that are not civil holidays, canon law designated ten holy days: Christmas, Circumcision, Epiphany, Ascension, Corpus Christi, Assumption, SS. Peter and Paul, All Saints, the Immaculate Conception, and St. Joseph. By papal permission this number is reduced in some countries. Thus the feast days of the Immaculate Conception and St. Joseph are not observed in England and Wales; Epiphany, Corpus Christi, SS. Peter and Paul and St. Joseph are not kept in the United States. Canada has the same holy days as the United States except that the Epiphany is observed and the Assumption is not. Scotland and Ireland keep all ten holy days, except that Ireland celebrates St. Patrick's day instead of St. Joseph's. The various Eastern Catholic churches have their own feasts of obligation, which are generally more numerous than those of the Western Church. *See* also CHURCH YEAR. (J. H. Zi.)

HOLY GHOST: *see* HOLY SPIRIT.

HOLY GHOST, CONGREGATION OF THE (CONGREGATIO S. SPIRITUS SUB TUTELA IMMACULATI CORDIS BEATISSIMAE VIRGINIS MARIAE; C.S.Sp.), a Roman Catholic society of men, founded in 1703 in Paris by Claude Francois Poullart des Places. Originally intended only for the training of seminarians, the congregation gradually began to take an active part in missionary work. Suppressed by the Revolution, it was restored under Napoleon, but persecution kept it weak until 1848 when the Congregation of the Immaculate Heart of Mary merged with it and Venerable Francis Libermann, a convert from Judaism, became its 11th superior-general. The congregation pioneered in the resumption of African missions in the 19th century. Along with missions the Holy Ghost Fathers (Spiritans) staff many educational and social works. The general mother house is in Paris. (V. F. G.)

HOLYHEAD (CAERGYBI), a seaport town and urban district of Wales, on Holy or Holyhead Island at the western end of the county of Anglesey. Pop. (1961) 10,408. It is a railway terminus and one of the main ports for Ireland, 263½ mi. by rail and 257 mi. by road northwest of London. There are many traces of prehistoric and Roman occupation including a large hill fort on Holyhead mountain and the Roman fort of Caer Gybi. A fishing village, Holyhead was selected as a port for Dublin in 1801 and in 1815–19 T. Telford built the Shrewsbury–Holyhead road with the Menai bridge. A new harbour protected by a breakwater (1½ mi.) was opened in 1873 and enlarged in 1875–80. Steamers ply to Dun Laoghaire and Greenore, and as well as port activities there are quarrying and some light industry. The town is also a seaside resort. Holyhead mountain (720 ft.) is a heather-covered granite rock joined by a suspension bridge to South Stack, where there is a lighthouse. Sea birds breed on the surrounding cliffs.

HOLY ISLAND or LINDISFARNE, an island in the North sea, 2 mi. from the coast of Northumberland, in which county it is included. At low water it is accessible by a causeway from the mainland. Area 2.1 sq.mi. Pop. (1951) 238. To the north are sand hills, noted for wild flowers. The south is fertile and under cultivation. There is a lake of 6 ac. in the northeast and three miles of sandy beach on the north shore. The village lies at the southwest angle, beside a small, natural harbour used by fishing boats and by yachts in summer. To the east is the castle, built on a basaltic rock rising about 90 ft. from the sea, and off the southwest shore is St. Cuthbert's Island, a flat grass-covered rock with traces of a chapel used as a retreat by St. Cuthbert, according to Bede.

The island's history begins with the arrival in 635 of St. Aidan (*q.v.*), who came from Iona at the request of King Oswald, later saint and martyr, to preach to the Northumbrians. He made it the site of his church and monastery and the head of the diocese. The sixth bishop in succession was St. Cuthbert (*q.v.*; 685–687) who was buried in the place of honour on the south side of the altar. In 793 the Danes landed, burning the settlement and killing many of the monks. The survivors rebuilt the church but in 875, fearing a second invasion, they fled inland with St. Cuthbert's body, the Lindisfarne Gospels—famous 7th-century illuminated manuscripts now in the British museum—and other relics. They settled first at Chester-le-Street and eventually at Durham (995). In 1082 the prior and convent of Durham refounded the monastery of Holy Island as a dependent cell. Threatened again by invasion, the island was garrisoned toward the end of the 16th century. During the Civil War the castle was held for the king until 1646. In the first Jacobite rising (1715) it was seized for the Old Pretender. The parish church of St. Mary, close by the village market place, grew from a Norman core. The southwest front may include part of the original building (1146) while the three Norman arches of the north arcade show the ornamental use of alternate red and white stones. Nearby are the red sandstone ruins at Lindisfarne priory (*c.* 1100) and the museum containing carved stones of the Viking period. A Celtic cross on the village green, designed by John Dobson, was set up in 1828 on the site of the old market cross. The castle, built *c.* 1500, was restored as a private residence by Sir Edwin Lutyens after 1900. Sir Edward de Stein presented it to the National trust in 1944. Inshore fishing and tourist traffic are the principal resources. The nearest railway station is Beal, opposite the island but 1¼ mi. inland. There are coastguard and lifeboat stations. (E. M. Hw.)

HOLYOKE, a city in Hampden county, Mass., U.S., 8 mi. N.W. of Springfield, between the Mt. Tom range on the west and the Connecticut river on the east. The city's many hills and industrial canals give it a European character. The residents are mainly Roman Catholic and tend to group themselves into districts which are predominantly Irish, French, Polish and German.

Holyoke was first part of Springfield (*q.v.*) and was included in West Springfield when that town was incorporated in 1774. Holyoke was settled in 1725. Industrial development began with the building of a dam across the Connecticut river in 1828. The present dam at Hadley falls, providing waterpower for the paper mills, was completed in 1900. Holyoke was incorporated in 1850 and became a city in 1873.

The city enjoys considerable cultural and economic autonomy (its public utilities are municipally owned), and is identified as part of the Springfield-Holyoke metropolitan area. Once regarded as "The Paper City," its industry became diversified after the depression of the 1930s. Manufactures include electric equipment, beer, fabricated steel, leather and synthetic fabrics; however, paper, printing and textiles remain the most important products. Mount Holyoke college (1837) is at South Hadley across the river. Pop. (1960) 52,689, or 13.7% below the 1920 peak of 60,203 (*see* table in MASSACHUSETTS: *Population*). (GE. G.)

HOLY ORDERS, a grade or status in the ordained ministry of the Christian church, comprising the major orders of priest, deacon and subdeacon and the minor orders of porter (doorkeeper), lector, exorcist and acolyte. The term "order" (Lat. *ordo*, plural *ordines*) was adopted by the church from Roman civil life and was first used ecclesiastically by Tertullian to mean both clergy and laity. Gradually, however, it came to mean some office to which a person had been specifically admitted by a bishop and authorized to perform its duties. By the 6th century a bishop admitted young boys into his *familia* ("household"), giving them their first tonsure, after which they were trained to discharge minor duties in the church. This adoption rite included the verse Ps. xvi, 6, containing a reference to "inheritance" (Gr. *clerus*), meaning that the boy was now a clerk and a member of the clergy, having office in one of the four minor orders. Later he could be ordained by the bishop to the major orders of subdeacon, deacon, priest and bishop (at that time considered an order apart from the priesthood).

In the earlier centuries there is no evidence either that a clerk in a lower order was required to pass by regular steps to a higher order or that a layman could not pass directly to any office in the church. By the 9th century, however, there were cases of clergy being deposed from the higher orders because they had not passed through the lower. In consequence it began to become the rule that a clerk must progress from the lower to the higher order,

and that he should do so at regular intervals of time. These requirements are still observed; it is for instance not permissible to receive two major orders on the same day. Though early in the history of the church the office of bishop was regarded as completely separate from the other orders, later bishops and priests were classed together as *sacerdotes*. This usage was confirmed by the 23rd session (1563) of the Council of Trent, according to which archbishops, metropolitans and patriarchs are bishops who hold separate grades not of the episcopate but of the priesthood. Some eastern churches, however, notably the Nestorian, Syrian and Coptic, continue to recognize within the episcopate different grades, each of which is entered upon after a distinctive ordination.

Roman Catholic Church.—A candidate for holy orders must be a baptized man, not suffering under canonical impediment, who has a vocation, has reached the right age, has attained the appropriate academic standard, is of suitable character and has a specific clerical position awaiting him. A candidate for the subdiaconate must be at least 21 years old, for the diaconate 22, for the priesthood 24, for the episcopate 30. All persons in holy orders (which, once given, have an indelible character) must be celibate and recite the divine office daily. The chief duty of both deacon and subdeacon is to assist the priest at high Mass, when the subdeacon reads the epistle and the deacon the gospel (though in practice two priests normally act as deacon and subdeacon). The deacon is also allowed on occasion to baptize and to preach. The priest has authority to celebrate Mass, to pronounce absolution, to administer solemn baptism, to anoint the sick, to bless and to preach. He enters upon his office through the sacrament of ordination, which is administered by the bishop. If appointed to a parish he has the cure of souls within that parish.

Bishops are either elected by the cathedral chapter or chosen by the pope from a list of names submitted by the chapter; in both cases the pope's approval is requisite. After taking an oath of fidelity to the Holy See, undertaking to visit Rome at appointed intervals there to report upon the administration of his diocese, and making a profession of faith, the bishop elect is consecrated by at least three bishops. The bishop is normally the chief pastor in a diocese, where he alone has authority to ordain, to confirm and to bless the chrism for confirmation and oil for anointing the sick.

Church of England.—In the 16th century the Church of England abolished the minor orders, the subdiaconate and the necessity for celibacy. The requisites for entering on holy orders are the same as in the Roman Catholic Church, save that the deacon must be 23 years old. All persons in holy orders are required to recite matins and evensong daily. The deacon assists the celebrant at the Eucharist by reading the epistle and administering the chalice; he may perform baptisms and is allowed occasionally to preach. He normally remains in the diaconate a year before being ordained to the priesthood by the bishop. As a priest he celebrates the Eucharist, pronounces absolution and gives the blessing. As a "clerk in holy orders" he is freed from certain civil obligations and at the same time labours under certain disabilities in order to discharge his office more efficiently. Although holy orders are regarded by canon law as indelible, the Clerical Disabilities act of 1870 made provision for a member of the clergy to execute a deed of relinquishment of holy orders.

A priest is consecrated bishop by at least three other bishops, thereby receiving authority to consecrate, ordain and confirm. A diocesan bishop, who is appointed by the crown and elected by the dean and chapter after they have received the *congé d'élire* (*q.v.*), takes an oath of temporal allegiance to the sovereign before he enters into full possession of the temporalities of his bishopric.

Other Episcopal Churches.—Some churches that are episcopally governed have no archbishops or metropolitans. The seven bishops of the Episcopal Church in Scotland elect one of their number as "primus" to have authority to convoke and preside at the Episcopal Synod. The Protestant Episcopal Church in the United States elects a presiding bishop to preside at the General Convention and the National Council of the church. Similarly, the chief bishop of the Polish National Catholic Church in the United States is known as prime bishop.

Orthodox Eastern Church.—A candidate for holy orders must fulfill the same requirements as in the Roman Catholic Church, save that celibacy as such is not required for the diaconate or priesthood. A priest may be a married man if he was married before his ordination but must not remarry if his wife dies after he is ordained. A priest unmarried at ordination must remain celibate. Only unmarried or widowed priests may be consecrated bishop. The functions of bishops, priests and deacons do not differ from those in the Roman Catholic Church save that the priest has authority to administer confirmation, which takes place at the same ceremony as baptism. There are only two minor orders (though this terminology is not used), lectors and subdeacons, and in practice these grades of the ministry have tended to lapse. A priest can divest himself of his orders, which are not indelible, and become a layman.

See also ACOLYTE; CLERGY; DEACON; EPISCOPACY; MINISTRY, CHRISTIAN; ORDINATION.

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(J. W. L.)

HOLY ROMAN EMPIRE is the designation commonly given to the varying complex of lands ruled over first by Frankish and then by German kings for ten centuries from the coronation of Charlemagne in 800 until its dissolution in 1806. In fact, the precise term *sacrum Romanum imperium* dates only from 1254, though the title "Holy empire" reaches back to 1157 and the term "Roman empire" was used from 1034 to denote the lands under Conrad II's rule. The term "Roman emperor" is older, dating from Otto II (d. 983). This title, however, was not used by Otto II's predecessors, from Charlemagne to Otto I, who simply employed the phrase *imperator augustus* without any territorial adjunct. The first title that Charlemagne is known to have used, immediately after his coronation in 800, is: "Charles, most serene Augustus, crowned by God, great and pacific emperor, governing the Roman empire." This clumsy formula, however, was soon discarded.

These terminological questions reveal some of the problems involved in the early history of the empire. It can be regarded as a political institution, or approached from the point of view of political theory, or treated in the context of the history of Christendom as the secular counterpart of a world religion. The history of the empire is also not to be confused or identified with the history of its constituent kingdoms, Germany and Italy, though clearly they are interrelated. The constituent territories retained their identity; the emperors, in addition to the imperial crown, also wore the crowns of their kingdoms. Finally, whereas none of the earlier emperors from Otto I had assumed the imperial title until actually crowned by the pope in Rome, after Charles V none was actually emperor in this sense, though all laid claim to the imperial dignity as if they had been duly crowned as well as elected. Despite these anomalies and others, the empire, at least in the middle ages, was by common assent, along with the papacy, the highest and most important institution of western Europe.

Theologians, lawyers, popes, ecclesiastics, rulers, rebels like Arnold of Brescia and Cola di Rienzi, literary figures like Dante and Petrarch, and the practical men, members of the high nobility, on whom the emperors relied for support, all saw the empire in a different light and had their own ideas of its origin, function and justification. Among these heterogeneous and often incompatible views, three may be said to predominate: (1) the papal theory, according to which the empire was the secular arm of the church,

set up by the papacy for its own purposes and therefore answerable to the pope and, in the last resort, to be disposed of by him; (2) the imperial or Frankish theory, which placed greater emphasis on conquest and hegemony as the source of the emperor's power and authority and according to which he was responsible directly to God; (3) the popular or Roman theory (the "people" at this stage being synonymous with the nobility and in this instance with the Roman nobility), according to which the empire, following the tradition of Roman law, was a delegation of powers by the Roman people. Of the three theories the last was the least important; it was evidently directed against the pope, whose constitutive role it implicitly denied, but it was also a specifically Italian reaction against the predominance in practice of Frankish and German elements.

It is also important to distinguish between the universalist and localist conceptions of the empire, which have been the source of considerable controversy among historians. According to the former, the empire was a universal monarchy, a "commonwealth of the whole world, whose sublime unity transcended every minor distinction"; and the emperor "was entitled to the obedience of Christendom." According to the latter, the emperor had no ambition for universal dominion; his policy was limited in the same way as that of every other ruler, and when he made more far-reaching claims his object was normally to ward off the attacks either of the pope or of the Byzantine emperor. According to this view, also, the origin of the empire is to be explained by specific local circumstances rather than by far-flung theories.

Origins of the Empire and Sources of Imperial Ideas.— There was no inherent reason why, after the fall of the Roman empire in the west in 476 and the establishment there of Germanic kingdoms, there should ever again have been an empire, still less a Roman empire, in western Europe. The reason why this took place is to be sought (1) in certain local events in Rome in the years and months immediately preceding Charlemagne's coronation in 800; and (2) in certain long-standing tendencies which made this particular solution of a difficult situation thinkable. These long-standing tendencies are to be regarded as preconditions rather than causes of the coronation; they do not account for it, but without them it is difficult to imagine how it could have taken place.

The first is the persistence, despite the fact that it was no longer a political reality west of Italy, of the idea of the universal and eternal Roman empire. The importance of this tradition may easily be exaggerated. After the establishment of the Germanic kingdoms, kings such as Clovis in Gaul and Theodoric in Italy were glad to accept Roman titles from the Byzantine emperor, who sought to maintain the formal unity of the Roman empire by treating them as his vicars and lieutenants; but this was a short-lived expedient. By the 8th century any sense of belonging to the empire, now confined to eastern Europe, had disappeared in the west.

Far more effective in the minds of the barbarian peoples of the west was the idea of the *imperium Christianum* or "Christian empire," which took shape after the conversion of Constantine (*q.v.*) the Great and the reconciliation between Christianity and the Roman empire. Not only did the Christian church become a state church, including in its liturgy prayers for the empire and the emperor, but it also brought the Roman empire into the framework of Christian eschatology, as the last of the world monarchies whose end would mark the inception of the kingdom of God. Through Christian iconography and through the liturgy the church's view of the empire as a vehicle of God's will, for the Christianization of the world, became prevalent. It was expressed with peculiar force in the letters of Charlemagne's adviser Alcuin.

Apart from the persistence of the idea of a Christian Roman empire, a third precondition for the establishment of an empire in the west was the existence of a candidate of sufficient power and standing in the person of the Frankish king. The expansion of the Frankish kingdom until it comprised most of western Europe, particularly its acquisition of the Lombard kingdom in northern Italy in 774, is described elsewhere (*see* FRANCE: *History;* also CAROLINGIANS); its importance and the importance of the ties forged by Charlemagne's immediate predecessors with the papacy are obvious. Though it is scarcely true that Charlemagne's accession to the empire was simply a consequence of this expansion, his outstanding position was evidently a precondition of his elevation to the imperial throne.

When we turn from the preconditions to the causes of the events of 800 and from the realm of ideas to that of political facts, we enter another world. It is the world of the Roman, Eastern or Byzantine empire, of which the pope was a subject, confirmed in his bishopric like other bishops by the emperor. By the 8th century, however, the imperial position in Italy, centred in the exarchate of Ravenna (*q.v.*), was crumbling. Confronted by the power of Islam, the empire concentrated on the problems of the east and was unable to defend its Italian lands from the Lombards, who had entered Italy in 568. Furthermore, the emperors of the Isaurian dynasty, of whom the first was Leo III (717–741), were estranged from the papacy by the iconoclast controversy. Hitherto fear of the Lombards had kept the popes faithful to the emperor and to the exarch in Ravenna. Now the situation changed. When the Lombards renewed their advance southward, taking Ravenna in 751 and driving out the exarch, the pope appealed in vain to the emperor, then turned to the Frankish king, Pepin, who invaded Italy, reduced the Lombard king Aistulf to

(TOP) EMPIRE OF CHARLEMAGNE ABOUT A.D. 800; (BOTTOM) EMPIRE IN THE 16TH CENTURY

submission (754) and then, returning in 756, bestowed on the papacy the territories belonging to the exarchate. Thus was born both the temporal power of the papacy and the close alliance between the papacy and the Frankish monarchy.

Particularly significant of the anomalous position that had arisen in Italy was the action of the pope in conferring on the Frankish king the title of patrician, which could legally be conferred only by the emperor; in the form the pope gave it (*patricius Romanorum*), the title was meant to authorize its possessor to defend and support the Holy See against its foes. Even so, the papacy was reluctant to break its constitutional links with the imperial system, and this was particularly so under Pope Adrian I (772–795), after Charlemagne had in 774 defeated the last independent Lombard king, Desiderius, and taken his kingdom. As king of Lombardy the defender might become as dangerous to the pope as those against whom he had provided defense.

The events briefly related show, first, the growing estrangement between east and west; second, the difficult position of the pope between the emperor and the Frankish king; third, the tenuousness of the imperial hold over Rome and central Italy. After the expulsion of the exarch in 751, the pope himself, now in *de facto* possession, probably hoped to become the emperor's successor in the west. Whether the document itself belongs to the 750s or not, this was the sense of the forged Donation of Constantine, in which the emperor Constantine I is represented as having conferred on Pope Silvester I the imperial palace of the Lateran, the imperial insignia and "all the provinces, places and cities of Italy and the western regions" (*see* DONATION OF CONSTANTINE). Such ambitions, however, proved illusory when Charlemagne became king of the Lombards. When it was even rumoured that Charles intended to depose Adrian and set up a Frankish pope in his place, it would have been folly for the pope to think of formal severance from the existing empire. Nevertheless, the empire's shadowy titles were unlikely to be respected long in Italy unless the emperor took action. From 781 papal documents were no longer being dated by the emperor's regnal year, and the pope was minting his own coins.

Coronation of Charlemagne as Emperor.—By comparison with Adrian, Pope Leo III (795–816) was a man of inferior calibre. Where Adrian had tried to maintain independence by balancing the Byzantine emperor against the Frankish king, Leo from the first showed subservience to the latter. Both in Constantinople and in Rome the situation was unstable. In Constantinople, after troubles reaching back to 790, the empress Irene had her son Constantine VI blinded and deposed (797) and took his place, the first woman to rule the empire in her own right. Her constitutional position was thus doubtful; Alcuin in the west, in 799, regarded the imperial throne as empty. Meanwhile, in Rome, the hostile nobility exploited the opportunity to attack Leo, who fled across the Alps to his protector, Charlemagne, at Paderborn. This was in Aug. 799. Though unfavourably impressed by the pope, Charlemagne was persuaded by Alcuin to send him back to Rome with a commission which adjudged the complaints against him false and arrested and deported his accusers. The situation, however, was still uncertain. In view of the plight of both pope and emperor, "the whole salvation of the church of Christ" now rested (so Alcuin wrote) in Charlemagne's hands, and in the autumn of 800 he set out for Rome "to restore the state of the church which was greatly disturbed." On Dec. 23 Leo solemnly purged himself of the charges against him. Two days later, on Dec. 25, a large gathering assembled in St. Peter's, where the pope was to consecrate Charlemagne's son as king. Suddenly, as Charlemagne rose from prayer, Leo placed a crown on his head and, while the assembled Romans acclaimed him as "Augustus and emperor," the pope abased himself before Charlemagne, "adoring" him "after the manner of the emperors of old."

It seems clear that this coronation was the work of the papacy, not of the Frankish king, who is said to have been surprised and angry at it. The immediate beneficiary of the coronation was the pope, whose position henceforth was secure. Charlemagne was left to face its momentous consequences and, particularly, to secure that recognition from Constantinople without which his title was legally invalid. This, according to the chronicler Theophanes, he sought to do by offering marriage to the empress Irene, hoping thus "to reunite east and west." If so, a revolution in Constantinople and the deposition of Irene (802) brought the plan to nothing. In any case, the coronation of Charlemagne was an extra-legal, indeed an illegal and revolutionary proceeding. The pope had no right to make him emperor. Nor did the coronation create a new western by the side of the existing eastern empire. A usurper in the eyes of the Byzantines, Charlemagne had not the least prospect of succeeding to the throne of the Caesars. The only imperial territories on which he laid hands were the duchy of Rome and the former exarchate. Otherwise he remained, as before, king of the Franks and of the Lombards. Since in 806 he made arrangements to divide his territories among his three sons, it is even doubtful whether Charlemagne's empire would have survived had not the two elder sons died before him, leaving the undivided inheritance in 814 to the third son, Louis I the Pious.

While the immediate context of the imperial coronation of 800 was limited, it had wider connotations. In the first place, the separation between east and west was now an accomplished fact in the political sphere; for, though the intention in 800 was not to divide the empire, this was the practical outcome. In 812, after unsuccessful war and wearisome negotiation, the Byzantine emperor Michael I recognized Charlemagne's imperial title. It was still a personal title, and Charlemagne was recognized merely as emperor, not as emperor of the Romans; in other words, the emperor in Constantinople maintained his claim to be the only true successor to the Roman Caesars. Furthermore, the recognition was grudgingly given, and later, when Byzantium was stronger and the Carolingians weaker, Michael's successors refused to extend it automatically to Charlemagne's successors. Thus the second consequence of the act of 800 was a rivalry with Constantinople which remained an important factor in imperial history at least until 1204. In the third place, Charlemagne's coronation involved him and his successors ever more deeply in the ecumenical pretensions of the papacy. The relationship between the papacy and the Frankish rulers, close for nearly 50 years before 800, was intensified now that the Roman see was the first metropolitan church of Charlemagne's dominions. Religious emperors and their ecclesiastical advisers would henceforward see as the main function attaching to their imperial dignity the promotion of Christian unity. Furthermore, the fact that the pope had crowned Charlemagne emperor—rightfully or not—could not but impress. It was the pope who had taken the initiative. Had he not, in fact, constituted Charlemagne emperor? In Innocent III's time it was to be argued that Pope Leo III had transferred the empire from the Greeks to the Germans and that his successors could transfer it elsewhere if they so wished. This was a later doctrine; but already to Charlemagne the dangers were evident. Hence when, in 813 after his agreement with Michael I, Charlemagne decided to associate his surviving son, Louis, in the exercise of imperial power, he framed his actions accordingly. The ceremony took place not in Rome but in the imperial chapel at Aachen; the pope was not present; the constitutive act was the acclamation of the gathered Frankish nobility; and Louis either received the diadem from his father or took it with his own hands from the altar. The contrast with the Roman ceremony of 800 was deliberate. Henceforward the conflict between the two contrary views or theories of the empire—the papal and the Frankish—was to be a dominant theme.

The Carolingian Empire.—Louis the Pious (814–840) was a man in every way different from his father. For him the word empire was to be the unifying idea holding together his various dominions, and accordingly he abandoned his separate royal titles. This was the underlying notion of the *Ordinatio imperii* of 817; by this, Louis made his eldest son, Lothair I, emperor with him, while the younger sons, Pepin and Louis the German, received subordinate kingdoms (Aquitaine and Bavaria). Louis I's ideas, however, aroused the conservative opposition of the Frankish nobility, and soon the Frankish lands were involved in civil war. Furthermore, internal dissension helped the papacy, which increased its influence by favouring one party or the other. Already in 816 Pope Stephen V (IV) persuaded Louis to receive unction

at his hands, perhaps also to be recrowned, thus repairing the defect of 813; and though Lothair I had been raised to the imperial dignity in 817, as Louis had been in 813, without papal intervention, he also saw fit to strengthen his title by being crowned by Paschal I in Rome in 823. Thus the empire, instead of becoming an appendage of the Frankish kingship, was drawn back into the papal sphere. Lothair's son Louis II was crowned by the pope in 850, to be sole emperor from Lothair's death in 855 to his own in 875; his uncle Charles II the Bald was emperor from 875 to 877; then Charles III the Fat was crowned emperor in 881. But the imperial title, without power to support it, was a mere name, and with the dislocation of the Carolingian realm, culminating in the deposition of Charles the Fat by the East Frankish magnates in 887, its decline was rapid. From 888 France, Germany and Italy were separate states, with the kingdom of Burgundy and Lotharingia (Lorraine) as debatable lands. Who, in these circumstances, was to be emperor? The nominee of the pope, himself a puppet of Italian aristocratic factions? Or Charlemagne s rightful heir, whoever he might be? Or simply the strongest ruler of western Europe? For the moment, the first solution prevailed, and there followed a series of emperors chosen from the Italian nobility, starting with Guy of Spoleto (891–894) and his son Lambert (892–898), in concurrence with the East Frankish king Arnulf, who was also crowned emperor in 896 (d. 899). But such men were of little use to the papacy, and the papacy, in the depths to which it had now sunk, was little use to them. Louis III, crowned in 901, was deposed in 905 by Berengar of Friuli, who was himself crowned by the pope in 915, but on Berengar's death (924) the powerful Roman family of the Crescentii, determined to keep authority in its own hands, stepped in and suppressed the imperial title. Thus the empire created in 800 disappeared, ineffective and unmourned.

The Ottonian Empire.—While in Italy the empire was in process of dissolution, north of the Alps imperial ideas persisted, but not in the form associated with the papacy. The Frankish tradition of empire looked back to Charlemagne; amid the divisions of the dying 9th century it reflected the notion of Frankish unity. It was also seen as the expression of power and hegemony and of rule—as Charlemagne had ruled—over a number of different countries. Thus the West Frankish king Charles II the Bald had been proclaimed emperor and Augustus when he invaded Lotharingia in 869—six years before he was crowned emperor in Rome—because he was now ruler of two kingdoms. The first Saxon ruler of Germany, Henry I, was acclaimed emperor (the chronicler Widukind relates) because of his victory over the Hungarians in 933, as was his son, Otto I, after the battle of the Lechfeld in 955. This is a Frankish idea of empire which has nothing to do with Rome. Indeed, the successor-states which we call France and Germany remained Frankish—the West Frankish and the East Frankish kingdoms, though the latter was now ruled by a Saxon. As such, it was their ambition to succeed to the Frankish inheritance, and it was inevitable, in view of the anarchic state of Italy, that the ruler of the one or the other, when strong enough, would cross the Alps. In fact, it was the East Frankish kingdom which recovered first from the 9th-century anarchy, not least because its kings knew how to use the Frankish church for their ends.

In this Otto I, who succeeded to the East Frankish throne in 936, was the true heir of Charlemagne; he made churchmen his ministers and established missionary bishoprics on the Elbe river to spread Christianity among the Wends. In the west the Carolingian Louis IV of France was his protégé, and only Otto's support kept the young king of Burgundy, Conrad, on his throne. In 951 Otto descended on Italy, married the late king's widow and forced the new king, Berengar of Ivrea, to hold his kingdom as a vassal of the German crown. Ten years later, summoned by the pope when Berengar was on the point of taking control in Rome, Otto returned to Italy. He was crowned emperor by Pope John XII on Candlemas day 962.

Once again, as in 800, it was the pope who took the initiative; his need for protection was the immediate cause of the coronation. But Otto's empire was more limited in scope than Charlemagne's, its pretensions less universal. In the intervening period the import of the title *imperator augustus* had shrunk, so that by Otto's time it scarcely extended beyond protection or "advocacy" of the Roman church. Likewise the extent of the empire, territorially, had decreased. Neither Otto I nor his successors made any claim, as heirs of Charlemagne, to rule over the West Frankish lands. Henceforward what came to be known as the empire meant simply a union of Germany and northern Italy (and after 1032 the kingdom of Burgundy) under a single rule. This was far from the ecumenical pretensions of Rome, and though, partly because of the extent of their territories, partly because of their special connection with the papacy, the Ottonian and Salian emperors enjoyed pre-eminence among the rulers of western Europe, they certainly did not seek to exercise world dominion. Nor did they seek to challenge the Byzantine emperors in their rule over the empire of the east. Nevertheless the problem of the relations of the two empires necessarily reasserted itself, for the Byzantine empire had made rapid recovery and was preparing, under Nicephorus II Phocas and Basil II, to embark on expansion and reconquest. Fears of Byzantine interference in Roman politics and conflicting claims in southern Italy soon brought the two powers into rivalry, and the conflict proved to be the spur for a major development—the romanization of the western empire. Whereas Otto I had laid no claim to the Roman title, Otto II (co-emperor 967; sole emperor 973–983), to bolster his claims against Basil II, proclaimed himself Roman emperor. From this it was only a short step to describing the empire itself as the Roman empire, and this change occurred in Conrad II's reign (1024–39; crowned 1027). It was reinforced, from 1040, by the introduction of the title "king of the Romans" for the emperor-elect before his coronation, or for the emperor's designated successor. It is noteworthy, however, that these formal changes were the result not of claims to the heritage of ancient Rome or of universal pretensions but simply of rivalry with Byzantium.

In this development the reign of Otto III (983–1002; crowned 996) forms an interlude. The son of a Greek princess, imbued with Byzantine traditions, Otto III drew on Roman, Carolingian and Christian strands to form a new synthesis combining the heterogeneous elements in the imperial idea. Rome was to be his capital, the pope his lieutenant in the spread of Christian dominion. How much of this would have survived, if Otto had lived longer, remains doubtful. In fact, distance alone made unified imperial rule over Germany and Italy impossible. Otto himself lost Rome shortly before his death. What did survive, as the characteristic feature of the empire from Otto I to Henry III, was the close subordination of pope to emperor. Otto I deposed John XII and Benedict V; Otto III nominated his cousin, Gregory V, and his tutor, Silvester II; and after neglect of Italian affairs under Henry II (1002–24; crowned 1014) and Conrad II, Henry III (1039–56; crowned 1046) deposed Benedict IX and Silvester III and compelled Gregory VI to abdicate. This was not oppression or force but the fulfillment of the emperor's supreme duty—to watch over the welfare of the church. The iconography of the time shows the emperor, not the pope, as the representative of St. Peter and often standing alone as God's vicar on earth. The period from 962 to 1046, in fact, saw the empire at its zenith. No other kingdom of Europe was its match; while the papacy, except when under imperial protection, was the degraded tool of Roman factions. Morally, also, the empire had the support of the greatest reformers of the age—the abbots of Cluny, for example—who looked to the emperor rather than to the pope as the effective head of Latin Christendom.

Empire and Papacy.—From the middle of the 11th century the situation began to change. One cause was the rapid progress of European economic recovery, which brought shifts of power detrimental to Germany. More immediately important was the revival of the papacy, which the emperors had done so much to further. After Henry III's death in 1056 the initiative passed into papal hands. It was favoured by the long minority—till 1065—of Henry IV (crowned 1084; d. 1106), which enabled the papacy to act without fear of intervention from north of the Alps, and by the appearance of allies—particularly the Normans of the kingdom of Sicily, who for their own purposes supported the papacy against the empire. As they reached maturity the peoples of

Europe turned to the pope as leader of Christendom. Even within the imperial frontiers the emperor's power meant more to the Germans than to the inhabitants of Burgundy or of Italy, for whom it betokened subjection to German rule. Furthermore, only Otto III—and he for less than four years—made Rome the seat of empire; all the rest, from Charlemagne onward, concentrated their efforts north of the Alps. In practice, therefore, the empire was a very imperfect realization of the ideal of an *imperium Christianum;* and as soon as it was in a position to vindicate its independence, the papacy found many adherents. Under Gregory VII (1073–85) the papal theory of the empire, as formulated in the 9th century, was revived, but now on broader and firmer foundations. The result was the conflict, from 1076 until 1122, known as the Investiture contest (*see* INVESTITURE CONTROVERSY). The real issue, however, was not the investiture of bishoprics but the place of the emperor in Christian society and his relations with the papacy. Only the pope, Gregory VII asserted, might use the imperial insignia; he might lawfully depose emperors, but should himself be judged by none (these lapidary statements are among the 27 included in the *Dictatus papae* of 1075 and were set down in Gregory's register). Thus the claim to independence turned rapidly into a claim to superiority. In particular, the sacred character of the emperor was challenged and his claim to be responsible directly to God. Instead, on the basis of the Donation of Constantine and a papal interpretation of the coronation of 800, it was argued that it was for the pope to convey the imperial dignity and, if he thought fit, to withhold or withdraw it. The Investiture contest was brought to a close by compromise in the treaty of Worms of 1122 between Calixtus II and Henry V; but Gregory VII's claims were taken up again by Alexander III, Innocent III, Innocent IV and Boniface VIII, in a series of conflicts that shook the empire to its foundations.

The challenge thrown out by Gregory VII forced the emperors to seek new foundations for their position. Gregory's great opponent, Henry IV, had still asserted the traditional rights of his father. His successors in the 12th century, Henry V (1106–25; crowned 1111), Lothair II (1125–37; crowned 1133), Frederick I Barbarossa (1152–90; crowned 1155) and Henry VI (1190–97; crowned 1191), shifted their ground. To counter the arguments of church lawyers they grasped the weapons provided by the revival of Roman law. A new and more exalted conception of the empire was the result. Best known was the addition by Frederick Barbarossa, in 1157, of the word *sacrum* to the name of the empire, which now became the "Holy empire" as a counterblast to the *sancta ecclesia*. Equally characteristic was the canonization of Charlemagne by Frederick's antipope Paschal III in 1165. In this way Frederick emphasized continuity with the Frankish past and asserted his rights as Charlemagne's successor. They derived, he argued, not from conferment by the pope or by the Roman people but from Frankish conquest.

Unlike earlier emperors, who had based their position on their special relation with the church, the Hohenstaufen emperors emphasized its secular foundations. Against Pope Innocent III's claims to confer the imperial crown, imperial lawyers asserted that "he who is chosen by the election of the princes alone is the true emperor, even before he has been confirmed by the pope." Nor is it surprising that, confronted with the universal claims of the papacy, the Hohenstaufen emperors asserted rights no less universal. Though in day-to-day politics, in their relations (for example) with the kings of France or of England, there is no sign that they were seeking world dominion, nevertheless the new imperialism soon called forth protests from all sides—from England and France, from Denmark and Hungary. "Who," asked John of Salisbury, "appointed the Germans to be judges over the nations?"

Meanwhile, the conflict with the papacy and the desire to restore the territorial basis of imperial power, which the Investiture contest had shattered, drew the emperors more and more into Italy, where they encountered the same national reaction. Unable to defeat the Lombard league, Frederick I patched up a peace at Constance in 1183. His ultimate sovereignty was recognized, but his power in Italy was fatally compromised. After his son, Henry VI, had married the heiress of Sicily, the power of the Norman kingdom was used to restore the imperial position in Italy. It was a grandiose policy but overstrained. The papacy, fearing that Rome would be engulfed, reacted violently.

Innocent III, profiting from German dissensions after the early death of Henry VI (1197), played upon the German factions (Otto IV, not established as king till 1208, was crowned emperor in 1209). Henry VI's son Frederick II (1212–50; crowned 1220), by the *Privilegium in favorem principum ecclesiasticorum* (1220) and by the *Statutum in favorem principum* (1232), made far-reaching concessions to the German princes in order to ensure their support for his Italian policy, but in vain. In spite of his striking victory at Cortenuova in 1237 Frederick failed to crush the Lombards and was excommunicated in 1239 and deposed in 1245. His death in 1250 marked the effective end of the medieval empire. In Germany a long interregnum (1250–73) brought down the imperial structure. In Italy, to ensure that there could be no restoration, the papacy called in the Frenchman Charles of Anjou (*see* CHARLES I of Naples and Sicily). When Rudolf of Habsburg succeeded as German king in 1273, he was only the head of a federation of princes, while in Italy he abandoned all claims over the centre and south, retaining only titular rights in Lombard.

The Empire after Frederick II.—It is characteristic of the new situation that Rudolf of Habsburg, though he made a number of attempts, never achieved the imperial dignity. Henceforward the title was largely in abeyance. For a century after Frederick II's death the only emperor was Henry VII (king from 1308 to 1313), who was crowned in Rome in 1312 by legates of the Avignon pope. Thereafter till the end of the empire there were in all only four emperors duly crowned: Charles IV, crowned by a legate in 1355; Sigismund, by the pope in 1433; Frederick III, in 1452; and Charles V, by the pope but at Bologna, in 1530. If the empire continued to exist, it was due partly to the force of tradition, partly to the exigencies of German politics, partly to fear of the dangerous conflict of interests which any plan for its abolition would involve.

The Germans, naturally, were unwilling to surrender hope of regaining something of the empire's former power: both Henry VII and Louis IV (king from 1314 to 1347; his Roman coronation in 1327 was by representatives of the people) sought to revive the Italian policies of the Hohenstaufen. But the balance had swung against them. France was already striving for the imperial position which Napoleon was ultimately to secure and determined at least that the Germans should not recover it. Moreover, in Germany itself, civil war had undermined the power of the kingship, and the elective monarchy was effectively controlled by the princes through the college of electors (*q.v.*), definitely established soon after 1250. French pretensions to leadership in Europe provoked a last tardy revival of imperialist sentiment both in Germany (Alexander of Roes at the end of the 13th century, Engelbert of Admont at the beginning of the 14th) and in Italy (Marsilius of Padua and Dante), but Charles IV, a sober realist, drew the necessary conclusions. By now the axiom that "the king is emperor in his kingdom" was firmly established; it marked the end of any universalist dream. Charles set out accordingly to make the empire a specifically German institution. By agreement with Pope Clement V, he formally abandoned Italy; he would only enter Rome on the day fixed for his coronation and leave again the same day. This he did on April 5, 1355. Then he turned to the definition of the German constitution, particularly the rights of the electors, in the Golden bull (*q.v.*) of 1356. The change was reflected in the final evolution of the empire's title: *sacrum Romanum imperium nationis Germanicae* (the Holy Roman Empire of the German Nation). This title, which appears under Frederick III (king from 1440, emperor from 1452 to 1493), indicates clearly enough that the emperor's powers were limited to his German lands. In 1508 Frederick's successor Maximilian I, unable to go to Rome, assumed with papal consent the style "elected emperor" (*imperator electus;* Ger. *erwählter Kaiser*).

The Empire in Modern Times.—The history of the empire after the promulgation of the Golden bull may be treated briefly, because from that time it is essentially a part of German history. It is true that memories of an imperial past continued to have an

influence on German thinking and that in the Habsburg lands there was a sense of belonging to a multinational empire. A few emperors—Sigismund in the 15th, Charles V in the 16th century—may even have thought to recover part of the old imperial prerogative. It was also possible to make something of the empire's leadership of Christendom against the Turk. But institutionally the role of the empire was almost continuously whittled away. After the failure of the project of imperial reform sponsored in 1495 by the elector of Mainz, Berthold von Henneberg (*q.v.*), the hope vanished of endowing the empire with permanent institutions effective beyond the limits of the different principalities. The Reformation entrenched the princes firmly in their rights and accentuated their autonomy.

When Charles V, opening the diet of Worms in 1521, declared that "the empire from of old had not many masters, but one, and it is our intention to be that one," he was shutting his eyes to the realities. The extent of his dominions was imposing, but they were a weak dynastic agglomeration; and though Charles championed the Catholic Church against the Reformation, his empire was neither in spirit nor in fact a revival of the medieval empire. When he accepted the peace of Augsburg in 1555 and abdicated in 1556, the change begun with the accession of Rudolf of Habsburg was completed. With Germany split into two religious camps, the emperor was little more than the head of a religious faction. Furthermore, the fact that after Sigismund of Luxembourg's death (1437), with one short intermission for Charles VII from 1742 to 1745, the imperial crown, though in theory elective, was hereditary in the Habsburg dynasty of Austria, produced a cleavage of interests between emperor and empire.

From 1556 until its end under Francis II in 1806 the empire meant little more than a loose federation of the different princes of Germany, lay and ecclesiastical, under the presidency of the house of Austria. After the Thirty Years' War, no emperor again attempted, as Charles V had done, to re-establish a strengthened central authority; and the treaty of Westphalia (*q.v.*) in 1648 marks its final organization on federal lines. Yet even at the end the empire had loyal adherents, particularly among the small knights and noblemen of western Germany, who regarded it as their safeguard against princely absolutism, and its role was not so entirely negative as is sometimes thought. Its loose structure still suited to some degree the cosmopolitan spirit of the 18th century. But with the French Revolution, and the intensified nationalism which followed, it became an anachronism.

As far back as the end of the 13th century French kings had been scheming to annex the title as well as to absorb the outlying territories of the empire. With Napoleon this ambition came within reach. Posing as the new Charlemagne ("because, like Charlemagne, I unite the crown of France to that of the Lombards, and my empire marches with the east"), he resolved in 1806 to oust Francis II from his title and to make the Holy Roman empire a part of the Napoleonic "new order." He was anticipated, however, by Francis, who in 1804 had assumed the title "hereditary emperor of Austria" and who, resolving that no other should wear the crown which he was powerless to defend, resigned the old imperial dignity on Aug. 6, 1806.

So perished the Holy Roman empire. The extent and character of its influence will always be a matter for debate; but it left a deep imprint on Europe. Nor did it cease to be influential after its extinction. The debate about the medieval empire was an ideological background to the creation of the second *Reich* or German empire in 1871, and even Hitler's third *Reich* drew sustenance from memories, often thwarted and perverted, of Charlemagne and Otto the Great and Frederick II.

See further EUROPE: *History;* GERMANY: *History;* PAPACY; also AUSTRIA, EMPIRE OF; biographies of the individual emperors; *see* also references under "Holy Roman Empire" in the Index volume.

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HOLY SPIRIT (HOLY GHOST), in Christian theology, the Third in the divine Trinity (*q.v.*). The limits of this article allow only the briefest summary of the history of the doctrine. It has been marked by three great controversies, which have centred in turn on the divinity of the Holy Spirit, his relation to the Son and his distinct personality.

Divinity of the Holy Spirit.—In the pre-Arian period, the doctrine of the person of the Holy Spirit was not a matter of controversy. In the form of baptism and in the interrogations put to the neophyte, both of which derived from Matt. xxviii, 19, the Holy Spirit appears as sharing with Father and Son in the one "name" of God and as being with them the object of Christian faith and the agent of the grace of regeneration. In early doxologies, the Holy Spirit is named along with Father and Son as the object of praise and adoration. In the primitive creeds (simple developments of the baptismal formula and brief summaries of the apostolic rule of faith), belief in the Holy Spirit was professed in a distinct article, whose parallel structure to the articles on the Father and the Son indicates the essential place of the Spirit in the Trinity (*see* CREED). Early interpretations of the creed keep this parallelism and, again after the fashion of the creeds, bring the Holy Spirit into close relation with the gifts of God in the new dispensation—the holiness and unity of the church, the inspiration of its sacred writings, its guidance in the truth, the forgiveness of sins and the resurrection of the body.

In certain pre-Nicene private theological speculations there is a tendency to subordinate the Holy Spirit to the Son, as the Son to the Father. Moreover, in a few writers of inferior authority, such as Hermas and Tatian, there is some uncertainty about the Spirit's personal distinctness. But the collective faith of the church as such shows no traces of these errant tendencies. Its simplicity and definiteness appear, for instance, in the famous oath of Clement of Rome's first Epistle to the Corinthians: "As God lives, and the Lord Jesus Christ lives, and the Holy Spirit, who are at once the faith and the hope of the elect."

At first, Arianism put forward no more than a doctrine of the Word, as God in name only, quite other in substance than the Father, and created by him in time (*see* ARIUS; ARIANISM; ATHANASIUS, SAINT; COUNCIL). Arius was apparently conscious of the consequences of his position, but he refrained from working out his theory of the "infinite inequalities" within the Trinity. The Council of Nicaea (325) was content to define the single point explicitly at issue, the consubstantiality of the Son, and simply added to its creed the traditional third parallel member: "And [we believe] in the Holy Spirit." In fact, it was not until after 350 that a new phase of the Arian controversy was initiated in Egypt, whence Arianism itself had come. Athanasius, in his first letter to Serapion (*c.* 359), quotes his correspondents as saying that certain members of the Arian party, repelled by its irreverences, had returned to the Nicene doctrine of the Son but refused to admit the Godhead of the Holy Spirit, "affirming that he is not only a mere creature,

but simply one of the ministering spirits, who differs only in degree from the angels."

The new debate was joined on the single issue of the Spirit's divinity; his distinct personality was universally assumed, save, of course, by Sabellians like Marcellus of Ancyra (d. 374). Athanasius calls his new adversaries the "enemies of the Spirit" (*pneumatomachoi*) or the "trope-mongers" (*tropikoi*) from their habit of explaining away in terms of metaphor the scriptural passages on the divinity of the Holy Spirit. He makes short work of their orthodox pretensions: "This view is no different from that of the Arians. . . . If they think wrongly about the Holy Spirit, they do not think rightly about the Son." He makes it clear that their view had no scriptural inspiration, but derived from the same sort of rationalism that gave rise to Arianism itself and that apparently had radiated from the school of Lucian of Antioch (d. 312).

The standpoint of Athanasius' refutation is the customary patristic one: "This is not the apostolic faith, nor may a Christian at all tolerate such views"; and his arguments are from the common patristic sources—the Scriptures, and "the tradition and the teaching and the faith of the Catholic Church from the beginning, which the Lord gave, and the Apostles preached, and the Fathers defended." In 362 the important synod of Alexandria demanded of those who would share the Catholic communion the condemnation of "those who say that the Holy Spirit is a creature, and separated from the substance of Christ." In effect, this was to apply the Nicene *homoousion* to the Holy Spirit; at the first direct challenge, the church was instantly conscious that such had always been its faith.

Meanwhile Macedonius (*q.v.*), the semi-Arian exiled bishop of Constantinople, was heading a similar school of thought and gaining many adherents around the Hellespont, in Thrace and in Bithynia. The Macedonians, as they were called, even succeeded in deceiving Pope Liberius and in spreading their ideas in the west. But Damasus, Liberius' successor, saw more clearly and condemned Macedonianism with characteristically western definiteness. The dispute in the east grew more violent when Eunomius, head of the radical Arian party, entered the lists on the side of the Macedonians, much to their distress. He was opposed by Basil (*q.v.*) of Caesarea, the chief Catholic champion after the death of Athanasius in 373. Basil himself died on the eve of the final defeat of Arianism and its Macedonian offshoot, accomplished politically by the extreme repressive measures of Theodosius and theologically by the Council of Constantinople (381), which reaffirmed the faith of Nicaea and condemned explicitly all shades of Arian opinion. In the so-called Nicene creed (almost certainly the work of the Constantinopolitan council of 381), the article on the Holy Spirit is expanded thus: "[We believe] in the Holy Spirit, the Lord and the life-giver, who proceeds from the Father, who with the Father and the Son is together worshipped and together glorified, who spoke through the prophets."

The formulas reveal the customary reverence of the early Eastern Church for scriptural language, when it sufficed for the purpose. The Holy Spirit is not explicitly called God, for the Scriptures do not explicitly call him God; but such a description is given of him that clearly forbids any thought of him as a creature; his action is divine, he shares equally with Father and Son in the honour due to God, and, above all, he proceeds from the Father—a formula that in the context clearly implies equality in divinity with the consubstantial Son, who is likewise from the Father, and that directly rules out the Macedonian idea of the Holy Spirit as the creature of the Son. Moreover, as at Nicaea in 325, the personal property (Gr. *idiotes*) of the Son had been marked by calling him, not simply God, but "God of God," so at Constantinople in 381 the personal property of the Holy Spirit is indicated with the degree of clarity that the Scriptures permitted; he is described in relation to the church as the cause of its unity, holiness, catholicity and apostolicity and of the gift of life (regeneration and resurrection) found in it. By his function in the economy of salvation, in which he is considered as bringing to its term and perfection the life-giving work of Christ, the union of men with God and with each other, the place of the Spirit in the economy of the divine life itself is suggested: in him, as the Third Person, the divine life of completest unity comes to its term and its perfection.

The Arian controversy, especially perhaps in its Macedonian phase, illuminates the intimate unity in Catholic thought between the nature of God, as subsistent in Three who are coequally divine, and the nature of man's salvation, as consisting in a true deification (*theosis*), whereby man individually shares in the nature of God (II Pet. i, 4) and collectively, as gathered into the unity of the church, somehow faintly reflects the unity of the divine life (John xvii, 20–26). Against the Arians, Athanasius had argued in his work *On the Synods* that if the Word Incarnate is not truly God by nature, he could not deify man. In his first letter to Serapion he uses a similar argument: "All of us are said to be sharers of the Godhead through the Spirit. . . . But if the Holy Spirit were a creature, no share in the Godhead would result in us through him; we would be joined simply to a creature, and be alien from the nature of God, in no respect sharing in it." The premise of the argument—man's deification, the gift that "comes from the Father through the Son by the Holy Spirit"—is assumed to be an admitted commonplace of Christian faith. Its denial was seen by Athanasius, and by the Greek Fathers in general, as an intrinsic element of the Macedonian "impiety"; by separating the Holy Spirit from the inner life of God, they separated mankind from a share in that life and reduced Christianity to a bare naturalistic moralism, devoid of its proper supernatural character as gift and mystery. (J. C. My.)

Procession of the Holy Spirit.—To discuss whether the Holy Spirit proceeds from the Father alone or from both the Father and the Son might seem at first sight presumptuous and useless; for the matter so exceeds human conceivings that it might well be left in reverent obscurity, and it is not obvious how speculation about it can affect Christian life. Yet both Eastern and Western theologians have treated the matter with intense seriousness; and their sense of the importance of the question remains even when all possible allowance has been made for the nontheological factors which embittered Eastern-Western relations. Both sides were radically convinced that correct language about Father, Son and Holy Spirit is essential to the authentic message of salvation; a mistake about the Trinity would mean a mistake about the message itself, for the nature of God must affect man's relation to him. The two great errors which the church always has to meet are a Sabellianism which reduces Son and Holy Ghost to mere names or to mere manifestations of the one undifferentiated Godhead, thus making Christianity no different from Judaism or Islam; and Arianism, which, with its hierarchy of semidivine beings, would make Christianity scarcely less than a veiled polytheism. The specifically Christian virtue of charity derives from the mutual self-giving of Father, Son and Holy Spirit, and if this divine mutuality is distorted or falsified then the basis of Christian charity itself is distorted or falsified and the finality of Christian revelation fails. It was this conviction that lay behind the disputes about the *Filioque*, the procession also from the Son.

In the Gospel of St. John the Holy Spirit is said to proceed from the Father, to be sent and to be given by the Father (xv, 26; xiv, 26; xiv, 16); he is also said to be sent by the Son and to be breathed forth by the Son, and to "receive" from the Son because "all that the Father has is mine" (xv, 26; xx, 22; xvi, 13–15). St. Paul makes clear that the Spirit of the Father is likewise the Spirit of the Son (*e.g.*, Rom. viii, 9; Gal. iv, 6). Thus the Son is absolutely one with the Father as regards the Holy Spirit, and this is expressed by saying that the Holy Spirit proceeds from the Father and the Son, or from the Father through the Son, expressions taken as equivalent.

Moreover, Scripture attributes divine works of unity, charity and holiness to the Holy Spirit, and this attribution is understood as indicating the distinctive characteristic of the Holy Spirit. Hence both East and West agree that the Holy Spirit is the bond, the fellowship (*koinonia*) or the mutual charity between Father and Son, in whom they are absolutely united. This may be taken as the ultimate reason why it is said that God is love (I John iv, 7–9).

The Greeks, however, recoiled from saying that the Holy Spirit proceeds from the Son, partly at least because the assertion had

been used by heretics to draw Sabellianistic or Arianistic conclusions. Marcellus of Ancyra argued that as the Spirit comes from the Son and likewise comes from the Father there can be no real distinction between the Father and the Son and hence the words Father and Son are only names indicating the activities or the "unfoldings" of the one God in the created universe. Thus the origin of the Holy Spirit from the Son was urged in support of unitarian views. The 9th-century patriarch Photius also thought that the procession from both Father and Son tended toward Sabellianism, as have Vladimir Lossky and John Meyendorff among modern Orthodox theologians.

On the other hand, Eusebius of Caesarea (d. *c.* 340) argued in his work on ecclesiastical theology that since the Spirit is sent by the Son and receives of him, the Spirit must be a creature made by the Son. The Spirit, since he did not receive his origin, as did the Son, directly from the Father, must be inferior to the Father and the Son. Theodoret of Cyrrhus (d. *c.* 466) declares explicitly in his answer to the ninth of the 12 chapters of Cyril of Alexandria that if the Spirit is not from the Father alone, but were even from the Father "through" the Son, he would be a creature of the Son.

Since, then, an origin of the Holy Ghost from the Son was associated with heretical opinions either about the distinction of the Persons in the Trinity or about the full divinity of the Holy Spirit, the Greek Fathers tend to avoid explicit statements that the Spirit derives his origin from the Son as well as from the Father. Such statements can indeed be found in Epiphanius, Didymus and Cyril of Alexandria; moreover, what the Greek Fathers say about the unity of Son and Spirit in sanctification and about the "sending" of the Holy Spirit by the Son imply that the being of the Spirit is grounded in the being of the Son just as the being of the Son is grounded in the being of the Father. And yet Greek Fathers such as Athanasius and Basil are so preoccupied with the denial that the Holy Spirit is a creature that their teaching about the relation of the Holy Spirit to the Son can be learned only by inference and deduction, though Athanasius says in his third letter to Serapion that the Spirit has all that the Father has "through the Son."

In the West the Macedonian denial of the divinity of the Holy Spirit seems not to have been so dangerous as in the East. But in Spain the Priscillianists of the 6th century, though marked by a Sabellian trend, forcibly denied that Christ was the eternal Son of God; and the Adoptionist heresy of the 9th century maintained that Christ was merely an adopted son of God through the action of the Holy Spirit upon him. Against such heresies the assertion that Christ was the origin with the Father of the Holy Spirit affirmed that the Son was in no way inferior to the Father and that all three Persons participated equally in the divine essence.

Thus the Greek hesitancy about the *Filioque* and the Latin assertion of it were both due to equal concern for orthodoxy; and the different stress laid upon different aspects of the truth was due to the different attacks which had to be met upon the common faith. The Latin doctrine is not of a double procession but of one procession from Father and Son as from one principle and one "breathing forth" of the Holy Spirit. The Council of Lyons (1274) condemned any procession "as from two principles" and not from one. At the conference at Bonn in 1874 between Russian theologians and Old Catholics there was agreement to reject any expression implying "two principles" or *archai* or *aitiai* in the Trinity; and Orthodox theologians in their conference with the Anglicans in 1931, while rejecting "a separate principle in the Godhead," seemed to admit that both Eastern and Western forms of expression were permissible and "were intended to express the same faith." The Russian synod in Moscow in 1948, however, considered that the *Filioque* tainted the purity of the ancient faith. This unhappy dispute was admittedly complicated by nontheological factors which led each side to make the worst of the other.

Many Orthodox hold that the introduction of the *Filioque* into the so-called Nicene creed violated the prescriptions of the ecumenical councils of Ephesus (431) and Chalcedon (451), which forbade putting forward "another faith" or "another creed." The Western churches, however, understood this prohibition as referring to a change of belief and not as referring to explications of the ancient faith, necessary in certain circumstances to defend it. At the Reformation, and in orthodox Anglicanism and Protestantism, the *Filioque* was retained. (*See* also CREED: *Nicene Creed: Filioque Clause.*)

Would it prove an acceptable compromise formula to rest content with the expression that "the Holy Ghost proceeds from the Father through the Son"? The formula avoids any suggestion of a "double" procession yet keeps the person of the Son in the procession. Yet this formula, though acceptable both to Greeks and Latins, as is clear from the Council of Florence in 1445, proved, unless analyzed, inadequate as a reconciling terminology. The word "through" (Gr. *dia*), used of the divine processions, must signify, since the Son is a person, some personal relationship of the Holy Ghost to the Son. What is the nature of this relationship? The word "through" clearly denies any suggestion of a parallel or, as it were, independent relationship of the Son and of the Holy Ghost to the Father, and this being so the relationship can only be one of origin from the Son, as is indeed implied by the scriptural teaching that the Spirit is the Son's very own Spirit, just as he is the Father's very own Spirit. This origin, however, of the Holy Ghost from the Son, as the expression "through the Son" implies, derives from the Son's own procession from the Father and is necessarily connoted by the completeness of the Father's self-giving to the Son. Augustine well says that the Holy Ghost proceeds "principally" from the Father, since the Son's breathing forth of the Spirit is given to him by and in his own procession from the Father.

Almost every prayer of the church is made "through our Lord Jesus Christ," and this applies to prayers that God may give to his church and to the faithful the gift of his Spirit. Thus the gift even of God's own Spirit comes through Christ and comes through him personally. But the temporal gift, like the temporal sending, rests upon an eternal relationship, and the very being of the Holy Spirit consists in being breathed forth from the single and undivided unity of Father and Son. That unity, however, does not destroy the Son's reception from the Father of all he is and has.

Personality of the Holy Spirit.—In English the individual designation of the third Person of the Blessed Trinity is indifferently "Holy Ghost" or "Holy Spirit." In Old English it was written in two words, *hálza gást* or *háliz gást;* in Middle English very generally a combination, *haligast, holigost,* and then, since the 16th century, as two words. In the Book of Common Prayer (1549) and even in the additions and deviations proposed in 1928, the two titles are used almost indifferently. In more modern theological writings, especially American, the tendency is to favour the designation "Holy Spirit" over the older name "Holy Ghost."

The word "person" is used of Father, Son and Holy Spirit in an analogical, not a univocal sense. Each is distinct, intelligent, free and substantial; but no word used of God applies to him in the same way as it applies to creatures. Hence great caution is needed in the use of such words as "individual," "ego," "self," "conscious," "personality," as well as in assigning the meaning of "father," "son" and "spirit" when applied to God. Gregory of Nazianzus points out in his fifth *Theological Oration* that the Macedonians failed to recognize this and says to them: "If you say that the Holy Spirit proceeds from the Father as the Son does, why do you not say that he is the brother of the Son? If he proceeds from the Son, why do you not say that he is the grandson of the Father?"

This necessary analogical use of words springs from the absolute unity of the divine nature, intellect, will and all activities; upon this the Sabellians based their denial of the distinction of persons. The Macedonians judged that the orthodox doctrine of Gregory involved Sabellianism and urged the following difficulty against him: "What is lacking to the Holy Spirit that he should not be the Son? If something is lacking, then he is not equal to the Son and is not true God. But if nothing is lacking then he is really the Son." Gregory answers:

> We say that nothing is lacking to him, for nothing can be lacking to God. But the difference in their manifestation and the difference in their relation to one another [Gr. *tes pros allela scheseos*] justifies their different names. Nor is anything lacking to the Son to make him the

Father, for Sonship is not a lack of anything, and yet he is not the Father. Otherwise, on the same principle something should be lacking to the Father to make him the Son; yet the Father is not the Son. The terms "he is not begotten," "he is begotten" and "he proceeds" justify our saying that one is the Father, another the Son and another the Holy Spirit and thus the unconfused distinction of the hypostases [persons] is preserved in the one nature and honour of the Godhead. For the Son is not the Father but is what the Father is; nor is the Spirit the Son, but is what the Son is. These three are one if you look at the divinity, and the One is three if you take account of their distinguishing characteristics [Gr. *idioteseis*], so that the assertion of the unity is not Sabellian, nor are the Three split up as by these modern pestiferous dividings.

Thus the relations of one to another is what distinguishes the Persons: the Father is Father only with regard to the Son: the Son is Son only with regard to the Father; and the Holy Spirit is holy and is spirit with regard both to Father and to Son. This truth is expressed technically by the adage "everything is one save where relative confrontation prevents it" (*omnia sunt unum ubi non obviat relationis oppositio*). And so the "personality" of the Holy Spirit is essentially a relation and not an absolute "thing." Personality in God is relativity to others and not self-enclosedness, a truth which has far-reaching repercussions upon right concepts of human personality. Gregory of Nazianzus was well aware that some Macedonians imagined that the Holy Ghost was an impersonal influence, an emanation, a gift, an energy or operation of God. He accused them in the same oration of being "binitarians," not trinitarians, and points out that Scripture presents the Holy Spirit as being intelligent, free and as acting as "personally" as God himself, for he gives commands, is made sad and becomes angry.

In the 19th century and in the early decades of the 20th the "liberal" school of theologians dealt with the Trinity under various philosophical influences, Kantian, Hegelian, Ritschlian, idealistic and subjectivistic; consequently they either rejected the traditional teaching or tried either to extract from it what they considered its kernel of "religious value" or else to restate the doctrine in ways that would reconcile it with "the modern mind." Very often the presuppositions were subjectivistic and it was taken for granted that human experience, enlightened by new outlooks, was the sole theological standard. The too general tendency to identify personality with self-consciousness was fatal to any save a Sabellian view of the Trinity and a Nestorian view of the incarnation. As regards the person of the Holy Spirit, the liberal school, laying undue stress upon the uncertain language of some early Christian writers, held that up to the 3rd or 4th or even 5th century Christianity might have been considered as equally "binitarian" or "ditheistic" as trinitarian.

Sharp and radical dissent from the liberal trend is shown by what has been called the neo-orthodoxy associated with Karl Barth and by what may be called the neo-evangelicalism associated with periodicals such as *Christianity Today* in the United States and the *Churchman* in England, though such generalizations may perhaps be misleading. Notable, however, is Barth's renovation of the Augustinian adage *mitti est cognosci ut ab alio procedens* ("to be sent is to be known as proceeding from another"), which denies a distinction between the manner of God's revelation and its content, since the very being of Christ and the sanctifying action of the Holy Spirit reveal the inner and ultimate nature of God; and his independent and spirited exposition of the Holy Spirit as the *koinonia*, or, as the English translation awkwardly calls it, the "communityness," of Father and Son.

Roman Catholic theologians, if they have seemed to some a little unadventurous in their expositions of the Trinity, have nevertheless made worthy studies of the development of the doctrine and have been striving to break new ground on the intricate question of the indwelling of Father, Son and Holy Ghost in the souls of the sanctified. It is possible that these studies may eventually provide a meeting of minds with the Palamite doctrine (*see* PALAMAS, SAINT GREGORY) of the "divine energies," though the outlooks and the terminologies seem very far apart. Leo XIII explained and encouraged devotion to the Holy Spirit in his encyclical *Divinum illud munus* (1897). He justified the refusal of Innocent III to institute a feast of God the Father on the ground that liturgical worship, though always directed to Father, Son and Holy Spirit, yet celebrates only the mysteries of the Son as incarnate and of the Holy Spirit in his external mission, lest any mistake should creep in about the unity of God. Leo then details the activities of the Holy Spirit in the incarnation, in the church and in the souls of the faithful.

In many liturgical prayers and hymns petition is made to God that the Holy Ghost may be given in more abundant measure to the faithful, individually and collectively; and this prayer accords with the theological doctrine of the "sending" of the Holy Ghost by Father and Son. There are also prayers to the Holy Ghost himself, which accord with the teaching that the Holy Ghost is neither Father nor Son even though he is one in nature with them. Both types of prayer combine accuracy of theology with warmth of devotion. (BE. L.)

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HOLY WATER. Water is a natural symbol of purification and has been used by religious peoples both primitive and advanced as a means of removing uncleanness, either ritual or moral. In the early Christian community the "living" water of rivers and streams was the preferred water for baptism and apparently received no special blessing. In the 4th century, however, the still waters of the baptismal font or pool were exorcised and blessed with the sign of the cross. At the same time other water was blessed for the use of the faithful as a means of warding off the unclean spirit and as a safeguard against sickness and disease. In the course of time this blessed or holy water was used as a reminder of baptism by the faithful on entering the church and by the celebrant in sprinkling the congregation before the Sunday Mass (*see* ASPERGES). In the Christian churches of the east and in the Catholic church of the west the rite of sprinkling with holy water is the usual accompaniment to the blessing of churches, homes and articles of devotion. (P. F. P.)

HOLY WEEK in the church year is the week between Palm Sunday and Easter (*qq.v.*); it is observed with especial solemnity as a time of devotion to the passion of Christ. In the Greek and Roman liturgical books it is called the "Great Week" not, as John Chrysostom remarks in his homily on Ps. cxlv, 2, that it contains either longer or more days than other weeks but because great deeds were done by God in it. The name "Holy Week" also is very old and was used in the 4th century by Athanasius and Epiphanius. Originally only Friday and Saturday, the nucleus of Holy Week, were observed as holy days; later Wednesday was added as the day on which Judas planned with the Jews to betray Jesus Christ, and by the beginning of the 3rd century the other days of the week had been added. The pre-Nicene church concentrated its attention on the celebration of one great feast, the Christian Passover (*pascha*), on the night between Saturday and Easter Sunday morning. By the later 4th century the practice had begun of separating the various events and commemorating them on the days of the week on which they occurred: Judas' betrayal and the institution of the Eucharist on Maundy Thursday (*q.v.*); the passion and death of Christ on Good Friday (*q.v.*); his burial on the Saturday; and his resurrection on Easter Sun-

day. The Holy Week observances in the Roman missal were revised according to the decree *Maxima redemptionis* (Nov. 16, 1955) to restore the services to the time of day corresponding to that of the events as narrated in Scripture (*see* LITURGY: *Latin Eucharistic Rites: Roman Rite and Paschal Mystery*). *See* also CHURCH YEAR; *Jerusalem*.

See W. J. O'Shea, *The Worship of the Church* (1957); H. Thurston, *Lent and Holy Week* (1904). (L. C. S.)

HOLYWELL (TREFFYNNON, "well town"), a town and urban district (established 1894) in Flintshire, Wales, lies on the left bank of the Dee estuary. Pop. (1961) 8,459. The holy well is that of St. Winifred (Gwenfrewi), who is said to have lived in the 7th century and to have been beheaded by her lover. Her head rolled down the hillside and where it came to rest water immediately gushed forth. St. Beuno was believed to have restored her to life. The site became one of the most famous well-shrines in medieval Britain and continues to attract both Protestants and Roman Catholics. The well itself is covered by a Gothic chapel founded by Margaret, mother of Henry VII. In 1870 a hospice for poorer pilgrims was built. The parish church (rebuilt 1769) has some remnants of an earlier building and a 15th-century embattled tower. About 2 mi. from the town are the remains of Basingwerk abbey, partly Saxon and partly Early English. It became a Cistercian house in 1131 and was dissolved in 1535. The district around had copper, lead and coal mines in the 18th century, while the town possessed chemical and textile works. Modern industries are associated with the north Wales coal field. (E. G. Bow.)

HOLZ, ARNO (1863–1929), German writer whose early work as critic, poet and dramatist, largely undertaken in collaboration with his friend J. Schlaf, inaugurated naturalism in German literature. He was born on April 26, 1863, at Rastenburg (Ketrzyn), East Prussia. He expounded his theory in *Die Kunst, ihr Wesen und ihre Gesetze* (1890–92). In *Buch der Zeit* (1885, augmented 1905 and 1924) he introduced the factories and proletariat of urban society into poetry. Holz and Schlaf also provided models of the new naturalistic-photographic technique in *Papa Hamlet* (1889; three stories) and the drama *Familie Selicke* (1890), both of which powerfully influenced Gerhart Hauptmann's *Vor Sonnenaufgang*. In *Revolution der Lyrik* (1899) Holz rejected rhyme, strophe and all traditional rhythm, and further exemplified his theory in *Phantasus* (1898–1916, revised 1924), poems written in a rhythm that is reminiscent of Walt Whitman. In his later work (*Die Blechschmiede*, 1902, revised 1924) he departed increasingly from naturalism, but his influence is evident in the lyrical poetry of the German expressionists. He died in Berlin on Oct. 26, 1929.

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HOMAGE, in feudal law, was the solemn, ritual act by which a person became the vassal of a lord (*see* FEUDALISM). It consisted essentially in an act of surrendering oneself to another (*se commendare*). This was symbolized by the prospective vassal's kneeling and tending his joined hands to the lord, who clasped them in his own (*immixtio manuum*), thus accepting the surrender. This ritual, however, could also be applied in circumstances not connected with feudalism; *e.g.*, in the servile homage (when a man surrendered himself to a master to become his serf) or in the peace or conciliation homage after a blood feud (in which a man gave himself up to another family in compensation for the killing of one of its members). The feudal homage included an oral statement, usually a short formula, to which the lord sometimes gave a short reply. The original term for the ritual, *commendatio*, came to be replaced by *homagium* (or *hominium* or other variants) and by its Germanic equivalent *Mannschaft* because the most widespread word for vassal was "man" (Lat. *homo*). As far as is known, examples of *hominium* and its variants are not older than *c.* A.D. 1030. Homage was followed by a separate oath of fealty, perhaps to stress the fact that the new vassal was still a free man. (R. C. v. C.)

HOME, EARLS OF, a title held since 1605 by members of the famous border family of Home (or Hume), whose ancestral stronghold was Home castle in Berwickshire and who claim descent from the great comital house of Dunbar. ALEXANDER (*c.* 1566–1619), 6th Lord Home, was created earl of Home in 1605. Warden of the east marches, he was often at feud with the Hepburns, a rival border family; he accompanied James VI to England in 1603. The 1st earl was the son of Alexander (d. 1575), 5th Lord Home, who fought against Mary Stuart at Carberry Hill and Langside, but later became one of her staunchest supporters, defending Edinburgh castle for her in 1573 and probably dying in captivity.

On the death of JAMES (*c.* 1607–1633), 2nd earl, the title passed to SIR JAMES HOME (d. 1666) of Coldingknows, a descendant of the 1st Lord Home. The 3rd earl fought at Preston in 1648 and lost his estates under Cromwell, but they were restored in 1661. His descendant WILLIAM (d. 1761), 8th earl, fought on the English side at Prestonpans (1745) and from his brother ALEXANDER (d. 1786), 9th earl, the present earl descends. COSPATRICK ALEXANDER (1799–1881), 11th earl, was created a United Kingdom peer as Baron Douglas in 1875 and his son CHARLES ALEXANDER (1834–1918), 12th earl, took Douglas as an additional surname. The 14th earl, having been foreign secretary from 1960, renounced his peerages on being appointed prime minister in 1963 and became known as Sir Alexander Frederick Douglas-Home. (T. I.)

HOME, JOHN (1722–1808), Scottish dramatist and poet who was said by Thomas Gray to have "retrieved the true language of the stage" in his tragedy, *Douglas* (1756), was born at Leith, Sept. 21, 1722, and studied at Edinburgh. After taking orders, he fought against the Jacobites in 1745 before becoming minister at Athelstaneford, East Lothian, in 1746. His first tragedy, *Agis* (1747), was rejected by Garrick, who in 1756 also rejected *Douglas*, despite its striking plot based on the ballad of *Child Maurice* or *Gil Morrice;* its production in Edinburgh, however, enjoyed great success. The presbytery, who disapproved of the theatre, summoned Home, and prosecuted Alexander Carlyle for attending it. Home ignored the summons, but resigned from the ministry after a visit to London (1757), where *Douglas* had great success at Covent Garden. Garrick then produced *Agis*, acting in it himself, and subsequently produced Home's other plays, despite their lack of merit. Home, who spent several years as private secretary to the earl of Bute, took up soldiering again in later life. He counted among his friends David Hume, Adam Smith and Scott. He died at Merchiston Bank, near Edinburgh, Sept. 5, 1808.

BIBLIOGRAPHY.—Home's *Works*, ed. by H. Mackenzie, 3 vol. (1822), includes a biography, the plays and *The History of the Rebellion in 1745* (1802). There are poems by Home in *Original Poems by Scottish Gentlemen*, vol. ii (1762). *See* also A. E. Gipson, *John Home: a Study of His Life and Works with Special Reference to . . . "Douglas" and the Controversies Following Its First Representations* (1917); F. S. Boas, "Home's First Two Plays," *Fortnightly Review*, clxxiv (1850).

HOME AND SCHOOL: *see* PARENTS AND TEACHERS, NATIONAL CONGRESS OF.

HOME COUNTIES. Until the London Government Act 1963 introduced changes, implemented on April 1, 1965, this term generally referred to the English counties of Middlesex, Surrey, Kent, Essex (the counties surrounding London). Under the act, Middlesex (*q.v.*) has ceased to exist; the counties now bordering Greater London are Buckinghamshire, Hertfordshire, Essex, Kent, Surrey. Before the act Sussex and Berkshire, as well as Buckinghamshire and Hertfordshire, were sometimes included in the Home Counties.

HOME ECONOMICS (ARTICLES ON). The article HOME ECONOMICS discusses the knowledge and skills comprised by the term; the evolution of methods of communicating them; and the professional careers open to one with education in this field.

FOOD PREPARATION describes methods of cookery approved by experts for bread, fish, fruit, gravies, meat, mushroom dishes, pastry, stuffings, vegetables, etc. Among additional articles dealing with food are DIET AND DIETETICS; FLAVOUR; FOOD, CARE AND STORAGE OF (IN THE HOME); FOOD PRESERVATION (IN THE HOME); NUTRITION; VITAMINS. Characteristic dishes of various countries of the east and west are described in FOODS, NATIONAL. Many articles descriptive of the processing of individual foods contain material of interest to the consumer; for example, BACON; BEEF; BISCUIT; BREAD; BUTTER; CEREALS; CHEESE; CONFECTIONERY

MANUFACTURE; HAM; ICE CREAM; MARGARINE; MILK; PORK.

Articles on beverages include ALCOHOLIC BEVERAGES, DISTILLED; BEER; SOFT DRINKS; WINE.

INTERIOR DECORATION surveys the field in terms of both aesthetic and practical considerations, covering decorative planning, materials and accessories, and methods of applying this information; INTERIOR DECORATION, HISTORY OF is a survey of period decoration. Among supplementary articles are BROCADE; FURNITURE DESIGN; GLASS; IRONWORK; POTTERY AND PORCELAIN; RUG AND CARPET; SILVER AND GOLD WORK; TAPESTRY; EMBROIDERY; TEXTILES, HOUSEHOLD; WALLPAPER; and articles on individual pieces of furniture: BED; CABINET FURNITURE; CHAIR AND SOFA; SCREEN; TABLE; etc.

Articles on domestic architecture include HOUSE DESIGN and RESIDENTIAL ARCHITECTURE. Gardens are discussed in HORTICULTURE and LANDSCAPE ARCHITECTURE.

HOME EQUIPMENT is a general survey, dealing with cleaning equipment, cooking utensils, dishwashers, heating equipment, home laundries, ranges, refrigerators, etc.

DRESS surveys the history of costume. Related articles include NEEDLEWORK and SEWING, HOME. Articles concerned with personal appearance include COSMETICS AND COSMETOLOGY and HAIRDRESSING.

Many articles on industries contain material of interest to the homemaker as a consumer. These include BLEACHING; BRUSH; CHINAWARE; CLOTHING MANUFACTURE; CUTLERY; DRY CLEANING; FLATWARE; FURNITURE MANUFACTURE; GLASS MANUFACTURE; GLOVES; HARDWARE; LAUNDRY INDUSTRY; LEATHER; PERFUME; PLASTICS; STARCH; etc.

Information on home maintenance is included in such articles as CARPENTRY; HEATING AND VENTILATION; JOINERY; LIGHTING; PAINT; PLUMBING; WOODWORKING MACHINERY.

Articles on the home in relation to the community include APARTMENT HOUSE; CITY PLANNING; HOUSING; SEWAGE DISPOSAL; ZONING.

Among discussions of family finance are BUDGET, FAMILY; COST OF LIVING: *General Considerations;* INSURANCE; INVESTMENTS: INDIVIDUAL.

Etiquette is treated in an article under that title; *see* also ADDRESS, FORMS OF and PROTOCOL AND PRECEDENCE.

Among articles on laws affecting home life are HOUSING; LANDLORD AND TENANT; REAL PROPERTY AND CONVEYANCING, LAWS OF; WOMEN, LEGAL POSITION OF. Additional listings are given in LAW (ARTICLES ON).

The lists given above are intended merely as illustrations of the method of arrangement. Additional listings on relevant topics are given in CHILDREN (ARTICLES ON); ECONOMICS (ARTICLES ON); EDUCATION (ARTICLES ON); FINANCE (ARTICLES ON).

In researching any topic, the Index should be consulted.

HOME ECONOMICS, in some countries called domestic economy, domestic science or home science, is a broad field of learning integrating the subject matter of several disciplines to form a body of knowledge focused on the problems of the home and family living. It draws upon knowledge from such fields of study as art, bacteriology, biology, chemistry, economics, physics, psychology and sociology. It is concerned with all phases of home life and includes the following subject areas: child development and family relationships; clothing, textiles and related art; family economics and home management; food and nutrition; and housing and household equipment. A relatively new professional field, it acquired the name home economics—now the usual term in the U.S.—at the first Lake Placid conference in 1899. It developed rapidly into a well-organized profession, with more than 27,000 members in the United States in the 1960s and an international organization including members in almost every country of the world.

This article is concerned primarily with home economics as a profession. For articles in *Encyclopædia Britannica* on the various subject areas in home economics, *see* HOME ECONOMICS (ARTICLES ON).

HISTORY

Early developments which culminated in the home economics movement were widespread and extended over a considerable period of time. The home and family, the basic unit of society, naturally provided the first training in the home arts, and the heritage and culture of the family was passed down for generations from mother to daughter through an apprentice type of training. Formal study of household problems both in Europe and the United States began with the early sewing and cooking schools, sponsored by private individuals or groups. In 1821 Emma Willard began the teaching of household arts in the Troy Female seminary, Troy, N.Y.; and in 1835 Boston girls were taught sewing in the second and third grade. The New York Cooking school started in 1874 under the management of Juliet Corson; and in 1879 the Boston Cooking school was organized by the Women's Education association of Boston, Mass. This was the first incorporated cooking school in America. These schools varied greatly in the nature and quality of the program presented. (*See* also WOMEN, EDUCATION OF.)

The home economics movement received momentum from the work and writings of Catharine E. Beecher, a pioneer in education for women in the United States. Her books, *A Treatise on Domestic Economy* (1841), *The Domestic Receipt Book* (1842) and *The American Woman's Home or Principles of Domestic Science* (1869), are among the early classics of home economics literature. In the first two, she set up a pattern for teaching domestic economy in schools. The third book presented a plan for establishing and maintaining an economical, healthful, beautiful Christian home. Miss Beecher's most significant contributions to education for women were her emphasis on the importance of a scientific background as a basis for an intelligent study of the home and her recognition of the need for economic independence of women.

Another important agency of the early 1870s which promoted education for the home in the United States was the Kitchen Garden movement of New York, formally organized as the Kitchen Garden association of New York in 1880. It was a program designed to teach children household tasks through play activities. In 1889 the New York College for the Training of Teachers (Teachers college of Columbia university) was established as a result of the Industrial Education association of New York (1884), which was an outgrowth of the Kitchen Garden association.

The Chicago World's fair of 1893 also reflected the growing interest in problems of the home and family living. The National Household Economic association was organized there, and two of the exhibits were significant in the development of home economics: the food exhibit, including an analysis of food materials (the precursor of nutrition research) by the U.S. department of agriculture, and the Rumford Kitchen, which depicted a working man's home operated on $500 a year.

The Rumford Kitchen was directed by Ellen H. Richards, destined to become the foremost leader of home economics in the United States. Mrs. Richards, a graduate of Vassar college, Poughkeepsie, N.Y., and the Massachusetts Institute of Technology, Cambridge, was interested in the application of the principles of science to the problems of the home. It was at her suggestion that the first conference on home economics in the United States was held in Sept. 1899 at the Lake Placid club in Lake Placid, N.Y. Mrs. Richards served as chairman, and 11 persons, 10 women and 1 man, attended. The group encompassed a variety of specialists (a chemist, an economist, a librarian, educators) all dedicated to a single purpose: a study of the economic and sociological problems of the American home.

At the tenth and final Lake Placid conference steps were taken to form a national organization. About six months later, on Jan. 2, 1909, the American Home Economics association was organized at a meeting of the teaching section of the Lake Placid conference in Washington, D.C. Mrs. Richards was unanimously elected the first president. The purpose of the association was stated as "the improvement of living conditions in the home, the institutional household and community."

The greatest impetus to the development of home economics in the United States was the support and recognition rendered by the federal government in the enactment of legislation which has had a direct bearing on the development and expansion of the program,

such as the Morrill acts of 1862 and 1890, the Smith-Lever act of 1914 and the Smith-Hughes act of 1917.

The Morrill act of 1862 provided for the establishment of colleges of agriculture and engineering in every state to promote the liberal and practical education of the industrial classes. This legislation laid the foundation for a system of public higher education —the land-grant colleges and universities (*q.v.*)—that was to develop and to become a powerful force in the economic and social advancement of the United States. The act of 1890, defining the areas of instruction, designated home economics as one of the economic sciences which would also provide for the education of women in the land-grant colleges. The Smith-Lever act provided for the co-operative agricultural extension service to aid in diffusing useful and practical information on subjects relating to agriculture and home economics. The Smith-Hughes act, which was designed to promote vocational education of less than college level in agriculture, home economics and the trades stimulated the development of home economics at all levels; the secondary school teachers of such programs were required to be degree graduates of four-year programs including instruction in all phases of home economics.

In Great Britain and in most European countries, the earliest educational programs in domestic economy were sponsored by private groups, such as women's societies with a philanthropic interest in the welfare of man and society. The instruction dealt primarily with the attainment of skill in sewing and in cooking. The aim of these programs was to improve the domestic service and to raise the standard of living particularly among the working classes. (*See* also *Great Britain* below.)

The establishment of home economics in Canada was greatly influenced by its development in Great Britain and in the United States. Household tasks were taught to young girls by the Ursuline nuns in the convents of Quebec as early as the 17th century. However, Adelaide Hoodless (1857–1910) is credited with having instigated the first introduction of home economics into the public schools in Hamilton, Ont., in 1896 and the establishment of the Women's Institute movement in 1897. This organization for rural women interested in problems of home and family living spread rapidly throughout Canada and later to Great Britain and the commonwealth countries. Mrs. Hoodless was also instrumental in persuading Sir William Macdonald to create the Macdonald Training fund (1899), which provided teachers and equipment for training centres organized in the public schools of Ontario, British Columbia and the maritime provinces, and to provide funds for the establishment of the first college programs in household science. The Technical Education act of 1919 similarly advanced the spread of home economics in Canada.

The growth of home economics after 1948 was world wide. Technical assistance in home economics provided by the Food and Agriculture Organization of the United Nations (FAO), the International Cooperative administration of the United States of America (I.C.A.), the U.S. office of education, the American Home Economics association, the Ford foundation, the Rockefeller foundation and others in co-operation with the government of countries in Latin America, the Caribbean, India, the near east, the middle east and Africa contributed much to the changing patterns of family living around the world.

EDUCATION IN HOME ECONOMICS

United States.—The first formal instruction in home economics at the college level was given at Iowa State University of Science and Technology, Ames, in 1872. The first four-year, degree-granting program was given at the University of Illinois (at that time the Illinois Industrial university) when a school of domestic science and art was established in 1874. The Boston Normal School of Cookery, the first in the east for training teachers for the new subject, was established in 1887. Later it became the State Normal school at Framingham, Mass. In 1889 the New York College for the Training of Teachers, now Teachers college of Columbia university, was established. By 1890 departments of domestic science and art had been established at Oregon State university, Corvallis, and South Dakota State college, Brookings. Thirty colleges were offering programs in home economics by 1900.

In the southern states, Mississippi State College for Women, Columbus, was founded in 1884. The South Carolina Industrial and Winthrop Normal college (now Winthrop college), Rock Hill, offered work in dressmaking and cooking in 1892. In 1893 the University of Alabama, University, Ala., included domestic art and domestic economy in its curriculum. The University of Tennessee, Knoxville, introduced domestic science in 1897 and the Georgia Normal and Industrial college (now Women's College of Georgia), Milledgeville, was established in 1889.

In the early 1960s there were in the U.S. over 400 institutions granting degrees in home economics. About half of these were privately supported.

Elementary and Secondary Schools.—There were sporadic evidences of some form of home economics in elementary schools prior to the Civil War, but little attention was given the subject before 1880. Thereafter its development was closely related to the advent of science into the high-school curriculum and to the rapidity with which the country had become industrialized. In addition, the passage of the National Vocational Education act (Smith-Hughes act of 1917) promoted the expansion of home economics in the secondary schools. This act provided federal funds to be used for the reimbursement of the salaries of teachers and supervisors of home economics in schools below college level. It also included support for the preparation of teachers of home economics at the college level. The requests by the states for these funds were so great that a succession of federal appropriations between 1929 and 1946 (the George-Reed, George-Ellzey, George-Deen and George-Barden acts) were passed to meet the demand. Not only were the monies increased and made permanent but provision was made for travel expenses, equipment, supplies and rent and research in home economics education.

Federal aid to vocational education encouraged the growth of home economics in the secondary schools of the U.S., although not all schools offering such instruction received reimbursement. The federally reimbursed programs were important in demonstrating methods of instruction and the value of such programs in the curriculum of the secondary school.

Other Types of Education.—Home economics in the agricultural extension service was established in conjunction with the land-grant colleges by legislative act in 1914 (the Smith-Lever act) and has become one of the most highly organized and largest programs of adult education in the country. In addition, the Smith-Hughes act of 1917 provided funds for education in home economics for adults and out-of-school youth. (Do. M. L.)

Great Britain.—The publication of *Household Management* by Mrs. Beeton in 1861 was an important contribution to developments in the subject in that it included all aspects of home management; notable earlier books, such as *The Art of Cookery Made Plain and Easy* by Hannah Glasse (1747), had dealt mainly with recipes for foods and medicaments.

Further impetus to education in home economics was given by the International exhibition at South Kensington, London, in 1873, when an organizing master of the science and art department, J. C. Buckmaster, whose special subjects were chemistry and physics, gave lecture demonstrations on the application of scientific principles to cookery. The direct outcome of this venture was the establishment in London in 1874 of the National Training School of Cookery, with which Buckmaster was associated for many years. His duties took him to all parts of the country and as a result of his work six similar schools were founded in other cities between 1874 and 1877. These schools gave instruction in cookery at different levels but as the demand grew for teachers of cookery in elementary schools they became increasingly important as teacher-training establishments. A special grant for this subject was available after 1882. In the schools, the need for improvements in personal hygiene led to the introduction of laundrywork. A little later housewifery was started in an attempt to overcome clumsiness and ignorance of good methods in simple cleaning operations. These two subjects were eventually taught together as household management; teachers were given a two-year course in training colleges of domestic science, which had developed from the early cookery

schools. After 1931 these colleges gave three-year courses which included training in the teaching of general subjects as well as domestic science.

The professional organization for teachers of domestic science was founded in 1897. It developed from a subcommittee of the National Council of Women in the United States, a society interested in social service to which a number of the leading domestic science teachers of the day belonged.

A development at a higher academic level took place soon after the turn of the 20th century. It was appreciated that there was a place for the training of women in the organization and administration of the household both in ordinary home life and in institutional life and that such training should be based on a sound knowledge of science and applied science. Women educated in this way could be expected to focus their trained minds on household matters and the relationship of social and industrial problems to the home and its conditions. They would also play their part in education by developing the teaching of the application of science to all aspects of the organization and administration of the home. The result of this movement was the establishment in 1908 of a department of home science in King's college, London university, where a degree of B.Sc. (Household and Social Science) was first granted in 1921. The department in London university would very probably have been followed by others in different parts of the country except for the onset of World War I. One other university, Bristol, gave a B.Sc. (Domestic Science) degree after 1927; London university after 1953 awarded the B.Sc. degree in two subjects, household science and nutrition; courses for both are given at Queen Elizabeth college, the descendant of the home science department of King's college. (J. E. WA.)

Canada.—In 1896 the first public-school classes in household science were opened in the province of Ontario. The Technical Education act (1919) and later the Vocational Training act provided grants to provincial governments for development and maintenance of vocational education, including homemaking, at the secondary school level. Programs for adults have been established in the schools of many urban communities, and the Women's Institute movement with support from the department of agriculture has been responsible for the growth of training in home economics in rural areas. The first degree program in household science was established at the University of Toronto, Ont. By the 1960s there were several Canadian institutions of higher education offering degrees in home economics, located throughout the country.

Europe.—Organized class instruction in sewing appeared in the elementary schools of several European countries as early as 1850. While the first courses offered were in needlework and sewing, there soon followed cooking and housewifery, which included cleaning, hygiene, washing and ironing. By the beginning of the 20th century most countries (Austria, Belgium, Denmark, Finland, France, Germany, Holland, Hungary, Italy, Norway, Sweden and Switzerland) offered instruction in these subjects in the elementary schools.

With the advent of the academy or higher school to provide education beyond the elementary grades for young ladies, technical schools to provide training for needy girls in certain trades, including that of domestic service, were established. There were sewing and cooking schools and complete housewifery schools with practice centres. While uniformity was lacking, the better and more comprehensive programs were to be found among those in France, Germany, Austria-Hungary, Belgium, Switzerland, Finland, Norway and Sweden. Schools in these countries had been established to serve all class levels from the domestic of the working classes to the lady of the household.

Because of the diversity of educational organization and administration as well as the lack of nationally sponsored programs for home economics within the different countries, variation in objectives and standards has existed among the institutions of the European countries. University work in this area is comparatively recent, Finland being the first, in 1946, followed by the Netherlands in 1953. The University of Helsinki offers a five-year degree course which includes a year of practical training in field work. The State Agricultural University of Wageningen in the Netherlands gives degree courses in rural home economics which extend over six academic years and include six months of practical experience through field work.

Australasia.—In New Zealand there was a school of home science in the University of Otago, Dunedin, after 1911; it has graduate and postgraduate courses. In Australia the subject is not taught within any of the universities but facilities for training are available in several of the large cities, the Amy MacPherson college at Melbourne being the oldest. (*See* also VOCATIONAL EDUCATION.)

Careers in Home Economics.—By far the greatest number of employed home economists are in teaching, either in schools or colleges or in informal educational programs such as co-operative extension work. The next largest number are dietitians in hospitals (which employ about half of all dietitians) or in other kinds of institutional food service, such as school dining rooms and restaurants. There are also a lesser number of highly varied positions open to home economists in research; in home service—that is, customer service rendered by gas or electric companies and manufacturers and distributors of fabrics, food products, household appliances and kitchenware; and in journalism, radio and television. Most positions for home economists require at least a bachelor's degree and some require further training or specific qualifications; dietitians, for example, serve a period of internship, and teachers of home economics in schools must meet certification standards required of other teachers.

PROFESSIONAL ORGANIZATIONS

The International Federation of Home Economics, in which individual members and professional organizations of home economists throughout the world hold membership, serves as a clearinghouse for the interchange of ideas on education and research in home economics. It originated from a congress at Fribourg, Switz., in 1908, organized by Georges Python, head of the public-education department of the canton of Fribourg. This congress was attended by 700 delegates from 20 countries. The federation subsequently organized congresses in other countries; the congress marking the 50th anniversary of the organization, held in 1958 at the University of Maryland, College Park, was attended by more than 1,000 delegates from 60 countries. A quarterly bulletin is issued to all members from the office in Paris.

In the United Kingdom there are a number of professional organizations concerned with home economics education. In 1955 they became affiliated under the title United Kingdom Federation for Education in Home Management.

The American Home Economics association (A.H.E.A.) is the organization to which all individuals with a bachelor's degree in home economics from an accredited institution in the U.S. are entitled to belong. A journal published monthly, September through June, is included in the regular individual membership. In many countries of the world where there are enough professional home economists to form an organization, it has been patterned after A.H.E.A. The Finnish, Japanese, Korean, Philippine, Thailand and Ryukyuan Home Economics associations are examples of those affiliated with the American Home Economics association.

The American Vocational association, which was an outgrowth of the National Society for the Promotion of Industrial Education and which developed as the result of the passage of the National Vocational Education act, 1917 (Smith-Hughes), has a home economics education section. A journal published monthly from September through June is included with membership. Membership is composed largely of secondary school teachers, college teacher educators and supervisors of home economics.

The Department of Home Economics, National Education association, is one of the many subject-matter sections of that body. Membership is open to every home economist interested in education.

The American Dietetic association was organized in 1917. Membership is limited to home economics graduates with a major in foods, nutrition or institution management and satisfactory completion of one year's internship in applied nutrition or institutional management. Membership is made up largely of hospital dietitians, institutional managers of food service and college teachers of food and nutrition. A journal published monthly is included

with membership. The association maintains a placement bureau for the benefit of its members.

The Canadian Home Economics association and the Canadian Dietetics association are similar to their counterparts in the United States and are open to qualified home economists in the dominion of Canada. The Home Science association of India is the name of the home economics organization in that country.

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HOME EQUIPMENT. During the 20th century home equipment developed from simple hand-operated tools for cooking, washing and cleaning into highly complicated mechanical appliances, many of them automatically controlled. There were a number of reasons for this development, one of the main ones being the near disappearance of the domestic servant. Equipment was therefore designed to save the housewife's time and energy and to take the drudgery out of housework. The demand for these new and improved appliances was increased by the growing number of married women gainfully employed outside the home, many of whom continued with paid work for the first few years after marriage in order to purchase equipment which later would make running of the home, with children, less burdensome.

This equipment included such basic appliances as ranges or cookers, refrigerators, washing machines, vacuum cleaners and hand irons. In addition, there was a growing market in the second half of the 20th century for such items as automatic dishwashers, garbage grinders, power mixers, electrically heated blankets and air conditioners. Also contributing to the increase in number of basic electrical appliances—as well as of such newer types of equipment as electronic cookers, electric frying pans and saucepans, etc.—in use was the extension of electric power to homes.

KITCHEN EQUIPMENT

RANGES AND COOKERS

The range is one of the most necessary items of home equipment. The four principal types of ranges, according to the fuels used, are gas (natural or manufactured), electric, kerosene (also gasoline and fuel oil in the U.S.) and solid fuel (wood, charcoal, lignite, bituminous coal, anthracite or coke). The following discussion of ranges will be limited to gas and electric types.

Traditionally, regardless of the type of fuel used, surface cooking units and oven were combined in one frame; after about 1930, most of the models were 36 in. in height with oven and broiler or grill below the surface units. Later, however, particularly in the U.S., the divided range began to be popular, with the surface cooking units installed in a counter area while the oven, raised to waist height, was built into a wall in another area of the kitchen. The divided range has distinct advantages in use but requires more space for installation than does the conventional range. Moreover, installation costs are higher, since either gas or electrical wiring must be carried to two locations.

Gas Range or Cooker.—Four types of gas are used in the U.S.: natural gas, manufactured gas, a combination of the two and liquefied petroleum. The first three require piping from the gas mains to the home, but liquefied petroleum can be brought to homes in cylinders or placed in tanks under the ground in the home yard. These gases vary in composition and heating values.

Two types of gas are used in the United Kingdom: town gas and Calor gas, the latter much higher in calorific value. The former is supplied through pipes and is available in all urban areas; the latter is delivered in cylinders.

The efficiency, durability and safety of gas ranges have steadily improved. Most manufacturers submit their gas appliances for testing, in the U.S. to the American Gas association, in the U.K. to the Gas council. Minimum requirements agreed on by the A.G.A. and the British Standards institution include gauge of metals to be used in various parts; regulation of flues, valves, ovens, etc.; conditions of gas consumption; protection against gas leakage, carbon monoxide production and fire hazard; satisfactory distribution of oven heat; and thermal efficiency of top burners.

Approximately 75% of food cookery is done on the surface units. Although the burners differ in design, their principal parts include the mixer, mixing tube and burner head. The mixer carries an air regulator (shutter) and an opening, either fixed or adjustable, for the orifice (through which the flow of gas is controlled).

The ports or openings in the burners usually are drilled horizontally on the rim and at a 45° angle in the centre of the burner, so that they do not clog with spilled-over foods so easily as did earlier vertical ports.

Burner sizes usually range from 2½ to 3½ in. in diameter. The larger or giant burner is built for a heat capacity of not less than 12,000 B.Th.U. (British thermal unit) per hour, while regular burners take 9,000 B.Th.U. in the U.S. and 10,000 B.Th.U. in the U.K. Some ranges have separate simmer burners; in others the burners can be regulated so that only the centre ports function, providing heat as low as 500 B.Th.U. per hour. A later development on gas ranges was the thermostatically controlled burner. The control device, centred in the burner, presses against the bottom of a utensil (only utensils with flat bottoms can be used) and, when the temperature of the utensil reaches that set on the burner valve, the flow of gas is automatically reduced and the gas flame controlled to hold the utensil at that temperature. This development served to simplify meal preparation, as the food being cooked could be left almost unattended without burning or overcooking.

When the burners are operating, gas flows from the main line through a horizontal pipe called the manifold. Burner valves, operated by hand, direct the flow of gas through the orifice and mixer of the burner at very high velocity. "Primary" air is sucked through the partly open shutter and mixed with the gas in the tube; this mixture of gas and air will not burn until it comes in contact with the "secondary" air surrounding the burner.

The range top usually consists of four burners with cooking vessel supports arranged in various ways, the main arrangements being two behind two or all across the back. In some models, particularly in the U.K., a broiler or grill forms part of the range top, a space being provided for the broiler pan between the top of the oven and the range top. Another position for the broiler is above the range at eye level. In the U.S. the oven burner usually serves for broiling, with the broiler pan, often built in, being placed in a special compartment beneath the main oven.

Most ranges are equipped with automatic lighting by means of a small pilot flame which is kept constantly burning by gas released through a bypass line. As the burner is turned on, some of the gas-air mixture passes into a flash tube, is ignited by the pilot light and in turn lights the main burner.

The oven consists of a metal box heated by a burner, usually located at the bottom of the back wall. To minimize heat loss the oven is made with double walls, the space between being filled with insulating material. Slag wool was formerly used, but aluminum foil and glass fibre have come to be more generally employed, the former because it reflects radiant heat and the latter because it has low thermal conductivity and a high specific heat, thus preventing a sudden fall in temperature when a large quantity of cold food is placed in the oven. The surfaces of the oven are finished with porcelain enamel. A vent is provided for discharging the products of combustion of the gas and of steam evolved during cooking. Commonly the vent is located in the upper part of the back wall, where it leads into a pipe that discharges through the back panel of the range top over the burners. A constant oven temperature is provided by means of a thermostat, either rod or liquid type. The dial setting in the U.S. is by

temperature and in the U.K. by number which corresponds directly to temperature. The time taken to reach a given temperature setting from cold varies in different models, but is generally about 15 min.

Special features include folding tops to cover burners when not in use; lighted back panels and oven lights; electrically controlled clock timers and minute timers; nontipping oven racks; rotating temperature guide; lock-position burner valve handles; motor-driven rotisseries; infrared lamps for warming oven; outlets for electrical appliances; chrome-lined ovens; pull-out towel racks; built-in meat thermometers and griddles.

Electric Range.—In the U.S. standards for performance and safety of electric ranges are determined by the National Electrical Manufacturers association, American Standards association and the Underwriters laboratories; in the U.K. by the British Standards institution.

Two types of units, the tubular or radiant and the solid plate, are available. In the U.S., the former is almost universal except on older models. In the U.K. the latter is most generally employed, but use of the first type is increasing. The tubular design consists of a tube of stainless steel or nickel-chromium-iron alloy into which coils of resistance wire are inserted and the tube filled with fused magnesium oxide powder. The tube is flattened on the top to allow for better contact and conduction of heat to the utensil. The solid type consists of a plate of a nickel-containing alloy of cast iron, grooved on the underside to house spiral resistance wire embedded in refractory cement. The upper side has a flat machined surface to ensure maximum contact with a cooking vessel placed on it. One type of tubular unit utilizes two tubes in spiral form to provide different heat patterns with different switch settings; for small utensils the inner coil alone may be heated. The second type of tubular unit uses a larger diameter tube with two or three inserted resistance coils, producing even heat over the whole system.

In the U.S. infrared units also have been developed. These consist of a gold-lined 1,550-w. infrared bulb mounted in a metal reflector and covered with a red glass cover. Infrared type units heat by radiation, whereas other electrical units heat mainly by conduction; because infrared heat is instantaneous, it is especially good for rapidly heating small amounts of liquid or foods. A range usually has only one top-surface unit of this type, but it is used extensively for broiling foods in restaurants and for exhibition purposes.

Most surface units are of two sizes: 8 in., with wattages of 1,600–2,100 in the U.S. and 1,800–2,000 in the U.K., and 6 in., with wattages of 1,100–1,600 in the U.S. and 1,000 in the U.K. (where, however, surface units with higher loadings similar to those in the U.S. are available and growing in popularity). Control of surface units is effected either by means of a 5- or 7-heat switch or by a timer giving an infinite number of heat settings. Many ranges have one or more surface units temperature-controlled by a thermostat.

Oven construction and finish in the electric range are similar to those in the gas range. Heating elements usually are located on the lower part of the two side walls (in the U.K.) or in the ceiling and floor (in the U.S.). They are of two types: the open coil, consisting of a continuous coil of high-resistance wire, which glows red when a current passes, and the tubular sheathed wire, which remains black when current flows. Oven control is by a thermostat, the settings given ranging up to 500° F.

Special features include push-button controls and illuminated dials with different colours for each heat setting; thermometer for meat roasting with cable connections to a thermostat dial in the back panel; motor-driven rotisserie; vertical broiler with two elements to broil on both sides simultaneously; electric filter in oven vent to eliminate smoke and odours from oven; divided oven doors which, as they open, automatically pull out shelves; specialized surface cooking units such as a deep-well cooker or a griddle that can be covered and converted to counter space when not in use; outlets for electrical appliances; and even radios.

Electronic Oven.—In this oven energy from the high-frequency radio band is used for cooking. The radio waves penetrate to the centre of the food and are absorbed evenly throughout, whereas in conventional methods heat is absorbed by the exterior only and transferred by conduction to the centre. Two outstanding features of the electronic method are very short cooking times (often measured in seconds) and complete absence of heat in the oven. The containers used are all made of glass, china, plastic or paper, which transmit the waves and themselves remain unheated. The metal walls of the oven reflect the waves and also remain cool. Electronic ovens were used by caterers in the U.S. for several years before domestic models became available in the 1950s. A magnetron is used for the generation of energy of 2,450 mc. and 12.7 cm. wave length. It has a normal output rating of 2 kw. and is suitable for a maximum operating demand of 5.25 kw.

The appearance of food cooked in this type of oven is different from the conventional, and for foods, such as steaks, that require a brown exterior a conventional broiler must be used as well. This usually is incorporated in the electronic oven. As a safety precaution the oven is designed so that the unit will not function when the door is open. Microwave energy produces no effects on the body except those normally produced by heat.

Refrigerators and Freezers

Refrigerator.—The refrigerator is an appliance in which food and other materials are preserved at temperatures near freezing point (32° F.); in the freezer, food is frozen and preserved at 0° F. and lower. The period during which foods can be preserved in a refrigerator is limited to a few days; they may be preserved in a freezer indefinitely. The refrigerator usually contains a compartment maintained at a temperature considerably below freezing point where frozen foods can be stored, but unless the temperature is 0° F. or less frozen foods should not be stored in it for more than a few weeks. One reason for keeping foods at low temperatures is to inhibit the growth of microorganisms, which cause decay in food. The optimum temperature for the growth of yeasts, molds and bacteria is 70°–80° F.; at 40°–50° F. the rate of growth, although not stopped completely, is slowed considerably. Practically no growth takes place below 10° F., but storage temperatures near 0° F. are recommended for frozen foods, to discourage ice crystal growth. In many foods the formation of large crystals causes rupture of cell walls and subsequent rapid deterioration of food on thawing. (*See* also Food Preservation [in the Home]; Food, Care and Storage of [in the Home].)

The first home refrigerator, made early in the 19th century, consisted of an insulated cabinet into the top of which a block of ice was inserted. Melt water was carried off by a drain pipe extending through the cabinet and out the bottom. The food stored in the section below the ice compartment was kept cool by cold air currents. The modern refrigerator, use of which gradually became widespread after 1918, is automatic, generally operating on one of two basic principles, namely compression and absorption (*see* Refrigeration). The advantages of the compression type are lower running costs and a greater reserve of cooling power, which in practice means that ice cubes can be made more rapidly. The main advantages of the absorption type are that it is completely silent and, because there are no moving parts, there is less possibility of defects developing in operation. Also, because heat is the source of energy used, it can be operated by gas or kerosene as well as electricity.

The automatic home refrigerator consists of a double-walled box with a hinged door, the space between the walls being filled with insulating material. The outer walls of pressed steel have an exterior finish of baked enamel (porcelain enamel may be used for the top surface if it is intended as a working area). The interior walls, when made of pressed steel, are finished with acid-resisting porcelain enamel. The door is also double-walled and insulated. A rubber gasket on the frame maintains a seal and prevents leakage of warm air into the box when the door is closed and locked by means of a latch, a friction locking device or magnets embedded around the frame. Polystyrene is used increasingly for both outer and inner walls, primarily because it can be molded in a complete whole without joints. Shelves and trays

usually are made of anodized aluminum or of mild steel wire coated with tin, chromium or polyvinyl chloride.

The sizes of refrigerator cabinets available range from 3 cu.ft. to 16 cu.ft. in the U.S. and from 1½ cu.ft. to 10 cu.ft. in the U.K. The horsepower rating of motors ranges from ⅛ to ½ and heating units from 150 to 350 w. Temperature is thermostatically controlled by a dial that may be adjusted to effect changes as required. The setting must be related to the external temperature.

All foods should be as cool as possible when they are put into the refrigerator and should be wrapped or tightly covered to prevent drying out by the evaporator in the cooling compartment. In cold-wall models, however, unwrapped food does not dry because evaporation takes place in another compartment.

Special features include automatic defrosting; frozen food storage accommodation of 2–3 cu.ft.; rotating or adjustable shelves; automatic ice cube dispensers; and door racks and special compartments for foods such as butter, eggs, cheeses and fresh vegetables.

Freezer.—The food freezer is a cabinet or chest, maintained at a temperature of 0° F. or lower, in which fresh foods can be frozen and frozen foods can be stored indefinitely without deteriorating. In rural areas freezers are used for preserving fruit, vegetables, meat and poultry produced locally in excess of requirements and also for maintaining a store of commercially frozen foods for everyday use. In urban areas freezers are used mainly for storing commercially frozen foods.

All freezers are operated by the compression system, using motors ranging from ⅛ to ½ h.p. In the chest type the evaporator coils are clamped to the sides and bottom of the inner wall; in the upright type they are attached to the walls and undersides of fixed shelves. Both types have a thicker layer of insulation than the average refrigerator, usually about 4–6 in. There are advantages in both types of construction. Foods are generally more easily removed from the upright type, which occupies less floor space.

The chest type is more economical in operation because when the lid is opened the cold air inside, being heavier than the warm air above, remains in the chest, whereas in the cabinet type the cold air falls out and is replaced by warm air when the door is open. Two sizes are generally available in the U.K., 4 cu.ft. and 9 cu.ft. In the U.S. the range is normally from about 5 cu.ft. to 18 cu.ft.

Cooking Equipment

Basic Utensils.—*Saucepans.*—Saucepans are made of cast iron or sheet steel with a protective coating of tin or porcelain enamel, and of stainless steel, sheet or cast aluminum, copper, brass, nickel, Monel metal and glass flameware. Desirable qualities of the material used for pans are durability; hardness to resist scratching, pitting, abrasion and percussion; strength to keep their shape under strain; a surface relatively easy to keep clean; resistance to moisture and alkalies; and high thermal conductivity. Choice, therefore, usually is governed by cost and the extent to which the material conforms to the above qualities. Stainless steel is one of the best materials, but it is expensive and, because it has a relatively low thermal conductivity, is not satisfactory for all types of cooking unless thickly clad on the base with copper, brass or aluminum. The other important feature affecting choice is design of the pan and cover. Balance, internal radius of the corners at the base for easy cleaning, shape, length, thermal insulation, efficiency of fixing and comfortable grip of the handle, general design of the cover for easy cleaning and the design of the knob for grip are all points to consider.

Casseroles.—Materials used for casseroles, in addition to those given for saucepans, include heat-resisting glass and ceramic materials. Enameled iron, stainless steel and some ceramic materials that can be used on a surface cooking unit as well as in the oven or on the table as a serving dish are especially popular.

Frying and Omelet Pans and Deep Fryers.—Materials used for frying and omelet pans are the same as those for saucepans, a heavy gauge being found more satisfactory because it does not buckle or warp in use. Deep fryers are made of iron, steel, stainless steel or aluminum. These are provided with a wire immersion basket for holding and draining food and a cover for use in case the fat catches fire.

Kettles.—The kettle for boiling water to make tea is an essential item of the kitchen in the U.K., but less common in kitchens in other countries. Materials used include iron; steel, with or without enamel; stainless steel; and aluminum.

Pressure Cookers.—Basically a pressure cooker is a saucepan with a cover that forms an airtight seal when locked in place and traps the steam that otherwise would escape during the cooking process. As the pressure inside builds up, the food is cooked at temperatures above those attainable in an ordinary saucepan. Safety valves are provided to vent the pressure before it can build up to an explosive level. Pressure cookers are especially useful at high altitudes, where normal cooking temperatures cannot be obtained with conventional saucepans.

Knives.—Many different sizes and shapes of knives are used in the kitchen, the two most useful being the chopping knife in different sizes and the vegetable paring knife. The blade is made of stainless steel or carbon steel, the latter, when of good quality, maintaining the best cutting edge if sharpened regularly. The rearward continuation of the blade, called the tang, should extend throughout the length of the handle, to which it should be firmly riveted. The handle should be of material which is impervious to water (hardwood, bone, plastic or laminated plastic) and be comfortable to hold firmly while in use. (*See* also Cutlery.)

Baking Sheets and Cake Tins.—These are made of tinned sheet steel or aluminum, which should be of a heavy gauge that will remain rigid and flat in use and not buckle or bend. A surface that is easy to clean and not likely to cause food to stick, if used ungreased, is produced by coating with silicones and by anodizing aluminum.

Whisks.—These are made in many different sizes and shapes, the bat- or balloon-shaped type being used for simple, short operations and the hand-operated rotary egg beater for longer periods. Comfort and efficiency in use and cleaning are important factors which should influence choice.

Graters.—Graters are made in tinned steel, aluminum, stainless steel and plastic. When choosing it is important to consider efficiency in use and to check for jagged edges that will tear the fingernails.

Electrically Heated Utensils.—Individually heated and thermostatically controlled cooking utensils include skillets, frying pans and deep fryers, roasters and rotisseries, saucepans, kettles, pressure cookers, coffee makers, toasters, broilers, hot plates and sandwich grills, waffle irons, corn poppers and egg cookers. With a proper combination of these utensils, an entire meal can be cooked without the use of a range.

Motor-driven Appliances.—Another class of kitchen appliances are those small devices classed as motor-driven. These include ice crushers, beaters, juicers, blenders, coffee grinders, knife sharpeners, can openers and exhaust fans.

Washing, Mixing and Disposal Equipment

Sinks and Dishwashers.—Materials used for sinks include glazed fire clay, porcelain enamel, aluminum, stainless steel and plastics such as methyl methacrylate and glass fibre bonded with polyester resins. As the kitchen sink receives a great deal of hard wear and often rough treatment, it must be resistant to chipping, cracking, scratching and breaking.

A mechanical dishwasher consists of a porcelain-enameled compartment in which two wire racks are hung. The racks, usually plastic-coated, are designed to hold a given number of dishes, flatware and utensils. A device, usually located in the bottom of the compartment, forces water over the dishes by means of a fan-like impeller, which throws the water upward, or of a rotating perforated arm through which the water is forced up and around in the compartment. The amount of water used varies from seven to ten gallons and must be at a temperature of 150° F. or higher to ensure efficient washing and drying. Many machines are completely automatic, the length of each operation being con-

trolled by a timing device. After the final rinse the dishes are dried in one of two ways: (1) by a sealed heating element, located beneath the racks or outside the tub, over which hot air is blown by a fan; (2) the cover or door opens automatically and the hot dishes dry because of the amount of heat they have retained. Dishwashers are available with either top opening, pull-out drawer or front opening, the top opening being the least popular because it is less easily placed in the kitchen.

Food Mixers.—Beating, whisking and kneading are performed automatically by the basic model mixer, and attachments can be added for blending and making purées, mincing, coffee grinding, juice extracting, shredding and grating.

Three different systems are used for the basic operation: (1) a detachable beater or whisk is attached to a vertical spindle which rotates about a secondary axis concentric with the mixing bowl; (2) two whisks fixed to a central shaft rotate at high speed and in so doing cause a mixing bowl to revolve slowly; (3) a mixing bowl is electrically driven to revolve at a medium speed and the contents are beaten by a wooden dolly attached to an arm projecting over the bowl. The dolly also rotates by friction from the rim of the bowl with which the rubber-lined upper surface of the dolly is in contact. The apparatus is driven by an electric motor, usually portable, of $\frac{1}{16}$ to $\frac{1}{4}$ h.p. The motor is heavy and unwieldy to lift, however, and therefore frequently is kept permanently in the place where it is used. In one available model the motor is fixed immediately beneath a working surface and is provided with a projection to which the bowl and beater arm can be attached. This type has the advantages that only the light-weight bowl and mixer need be lifted and that the work area is free from obstruction when the mixer is not in use. Hand models of type (2) are generally available and useful for whisking eggs and beating potatoes, but they are not very satisfactory for longer operations, such as cake mixing, because they save only energy and not time. Most models with high-speed whisks are made with a detachable head for manual use.

Food mixers are generally satisfactory in operation but, when purchasing, it is advisable to ensure that they are simple to operate and that the motor in running is reasonably quiet.

Food Waste Disposer.—The food waste disposer or garbage grinder, designed to pulverize food waste, is fitted into a sink drain so that, with the aid of a continuous flow of cold water, the resulting material is flushed into the sewage system. It consists essentially of cutting knives of high-quality steel that rotate at high speed inside the food waste container. The electric motor driving the blades is generally $\frac{1}{4}$ h.p. for the small home model. Two different methods of control are used. In one, a switch starts the motor but the operator is responsible for turning on the water and feeding waste into the hopper. A hand guard usually is provided with this type. In the other, the top of the disposer is locked in place and, when the cold-water faucet is turned on, a small quantity of water is bypassed through a separate pipe, where the pressure trips a switch and starts the motor. This method ensures a good flow of water for flushing the drainpipe. The disposer will pulverize a great number of materials composing kitchen waste, but certain items for which it is not satisfactory include paper, tin cans and large bones. Stringy foods such as cornhusks, artichokes or celery are difficult to pulverize unless added with other foods and in small amounts.

LAUNDRY EQUIPMENT

Washing Machine.—This consists of a tub in which articles are agitated in soapy water by a mechanical device of which there are two main types, the agitator and the cylinder. In the former an attachment with blades or fins is fitted over a central shaft, which rotates first in one direction and then in another, in so doing moving the clothes in the water. In the latter a perforated drum revolves on a horizontal axis and carries the articles with it. Some types of small machines work by means of an impeller, a finned disk fitted in the side wall or base of the tub; rotation of the impeller causes the clothes to rotate in the water. Almost all washing machines incorporate in their designs a device for extracting water from the clothes. This device may be either a power-driven or hand-operated wringer or a rotating perforated drum revolving at high speed on either a vertical or horizontal axis. The tub is usually of aluminum, stainless steel, sheet steel lined with porcelain enamel or glass fibre bonded with polyester resin. The agitator attachment is normally made of aluminum alloy or reinforced Bakelite. Tubs are designed to hold $4\frac{1}{2}$–10 lb. of dry clothes and about 5–17 gal. of water. The motor is of $\frac{1}{8}$ or $\frac{1}{4}$ h.p. and energy is transmitted to the drum or agitator shaft by belt, gears or friction wheels.

Washing machines may be (1) fully automatic; (2) semiautomatic; or (3) hand-operated. In (1), after the articles have been placed in the tub, the controls adjusted and the current switched on, the washing cycle is completed without further attention by the operator. This cycle consists of filling the tub with hot water, washing for a set time, rinsing one or more times and extracting the water. In (2) the amount of attention necessary by the operator varies. This type always has a power-driven device for washing and usually one for extraction and emptying of the tub, but in general each process must be started and stopped by the operator. In (3) the mechanical device for both washing and extraction of water is hand-operated. In many washing machines in the U.K. an electric heating element or gas burner is included so that water can be heated and articles can be boiled in the tub.

Spin Dryer or Extractor.—The spin dryer does not dry clothes but merely extracts water from them, the amount remaining being 33%–50% of the dry weight of the articles compared with 100%–150% for the conventional power-driven wringer. The method of extraction by rotation of a perforated drum on a vertical axis is similar to that used in some washing machines, but the speed of rotation is generally higher, ranging from 1,000 to 2,800 r.p.m., and the percentage of water extracted therefore also is higher.

Clothes Dryer.—Cabinet dryers, heated by gas or electricity, can be used for drying clothes after washing or airing them after ironing. These appliances usually are made with metal bars over which the clothes are hung.

The automatic dryer, sometimes called the tumbler dryer, is a power-driven device which, through heat and tumbling (with or without air flow), evaporates water from fabrics for a period of time determined by the operator. Although all dryers operate on the same principle of tumbling clothes in a cylindrical basket or drum, in the presence of heat, they fall into two general types, those that are time-controlled and those that are temperature-controlled. The former may have two dials, one to control drying time, the other to set the degree of heat desired according to the fabric being dried; some have only one dial, for timing the operation, temperature being thermostatically controlled. Temperature-controlled dryers have a thermostatic control set for a desired temperature; when sufficient moisture has evaporated to cause a rise in temperature equivalent to the setting, the machine stops.

The capacity of the automatic dryer is rated as 8–9 lb. dry clothes or 16–18 lb. wet weight. Most dryers have a moisture removal rate of 8–12 lb. per hour.

Hand Irons and Power Irons.—Heat, moisture and pressure are necessary to remove from fabrics the creases acquired from washing and drying. When heated and damp, the fibre temporarily becomes plastic so that the pressure of the iron removes the creases. Before electricity was generally available irons were heated in the coal fire, on the range top or by gas or charcoal.

The electric hand iron consists of a sole plate of aluminum alloy, cast iron or steel plated with chromium, to which is attached a well-insulated cover and handle made of wood or plastic. Heating elements are of two types: In the herringbone, mica-insulated type the element is firmly clamped against the sole plate by means of a pressure plate; the efficiency and life of the element depends to a great extent on the uniformity of this pressure. The later type, with a ceramic-insulated element cast into the sole plate, gives more uniform heating if well designed and has a longer life. The electric loading of hand irons ranges from 630 to 1,000 w. and the weight from 3 to 6 lb. Many irons are made with a thermostatic control, the settings being labeled in terms of the fabrics for which they are suitable. Temperatures widely

recommended are as follows: synthetics, 300° F.; silk, 325°; rayon, 350°; wool, 375°; cotton, 425°; linen, 475°.

The steam iron, which became very popular in the second half of the 20th century, is a heat-controlled iron containing a reservoir of water which is heated in the iron and released as steam through holes in the sole plate. There are two major types of steam irons, the kettle and the flash boiler. The former holds one to two cups of water, all of which must be heated to boiling point before steam issues from the sole plate. The latter, which holds varying amounts of water, produces steam instantly when each drop of water comes into contact with the sole plate. Both types also can be used for conventional dry ironing.

There are two types of power irons, the flat plate or press and the rotary or mangle, both of which require practice to acquire the skill necessary to iron all types of articles. In the press, a hinged, thermostatically controlled, electrically heated, rectangular metal shoe, about 2 ft. x 1 ft., is lowered onto a padded ironing board on which the article to be ironed has been arranged. Considerable pressure (about 300 lb. per square inch) is exerted by the shoe on the article, thus producing a satisfactory finish on such articles as starched linen and cotton. The electrical loading is 1,350 kw. In the rotary type the article passes between a padded revolving roller and a concave polished metal shoe that presses firmly on the roller. The shoe, electrically heated and thermostatically controlled, may be located either above and slightly to the back of the roller or below and slightly in front of it. In the former, articles pass under the shoe and over the roller, which has one open end and is supported at the other end. In the latter, the articles pass over the shoe and under the roller, which may have one open end or be open at both ends. In the latter case it is supported by a wishbone-type frame. The electrical loading of the sole plate ranges from 1,250 to 1,600 w., and the roller is driven by a small electric motor of about $\frac{1}{8}$ h.p. These irons may be either portable or cabinet type. Some models also may be fitted to the washing machine as an alternative to the wringer.

CLEANING EQUIPMENT AND MATERIALS

Carpet Sweeper.—This is a hand-operated machine designed to remove surface dirt from rugs and carpets. It consists of a long-handled metal or wooden container on wheels. Inside the container is mounted a cylindrical brush that rotates when the appliance is pushed over carpets and other floor surfaces. The dirt picked up by the rotating brush is deposited in two pans alongside the brush.

Suction or Vacuum Cleaner.—This is an electrically operated machine consisting essentially of a high-speed fan, driven by an electric motor, which draws air through the machine. It is designed with a nozzle opening that, when placed on the surface to be cleaned, sucks up dust as air is drawn through the carpet material. Embedded dirt is difficult to remove by suction only, and brushes and other agitators to loosen it often are included in the nozzle.

There are two main types of suction cleaner, the upright and the canister. The former is a long-handled metal or plastic container in which is located the motor, the fan and the rotating cylindrical brush driven by a belt from the motor. When the current is switched on, the brush rotates and air is drawn over it through the container and into a bag suspended from the handle. The bag is made of either fabric or paper which permits the passage of air but not of dust, which is deposited in the bag. The canister type consists of a metal or plastic cylinder or sphere in which is located the motor, the fan and the bag in which the dust is deposited. A flexible hose attached to a tube with a nozzle end is fixed into a hole in the cylinder or sphere. When the current is switched on air is sucked through the nozzle; with it is carried dust, which is deposited in the bag. A brush and an agitator may be included in the nozzle.

Motors range in size from $\frac{1}{2}$ h.p. to $\frac{3}{4}$ h.p. and in speed from 6,000 to 16,000 r.p.m. and more. Canister types usually have larger motors, but the amount of suction depends primarily on the size, speed and design of the fan and the design of the fan chamber. Suction, and thus efficiency, is reduced as the amount of dirt in the bag increases, hence it should be emptied frequently. Where the design incorporates a paper bag, the bag can be removed and replaced by a new one.

Most suction cleaners are designed to be used with tools for other cleaning jobs. Such tools include a crevice tool and brushes for dusting and for cleaning upholstery, walls and bare floors. A spray device for paints, insecticides or other liquids, and a demothing device may be attached to a second hole on the reverse or "blower" side of the fan in most models.

Cleaning of Rugs.—Soil that sticks to and cannot be removed from rugs by regular vacuuming often can be removed by rug-cleaning powders made of sawdust or clay products and mixed with a spirit solvent. This mixture can be spread over and into the nap or loops of the rug with the floor brush attachment of a vacuum cleaner or with a broom. As the solvent evaporates, the soil becomes attached to the powdery material, which, when dry, is removed from the rug by the vacuum cleaner. This type of cleaning product is especially suitable for oily types of soil.

Another method of cleaning rugs is to use concentrated liquid synthetic detergents. Added to water, these may be sprayed or sprinkled on the rug and scrubbed with a stiff brush or broom until all lather has disappeared. When dry, the rug is vacuumed to remove residual soil and detergent.

Floor Polisher.—The floor polisher usually consists of one, two or three motor-driven disk-shaped brushes, with long stiff bristles, that revolve at high speed. The heat created by the friction of the brushes melts wax into the floor and gives a polish. The utility of these machines is increased by the attachment of steel wool pads, which may be used for soil removal instead of scrubbing; or sandpaper disks may be inserted for use in roughening surfaces before applying new finishes; or the brushes may be used for actual scrubbing with water. Felt disks also are available for high-lustre polishing.

Cleaning Materials.—Cleaning materials may be classified according to the general action they have, which may be one or a combination of two or more of the following: (1) Solvent; water and certain spirits used for grease removal are the main solvents. (2) Detergent; soap and synthetic detergents are used for clothes, dishwashing and for floor and general-purpose cleaning. (3) Abrasive; powders made up of particles of different sizes are used for their mechanical action in cleaning and polishing, those with fine particles of smooth shape being used on soft, easily scratched materials and powders with large, hard, sharp particles being used on harder materials. (4) Protective; waxes, silicones, oils and plastic materials are used to form a protective layer on floors and furniture. (5) Bleaching and bactericidal.

HEATERS, WATER SOFTENERS AND AIR CONDITIONERS

Water and Space Heaters.—The fuels used for appliances for water and space heating are solid fuel (coal or coke), oil, gas and electricity, the first two being most generally used for central heating systems because of lower running costs. The heat generated in the home furnace is transferred to the rooms of the house either by hot-water pipes and radiators or by hot-air ducts. Underfloor heating also is employed, with either hot-water pipes or electric elements embedded in the concrete subfloor.

Piped hot-water systems may be either direct or indirect, the latter being used for combined central and water heating. Direct systems employ independently fired water heaters using gas or electricity and are sometimes used as auxiliaries of the indirect systems during the summer months when the main heating system of the house is closed down. Independent heaters are thermostatically controlled, water temperatures of about 140° F. being generally used to minimize heat losses and scaling, which increase rapidly at higher temperatures. (For a more complete discussion of heating systems *see* HEATING AND VENTILATION.)

Water Softeners.—From the gases in the air, minerals and organic matter on and in the earth's surface, water picks up matter that makes it coloured, cloudy, iron-contaminated and hard with calcium and magnesium salts. Water with as little as 4 or 5 gr. (1 gr. = $\frac{1}{2\,6\,0\,0}$ oz.) hardness causes soap to unite with the

minerals, forming insoluble soap curd and causes scaling in water pipes and heaters.

Water hardness can be reduced by the use of packaged chemicals or a mechanical water-conditioning appliance. Of the packaged chemicals, one type, the hexametaphosphates, leaves the minerals in solution but makes them inactive. Other types of phosphates generally precipitate out the minerals. These chemicals generally must be added manually to washer, dishpan or bathtub and are difficult to dispense in showers or dishwashers.

The mechanical softener, on the other hand, is plumbed directly into the water system and removes hardness minerals by a process known as ion exchange. A tanklike container holds a quantity of beadlike ion exchange resins, which have an affinity for the calcium and magnesium ions found in hard water and prefer them to the sodium ions with which they were originally saturated. Thus, if water containing calcium and magnesium ions passes through a bed of the resin which contains a high concentration of sodium ions, the calcium and magnesium ions in the water will be replaced by the sodium ions of the resins and the calcium and magnesium will combine chemically with the resins. Mechanical water softening cannot be a continuous process, however, since the resins eventually become saturated with calcium and magnesium ions and must be regenerated. This is accomplished by washing the resins with a salt brine solution, which causes the resins to give up their load of calcium and magnesium ions and reunite with sodium ions. Following the wash, the brine, which now consists of calcium and magnesium chlorides, is flushed out of the system through a special outlet. This process may be repeated over and over. While ion exchange resins are not designed to remove iron compounds from water, they do remove some iron. For high iron content waters, however, special filters are necessary. Phosphate feeders inserted in the water line will help, in some cases, to keep the iron in suspension and retard its deposition on fabrics, plumbing fixtures and the like. (*See* also Ion Exchange.)

Air Conditioners.—The term air conditioner commonly implies the appliance installed in a window for the purpose of cooling, dehumidifying and purifying the air in a given area, usually one room. A true air-conditioning system, however, is a central unit designed for both heating and cooling, which works interchangeably and automatically to condition the air and maintain it at a set temperature throughout the home.

The room conditioner is most frequently installed in a window or other opening in the outside wall. Such units are generally rated from ½ to 1½ tons, a "ton" being equal to the amount of cooling produced by the melting of one ton of ice in 24 hours. Larger conditioners usually are water- rather than air-cooled and require 1½–5 h.p. motors. The motor of the ordinary room conditioner generally is about ½–1 h.p. Any size over that requires a 240-v. circuit.

The mechanism of the room conditioner is the same in principle and similar in construction to that of the compression-type refrigerator. Air is drawn through a filter that removes dust, smoke and pollen; the clean air, which may also be moisture-laden during hot humid weather, then passes over the cooling coils, causing some condensation. The condenser fan throws the excess moisture onto the condensing coils, where it may all be evaporated or channeled to drain outside the conditioner. Heat from the condenser is dissipated outside the house, and cool air is blown through vents into the room by the fan. Adjustable vents allow for the air to be circulated in different directions—up, down or sideways—in the room to prevent drafts on the occupants. The air is usually about 15°–25° cooler than the temperature of the room would be without the conditioner. Some models are thermostatically controlled so that when the temperature of the room drops below that of the temperature setting the cooling unit shuts off and only the fan continues to operate, providing circulation without cooling. This feature is advantageous for nights when outside temperature may drop below that of early evening. Some models have to be manually set and operate until the user changes the control. Still other models have a heating element to warm the room on cool days. Certain models are designed only to cool and recirculate the air already in the room, others have a vent that can be adjusted to pull air in from outside or recirculate that in the room. The latter is advantageous on very hot days when it is easier to keep the already cooled air at the desired temperature than to cool that from the outside. If air becomes stale the vent can be opened to replenish it. Portable models that do not require permanent installation also are manufactured. To reduce noise, motors, compressors and fans are mounted on rubber. Since air conditioners can dry, cool and remove dust and pollen from the air, they are of aid to persons with hay fever and asthma. (*See* also House Design; Air Conditioning.)

(El. K. W.; J. E. Wa.)

SEWING MACHINES

Flat Bed and Free Lower Arm.—Most home sewing machines are the flat-bed type, on which it is difficult to sew or mend narrow tubular parts such as socks, elbows of a sleeve or knees of trousers. Free lower-arm machines have an enclosed lower portion over which tubular fabrics may be slipped.

Portable and Cabinet Styles.—Portable full-size heads of steel machines may weigh more than 30 lb. and are not easily carried; those made of aluminum are of course considerably lighter. Smaller-size heads weigh less, but they provide less free space for maneuvering fabric while sewing. It is more difficult to sew heavy or bulky fabrics on very small machines. Some carrying cases are designed to open to create a flat surface for the free-arm machine or double in use as a suitcase. Certain portable machines are made so that they can be locked easily into a cabinet or be removed by lifting a lever in the machine. Specially constructed tables, with a removable section in the top and a supporting base, into which portable machines may be set, provide a flat surface for sewing at a comfortable height.

Oscillating and Rotary Types.—It can be determined whether a machine is oscillating or rotary by noting the direction of the movement of the bobbin race (which is around the bobbin case) while stitching. Oscillating machines have a semicircular, backward and forward mechanical movement around the bobbin case, which clicks when the race starts to reverse itself. This knocking may cause wearing of parts. The mechanical movement in rotary machines is circular, continuous and smooth, with potentially greater speed and less vibration and noise during operation.

Stitching.—When a machine is evaluated, the stitch should be tested on several kinds of fabric—limp, thick and sheer. It should be noted if the machine stitches in the reverse position, for this is used in backstitching, for securing forward stitching and for mending. The machine head or upper tension may obscure the stitching area, and a slant-needle type machine may provide greater visibility than the vertical-needle machine.

Home sewing machines do three types of stitches: straight lock stitch, chain stitch and zigzag lock stitch.

Straight Stitching.—The commonest machine stitching is a straight, flat stitch produced by the interlocking of spool and bobbin threads, which is fairly difficult to rip out. Straight lock stitch machines often have the reverse stitching feature and sometimes accommodate attachments that do limited kinds of zigzag stitches and make buttonholes.

Chain Stitching.—Chain stitching is produced by one thread which loops over itself, as in knitting or crocheting. The stitching, which may be seen on feed and sugar bags, can be readily unlooped and pulled out, and to be secure the stitched ends therefore must be completed properly. A chain stitch is more upraised than a lock stitch, and since bulky stitching generally is undesirable there is little demand for new chain-stitch machines.

Toy machines for children are the chain-stitch type, being easy to thread because no bobbin is inserted. Toy model machines are adequate for occasional mending.

Zigzag Stitching.—Zigzag stitching is a lock stitch of bobbin and spool threads which zigzag because the threaded needle shifts from side to side during sewing. A close zigzag stitch results in a satin stitch. Buttonholes can be made without attachments, but care must be taken to move the proper levers on the machine and a semiautomatic buttonhole attachment is available for some machines to decrease the probability of mistakes in machine ad-

justments. Buttons can be sewn on with the shifting needle. By inserting two threaded needles, two rows of stitching can be done at one time. Although all zigzag machines do straight lock stitches, on some models the straight stitching is not so regular as it might be. Attachments can be used on zigzag models as on straight-stitch machines. Zigzag stitching usually is demonstrated on stiff fabrics, but it should be tested on limp fabrics too. The overcasting stitch also should be tested by sewing the cut edge of fabric; if the overcasting draws, the tension should be readily adjustable to improve the stitching.

Semiautomatic zigzag models produce decorative zigzag stitches by means of a lever moved manually and rhythmically while sewing. The right hand, working the lever, cannot be used to control the fabric, and as the hand becomes tired the rhythm is changed, resulting in an irregular stitch. Automatic zigzag stitching is done with the insertion of special cams (disks) or by built-in cams. Machines with built-in cams are capable of limited design variations by adjustments in the width (bight) and length of the stitch, and some of these machines accommodate insertable cams for additional decorative stitching. Machines with insertable cams are more versatile because the manufacturer may continue to make cams with new designs and because, since some cams come in several parts, new designs can be created by interchanging the parts. The important thing to consider when comparing automatic zigzag machines is whether it is necessary to have an almost unlimited variety of designs. Ease in inserting the cams also needs to be considered. Zigzag machines vary in complexity of machine adjustment for each decorative stitch.

Speed and Vibration.—Electric home machines may vary in maximum stitching speed within the range of 700–1,400 stitches per minute. On some machines, the maximum speed can be controlled by a lever. The rapidity with which a machine starts and stops sewing is important, and time is wasted if the handwheel must be grasped in starting or stopping. On all kinds of machines, speed of stitching is controlled by the operator. A machine should be tested for amount of vibration when sewing at all speeds, for vibration is likely to be the fault of the machine head rather than of the table. Vibration makes it difficult to control the fabric.

Bobbin.—Ease of bobbin insertion is an important factor. Some machines have built-in bobbin cases; in others the bobbin first must be inserted in a removable bobbin case or shuttle, then placed in the machine. In some machines the bobbin must be inserted on a vertical plane, in others on a horizontal plane; the latter often provides easier insertion and better visibility. Some machines have a "nonjamming" bobbin feature that prevents the thread from clogging the bobbin race if stitching is done when no fabric is under the needle, or that makes it possible to remove a caught thread easily.

Attachments.—The hinged presser foot is useful for sewing over irregular surfaces and pins. Adjustable cording and zipper feet make it possible to stitch close to an upraised surface, such as the teeth of a slide fastener or cording. The buttonhole attachment, adjustable or automatic with the insertion of templates, is useful on lock-stitch machines. Templates are available for both keyhole (one rounded end) and straight buttonholes. Tuckers, hemmers, rufflers and darning and quilting feet are other attachments. Practice often is necessary for skillful use of attachments. They usually are demonstrated on stiff fabrics, and careful adjustment may or may not make it possible to work on limp or glossy fabrics. An automatic zigzag attachment is available for certain brands of straight lock-stitch machines.

Machine Operation.—Sewing machines are powered by a handwheel, a foot treadle or electricity. Nonelectric machines often can be electrified, and electric machines can be adjusted so that they can be operated by a handwheel or foot pedal. Electric machine stitching is regulated by knee or foot levers, some machines having both features. A knee lever located in the proper position for the user may be a better choice than a foot pedal, which is so easily shifted that it is annoying to relocate it after the foot is removed. Foot-pedal machines may be altered to operate with knee levers. Machines may operate with built-in gear drives or with the less expensive friction or belt drives, either enclosed or exposed. (*See* also SEWING MACHINES.)

For small sewing equipment, *see* SEWING, HOME: *Equipment.*

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(F. TA.; M. L. BR.)

HOME FURNISHINGS: *see* INTERIOR DECORATION.

HOME OFFICE: *see* GOVERNMENT DEPARTMENTS: *Great Britain.*

HOMEOPATHY, a system of therapeutics based upon the "law of similars," *similia similibus curantur*, that was introduced in 1796 by Samuel Hahnemann (*q.v.*), a native of Meissen, Ger. Some points of Hahnemann's system were borrowed from previous writers, *e.g.*, Hippocrates and especially Paracelsus (*c.* 1490–1541). The essential tenets of homeopathy are that the cure of disease is effected by drugs that are capable of producing in a healthy individual symptoms similar to those of the disease to be treated, and that to ascertain the curative virtues of any drug it must be "proved" upon healthy persons—that is, taken by individuals of both sexes in a state of health in gradually increasing doses.

Another peculiar feature of homeopathy is its theory of dose. Most homeopathists believe in the action of minute doses of medicine. However, the American Institute of Homeopathy of the United States adopted the following resolution and ordered it to be published conspicuously in each number of the *Transactions* of the society: "A homeopathic physician is one who adds to his knowledge of medicine a special knowledge of homeopathic therapeutics. All that pertains to the great field of medical learning is his by tradition, by inheritance, by right."

In the medical profession homeopathy at mid-20th century remained under the stigma of being a dissenting sect. In the United States it was disappearing; there were comparatively few practitioners and no medical schools emphasizing this approach to therapeutics. There was still an "official" homeopathic compendium in the United States but it was "official" only by virtue of its being included in the compendiums recognized in the federal Food, Drug and Cosmetic act. An edition of the compendium was published in 1941. (A. E. SH.; RO. J. B.)

HOMER, Greek epic poet, regarded in early tradition as the author of most of the narrative poems in hexameter verse which had survived from the beginnings of Greek literature; according to later tradition, the author of the *Iliad* and *Odyssey* and of certain shorter poems (the so-called *Homeric Hymns* and *Homeric Epigrams*, which survive, and the *Margites*, which is known only from fragments). For Greeks writing under the Roman empire he was "the poet" par excellence; though modern writers are less certain about his identity as a person, the *Iliad* and *Odyssey* are still included among the first and greatest works of world literature.

This article is divided as follows:

I. The Poems and Their History
  1. Early References
  2. Early Textual Criticism
  3. Content
  4. Plot of the *Iliad*
  5. Plot of the *Odyssey*
  6. Language
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II. Homeric Archaeology
  1. The Place of Archaeology in Homeric Criticism
  2. The End of Oral Poetry
  3. The Beginning of Oral Poetry
  4. 13th and 12th Centuries
  5. The Historical Background
  6. Summary

I. THE POEMS AND THEIR HISTORY

Disputes about the date, authorship and composition of the *Iliad* and the *Odyssey* constitute the notorious "Homeric question," which was apparently first posed toward the end of the 6th century B.C., when a certain Theagenes of Rhegium began to inquire into

the poetry, pedigree and date of Homer: matters about which there was obviously no certainty even then. This uncertainty, it is clear, arose from the almost complete impersonality of early Greek epic; the author of the *Iliad* occasionally speaks in the first person of his own feelings, but there is no indication of the author's identity in either the *Iliad* or the *Odyssey*. The dates and places at which the poems were composed can only be inferred from internal evidence, and that evidence is scanty and ambiguous.

1. Early References.—External evidence is hardly more helpful: it can be demonstrated that Greek poets from the early 7th century onward were acquainted with poems about "the matter of Troy" and about Odysseus which contained lines similar to some of those which appear in modern texts of the *Iliad* and *Odyssey;* the Homeric authorship of the *Margites* is said to have been attested by Archilochus, and that of the *Thebais* by Callinus, both of whom were active in the 7th century B.C. These two pieces of information are both of very doubtful value; but it is probable that Stesichorus (*c.* 640–555 B.C.) criticized Homer by name for his abuse of Helen (the whole tone of this episode, as it can be reconstructed from references in Plato and Isocrates, suggests that Stesichorus was referring to a poem or poems which took a far less favourable view of Helen than our *Iliad* and *Odyssey* do), and it is certain that, about a century later, Simonides quoted Homer as an authority for what happened at the funeral games of Pelias (to which there is no reference in the *Iliad* or *Odyssey*).

The first references to the rhapsodes (professional reciters of poetry) date from the 6th century B.C. (Plato says in the *Ion* that in the later 5th century their repertory might include Hesiod and Archilochus as well as Homer): early in the 6th century, Cleisthenes of Sicyon is said to have abolished a competition for these people, on the ground that the Homeric poems (which they recited) were practically all about Argos and the Argives, with whom Cleisthenes was then at war; it is probable that Cleisthenes was thinking rather of the poems about Thebes, namely the *Thebais* and *Epigoni*, which seem to have had a strongly Argive bias, than about the *Iliad* and *Odyssey*. Not long after this (probably before 550 B.C.) the sudden popularity of epic subjects as decoration for Attic vases suggests that competitions for rhapsodes had recently been established as part of the four-yearly festival of the great Panathenaea at Athens; but there is no reason to think that the rhapsodes' choice of subjects was limited at first to any particular poem or set of poems. The only known organized group of rhapsodes, the Homeridae ("Descendants of Homer"), were mentioned by the 6th-century Argive chronicler Acusilaus as living in Chios; by Plato's time these people had apparently ceased to practise as rhapsodes themselves, but they had certain unpublished poems, they rewarded rhapsodes who had deserved well of the poet and they kept a sharp eye open for the defense of the poet's reputation. It was disputed even in antiquity whether these people were even nominally descended from a real man named Homeros (the parallel case of the Coan Asclepiadae is bound to have inspired doubts); but it is probable that some at least of the traditions about their supposed ancestor which are to be found in the late lives of Homer must have come from them; and it may reasonably be supposed that even in the 6th century they preserved written texts of the poems which they ascribed to Homer.

What these poems were is uncertain. Aeschylus described his plays as "slices from Homer's great banquet," but none of his surviving plays is based on the *Iliad* or the *Odyssey*, and it seems that few of the others can have been so based. Pindar (who holds that Odysseus has been overpraised because of Homer, and who quotes a phrase from the *Iliad* as "Homer's word") not only speaks of a poem in which Homer worthily praised Ajax (the reference may be to the *Aethiopis* or to the *Little Iliad*) but is credited also with having mentioned the story that Homer dowered his daughter with the *Cypria*. As early as the 6th century, however, more detailed knowledge about Homer and his poems became available. So Heraclitus (*c.* 540–*c.* 480 B.C.) of Ephesus tells the story (found also in the lives of Homer) of how the poet's death resulted from his perplexity over a rather elementary verbal puzzle set him by some fisher lads; and both he and the philosopher Xenophanes (6th–5th century B.C.) criticize Homer's morality, with reference, it seems, to incidents described in the *Iliad, Odyssey* and *Hymn to Hermes*. Attic vase paintings, too, from about 530 B.C. onward, show more detailed acquaintance with episodes in the *Iliad*, and the author of the dialogue *Hipparchus* which is included among those of Plato gives some reason to think that the arrangement by which, in the 4th century, the rhapsodes competing at the great Panathenaea recited the poems of Homer "picking up the cues, in due order" had been instituted by Hipparchus, son of the tyrant Pisistratus, in the second half of the 6th century.

Among the activities attributed by later authorities to Theagenes of Rhegium is the initiation of an attempt to defend Homer against such accusations of immorality as were brought against him directly by Heraclitus and Xenophanes, and obliquely by Pindar, on the plea that Homer's stories about the gods and heroes are to be interpreted allegorically; and this line of interpretation had a long future before it, from the elder Metrodorus of Lampsacus and Stesimbrotus of Thasos (both 5th century B.C.) to Hellenistic scholarship, and thence by way of the Neoplatonists to the Renaissance; among English students of Homer, the translator George Chapman is known for his allegorical interpretations.

In the 5th century B.C. there are also traces of other ways of studying the Homeric poems. Herodotus not only expresses what he claims to be entirely personal opinions about the date of Homer, whom he puts about four centuries earlier than himself (*i.e.*, in the second half of the 9th century), but he questions the reliability of Homer as an authority for historical events, and has doubts about the Homeric authorship of two early epic poems, the *Cypria* (which dealt mainly with the causes and earlier course of the Trojan War) and the *Epigoni* (which dealt with the successful expedition against Thebes by the sons of the original Seven). It was evidently doubts such as these about the nature of the Homeric canon which led in the 4th century to the limitation of that canon to the *Iliad, Odyssey, Hymns, Epigrams* and *Margites*, and to the ascription of the other poems excluded from the canon to such authors as Agias, Arctinus (*q.v.*), Lesches and Stasinus (there is no mention of any of these authors earlier than the generation after Aristotle, and even in the 2nd century A.D. their individual contributions do not seem to have been definitely known). At Alexandria in the 3rd century B.C. two otherwise obscure students named Xenon and Hellanicus pushed their doubts about the Homeric canon so far that they sought to "separate" (Gr. *chorizein*) the authorship of the *Iliad* from that of the *Odyssey*, thus earning the title of "Separators" (Gr. *chorizontes;* someone called Hellanicus, who may be this Alexandrian or the better-known 5th-century historian, tried to ascribe the *Odyssey* to a Lacedaemonian named Cinaetho, but without effect). This separating view was found worthy to be refuted by the great scholar Aristarchus (*c.* 220–*c.* 143 B.C.) of Samothrace in a lost pamphlet "Against Xenon's Paradox," but little more was heard of it until modern times; the ancient world almost unanimously persisted in ascribing the *Iliad* and *Odyssey* to the same author.

The rhapsodes, as can be seen especially from Plato's description of a famous one in his *Ion*, not only recited Homer but interpreted him. This interpretation must have included allegorizations of the type mentioned above, but it is clear from 5th-century references (in Aristophanes, for example) that the explanation of unfamiliar words and phrases (*glossai* or "tongues" in the terminology used by Aristotle in his *Poetics*) formed an important part of the interpreter's activity, and works on the vocabulary of the Homeric poems are ascribed to several well-known 5th-century writers, notably the philosopher Democritus. An anecdote recorded by Plutarch in his life of Alcibiades and references to the activities of the poet Antimachus of Colophon and of the younger Euripides (nephew of the tragedian) show that attempts were already being made in the latter part of the 5th century to produce "corrected versions" (*diorthoseis*) of the Homeric poems; these attempts can hardly be supposed to have deserved the name of textual criticism (which seems to have been the product of the great libraries, and especially of the Alexandrian library founded *c.* 300 B.C.) but they must be regarded as precursors of the critical editions of later times. If one may judge by what is known of 4th-century attitudes to the Homeric poems, the two main criteria employed by

such early revisers are likely to have been decency and appropriateness to the context (the words "indecent" and "unbecoming" played an important part in ancient literary and textual criticism). The 4th-century writer Zoilus of Amphipolis earned the title of "Homer's scourge" by the violence with which he expressed his disapproval of those anomalies of language and incident. But many of them, as more tolerant critics such as Aristotle have shown, are due to misunderstanding of Homer's purpose and those that remain after the clearing up of such misconceptions are best treated as they were by Horace, as evidence that even "good Homer" may nod at times.

2. Early Textual Criticism.—Textual criticism, which is properly speaking the attempt to establish as close an approximation as possible to the author's own version of the text by the detailed study of written evidence (which now includes a close study of the vehicle of that evidence—papyrology, codicology, bibliography—as well as the actual wording of what has been written and the manner of its writing) could not be developed until a considerable number of different copies of a particular text had been gathered together in one place, and so made accessible for comparative study; and though there are mentions of private libraries existing in the 6th century B.C. it seems that the institutional library, in a form ancestral to the learned libraries of the present day, was created in the philosophical schools of 4th-century Athens, and especially in that of Aristotle, who is credited by later authorities with the invention of the art of librarianship. Aristotle is credited also with an interest in the text of Homer, as well as in interpretation: it is reported that Alexander the Great took with him on his Persian expedition and greatly treasured a text of Homer which had been prepared for him by Aristotle, but nothing is known of the nature of this edition, and it is unlikely that Aristotle knew much of the critical activities of collation, recension and the elimination of codices (all of these were developed later, the last not until the 19th century).

The first major opportunity for the exercise of textual criticism in anything like the modern sense was provided by the foundation, *c.* 300 B.C., of the great library which formed part of the Museum at Alexandria. The first two Ptolemies (and especially the second) were among the world's most successful book collectors, and among the treasures which their agents gathered for them from as far away as Marseilles and Sinop were a great many copies of the works of Homer. Most of these had probably been obtained commercially, either from booksellers or from individual rhapsodes; and the comparisons which were made possible by the assembling of so many copies together revealed that the text of Homer was very unreliable (*i.e.*, "corrupt" in modern terminology); the main outlines of the *Iliad* and *Odyssey* stood firm, but individual copies varied widely in their treatment of the component episodes: there are many variations of wording in the fragments of contemporary texts on papyrus which have been recovered from Egyptian excavations, and these variations nearly always include expansions of the text, by comparison, that is, with a modern edition. The process of producing what could be generally accepted as a standard text seems, again from the evidence of the papyri, to have gone on for over a century; papyrus fragments dating from *c.* 150 B.C. bear texts which are manifestly ancestors of modern standard editions, but thereafter such texts become increasingly prevalent until under the Roman empire papyri whose text differs substantially from the later tradition (the so-called "wild" papyri) are almost nonexistent.

The evidence about the activities of Alexandrian scholars which is preserved, often in very fragmentary form, in later writings, and especially in the commentaries or scholia with which many Byzantine scholars and scribes enriched their manuscripts, stresses the importance of three men for the development of a reliable text of Homer. The earliest of these was Zenodotus of Ephesus (*q.v.*; fl. *c.* 280 B.C.); then came Aristophanes of Byzantium (*q.v.*; *c.* 257–180 B.C.). Little is known of the details of these two critics' work; Zenodotus has the reputation of having been a drastic editor, freely omitting or altering lines and passages which he regarded as un-Homeric, whereas Aristophanes appears to have been more moderate in his approach to textual problems. Apparently neither of these two left much behind in the way of commentary, whether critical or interpretative; they are reported to have revised the text and provided it with certain marginal symbols to indicate lines which for some reason they felt to be out of place where they stood, but they seem to have left their reasons to be guessed at by their successors. It is held by some that such revisions of the text as are ascribed to these scholars could have been made only on the basis of manuscript evidence; but it is more generally believed that subjective feelings played at least as great a part in providing them with criteria as did the evidence of older manuscripts.

This is certain for the third of the great trio, Aristarchus of Samothrace (*q.v.*; *c.* 220–*c.* 143 B.C.); he seems to have been a much more articulate person than the other two (or else he was more fortunate in his successors), since the records of his work are much fuller. He not only prepared, it is said, two revisions of the text of Homer but also compiled full critical and explanatory commentaries, together with monographs on a number of special points. None of these survives in the form in which he actually compiled it, but the remarkable collection of commentaries and of dictionary and encyclopaedia articles on Homeric matters which has been preserved in Byzantine manuscripts of the 10th and later centuries A.D. (and without which modern interpreters would often be helpless) derives very largely from the tradition of scholarship which he founded. It is thus reasonable to suppose, though it must be admitted that no definite evidence exists to confirm the supposition, that the text of the *Iliad* and *Odyssey* which appears to have been received as the standard since about 150 B.C. derives from a text sponsored by Aristarchus.

The awkward word "sponsored" is necessary here, because the evidence shows that the "received text" differs at a number of points from what Aristarchus thought that the text ought to have been; this can be explained either as the result of a "victory" of the received (or "vulgate") text over that prepared by Aristarchus or (with more probability) as suggesting that the text which, at about the time of Aristarchus' death, became the recognized standard version of the *Iliad* and *Odyssey* was derived from a source so authoritative that Aristarchus felt bound to accept its readings, even where he did not himself believe that it correctly recorded the author's intention. Since it is further stated that Aristarchus and his pupil, Dionysius Thrax, believed Homer to have been an Athenian, it is possible that this authoritative text came from an Athenian source; if so, it may have been a copy of that text which (according to 4th-century Attic sources) had been prescribed for the Panathenaic recitations since the 6th century. (Athenian origin is generally thought to be proved by the "Atticisms" which have been detected in the language of the poems; but it is less certain today than it was that these supposedly "Attic" forms are really such.)

3. Content.—It has not been possible to say very much so far in this article about the *Iliad* and *Odyssey* as works of literature, since it is not until the middle of the 2nd century B.C. that the modern scholar can begin to feel in touch with versions of the text of the two poems which can be proved to be substantially the same as those found in a Byzantine manuscript or in a modern edition. The earliest surviving Greek authors, no less than the earliest artists who illustrate scenes from legend, testify to the existence among the Greeks from the late 8th century B.C. at the very latest of a huge mass of stories dealing with the creation of the world, the successive generations of the gods and their triumphs and disasters, the creation and increase of men upon earth, the pedigrees of great families and the mighty deeds of heroes, whether in such collective undertakings as the wars against Thebes and Troy, the quest for the golden fleece and the hunting of the Calydonian boar, or in individual exploits like those ascribed to Perseus, Heracles and Theseus. That these stories originated long before they make their first attested appearance in Greek literature and art is certain; and it is at least highly probable that the medium in which they were preserved was that same dactylic ("heroic") hexameter verse in which the surviving remains of that mass of stories can still be read. It is not so certain that writing played any part in this preservation before the end of the 8th

century. There is no evidence that the Bronze Age script known as Linear B (*see* MINOAN LINEAR SCRIPTS) was ever used for recording any text worthy of the name of literature; and even if there were, there is still no evidence that knowledge of this script, or ability to decipher it, persisted after the end of the Mycenaean period (?1150 B.C.), or that texts recorded in Linear B could have been transcribed into the alphabetic script which (so far, at least, as the existing monuments go) makes its first appearance in Greece in the 8th century B.C. Until the development and dissemination of the alphabet, the only way (it seems) in which tales of the heroic past could have been preserved was by expert memorization; and each performance of the old stories would then be a new creation, in which the traditional events were described afresh in a new employment of the traditional diction which generations of experience had shown to be best adapted for this sort of poetical creation.

It does not seem that the birth (or perhaps one should rather say the rebirth) of literacy among the Greeks in the 8th century B.C. materially changed their old habits at first. Writing could be used to record a particular version of a story or a song, which could then be repeated exactly as its originator had first composed it; but the acceptance of this principle appears to connote the beginnings of a sense of literary property, and hence of the individuality of authors; it may well be significant that it is precisely in the last years of the 8th century and in the early years of the 7th (that is to say, in the first generation the members of which could certainly have been acquainted with the alphabet from childhood) that Greek authors become known not only by name but also by undoubted remains of their works, such as Eumelus of Corinth and Archilochus of Paros (Hesiod may have been another, but his dates are too uncertain to justify his inclusion here). However, there is no evidence that books were widely disseminated, or that a true reading public had begun to develop, until the latter years of the 5th century B.C. Until then the Greeks depended almost exclusively on their ears for their acquaintance with literature; and even after the development of an organized book trade at Athens in the last quarter of the 5th century authors still published their newly composed works by means of recitations; in the following century Plato expressed in the *Phaedrus* his deep disapproval of the modern fashion of private reading. (This disapproval, to judge from Xenophon, was not shared by Socrates, whose scorn was reserved for the bibliolater, not for the genuine reader.)

Thus from the late 8th until well in the 5th century B.C. there is no coherent evidence of the content of those poems about the Trojan War and its aftermath which then went under the name of Homer; it is not until the history of Herodotus (after 450 B.C.) that there are references to poems called by the now familiar names *Iliad* and *Odyssey*, and the verbatim quotations from "Homer" in the text of authors from Herodotus to Aristotle do not warrant the assertion that any of them had access to a version of either of these poems which would have satisfied Aristarchus. (Plato's quotations from, and allusions to, the *Iliad* and *Odyssey* have been studied in special detail; and though the conclusion is that Plato's text must have been very like the received text there are divergences between his quotations and the latter which cannot be accounted for entirely by the suggestion that Plato usually quoted from memory.)

Hesiod in the *Works and Days* singles out the operations against Thebes and Troy as the greatest achievements of the men of his fourth age, "the divine race of heroic men, who are called demigods," and who come between the Bronze Age and the Iron Age in his historical scheme. The Theban "cycle" of stories is known mainly from allusions in non-epic literature, and especially from the plays which were based upon parts of the cycle by the 5th-century tragic poets; much of the Trojan cycle is known from similar sources, although in this case there is also a collection of summaries of the poems which, in about the 2nd century A.D., were accepted as composing the cycle: the *Cypria* in 11 books, which carries the story down to the point at which the *Iliad* begins; the *Aethiopis* in five books, the *Little Iliad* in four, the *Sack of Ilios* in two, and the *Returns* in five, which bridge the gap between the end of the *Iliad* and the *Odyssey;* and the *Telegony* in two books, which carries the story down to the death of Odysseus and the domestic rearrangements which followed it. A Trojan cycle of sorts appears to have existed already in the youth of Simonides (*c.* 540 B.C.): there is a story that he learned singing in a temple decorated with a series of pictures from the "Trojan myth"; and Aristotle in the *Rhetoric* mentions a certain Phayllus who had already produced a summary of "the cycle." The strip-cartoon flavour of the story about Simonides is illustrated by the *tabulae Iliacae*, which are pictorial representations of the various poems of the Trojan cycle (usually in the form of reliefs) which were much admired in Hellenistic and Roman times; the most famous of these reliefs, in the Capitoline museum, Rome, has in the centre what would now be called "a low-flying oblique" of the sack of Troy, which was once framed by panels illustrative of the 24 books of the *Iliad* (the dexter side of the frame is lost), as well as of the *Aethiopis* and the *Little Iliad*, the whole (which included a prose summary of the *Iliad*) being described as the "Theodorean arrangement of Homer." The general impression which the evidence about these "cyclic" poems creates entirely supports both the condemnation of them found for instance in the epigrams of Callimachus and the good taste of those who preserved the *Iliad* and *Odyssey* complete while allowing the other poems to disappear.

4. Plot of the *Iliad*.—The *Iliad* (*i.e.*, "the poem about Ilios") describes its subject, in its first line, as "the wrath of Achilles," and this subject it follows from its beginning in a quarrel over captive women between Achilles, the greatest warrior, and Agamemnon, the commander in chief, of the Achaean army which has for nine years been besieging Ilios, capital of Troië, in order to recover Helen, the wife of Agamemnon's brother Menelaus, from her abductor Paris, son of the Trojan king Priam. The disastrous consequences of the quarrel, first for the Achaeans (who have to fight without Achilles' support, and in the face of the temporary, but nonetheless real, enmity of Zeus, the "father of men and gods"), then for Achilles himself in the loss of his beloved friend Patroclus and finally for the Trojan hero Hector, are followed to the point at which Achilles, having reconciled himself with Agamemnon and with the Achaean host in general, and having avenged upon Hector the killing of Patroclus and performed the last rites for his dead comrade, is at last reconciled with the gods and with the proprieties when he allows Priam to ransom the dead Hector and take the body back to Troy for proper burial.

Thus the theme of the poem is a single quite short episode, and a careful attention to the time plan of the story (as it is given in the poem) will show that it covers altogether a period of about 40 days, only a few of which are described in any detail. By itself, the "wrath of Achilles" could be dealt with adequately in quite a small compass; but in the *Iliad* it is used as the framework on which is built up an elaborate picture of the splendour and tragedy of war and the inconsistencies of gods and men. The author uses direct speech (hence his inclusion by Aristotle among the dramatists), prophecy, reminiscence, metaphor and simile to relate not only the events of these few weeks in the tenth (and last) year of the war but also the course of the war up to the point at which the poem formally begins; he tells too how the long agony of the Trojans is to end, and that Achilles is doomed to die not long after Hector, without seeing either the final victory or his old father or his son. The poem takes in events both on the battlefield and behind the lines, in the Achaean camp and in Ilios, and holds the balance so true between the two sides that it has been seriously debated whether Homer should not actually be called "pro-Trojan," so vividly and sympathetically are Trojan characters depicted and the dreadful ends to which they are doomed made plain.

It must have been to the feeling created in the minds of auditors or readers that this poem covers the whole course of the Trojan War and not simply the quarrel of Achilles and Agamemnon that the poem came to owe its title of the *Iliad;* but in its present form its horizon is far wider than the Troad. Thanks to reminiscences, whether personal like those of the older heroes Nestor and Phoenix, or inherited like the story of Bellerophon which his descendant, Glaucus, tells in book vi, or put into the mouths of

deities, or even at times directly narrated by the author, the Trojan adventure (which itself forms the background for Achilles' clash with his commander, his comrades, his gods and himself) is set against the background of the heroic world as a whole: much is told of Heracles, something of Tydeus and the Seven against Thebes, something of the wars of Lapithae and Centaurs in Thessaly, something of Meleager and the disastrous end to the Calydonian hunt, a good deal about the Trojan royal house and its ramifications and about Nestor and his early adventures in the southwestern Peloponnese. Prophecies help to set the whole story in some sort of perspective for the public for which the story is designed: the wall round the Achaean camp (erected in book vii for the confusion of commentators no less than of the Trojans) has long since been utterly destroyed, and the descendants of Aeneas are reigning in the Troad, apparently undisturbed by the catastrophe which befell their kinsfolk at Ilios.

5. Plot of the *Odyssey*.—The *Odyssey* tells a wider-ranging story than the *Iliad*, but employs a less complex narrative technique. Its formal subject is the home-coming of Odysseus from Troy, and the adventures in which he lost all those companions who, having sailed with him from Ithaca at the beginning of the war, had survived to the end of it. Like the *Iliad*, the *Odyssey* takes a comparatively short period (also of about 40 days, and again only a few are described in detail) as the framework for its narrative: at the beginning of the poem Odysseus is detained far from home in Ogygia, an island ruled by the nymph Calypso ("Concealer"), and it appears that, of all the heroes who went to Troy, his fate alone is now unknown to his family. It is the tenth year since the sack of Troy, and at Odysseus' home in Ithaca his wife Penelope and his son Telemachus, who had been a baby in arms when Odysseus left home for Troy nearly 20 years before, are struggling to maintain themselves against the nobles of the kingdom, who are competing for the apparently widowed queen's hand and for the sovereign rights which the winner of that hand will acquire (it is not at first emphasized that the continued existence of the lawful heir, Telemachus, now that he has reached manhood, would be altogether inconsistent with the exercise of those rights by a stepfather).

Having established the situation of Penelope and Telemachus, as well as that of Odysseus, in the public's mind, the poem devotes itself for most of the rest of books i–iv to the doings of Telemachus; on the advice of the goddess Athene, whom we know from the *Iliad* to have a special affection for Odysseus, Telemachus is to leave home to seek news of his father from the best informed of the surviving heroes, the indispensable Nestor at Pylos and the recently returned Menelaus at Sparta. These books show the gradual maturing of Telemachus as he makes his first acquaintance with the world outside Ithaca, and also two of the more successful attempts to restore the prewar Achaean world: Nestor and Menelaus both seem firmly established, and though Menelaus' majordomo tries to bring his master round to more modern ideas the kings themselves (and Helen) worthily maintain the heroic tradition of hospitality. Nestor brings Telemachus up to date about the disastrous returns of the heroes from Troy, but has been too long at home to have any information about Odysseus; Menelaus, whose recent past has been a good deal more informative, assures Telemachus (on first-class authority) that Odysseus is still alive and may be expected home before long.

The story then returns to Odysseus: in book v he leaves Calypso's island on a raft which he has made himself with tools provided by the goddess, and which brings him after 17 days at sea within sight of land, and also (less fortunately) within sight of his archenemy, the sea god Poseidon, who wrecks the raft and almost drowns Odysseus. Odysseus however swims safely to land on Scherie; and in book vi he is found and succoured by the princess Nausicaa, who tells him the name of the land and its people, and explains her own position and that of her family. Books vii and viii describe Odysseus' welcome at the palace by Nausicaa's parents, Alcinous and Arete, with the banqueting, athletic sports and entertainments which follow, and which bring Odysseus to the point where he can no longer conceal his identity. Now he must tell his hosts how he has come to their remote land; and in books ix–xii he describes "the moving accidents by flood and field" which have befallen him between his departure from Troy and his arrival on Ogygia (his voyage from there to Scherie he has described to Alcinous and Arete in book vii). This account which begins in the everyday world very soon passes into the world of fable, with magic plants, man-eating ogres and ogresses, a wizard who can charm the winds, a witch who can change men into beasts, a visit to the world of the dead and a variety of sea monsters. All this is told by Odysseus, and accepted by his hearers, as strictly true and the spell remains unbroken into book xiii, while the Phaeacians in their magic ship carry the sleeping Odysseus safely back to Ithaca and land him, still unconscious, upon the shore.

The rest of book xiii and books xiv–xvi describe how Odysseus, with the help of Athene, prepares for his home-coming (which will involve vengeance on the suitors for treatment of Odysseus' property and family); he finds a base in the homestead of the loyal swineherd Eumaeus, and Telemachus is brought there by Athene, escaping an ambush laid for him by the suitors, so that he can recognize his father and help him lay his plans. The working out of these plans, in which the concealment of Odysseus' identity from the suitors and their supporters (and, incidentally, from Penelope) is a vital factor, occupies the whole of the next four books (xvii–xx), giving the suitors plenty of opportunity to justify the vengeance which Odysseus is to take upon them, and Odysseus plenty of opportunity to justify his reputation as a taleteller. (It is noteworthy that whereas Odysseus' account of his real adventures to the Phaeacians is full of fabulous elements, his false accounts of himself in Ithaca are as factual as possible; fiction dare not be as strange as truth).

Book xx having ended with manifestly bad omens for the suitors, book xxi allows Penelope (inspired by Athene) to prepare the ground for the destruction of the suitors, by introducing the "trial of the bow," nominally as a means of determining which of the suitors she will marry. The exact mechanics of this trial are disputed; but no reader can fail to notice the rising suspense, as one after another the suitors fail to string the bow, let alone shoot an arrow from it. Telemachus, suitably and significantly, almost succeeds; but at last the bow comes into the hands of the still disguised Odysseus. That this is the climax of the story is made plain by the careful description of exactly what follows: the locking of the hall door, the securing of the courtyard gate, Odysseus' careful inspection of the bow, the comments of the suitors, the effortless ease with which Odysseus strings the bow, and the musical twang of the string as he tests it. "Then great grief came on the suitors, and the skin of all changed colour; and Zeus thundered loudly." The killing of the suitors, with its vicissitudes, the gruesome vengeance on disloyal servants and the purification of the hall occupy book xxii; and then the scene is set for the recognition of Odysseus by Penelope. This is a difficult business (though Penelope does not quote the deception of Alcmene by Zeus, or that of Tyro by Poseidon, she knows very well how the gods can deceive mortals), and it is not until near the end of book xxiii that Odysseus and she are fully reunited.

Aristophanes and Aristarchus are said to have regarded this as the "end" or "limit" of the *Odyssey*, but the poem in its present form goes on for another 600 lines. Most modern readers feel these lines to be superfluous; but Odysseus himself has pointed out that the killing of the suitors is not the end of the story (violent death never is, in Greek thought) and that the families of the dead men will have to be appeased. Nevertheless, the curtain conversation between Odysseus and Penelope and the intervention of Athene at the end of book xxiii, and the scene at the beginning of book xxiv in which the souls of the dead suitors pass to Hades and find Agamemnon describing to Achilles at considerable length the fight over Achilles' body and the noble funeral which the Achaeans gave him, have a strong air of contrivance; Agamemnon's story to Achilles fills one of the gaps between the end of the *Iliad* and the beginning of the *Odyssey*, but it seems to have very little to do with the return of Odysseus. The conversation following, between Agamemnon and the suitor Amphimedon, returns the poem to its main theme, with its contrast between Clytaemnestra and Penelope, and then come the meeting of Odysseus with his

father Laertes and the reconciliation of Odysseus with the suitors' kinsfolk, thanks to the intervention of Athene.

Whereas in the *Iliad* there are a number of apparent digressions from the Trojan theme, this is much less true of the *Odyssey*. In this poem practically all the material which does not bear directly on the adventures of Odysseus himself, and which may therefore be roughly classified as digressive, is taken from the Trojan cycle: the death and funeral of Achilles (dragged in rather by the hair, as has just been suggested), the award of Achilles' arms to Odysseus and Ajax's consequent suicide, the wooden horse and the heroism of Neoptolemus, the debates among the leaders after the taking of Troy, and the more or less disastrous returns of Agamemnon, the lesser Ajax, Diomedes, Menelaus and Nestor. All these episodes, which were doubtless treated at greater length in the cyclic poems, dovetail well into the narrative of the Trojan War as its course can be reconstructed from the indications given in the *Iliad;* and it is therefore tempting to argue that the *Odyssey* in its present form presupposes the *Iliad* in its present form. The main obstacle to this view is the passage in book viii (73–82) where Demodocus is reported as describing a quarrel which occurred at Troy between Achilles and Odysseus; no such quarrel is either mentioned or even remotely implied in the *Iliad;* it is, however, in accordance with the traditions about Troy which are found in other sources, notably in Attic tragedy (in which Odysseus is firmly established as a typically cruel and treacherous character) and in Latin literature (one may compare the references to him in Virgil's *Aeneid*). Such tales as that of the murder of Palamedes, which for Virgil cast an indelible stain on the memory of Odysseus, were already included in the common stock of tales about the Trojan War on which the authors of early Greek epic drew (Palamedes is to be found, for example, in the prose summary of the *Cypria*); but just as the *Iliad* and *Odyssey* give a more favourable picture of Helen than is found elsewhere (in Stesichorus, for example, or in Attic tragedy) so the *Iliad* and *Odyssey* agree in emphasizing the good traits in Odysseus' character; even his deceptions are invoked only for laudable reasons, and there is no trace of "slimness" in his dealings with his opponents.

6. Language.—It is not only for the elements of which their narratives are constructed that the *Iliad* and *Odyssey* are found to draw upon a common stock; the actual words in which the narratives are framed are also derived from such a stock. It has long been known that the language of early Greek epic (often called "the Homeric dialect," but that is doubly a misnomer) cannot be classified under any of the headings which students of Greek dialectology have devised to describe the linguistic phenomena of the archaic and classical periods: though the epic language is mainly Ionic in dialect colour it contains unassimilated elements which appear to derive from dialects normally classified as Aeolic, Arcado-Cypriot (*i.e.*, "old Achaean"?) and Attic. It is probably significant that in this apparent mélange of dialects there is no mention of Dorian (even Dorian epic poets like Eumelus seem to have used the epic language); and it is almost certain that the epic language had attained to a considerable degree of fixity before the invaders who brought the so-called northwestern dialects (of which literary Dorian is an offshoot) had established themselves in sub-Mycenaean Greece (*c.* 1100 B.C.). However this may be, it is clear from an analysis of the diction employed in the existing remains of early Greek poetry in hexameters (and in the related elegiac couplet) that the poets who composed these works were employing a very highly organized vocabulary, well adapted to the impromptu composition either of new versions of old stories or of accounts of recent (and not previously described) events, and evidently the distillation of generations of professional experience in this kind of composition.

The most noticeable feature of this highly organized vocabulary is its great dependence upon stereotyped phrases or formulas, ranging from the regular qualification of a particular substantive by a standard epithet, however inappropriate that epithet may seem at the moment of use (as when beached ships are called "swift" or "seafaring" or the murderous adulterer Aegisthus is called "blameless") to complete lines (such as, "But when haze-born rose-fingered dawn appeared . . .") and even to groups of several lines, descriptive of such standard activities as going to bed and getting up, putting on and taking off armour, sacrificing and feasting, launching and beaching ships. Most of the shorter formulas are of standard metrical patterns, suitable for a particular place in the hexameter line; and it is rare in such phrases for a single substantive to be associated with two adjectives or groups of adjectives giving a completely identical metrical pattern. The uniform effect of this dependence on formulas is often enhanced by the epic practice of direct repetition, as when a messenger repeats verbatim (or with only the minimum changes called for by a changed grammatical situation) to B instructions previously issued by A. At the same time there are of course influences operating in the opposite direction: differences of subject matter strongly influence vocabulary, so that it is possible to compose long lists of words which are found in the *Iliad* but not in the *Odyssey* (or vice versa), or again in one part of a poem and not in the others; and it is evident that one must make considerable allowances for differences in skill and inspiration, not only between different poets but between different parts of the work of a single poet. So, though it is at least arguable that the *Iliad* was composed by a different person from the author of the *Odyssey*, it did not seem absurd to the author of the treatise *On the Sublime* (ascribed to Longinus, *q.v.*, 3rd century A.D.) that the *Odyssey* might have been composed in old age by the author of the *Iliad*.

7. Early Manuscripts and Commentaries.—From the time of Aristarchus down to the Arab conquest of Egypt in the 7th century A.D., it is possible to trace the history of Homer's text from the papyri. From these it appears that most readers of Homer in Graeco-Roman Egypt read their author in a plain text, without adding any sort of marginal or interlinear notes; it is rare to find a copy with even the marginal symbols devised by Aristarchus to facilitate reference to his commentaries. The papyrus fragments include some vocabularies and paraphrases, as well as fragments of organized commentaries; but it seems clear that as long as the papyrus roll was the normal form of the Greek book complete texts of the *Iliad* and *Odyssey* must have been difficult to find in private hands (the *Iliad* occurs more frequently than the *Odyssey*, but even in the *Iliad* books iii–xxiv are much less well attested than books i and ii, which were probably, as in Byzantine times, the texts mainly studied in the schools).

It is not easy to trace the effects on the text of Homer of the coming of the codex (the ancestor of the modern book), since it makes its appearance at a time when all copying of secular texts appears to have been falling off: the John Rylands library at Manchester has fragments of a codex (3rd century A.D. parchment) which must originally have contained the whole *Odyssey*, and the codex form evidently owed its final victory in this battle of the books to the fact that it was better adapted than the roll for the integral preservation of long works or of large collections of shorter ones (*see* Book). Egypt was not, of course, the only place where the copying of Greek texts was practised; but thanks to the special conditions early copies of Greek texts (and especially those written on papyrus) have been preserved there in far greater quantities than anywhere else. At Rome, at Constantinople, at Athens, at Caesarea and in many other places elementary school masters used Homer as one of their introductory texts; and though the advanced study of Homer under the Roman empire never reached heights like those to which it had been carried by Aristarchus and his contemporaries at Alexandria and Pergamum the painstaking work of generations of scholars codified and digested the results of earlier research, and added here and there new contributions. There is, however, very little really contemporary evidence of these men's work, owing to the fact that practically all surviving secular Greek manuscripts were written in the 10th century A.D. or later, by which time much of what had once been the original work of particular individuals had been combined and recombined into an inherited conglomerate which defies easy analysis. Apart from the papyri, there are only two very early manuscripts of the *Iliad:* a fragmentary copy in the Ambrosian library at Milan with illustrations probably to be dated *c.* 500 A.D., and a palimpsest in the British museum, London, on which a Syriac text has been written over a 6th century text of the *Iliad*.

The coming of papermaking to the western world (after A.D. 751) and the development not long after of a new minuscule hand for the writing of Greek, followed by the victory of the Iconodules over the Iconoclasts, led to a remarkable renaissance in the study of Greek classical authors, and hence to a demand for copies of these authors in the new script. The earliest of these new manuscripts to survive is a Euclid of 888 in the Bodleian library, Oxford; the *Clarkianus* of Plato, also in the Bodleian, is not much later (895). The transliteration of poetical texts into the new script began later than that of prose texts; and it is therefore not surprising that the earliest complete manuscript of the *Iliad* should be datable to about the middle of the 10th century. This manuscript, known to textual critics of Homer as A, is in the Marcian library, Venice. It is a peculiarly rich and informative manuscript, since it not only contains a text of the *Iliad* with the most comprehensive set of Aristarchus' critical signs in existence, but is provided with elaborate prefaces and a noble series of commentaries, one written between the lines of the text, one written round the text on the three broad margins of the page and a third fitted into odd spaces between the text and the main marginal commentary. This main commentary is chiefly critical, and the bulk of its information derives from Aristarchus through works of four later Alexandrian scholars: those on the edition of Aristarchus by Didymus Chalcenterus and on the signs of the *Iliad* and *Odyssey* by Aristonicus (both of the Augustan age) and on punctuation by Nicanor and on the accentuation of the *Iliad* by Herodianus (Hadrianic or Antonine). These four works appear to have been combined with other material, perhaps in the 9th century A.D., into a single commentary ascribed to Apion and Herodorus (or Heliodorus; the second of these is unknown, but there was a lexicographer named Apion in the 1st century A.D.). This commentary in its turn appears to have been used as a source by the compiler of the main commentary in A, and also by the compilers of two of the great Byzantine lexicons (the Suda lexicon and the *Etymologicum genuinum*), as well as by the most voluminous of all medieval commentators on Homer, Eustathius (*q.v.*; who died as archbishop of Thessalonica in 1198). There was also a large explanatory commentary, which seems to have been put together at about the same time as that of "Apion and Herodorus"; extracts from this are preserved in a considerable number of manuscripts, of which the most important is that known as T, written in 1059, and now in the British museum, London.

The *Odyssey* is less well served by the Byzantine commentators and scribes than is the *Iliad;* the surviving scholia are fewer and less well organized (Eustathius' commentary on the *Odyssey*, for example, is only about half the size of that on the *Iliad*). This may be partly due to the fact that the *Odyssey* seemed to present fewer problems than the *Iliad;* but it must not be overlooked that whereas T. W. Allen's list of the manuscripts of the *Iliad* (see *Bibliography*) contains 190 items his list of *Odyssey* manuscripts runs to only 75 (seven of which contain the *Iliad* as well). The only surviving *Odyssey* manuscript on parchment earlier than the 10th century A.D. is the fragmentary codex in the John Rylands library, already mentioned; the latest manuscripts of both *Iliad* and *Odyssey* listed by Allen are of the 18th century. From the point of view of a modern editor no manuscript written after the appearance of the first printed edition (1488) is likely to have the slightest value; and the evidential value of many of those written after 1300 or so is unlikely to be great. Much more study is needed however before a history of the text of Homer in the middle ages could be written which would satisfy modern requirements, and until such a history can be written it is not likely that a really authoritative text of the Homeric poems (and especially of the *Iliad*) can be produced.

8. Influence.—It is now time to go back and look at Homer's influence in the Latin west after the fall of the western empire. Though there was never a time from then until the Renaissance at which Greek was totally unknown in the west, it is not easy to show that any Latin had direct acquaintance with the Greek text of any part of the Homeric poems. That Homer was "a clerk marvellous" was firmly believed by literary men, but this conviction was based on secondary sources at best (such judgments as those of Horace and Quintilian must have carried great weight); for specific information about the "matter of Troy" they depended on such works as the verse *Ilias Latina* and the contrasting prose versions ascribed to the pro-Trojan Dares Phrygius and the pro-Greek Dictys Cretensis (*qq.v.*). To show the quality of their knowledge it may suffice to point to the metamorphosis of the Homeric Chryseis into the Shakespearean Cressida; the student of Homer is hard put to it to imagine the plagues which Chryses might have invoked had his daughter been treated as her namesake is in Shakespeare's *Troilus and Cressida*. Petrarch (1304–74), it seems, was the first major writer to wish to learn Greek in order to be able to study Homer; but his plan was frustrated by the departure from Avignon of the monk Varlaam who was to have been his teacher, and he was forced to depend on a poor version of the *Iliad* and *Odyssey* into Latin prose which had been made by a Calabrian named Leonzio Pilato at the prompting of Boccaccio. Pilato's versions were superseded before long by the Latin versions of the great humanist Lorenzo Valla; and the steady influx into Italy throughout the first half of the 15th century of Greek manuscripts, of scholars who could interpret them and scribes who could reproduce them combined with the coming of the printing press to produce the *editio princeps* of the Homeric poems, made at Florence by Demetrius Damilas under the guidance of the scholar Demetrius Chalcondyles ("Brassknuckles") in 1488.

9. Modern Approaches.—From the beginning of the 16th century, it is possible to trace the development of two different ways of approaching the Homeric problem, which may be called for convenience the literary and the academic. At first the two are not far apart: the literary men want to read the poems and understand how they are composed, and what message they have for the development of vernacular literature; while the scholars are forced to acquire the elements of an understanding of the language, metre and subject matter of the poems, as a preliminary to the constitution of a satisfactory text. At first both groups tend to accept the valuations of Homer put forward by the ancient literary critics, especially Aristotle (for whom the *Iliad* and *Odyssey*, in the form in which he knew them, were "as well composed as possible, and as much as possible the representation of a single action") and Quintilian. During the 16th century, however, there was a growing tendency to insist on "correctness" as the criterion of literary excellence. Virgil thus began to be exalted above Homer. All the respects in which Homer differs from Virgil —his disrespect for the gods, his "kitchen-sink" comparisons (one may think of the appalling comparison of Odysseus tossing and turning on his couch, on the night before the killing of the suitors, with a haggis cooking!), the often unmanly and, by later standards, dishonourable conduct of his heroes (for which any reader of Plato could quote example after example)—became additional causes of offense. Literary chauvinism, out of which developed the famous "quarrel of the ancients and moderns," especially in France (*see* ANCIENS ET DES MODERNES, QUERELLE DES), had a depreciating effect on all the ancients (not only on Homer); but it did not cross the English channel until after the Restoration. In 17th-century England, Milton followed Virgil rather than Homer; but Dryden did not hesitate to put Homer at least on a level with Virgil, and the later labours of Pope and Addison made the position of Homer in the eyes of English literary men entirely secure. It is confirmed in magisterial words by Samuel Johnson, in the preface to his edition of Shakespeare (1765):

> The Pythagorean scale of numbers was at once discovered to be perfect; but the poems of Homer we yet know not to transcend the common limits of human intelligence, but by remarking, that nation after nation, and century after century, has been able to do little more than transpose his incidents, new-name his characters, and paraphrase his sentiments.

This judgment has never been shaken by the disintegrative activities of the academic students, which have still to be chronicled.

The academic assault on Homer springs from what is, in itself, the laudable desire to make all things plain and intelligible; and it is natural that it should start its period of greatest development at the time of the "scientific revolution." When men began to seek for simplified explanations of the movements of the heavenly bodies, of chemical and physical reactions, and of the movements

of the human mind, it was inevitable that attempts should be made to reduce the study of language and literature to the same sort of clarity and certainty. It is easy nowadays to look back and scoff at fantastic characters like François Hédelin, abbé d'Aubignac (1604–76), who appears to have been the first to set running the still active theory that there never was such a person as Homer, and that the poems which go under his name are the patchwork creation of late and incompetent compilers; but though D'Aubignac seems to have had little influence (F. A. Wolf mentions him politely in passing, but that is about all) until the Swiss scholar Georg Finsler, who had found a copy of his *Conjectures* (1715) in the Bibliothèque Nationale in Paris, published an account of him in 1912, it is surprising to see how often he anticipated the views of later Homeric critics.

In the new world of classical scholarship which arose out of the adaptation of scientific conceptions of evidence and proof to the study of antiquity, the greatest name is that of Richard Bentley (1662–1742). His intended edition of the text of Homer never reached the stage of "Proposals," but his influence on later students was great, for both good and evil. Following an ancient (though certainly unreliable) tradition, he argued that the Homeric poems had been composed as separate short pieces for recitation on public occasions, that Homer himself had been illiterate, and that the songs had not been written down as connected poems until the time of Pisistratus (*c.* 540 B.C.), some 500 years after Homer's own time. This is to say that he put Homer about 200 years earlier than Herodotus had done; his authority here seems to have been Aristarchus, who is said to have dated Homer 140 years after the Trojan War, which Eratosthenes put in 1193–83 B.C. Of more importance for the later history of Homeric scholarship is the fact that Bentley was the first to appreciate the working, in the linguistic and metrical patterns of the Homeric poems, of the old Greek letter digamma. This letter, both by its form and by its position in the earliest alphabets the ancestor of our letter *f*, represented the consonantal *u*- or *w*-sound; Bentley showed that though this letter had disappeared from the standard "Ionic" alphabet before the 5th century B.C. the sound which it represented had remained a living influence in the formation of the epic language until a late period in the history of that language. This was a matter of great importance for the constitution of the text, since it explained away many apparently unmetrical phenomena; but its full bearing could not be appreciated until the development of comparative philology as an organized discipline in the 19th century.

For most of the 18th century the interest of scholars in Homer centred on placing his poems correctly in the history of literature; and in this inquiry the question of Homer's knowledge of writing played an important part. That Homer's heroes are ignorant of reading and writing admits of no doubt; the one mention of writing (by Glaucus in *Iliad* vi) refers to an earlier generation and leaves the *modus operandi* distinctly hazy. This fact, which had already been observed by Aristarchus, does not of course prove anything about the author's own capacities; and it may be doubted whether the illiteracy of Homer could have become the dogma which it already was for Bentley (and still is for many scholars), but for a single passage in Josephus' polemical work against Apion, in which Josephus, in seeking to prove the cultural backwardness of the Greeks by comparison with the Hebrews, argues not only that Homer was later than Moses but also that, according to anonymous (and now unidentifiable) informants, Homer had not left anything in writing, but that his poetry had been preserved for a long time in men's memories before being collected together and written down. This view of Homer's illiteracy was strongly supported by the scholar-diplomat Robert Wood (1717?–71) in his *Essay on the Original Genius of Homer* (1769), a work which (owing to the skill with which the author exploited his experiences when traveling in the near east and investigating the ruins of Palmyra and Baalbek) exercised a great influence on the development of Homeric scholarship under C. G. Heyne at Göttingen in the latter part of the 18th century, and, through Heyne's pupils, in other German universities.

The view of Homer as an untutored natural genius (a Greek forerunner of "Ossian") predisposed students to seek for the genuinely "Homeric" elements in the transmitted text of the poems; and this led to a strong belief that anything which one could call "original," and therefore by definition Homeric, must at the same time be good and, conversely, that whatever one could call "good" must be original and Homeric. The conviction that whatever in the poems falls below an ideal standard of relevance and propriety (whether aesthetic or moral) cannot be the work of Homer, but must have been inserted in the text by someone else, has created the "Homeric question" in its present form. But all those who have taken the negative side in this controversy cannot simply be written off as the dupes of a logical fallacy. Though the belief of the 18th century in the illiteracy of Homer, and in the part played by memorization in the preservation of his poems was in fact very insecurely founded, the role of memory and improvisation in the development of epic poetry was indeed of great importance; and the feeling that the *Iliad* and *Odyssey* needed careful analysis if light were to be thrown on their origins was greatly reinforced by the rediscovery in the Marcian library at Venice of the two important manuscripts of the *Iliad* now known as A and B, and by the publication, by the French scholar J. B. G. d'Ansse de Villoison in 1788 of the commentaries with which both manuscripts were provided.

10. Wolf and His Successors.—The new material which Villoison had made available found a ready welcome in the mind of one of Heyne's former pupils, F. A. Wolf, who in 1795 published at Halle in Saxony (where he was a professor) a small volume entitled *Prolegomena ad Homerum I* (*Prolegomena II*, in which problems affecting the textual criticism of the poems were to have been discussed, never appeared). The main portion of this highly explosive book contains a thorough study, based alike on external and on internal evidence, of the conditions under which the *Iliad* must be supposed to have come into existence (there was less evidence about the *Odyssey*). The basic argument used by Wolf is that the *Iliad* in its present form cannot be the composition of a single man; it must have evolved over a long period, and many people must have contributed to the fabric. At the same time it is impossible to study the poem without recognizing that it follows a master plan; the *Iliad* must therefore have evolved in accordance with a definite design, and the designer, who must also have begun the weaving of the web (the metaphor is Wolf's) cannot be anyone other than Homer. There is no space here to follow the ramifications of the controversies which grew out of Wolf's work; it can only be said that Wolf seemed to his fellow scholars and even to those who disagreed with him in detail to have provided an intellectual justification for the detailed analysis of the Homeric poems in the hope of establishing the facts about their date and composition and about the identity of the man or men concerned in their creation. This is still the real justification of Homeric analysis but much of the effort which has since been devoted to this matter seems to have been directed down false trails.

Wolf's successors in the work of Homeric analysis are usually divided into "unitarians" and "analysts" (or, in the more romantic terminology devised in early 19th-century Germany, "unity-herdsmen" and "lay-hunters"). The original unitarians, who are not to be confused with fundamentalists, believed that the core of the *Iliad* was a single continuous poem by an individual author, and that it has attained to its present dimensions by the insertion of great quantities of material by later (and in many cases less practised) hands; whereas the analysts believed, with Bentley, that the poem originated as a more or less incoherent collection of separate short poems, and that these were gradually combined over a long period of time, by the work of many successive reciters and editors, into the poem in its present form.

The earliest important figure in the first of these two schools appears to have been the English dilettante Richard Payne Knight, who in 1820 produced a remarkable edition of the Homeric poems in which he (in this too far ahead of his time) transcribed the poems into what he courageously believed to have been their original orthography. The most thoroughgoing exponent of the second school, which acknowledges Gottfried Hermann as its head, was the Berlin professor Karl Lachmann, who, having lopped off books xxiii and xxiv from the *Iliad*, then proceeded to divide up the rest

into 16 separate lays (1837–1841). George Grote, the first volumes of whose *History of Greece* appeared in 1846, sought to reconcile the two schools: he makes great acknowledgements to Hermann, but his own solution is neither unitarian nor completely analytical. The first stage in the making of the *Iliad*, he suggests, was a series of short lays, out of which there developed a comparatively short continuous poem about Achilles (consisting of books i, viii and xi–xxii of the *Iliad*), and then, very soon after (in "the same generation"), Homer created the *Iliad* by inserting books ii–vii, ix–x and xxiii–xxiv in the *Achilleis*. The *Odyssey*, he thought, was the work of a single author, who was not the same as the author of the *Achilleid* but was contemporary with him, and the date of all three poems (*Achilleid, Odyssey, Iliad*) was "very early" (defined by him as before 776 B.C.).

For the Scottish scholar William Geddes, writing in 1878, Homer was the author of the *Achilleid;* for him the apparently poorer quality of the parts of the poem which Grote regarded as having been the work of Homer proved that they were really the work of later imitators; and something like this is now the view of most Homeric analysts. Analysis of this kind was extended to the *Odyssey* in 1859, when A. Kirchhoff published the first of his analyses of the *Odyssey*. Since then many analyses of both poems, of increasing complexity and contradictoriness, have been published (see *Bibliography*). Special note should perhaps be made of the out-and-out fundamentalism of Benedictus Niese, whose book on the development of Homeric poesy (1882) put forward the view that the whole Trojan story was Homer's own invention. It is of more importance in the history of Homeric scholarship in the second half of the 19th century to note the growing influence of new disciplines: the development of comparative philology, which has thrown light on the vocabulary, morphology, syntax and metrics of the poems; the growth of Egyptology, leading to the large finds of texts on papyrus to the evidence of which frequent appeals have been made above; the coming of archaeology to Bronze Age Greece, thanks to the work of Heinrich Schliemann (from 1869) and a host of others, whose work is described in more detail below; and the application of anthropology to the interpretation of the religion and customs recorded in the poems.

The results of all these different types of inquiry were disintegrative in their effect upon the literary study of the poems; the more carefully, it seemed, a particular type of phenomenon observable in the Homeric poems was studied, the more incomprehensible it looked that a single person could ever have put together the various parts of either poem, or have supposed that by doing so he could be creating what so many apparently trustworthy judges of poetry (from Pindar, may one say, to Goethe?) had recognized as works of the highest literary art. Shocked protests were being made even before World War I. by Andrew Lang in Great Britain and by Carl Rothe and Engelbert Drerup in Germany, but they were easily crushed by the triumphant analysts (for whom indeed "unitarian" had now come to convey the implication of fundamentalism) with their appeals to all the different types of discrepancy and anomaly which had been pointed out between the various parts of the poems.

11. Comparative Literature.—It is not to be denied that some of these discrepancies and anomalies really do exist, and are serious obstacles to a belief in the unity of the *Iliad* and *Odyssey* as works of conscious literary art, unless one is resigned, as the analysts for the most part do not seem to be, to the fact that even the greatest artists do not always work up to their own highest standards. The great scholar Ulrich von Wilamowitz-Moellendorff wrote in 1884 that "The history of the epic is the real Homeric question"; and this is not less true today, although ideas about the nature of that history have been fundamentally changed since then. This fundamental change has arisen from the discipline known as "comparative literature," which has enabled the scholar to relate the narrative poetry of the Greeks, as it is known especially from the Homeric poems, to the narrative poetry of other peoples, and, especially from the work of the American scholar Milman Parry (1902–35) and his associates and successors, to the narrative poetry of Serbs and Croats. Comparison of the results obtained by Parry and others shows that many of the features of the *Iliad* and *Odyssey* derive from the activities of professional singers, who had as their stock in trade a large repertory of stories, both traditional and new, and a traditional diction, which made it possible for them to produce a version of one of their songs on demand, the traditional diction not only lightening the task of improvisation but making it easier for the audience to follow the story. Such, it seems likely, were the "tales of men" (*klea andron*) sung by the Homeric singers (*aoidoi*); these tales, according to the *Odyssey*, were grouped in "paths" (*oimai*), which were taught by the Muse to the race of singers; and from such "paths" (or cycles?) must have come the materials combined in the *Iliad* and *Odyssey*.

The contribution made by students of comparative literature to the understanding of the origins of the *Iliad* and *Odyssey* is thus a vital one, since it (and it alone) explains how the traditional elements, alike of diction and of subject matter, were preserved between the end of the heroic age and the time at which the *Iliad* and *Odyssey* were composed; but it does not explain either the form in which those traditional elements are arranged in the *Iliad* and *Odyssey*, or the purpose for which those poems were created. Each of the two poems as it stands, in spite of all alleged discrepancies, is in fact a continuum, and must have been designed to reach its public in that form (the recognition of this is implied in the establishment of the rule for the conduct of Panathenaic recitations, which is spoken of as ancient by 4th-century Athenian writers). If it were simply a question of publication in book form for private reading, the preservation of the continuum would not present insuperable difficulties, though the Egyptian evidence suggests that the bulk of the book might be a handicap to its dissemination. But this is not the whole story: an *Iliad* and an *Odyssey* were known in ancient Greece before books for private entertainment were freely current, and the only way in which literary compositions could be published in such circumstances was by recitation. To judge by what is known of the daily program at the city Dionysia in 5th-century Athens, the *Iliad* (nearly 16,000 lines in length), would require at least three very long days for a complete recitation; the *Odyssey* (of over 12,000 lines) would also require three, but less crowded, days. The only place where an audience could be counted on for a performance of this kind would be at one of the great festivals. If this is so, the *Iliad* and *Odyssey* may have begun life as "festival compositions for momentary hearing" of the kind so despised by Thucydides; that nevertheless they became "possessions for ever" must have been due to the willingness of the public to overlook those imperfections which seem to loom so large in the scholar's study.

12. Unique Literary Position.—"Imperfections": this word is the key to the main problem in Homeric criticism. The French metaphysician Jean Wahl (1888–) has described works of art as *ces mondes à la fois achevés et inachevés;* and hearers and readers of works of literary art will tend to lay the main stress, according to their respective temperaments, either on the success or on the failure of an author to achieve the object of his work. But both "success" and "failure" here are subjective terms; the critic who employs them can seldom be sure what the author's object was, nor by what standards the author himself was judging. This difficulty is especially acute in dealing with the *Iliad* and *Odyssey*. If the argument developed in this article is sound, they are absolutely the oldest surviving works of European literature; in any case, they must have been composed more than two millennia ago, and in conditions of which there is no certain knowledge. It would thus be hard to judge what aims their composer (or composers) had in mind and by what standards he (or they) expected the poems to be criticized. When to this it is added that the two poems, as works of narrative literature, are found to be altogether unique among surviving Greek poems, and that there is no evidence that any of the lost epics was designed on a comparable plan or scale, it is clear that the critic who would stress the apparent imperfections of the works to the exclusion of their beauties must either be so superior to the ordinary weaknesses of humanity as almost to deserve to be called (in Aristotelian terms) a god, or so lacking in artistic sensibilities as to qualify for the designation of beast.

It has been argued (notably by Gilbert Murray) that the

Homeric poems in their present form are the products of an organic but virtually unconscious evolution (or, to put it more simply, that they "just growed"); but this was not the impression of men who were in a position to read far more widely than any modern scholar in the corpus of early Greek epic: neither Pindar nor Plato nor Aristotle ever suggests a doubt that the *Iliad* and *Odyssey* might not be the conscious work of individual literary artists, or indeed that more than one individual might be involved. This belief in the unity and indivisibility of the Homeric poems has seldom been challenged since by those who read them or listen to them simply as literature; it is true that disbelief has often to be suspended, but whether the poems be read in Greek or in translation that suspension is willingly performed by the receptive listener or reader, as is shown by the fact that Pope's translation, however much scholars may dislike it ("A very pretty poem, Mr. Pope; but you must not call it Homer," said Dr. Bentley), at once became and has ever since remained a classic of English literature in its own right.

The classification of epic poems as "primary" (*Iliad*, *Odyssey*) or "secondary" (the *Aeneid*, *Paradise Lost*, for examples) has this much of truth that Virgil and Milton were both deeply indebted to the Homeric poems for guidance as to the manner in which a long story might be told in verse without monotony; but there are not only some differences, already mentioned, between the *Iliad* and the *Odyssey* but also a fundamental distinction between the Homeric poems and their great successors: the *Aeneid* and *Paradise Lost* subscribe to a definition of epic which would have been meaningless to the composer of the *Iliad* or *Odyssey* (*see* EPIC POETRY). To Virgil and Milton the epic had to be "sublime," a great poem on a great theme; but this is not so with Homer—his themes are in essence those of "barrack-room ballads," a camp quarrel over a woman or a veteran's home-coming, everyday events without any intrinsic quality of sublimity or grandeur. Nor is Homer's treatment of his themes sublime or grand, in the sense in which those words are used by later critics; his language, once the conventions are understood, is simple and direct and his characters act naturally and with solid (almost three-dimensional) humanity; it is these qualities, and not any artificial "grandeur" (as the cockney said, "You don't need no granjer to sell stewed eels"), which have enabled what Pindar called Homer's "winged contrivance" to go on charming and teaching generation after generation all over the world.

The preservation of these remarkable works is still a problem; but continuing work on the history of the text suggests more and more strongly that the poems were written down soon after they were composed (perhaps they were dictated to an amanuensis), and then transmitted to posterity by the same process of copying and preservation as other works of Greek literature. If that is so, it would seem that the *Iliad* and *Odyssey*, as works of conscious literary art, must have been created out of traditional materials after the adoption of alphabetic writing in Greece; *i.e.*, at the earliest in the second half of the 8th century B.C. It is uncertain whether both are the work of a single author, and even whether both are the work of members of a single group of professional singers; but it seems likely that both poems originated from the group later known as the Homeridae and were composed upon the island of Chios. It is probable that all the narrative poems originating in this group were spoken of in early times as by "Homer" (one etymology of the name makes it mean "composer"); but it is not known what the real names of particular authors may have been. The Homeridae must have had records (and it may be from there that the names of Arctinus and the others make their appearance in Hellenistic times), but it is not certain how much of the information in the late lives of Homer may be derived from these records, or what it would be worth if it were. Even less than Shakespeare does Homer "abide our question": the singer or singers and the song have become indissolubly united. (JN. A. D.)

II. HOMERIC ARCHAEOLOGY

1. The Place of Archaeology in Homeric Criticism.—The material background of the Homeric poems has great verisimilitude, and they assume knowledge of a series of events which, however fabulous, were mostly said to have taken place in identifiable cities and countries. Since the middle of the 19th century archaeologists have discovered the brilliant civilization which flourished in the Aegean throughout the Late Bronze Age (*see* AEGEAN CIVILIZATION). It began *c.* 1600 B.C., when a vigorous stock on the Greek mainland was fertilized by the older civilization of Crete, and continued until it shared the general disruption of the Bronze Age world some time before 1100. Though it is usually called "Mycenaean" from its most famous city, it covered Greece as far north as Thessaly and most of the islands of the Aegean, and penetrated as far east as Syria and as far west as Sicily. There is no doubt that it is the historical fact behind the Greek legends of the heroic age, and it is generally agreed that only a succession of oral poets could have transmitted the memory of it through the four centuries of poverty and migrations between its end and the beginning of Archaic Greece *c.* 700 B.C.

In the course of the transmission there was inevitably some distortion, exaggeration and "modernization," but because of the scantiness of the archaeological evidence after the 12th century the character and extent of the changes are doubtful. It has been held that the content of the poems is almost wholly Mycenaean, with a small element of anachronism, or at the other extreme that it is almost wholly post-Mycenaean (every century between the 10th and the 6th has been suggested) with only vague and distorted memories of the Mycenaean past. A third theory is that each generation of poets inherited a mass of traditional material and blended it freely with new material drawn from the conditions in which they were living. This seems the only satisfactory explanation of the presence in the poems of customs and objects which never existed together at any historical period. It raises a number of further questions: how far back the poetic tradition can be shown to have existed; how long it continued to live and absorb new material; and how accurately it preserved the memory of conditions and events in Mycenaean Greece. This is part of the Homeric question in which archaeological evidence is essential; it can be used to elucidate the contents of the poems, but its contribution to literary questions of authorship and transmission is only indirect.

2. The End of Oral Poetry.—Scenes from legends are common in Greek art from *c.* 700 B.C. onward. Over 120 are known from the 7th century alone, including a blinding of the Cyclops from Eleusis, from Argos and from Magna Graecia. In each generation artists showed the heroes in the dress and surroundings of their contemporaries. The greatest concession to archaism was to retain some feature from the fashions of the previous generation, with which the older artists must have been familiar in their youth. This is most clearly seen in battle scenes. Hoplite fighting, which is known from the discovery of an actual panoply in a grave of the late 8th century near Argos to have been introduced shortly before 700, was distinctive (*see* HOPLITE). It was conditioned by the shield, which was carried by thrusting the arm through a central band and grasping a handgrip on the rim, and which could therefore be extended only the length of the upper arm. To compensate for the loss of protection, the soldier wore a plate corselet, greaves, and a helmet with nose- and cheekpieces. Since the helmet hid his face, he was distinguished by a blazon on his shield. The army advanced in close formation, kept in step by a piper, and tended to edge to the right, as each man sought the protection of his neighbour's shield. They fought with thrusting spears at close quarters, and cavalry, archers, or slingers played a supporting role on the flanks. The fallen were not rescued during the battle, but taken up under truce after it. If a hoplite ran away, his shield was a mere encumbrance, and "to throw away one's shield" was proof of cowardice from 7th-century lyric onward.

Artists adopted the new armour almost as soon as it was introduced. Shields with blazons appear on Attic vases of the late 8th century, and on the earliest 7th-century vases heroes are shown as hoplites. In a Corinthian representation (690–680) of the death of Achilles, the artist showed a crouching archer, sniping at a little group of fighting heroes. The episode is wholly inappropriate to hoplite fighting, but all the heroes are armed as hoplites, and there is a piper to keep the lines in step. The only archaism is that

two of the heroes have pre-hoplite shields of an "hourglass" shape normal in the 8th century, but they carry them at a slant on their arms, as though they were hoplite shields. The 7th-century artists visualized the Homeric heroes as hoplites; Homeric fighting, on the contrary, is the antithesis of hoplite fighting. The normal equipment is "shield and helmet and two spears," and they are all pre-hoplite. The shield is a parry shield, hung on a baldric and freely manipulated by a single central handgrip. It has a central boss, and sometimes a bronze face which may be decorated in concentric circles. The helmet leaves the face recognizable. The spears are thrown, and are therefore carried in pairs. Bronze corselets are rare, some probably being survivals from an earlier period (*see* below). The army advances in line, a formation not confined to hoplites, but the fighting is long-range and scattered. Mobility is given by the presence on the battlefield of chariots in which the heroes can flee, pursue or change ground. In flight, a soldier swings his shield round on the baldric to protect his back, and has therefore no temptation to throw it away. There is no trace of hoplite armour in the *Odyssey*, and in the battles of the *Iliad* its appearances are few, fleeting and inconsistent with the rest of the fighting: one blazon, imposed (in the self-contained lines xi, 36–37) on a shield which already has a central boss; one mention of bronze greaves; three or four isolated lines which seem to introduce a hoplite corselet; and two or three short passages (*e.g.*, iv, 446–449; viii, 60–63) which may describe the orderly advance of a hoplite phalanx.

In the 8th century there is no such difference between battle scenes on vases and fighting in Homer. So far as the silhouette style of Geometric art allows, the artists depict the same kind of fighting as the poems. The fighter has parry shield with baldric, helmet and two spears, and the spears are thrown. Chariots are present in the battle. Archers are more common than in the *Iliad*, and in this the vases are nearer to the *Odyssey*. The resemblances between the poems and 8th-century art, and the differences between them and 7th-century art, are of great importance for their date. There is no reason why poets should have been slower than artists in admitting the splendid figure of the hoplite. However the poems were transmitted, something happened before the end of the 8th century to prevent the oral poets from absorbing hoplite fighting as they had absorbed earlier changes in warfare.

Other conspicuous changes of the 7th and 6th centuries also failed to make their way into the heroic tradition. Homeric women do not wear the elaborate and beautiful combination of garments seen on archaic statues. Homeric temples are simple, thatched buildings on stone sockles, such as are known in the 8th century. The trireme is unknown. Coinage is unknown. Homeric society is illiterate, a lack of civilization which the Greeks were likely to attribute to the heroes only while the Phoenician alphabet, adopted before the end of the 8th century, was known to be a recent invention. Homeric works of art, such as the shield of Achilles and the baldric of Heracles, are not decorated with mythological scenes, as they commonly were after *c.* 700; and, if they are not heirlooms or gifts from gods, they are almost all foreign, either brought home by travelers or made by Sidonians and carried over the seas by Phoenicians. It was in the 8th century that the Greeks, after centuries of poverty and isolation, reopened their contacts with the east through the Orontes valley and with the Phoenicians in Cyprus and Sicily. The 7th and 6th centuries were times of rapid and exciting changes, and if the tradition of oral poetry had still been alive during them, they could not have failed to leave their mark on the poems. This is one of the main contributions of archaeology to the Homeric question.

At the time when the epic tradition was coming to the end of its growth in Ionia, there are signs of interest in the heroic past in Greece itself. On Ithaca, as early as the 10th century, dedications which included bronze tripods began to be made in a cave which was later sacred to Odysseus and the nymphs. At the end of the 8th century a hero cult of Agamemnon was established at Mycenae and of Menelaus at Sparta, and votives were put in many Bronze Age tombs. Some scenes represented in art are undoubtedly mythical, for instance battles with centaurs on Attic vases and on a clay votive shield from Tiryns. The Tiryns shields also show a hero fighting an Amazon. There are representations of two men joined at the waist, and, unless this is a clumsy way of crowding two figures into the space of one, they must be the legendary "Siamese twins," the Molione; and if so, since they twice appear in battle scenes, these battles at least must be legendary. A large fragment from Athens (first published in *Antike Kunst*, vol. 2, pp. 35 ff., 1959) shows a man holding up a boy before a mourning woman, and is very like later representations of the death of Astyanax. Two vases show shipwrecks, with all the crew drowning except one; there is nothing to show that it is the shipwreck of Odysseus, but one of the vases comes from a cemetery on Ischia which also yielded a cup with an inscription claiming that it is better than the cup of Nestor. Most of the vases come from graves, and the commonest scenes are battles and funerals. A suggestion has been made which would greatly increase the number of legendary scenes. In addition to round and rectangular shields there is a third type, shaped like an hourglass, and not dissimilar in outline to a much larger "figure-of-eight" body shield which was used in the early Mycenaean age (*see* below).

It is suggested that representations of the 8-shield were found and copied by the 8th-century artists, and used as a sign that the bearer was a hero. A parry shield with a waist is, however, practical, and has been used in other countries. Geometric vase painters exaggerated the waist, but a votive model has a convenient shape and a clearly marked construction. Hourglass shields are often carried in funeral scenes; and although the funerals are very Homeric, with mourners, sacrificial animals, processions of armed men in chariots and on foot, chariot races and funeral games, it does not seem possible that the dead man shown on his bier is not the man over whose grave the vase was placed. Moreover, deliberate imitation of a shield known only from "museum pieces" implies a self-conscious antiquarianism unbelievable at so early a period. The simple explanation of the resemblances between 8th-century vases and the Homeric poems is that both reflect the conditions of the 8th century, and this is true whether the scenes on the vases are legendary or contemporary.

The Greeks accepted the legends as the history of the distant past, but they had practically no antiquarian interest. They must sometimes have found Mycenaean works of art, but they do not mention them. When the bones of Theseus or Orestes were discovered, they did not ask why they had not been cremated in the Homeric manner. Thucydides projected the poverty and shortage of manpower of early Greece back into the heroic age, and when he describes the graves on Delos cleared during the Peloponnesian War does not say why the weapons and manner of burial showed that they were Carians expelled by Minos. Even Alexandrian critics were concerned only with internal discrepancies, such as the "anachronism" of Hector's four horses, or with classical parallels, between, for instance, the Homeric bronze corselet and the long obsolete hoplite corselet. The identification of Homeric places was the one subject of lasting interest. Aristophanes could raise a laugh by a cryptic reference to learned arguments about the position of Pylos, and Strabo and Pausanias prove the continuation of the discussions into Roman times.

3. The Beginning of Oral Poetry.—When the modern study of archaeology began, chance directed the attention of Homeric scholars to the earliest years of the Mycenaean age. The spectacular discoveries of Heinrich Schliemann (*q.v.*) diverted interest from the Etruscan evidence on which W. Helbig had mainly based his pioneer work on the archaeology of Homer. Schliemann began to trench the mound of Hissarlik (*see* Troy) in 1871, and, because of leveling in Roman times, came immediately to the settlement (Troy II) which had been destroyed by fire before the end of the Early Bronze Age in Greece. Since it was strongly fortified and rich in gold, he took it for Priam's Troy; but the mistake was discovered just before his death in 1890, when at a much higher level on the edges of the mound pottery was found which could be identified with the Late Bronze Age pottery that Schliemann had in the interval found at Mycenae and Tiryns.

At Mycenae, however, a somewhat similar accident had more lasting consequences. The great cyclopean walls of huge irregular blocks and the main gate, with its facing of smooth stone and

pediment of antithetic lions, had always been visible. Just inside, Schliemann found a stone circle, enclosing royal shaft graves which still contained their original wealth of bronze weapons, gold and silver vessels, gold masks, jewelry and seal stones, and artifacts of all kinds, including a little pottery (*see* AEGEAN CIVILIZATION; MYCENAE). It was inevitable that they should be taken for the tombs of the kings of the house of Atreus, whereas in fact they belong to the 16th century B.C., hundreds of years before any possible date for the Trojan War. They contained representations of warriors in armour of a hitherto unknown type. The shields were huge, covering the body from neck to ankles, figure-of-eight or towerlike in shape. They were carried on a baldric over the left shoulder. Their size and the absence of metal facings show that they were made of leather. No body armour was worn with them except belts, short kilts and elaborate helmets. The weapons were long thrusting spears, daggers and stabbing swords, bows and slings. On gravestones erected within the stone circle, there were carvings of warriors in two-horse chariots.

It was recognized that this armour explained things in Homer which had been incomprehensible, and W. Reichel reinterpreted the poems on the assumption that every leather shield with a baldric is a body shield. Homeric descriptions and epithets were forced into conformity, and passages which clearly referred to armour of a different type were condemned as interpolations. This theory was adopted by Walter Leaf in his edition of the *Iliad* (2nd ed., 1900, reprinted 1960); and many readers have been led to believe that his drawing of a hybrid savage of vaguely Viking appearance is a true picture of a Homeric hero. The only traces of a body shield in the poems are the rare epithets, "like a tower," "man-enveloping" and "reaching to the feet," one clear episode (*Iliad* xv, 638–652) and two or three obscure references. Body shields had certainly disappeared from the battlefield by the 13th century B.C. The figure-of-eight shield, which had religious associations, continued to be used in cult and decoration, but its structure had been forgotten; it is shown as two complete circles on an ivory plaque from Delos. The tradition must therefore have existed in the 14th century, and may well have begun considerably earlier.

4. 13th and 12th Centuries.—Bronze Age Greece was at the height of its prosperity *c.* 1300 (*see* ARCHAEOLOGY), and its collapse did not come until late in the 12th century. In that period, soldiers all over the Aegean area had small shields with baldrics and central handgrips, round or nearly round. They resemble the shields of the 8th century, and may never have gone out of use. Crested helmets, slashing swords, spears, bows and chariots are also common to both periods, and are useless for dating the Homeric poems. The differences are more informative.

1. All Bronze Age weapons and tools were bronze. In the transitional period, both iron and bronze were used, iron weapons appearing as early as iron tools. By 900 B.C. at latest, iron alone was used except for arrowheads, which continued to be made in both metals. In Homer all weapons are bronze except one iron arrowhead in the *Iliad* and a proverb in the *Odyssey* that "iron of itself draws a man on." But there are two iron knives and a number of iron axes and other tools; iron is used metaphorically and the poems show a knowledge of ironworking and trade in iron.

2. In the Mycenaean age a single thrusting spear was used; in the 8th century, pairs of throwing spears. This is important because it implies quite different tactics. In Homer both are found, but not used by different people or at different times. In battle, spears are always throwing spears, although when one has been cast the second may of course be used at close quarters. Even Achilles, who has a great ashen spear too heavy for Patroclus, throws it at Hector and has to have it returned surreptitiously by Athene (*Iliad* xxii, 273 ff.). In some arming scenes the hero takes one spear, and in others two; but they all fight as though they had two.

3. The peoples with whom the Bronze Age Greeks were in contact all used chariots in massed charges, and it is probable that the Mycenaeans used them in the same way. On 8th-century vases the actual fighting seems to be done on foot, with the chariot standing near. In Homer, chariots are always used to give mobility to men fighting on foot, but Nestor once gives precise instructions for a chariot charge in the Bronze Age manner (*Iliad* iv, 301 ff.).

4. There was more bronze defensive armour in the Bronze Age than used to be believed. Scale corselets were common in Asia and Egypt from the 15th century B.C. Clay tablets from Knossos list issues of equipment, normally one chariot, two horses and two corselets, an ingot being sometimes substituted for the corselets. Tablets at Pylos in Messenia record more effective corselets with unknown components which are also components of helmets on the same tablets, and it is difficult to see what the components can be if they are not bronze plates; the corselets and helmets are already called by their Homeric names. Bronze helmets are known from Knossos in the 15th and Tiryns in the late 12th century B.C., and other tablets from Knossos refer to body armour with "shoulderpieces" and helmets with "cheekpieces," both with the same unknown component. Much is still obscure, but the suggestion that the corselets are bronze is made almost certain by the discovery of a remarkable bronze corselet at Dendra (Midea) in the Argolid, in a tomb of *c.* 1400 (Society of Hellenic Studies, *Archaeological Reports for 1960–61*, pp. 9–10). The lower part is made of bronze hoops, the upper of overlapping bronze plates shaped to the body, and it has shoulderpieces and a collar. A bronze object found previously at Dendra and identified as a helmet is now seen to be a similar shoulderpiece. With the Dendra corselet were remains of a helmet, covered with slices of boars' tusks (a common Bronze Age type, uniquely described in *Iliad* x, 261 ff.) but with bronze cheekpieces, and possibly of greaves. Bronze greaves are also known in the 12th century B.C. from the Peloponnese and from a Greek settlement near Salamis in Cyprus.

The transitional centuries were poor in metal. By the end of the 8th century there were bronze helmets and shield faces, but it is unlikely that there were bronze corselets or greaves before the introduction of hoplites. The word *thorex* ("corselet") does not occur in the *Odyssey* and is rare in the *Iliad*. Agamemnon wears a Cypriote corselet of Bronze Age type in *Iliad* xi, 19 ff., but individual bronze corselets are rare and usually cause confusion in their context. Hephaestus makes greaves of "soft tin" for Achilles. Even bronze helmets are not very common. This agrees with what is known of the 8th century. But in contrast the Homeric battlefield in general terms gleams and glitters with bronze. Hector is completely covered with bronze when he is killed. The most common epithets for the Achaeans are "well-greaved" and "wearing bronze tunics." And greaves "with silver clasps" have a couplet in the arming scenes. It has been suggested that the glitter was introduced by later poets who were familiar with the polished armour of hoplites, but it is more likely to have come down in the tradition from the Bronze Age to poets who knew that soldiers in action really wore drab leather jerkins. A close parallel is the theoretical belief that heroic society was enormously rich in gold, compared with the small use that is made of it.

Homeric women wear a simple form of the loose, unshaped dress with pins and girdle which is known in classical Greece. There is no trace of Mycenaean court dress, with tight, open-fronted bodice and wide flounced skirt. In war and peace the Homeric dead are cremated, sometimes with their personal weapons, and their ashes buried under a mound. Cremations were not wholly unknown in the Bronze Age; three are reported from the Argolid, two from Messenia, and half a dozen from Attica, and a cremation cemetery of the 14th century was found at Troy. Yet it does not seem possible to connect these with the Homeric cremations. The contrast between universal cremation with few or no grave goods in Homer, and almost universal inhumation in a built tomb or underground chamber with rich grave goods in the Bronze Age, is striking. Achilles certainly paid Patroclus every honour the poet thought possible, but he gave him nothing of value. Cremation suddenly became universal at Athens soon after the end of the Bronze Age. It was taken to Asia Minor with the migrations and seems to have continued there until the 7th century. The graves are poor. By the 8th century Athens had reverted to inhumation, but Attic vases show everything that happened at the funeral of Patroclus except the actual cremation and the killing of prisoners and domestic animals. Dress and burial are post-Mycenaean.

In contrast, the elaborate plan of a Homeric palace is typical of Late Bronze Age Greece, and has as yet been found at no other period. The best-preserved example is the 13th-century palace excavated by C. W. Blegen at Messenian Pylos (*American Journal of Archaeology*, vol. 65, plate 53, 1961). It has the usual isolated megaron, with pillars and central hearth, entered from a pillared porch and anteroom; a door on each side of the anteroom (or of the porch, in palaces which have no anteroom) opens into passages which lead to private apartments, storerooms and staircases. There is even a luxurious room on the ground floor, reached by crossing the courtyard, in which Odysseus might have built his bed round a tree. All that is needed for the action of the *Odyssey* is to put into the megaron the small back door found in a contemporary house at Mycenae; it is the only known example, but in the *Odyssey* the raised back door of the megaron is clearly a surprise. It seems so improbable that poets and audiences could imagine the characters using doors and passages in a house type which had disappeared centuries earlier that various suggestions have been made: that the plan was transported to Asia Minor and similar houses built there, or that some of the palaces continued in use as temples. But at Old Smyrna, the only site where there is continuous evidence from the 10th to the 7th century, there is a series of much simpler house types, and it is inherently improbable that their builders could have solved the roofing problems of the complex Homeric type. Only the megaron would be turned into a temple, and the ancillary rooms, if they survived at all, would cease to serve their proper purpose. The Homeric palace is functional; it is only because the characters go to upstairs bedrooms or downstairs cellars or lock doors that we know of the existence of these rooms. Nonessentials, such as painted plaster floors, frescoed walls, bathrooms, archive rooms and standard lamps, were forgotten.

Some reasons for the survivals and nonsurvivals are beginning to emerge. The poets are most at ease with things common to both periods; they are, for instance, completely at home with the parry shield. Anything offensive to taste was likely to be rejected. In the 8th century, audiences would certainly be shocked by women with bare breasts, and would probably condemn Bronze Age burial customs as barbarian. They do not seem to have rejected convenient phrases simply because they attached no precise meaning to them, but the confusingly unintelligible probably tended to disappear. This is difficult to prove, but it may be noted that the only possible reference to the Bronze Age script is *Iliad* vi, 168–169: "he gave Bellerophon sinister signs, scratching many life-destroying things on a folded tablet." The repertory of formulas such as "with bronze," "with sharp (or pitiless) bronze," was clearly a great conserver; even if they survived for metrical convenience, they preserve the idea of bronze weapons. Other things seem to be saved by the requirements of the story. Bellerophon (*q.v.*) cannot repeat a verbal message in the normal Homeric manner. The plot of the *Odyssey* (and probably other palace dramas) cannot be staged except in a complicated building, and after the destruction of the palaces there were no suitable houses; and in fact formulas and action supply practically all the information that is given about the palace.

The Greece of the legends belongs to the Bronze Age. Settlements are thickest where the legends are richest. In the eastern Peloponnese the Atridae had their centre in the Argolid, dominating the gulf of Argos and probably stretching north to the Corinth isthmus and south to Malea. Here the walls of Mycenae, Tiryns and Midea may have helped to localize the legends, but the kingdom of Nestor in the southwestern Peloponnese was remembered without any help from visible ruins. After the discovery in 1939 of the palace of ancient Pylos north of Navarino, excavations and exploration showed that the whole area was thickly covered by settlements and cemeteries. Several sites have been identified but not excavated in the Spercheius valley, the kingdom of Peleus. Remains have been found on all the Ionian islands, especially Cephallenia. Crete was prosperous and populous at all times, though the great power of the palaces came to an end *c.* 1400 B.C. All the great heroes of the Trojan War came from these regions, except Aias (Ajax), whose affinities are obscure. Boeotia was covered with settlements; a palace at Thebes was burned in the 14th century, so that the Theban cycle is rightly put earlier, though not early enough. Settlements with good pottery in Aetolia and Acarnania make a setting for Meleager. In Thessaly the best localized legends are Jason and the Lapithae; at Iolcus itself, on Demetrias opposite, at Pherae, Boebe and a cluster of places round, Bronze Age sites are particularly long-lived and prosperous. Most of the cities (Thebes is an exception) were unimportant or unknown in classical times, and many of the districts were backwaters. The geographical distribution of the legends is good evidence of the tenacity of Greek memories. Many scholars think that the catalogues in *Iliad* ii are ultimately derived from Bronze Age records and give an even more accurate description. Place names which the Greeks themselves could not identify presumably are traditional but it does not follow that all the others are. The only thing that is certain is that the Achaean catalogue had an independent existence before it was adapted for its present position.

An expedition of all Greece under the king of Mycenae would have been inconceivable after the end of the Bronze Age. The homogeneity of the civilization in the 13th century, all over the mainland and in oversea settlements, makes the interrelationship of the ruling families very probable. Roads were good, and the widely exported pottery proves that travel was easy. After the decipherment of the Linear B script by Michael Ventris (*q.v.*) in 1952, the evidence of the tablets was added to the evidence of archaeology. Although the interpretation of much of it is disputed, it is clear that the Bronze Age kings had much in common with the contemporary kings of Asia. If not divine, they were under the special protection of the gods, and they controlled a great bureaucracy, sacerdotal and secular. The tablets say nothing about the relations of one kingdom with another, since they contain only palace accounts, but diplomatic and historical documents of Egypt and many kingdoms in Asia have survived. Everywhere it was common for a great king to have vassal kings, and the vassals were often rebellious. The *Iliad* is the story of a king and his rebellious vassal. Agamemnon has hereditary overlordship, symbolized by his Zeus-given sceptre. In war he is owed personal service, but his vassals can buy immunity. He gives away whole cities, another practice found in Asia. It is a reasonable supposition that this was the original position of the king of Mycenae, but it has been much obscured by interpretation. The oath taken by Helen's suitors has come into the story instead of an obligation to serve. The poets make Agamemnon a less remote figure than the Bronze Age king seems to have been, just as his sceptre becomes the staff held by whoever is speaking.

5. The Historical Background.—For deciding how far the events in the poems are historical, the evidence is: (1) The legends, told with considerable variations. The Greeks agreed on the order of events, but dated them on various systems. The differences may be ignored, since they had no material for precise dating; but it is interesting that the range of dates (omitting two eccentrics) for the fall of Troy is *c.* 1250 (Herodotus) to 1135 B.C. (Ephorus), with a preference for a date *c.* 1200. (2) Excavations at Troy, Smyrna, Miletus and a non-Greek site in the Maeander valley, modern Beycesultan, and many sites in Cyprus, Cilicia and Syria. Dating depends mainly on imported Greek pottery. The pottery of the last phase of the Late Bronze Age is divided stylistically into Mycenaean III A, B and C, very roughly 14th, 13th and 12th century. But there were transitional periods, and there is not agreement on the dates of the stylistic changes; *i.e.*, Mycenaean III B is dated 1300–1230 by A. Furumark and *c.* 1345–1215 by A. J. B. Wace, and may have continued into the 12th century. (3) The clay archives of oriental kingdoms, especially the Hittites. They are primary evidence, but series are incomplete and individual tablets mutilated. Dating is by reigns of kings, approximately fixed by cross references between Hittites (*q.v.*), Mesopotamians and Egyptians. The Linear B accounts of Knossos, Mycenae and Pylos may be included. These three groups can be combined into plausible historical narratives, but since the dovetailing of dates allows great latitude, there are almost as many versions as there are writers. It is not an easy story to follow.

The Hittites dominated central Asia Minor and expanded south

into Cilicia and Syria. Between them and the Aegean lay the Lukka (Lycians), Arzawa (Maeander to Hermus), Assuwa (Asia) in the north west, and Troy. Troy reached the height of its prosperity in the 14th century, after half a millennium of growth (Troy VI). There are resemblances between this city and Troy in the *Iliad*. Great walls with gates and towers and smooth stone faces sloped up and were surmounted by a vertical parapet. The angle they make explains the "elbow" on which Patroclus leaps (xvi, 702). The west section, retained from an earlier circuit, was smaller, weaker and rougher; in the *Iliad* there is a place where the wall is "most easily climbed" (vi, 433). The city rose in broad terraces on which were large, free-standing houses. At its best, the masonry is superb. In the *Iliad*, "polished stone" is what distinguishes the houses, and the house of Paris was made by the best architects (vi, 244, 313 ff.). "Well-walled" and "broad-wayed" are epithets closely attached to Troy, not to cities in general. Agamemnon once claims that his soldiers are over ten times as numerous as the Trojans without their allies (ii, 119 ff.). Heracles captured Troy with only six ships (v, 640) and Achilles could chase Hector round the walls; but usually Homeric Troy seems to be larger, a city rather than a fortress.

The Greek kingdoms were also expanding in the 14th century B.C. The cyclopean walls of Mycenae and Tiryns were built, and Rhodes and the islands of the south Aegean were colonized. Mycenaean pottery was imported to Troy in large quantities, and also to Cilicia and Syria, where Greeks would come into contact with Hittites. They were apparently excluded from the coast between Troy and Cilicia by the hostility of Arzawa, but at Miletus they maintained an outpost which had been founded in the 16th century. Before 1354 a Hittite king banished someone, probably his wife, to a place called Ahhiyawa, and a little later Millawanda (or Millawata) is mentioned in connection with a king of Ahhiyawa. Relations were friendly; for when a Hittite king was ill the gods of Ahhiyawa and Lazpa were sent to cure him. Some believe that these places are all in Anatolia, but identifications with Achaea, Miletus and Lesbos are widely accepted, and the king of Ahhiyawa is identified with the king of Mycenae or of one of the islands, Crete, Cyprus or Rhodes. The tone of the Hittite letters is more understandable if they were sent to the king of Mycenae.

About the end of the 14th century B.C., a Hittite king wrote to the king of Ahhiyawa, urging him to make his representative in Millawanda surrender a Hittite rebel. He said that he had entered Millawanda, with all possible respect for the rights of Ahhiyawa, but obtained no satisfaction. He also explained that he had shown no discourtesy to Tawagalawas, a relative of the king of Ahhiyawa, who had asked to become a Hittite vassal and then taken groundless offense. The bearer of this letter was the Hittite king's brother-in-law and groom, who had often ridden in a chariot with the brother of the king of Ahhiyawa and with Tawagalawas. The same Hittite king or his son had a loyal vassal, Alaksandus of Wilusa (an ancestor of Alexandros of Ilios?), who perhaps lived on the Sangarius.

At the transition from Mycenaean III A-B pottery styles, there was a great earthquake at Troy (the destruction by Heracles?), followed by immediate rebuilding (Troy VIIa) without cultural break. At about the same time strong fortifications were built at Miletus. Since on one later occasion a ruler of Millawanda appears as a Hittite vassal, it is suggested that the walls were built against Ahhiyawa and that Miletus is correctly assigned in *Iliad* ii, 868 to "non-Greek-speaking Carians." But Mycenaean III C and sub-Mycenaean pottery have been found at Miletus, and no Hittite period is reported; and his nationality did not prevent Tawagalawas of Ahhiyawa from wanting to be a Hittite vassal.

Early in the 13th century the palace at Pylos was built. The Hittites came into conflict with Egypt under Ramses II and a battle was fought at Kadesh (1299 B.C.). The Hittite forces included troops from Arzawa, and from Ugarit in Syria, where Greeks were settled, as well as Lukka and "Drdn" (Dardanians sent by Alaksandus of Wilusa?). Both sides claimed a victory, but the Hittites were able to extend their power in Syria. In 1283 the Hittites and Egyptians made a treaty, followed by a marriage alliance.

A letter of the Hittite king Tudhaliyas IV (1250–20) mentions ships of Ahhiyawa trading in Syria, and lists the kings that he considers of equal rank with himself. The king of Ahhiyawa was included, but crossed out. Whether it was a scribe's error or the king's second thoughts, the most likely explanation is that Ahhiyawa was a borderline case. Early in Tudhaliyas' reign, a king of Ahhiyawa was campaigning in person on the Caicus. This has been connected with the attack on Teuthrania in mistake for Troy, related in the *Cypria*; it was repulsed by Telephus, whose son Eurypylus led the Keteioi in *Odyssey* xi, 519 ff.; and Telipinus is a Hittite name. Unfortunately the Hittite text is very fragmentary.

Troy VIIa was captured and burned. At the time of the destruction, all open spaces were covered with small houses full of great storage jars, built in and over the houses destroyed by the earthquake, and the resemblance to Homeric Troy is therefore less close. No Mycenaean III C pottery was found in the destroyed city, but the survivers rebuilt it (Troy VIIb1), and made pottery influenced by the Mycenaean III C style. C. W. Blegen dates the sack of Troy as early as *c.* 1250 (about the time when a king of Ahhiyawa was active near the Troad) but a later date within Mycenaean III B is possible.

Tudhaliyas put down a revolt of Arzawa, and then faced a confederacy led by Assuva and including Taruisa (Troy) and Wilusiya (Ilios?). He claims to have defeated them and taken prisoner 10,000 foot soldiers and 600 chariots, but he then withdrew to deal with other troubles. A king of Ahhiyawa had something to do with this campaign, and one suggestion is that Agamemnon seized the opportunity to attack Troy and the remains of the confederacy. Another suggestion is that the Amazons were the beardless Hittites, and that this was the occasion when young Priam helped the Phrygians against them on the Sangarius (*Iliad* iii, 184 ff.). Except for Greek tradition, it would be natural to suppose that Tudhaliyas destroyed Troy as well as Assuva. About this time, the houses outside the walls at Mycenae were burned, and Thyestes or Aegisthus has been held responsible, according to the date taken for the Trojan War. Yet further trouble began before the death of Tudhaliyas and continued in the reign of his son and successor, Arnuwandas III. Attarissiyas, a man of Ahhiya, with a hundred chariots, drove out a Hittite vassal, Madduwattas, and pursued him far inland. The Hittites could deal with this; but later Attarissiyas and Madduwattas joined forces to seize the whole of Arzawa and raid Hittite territory in the east Mediterranean. Soon after this the archives stop; the central Hittite power was annihilated, and only a fringe of small states survived in northern Syria until they were engulfed by Assyria in the 8th century. The destruction was general. Everywhere peoples were on the move like a plague of locusts. Cities on the coasts were sacked. A series of land and sea raids on Egypt began, and though Ramses III repelled them from the Nile delta in 1191 the power of Egypt did not survive the shock. This is the latest date at which Troy VIIa could have been sacked.

In Greek tradition the destruction was remembered as the Dorian invasion. Pylos was utterly and finally destroyed *c.* 1200. The tablets record the presence of women from such places as Miletus and Chios, and though it is cautiously suggested that these are otherwise unknown places in Messenia a flight of refugees from the eastern Aegean might be expected at this time. A number of other settlements came to an end in this disaster. The citadel of Mycenae was burned, but there the recovery was immediate and the city lasted until late in the 12th century. Other places in Greece also survived, and in Cyprus and elsewhere overseas there are new settlements in which Mycenean III C pottery was made; the Greeks knew of Teucer at Cyprian Salamis, and of other heroes, Greek and Trojan, who settled abroad after the Trojan war. But by the end of the 12th century all the Bronze Age settlements except Athens had been destroyed or abandoned.

A historical Troy was burned within the period to which the Greeks dated the Trojan war, though there is no proof that the destroyers were not Hittites or sea raiders. A large and consistent group of names in the Hittite archives, none indisputable but together convincing, points to the activity of "Achaeans" in western Asia at this time. The Greeks had no reason to remember the destruction of Troy VIIa unless their ancestors had taken part.

Individually the arguments are not cogent, but together they are almost conclusive that the destruction of Troy by the Greeks is historical, although there is not yet enough evidence to decide between a national enterprise at the height of Mycenaean power and a marauding raid during its decline. The question therefore is not whether, but where, the memory was preserved. There was some continuity of culture in many parts of Greece, but an uninterrupted development, with abundant material from every phase, has been found only at Athens. Excavations at Miletus and Smyrna have confirmed the traditional connection between Athens and the Greek settlements in Asia in the 10th century. Athens, the natural refuge of Pylian and other refugees from the Dorians, thus appears as the link between Mycenae and Ioria.

6. Summary.—The contents of the poems, so far as they can be dated, belong almost entirely to the 13th–12th centuries or to the 8th. A few phrases and episodes survived from earlier centuries and are firmly incorporated in the epic language. The few passages which can be dated later are so superficial and alien to their context that they may reasonably be regarded as interpolations. Evidence of the history of the tradition in the intervening centuries is lacking; the material conditions can have made little impression on it, but the idea of an age of heroes probably emerged. The situations and events belong to the Mycenaean age, and their frequent accuracy, where there is independent evidence, shows that the tradition was retentive. Events are concentrated in too few generations, and there seems to have been some conflation, such as attributing to Troy the spaciousness of Troy VI and the fate of Troy VIIa. Therefore, although there is almost conclusive proof that the Trojan War and the relation of vassal king to great king are both historical, it does not follow that the war was protracted by a quarrel between two such kings. Some Mycenaean elements have been preserved within the stories (pre-Dorian geography, apparently the palace plan); others are found in formulas and typical scenes, and are used with little relevance to their context. Poets usually interpreted the tradition in terms of what they saw around them. A duel between men with thrusting spears is told on the assumption that they have throwing spears, even when the single-spear arming formula has been used. Motives are supplied to explain situations which are no longer understood. In action and mode of life, probably also in spirit, the poems belong to the 8th century; but the conservative influence of traditional stories told in traditional language is strong. It is probable that material which had once been admitted to the tradition vanished without trace only when it had become confusing or shocking. *See* also references under "Homer" in the Index volume. (D. H. F. G.)

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HOMER, LOUISE (1871–1947), U.S. opera singer, was born Louise Dilworth Beatty in Pittsburgh, Pa., on April 30, 1871. She was married to Sidney Homer, the composer, in 1895 and became known professionally under her married name. She studied music in Philadelphia, Boston and Paris before making her debut in Vichy, France, in 1898. The next season she appeared as Amneris in *Aida* at Covent Garden, London, and the season thereafter she was with the Royal opera in Brussels. She made her first appearance in New York city with the Metropolitan Opera company in 1900 and during her long career there developed an unusually rich contralto voice. In 1920 she joined the Civic Opera company of Chicago. She died May 6, 1947, in Winter Park, Fla.

HOMER, WINSLOW (1836–1910), U.S. painter, universally regarded as one of the greatest of American artists, was born in Boston, Mass., on Feb. 24, 1836. Apprenticed at 19 to a lithographer, he left on his 21st birthday to become a free-lance magazine illustrator. He moved to New York city in 1859 and during the Civil War attracted attention as a pictorial reporter for *Harper's Weekly*. He also began to paint during the war, his first important work in oils being "Prisoners From the Front" (1866; Metropolitan Museum of Art, New York city). His earliest water colours date from 1873.

Almost entirely self-taught and little influenced by other artists, American or European, Homer from the first painted with a freshness and clarity of vision which made him a pioneer of naturalism. In his early work his favourite subjects were scenes of country life, both fashionable (*e.g.*, "Long Branch," 1869; Museum of Fine Arts, Boston) and rustic (*e.g.*, "Snap the Whip," 1872; Butler Institute of American Art, Youngstown, O.). But from the mid-1870s his interest shifted to more dramatic subjects, reflecting the rugged lives of Adirondack hunters and New England fishermen, as in "Huntsman and Dogs" (1891; Philadelphia Museum of Art) and "The Herring Net" (1885; Art Institute of Chicago). His art was never stagnant, however, constantly growing in depth of feeling and breadth of execution.

Homer traveled to Europe in 1867 and again in 1881–82, when he produced a series on sea subjects deriving from his two-year stay in Tynemouth on the northeast coast of England. In 1883 he made his permanent home at Prout's Neck on the Maine coast. There he spent most of each year, almost a recluse, leaving only on

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"THE FOG WARNING" BY WINSLOW HOMER. IN THE MUSEUM OF FINE ARTS, BOSTON

painting trips to the Adirondacks, Florida and the British West Indies, where he found inspiration for some of his finest water colours (*e.g.*, "Rum Cay," 1898–99; Worcester Art museum). At first hostilely received by critics, his work began to receive acclaim in the mid-1880s with "The Life Line" (Philadelphia Museum of Art), "Eight Bells" (Addison Gallery of American Art, Boston) and other dramatic sea pieces, culminating with "The Gulf Stream" (Metropolitan Museum of Art) painted in 1899. He did little painting after 1904 and died at Prout's Neck on Sept. 29, 1910.

See William Howe Downes, *The Life and Works of Winslow Homer* (1911); Lloyd Goodrich, *Winslow Homer* (1944). (D. H. W.)

HOMERIC HYMNS, a collection of 33 Greek poems in heroic hexameters, of various lengths, ascribed in antiquity to Homer (*q.v.*), but of widely differing date and authorship. All are addressed to gods, whence the name "hymns," but most end with an indication that the singer intends to begin another song, and Thucydides calls the third one "Apollo's prelude." The poems, therefore, are preludes used by rhapsodes beginning recitals of heroic poetry. The collection is incomplete: it contains major hymns to Demeter, Apollo, Hermes and Aphrodite, but only short pieces to Zeus, Hera, Poseidon, Athena, Artemis, Hephaestus and Ares; the opening hymn to Dionysus is severely mutilated at the beginning. The hymns contain much information of value to the student of Greek religion, legend and literature.

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(Jn. A. D.)

HOME RULE (IRISH): *see* IRELAND: *History;* ENGLISH HISTORY.

HOME RULE (MUNICIPAL). The major aim of municipal home rule in the United States is to enable cities to govern themselves without interference from state legislatures. The desirability of encouraging local authorities to assume responsibility for local governmental services has been recognized in most countries which follow the Anglo-Saxon governmental tradition and in a number of others, such as Germany and Switzerland. This was the prevailing view in the United States immediately after the Revolution.

During the 19th century, however, the legislatures, under one pretext or another, gradually extended their control over local affairs. The means used were usually either special acts granting or changing the charters for individual cities or general incorporation acts for classes of cities. Laws were even passed to change the names of municipalities, grant public-utility franchises and fix the pay of local employees.

This legislative control of cities was bad both for the cities and for the legislatures. It tended to sap the initiative and responsibility of local officials, to promote governmental extravagance and to decrease public interest in local government. Furthermore, the volume of local legislation was sometimes so great that it required much of the legislators' time, thus preventing adequate consideration of major issues of state policy.

As urban centres grew in importance, they became increasingly restive of legislative interference. Municipalities were generally underrepresented in the legislatures because of failure to redistrict after each census or of unwillingness to take account of the faster growth of cities. In 1962 the U.S. supreme court ruled in *Baker* v. *Carr* that federal courts had jurisdiction to hear suits brought to correct this situation, which had resulted in urban centres having a decreasing voice in the state legislatures that controlled them.

Beginning with Missouri in 1875, more than half the states by the second half of the 20th century had adopted constitutional provisions conferring some power of self-government on their cities; *i.e.*, giving them home rule. These clauses vary greatly. Some are very general, giving cities broad powers "to determine their local affairs and government" (Wisconsin, 1924). Others provide an enumeration of the powers cities may enjoy (Colorado, 1901). Some merely withdraw constitutional objections to a grant of home rule by the legislature (Utah, 1932), while others are so specific that they can be put into effect without further legislation (Oklahoma, 1907). Oregon in 1906 extended home rule to "every city or town," but many states limit it to cities of a certain size or even to a single city. A few states extended home rule to counties and townships, but usually not to special-purpose governmental units such as school or park districts.

The heart of any home-rule article is the power it gives to the cities. These grants of power do not interpret themselves. In practice the state supreme court must decide if any specific matter is one of local concern or if the state's interest is paramount. Because the supreme courts are state organs, they often tip the scales against local autonomy. To prevent this some states specify in detail the exclusive powers given to localities, thus creating a government within a government, or local sovereignty. If the state constitution can be amended easily (*e.g.*, by an initiative petition followed by a popular vote, as in California), a narrow judicial construction of local powers can be reversed by constitutional amendment. The campaign to obtain more precise statements of local powers also sometimes modifies judicial aversion to local self-rule.

After 1945 there was a tendency to veer away from tight constitutional formulas. It was proposed, for example, that cities be authorized to exercise any powers within their boundaries that were not denied to them by the state constitution or by statutes that applied throughout the state. These proposals also commonly included prohibitions against the passing of special laws for a limited group of cities and against the imposition of financial burdens on cities; *e.g.*, legislative salary fixing for city employees. Reliance was placed on political and financial responsibility for both cities and states rather than on constitutional fences erected around each level of government. This method of obtaining local autonomy was patterned on the federal-state relationships provided in the United States constitution, in which the residual

powers rest by definition with the states. The Texas supreme court, exemplifying this approach, interpreted the home-rule action of that state's constitution consistently with these proposals.

See also CITY GOVERNMENT; LOCAL GOVERNMENT; MUNICIPALITY.

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HOMESTEAD, a borough of Allegheny county, in southwestern Pennsylvania, U.S., located on the Monongahela river, across from the southeastern edge of Pittsburgh. Homestead is part of a steel-producing complex which has long included several neighbouring communities. All are in the Pittsburgh (*q.v.*) standard metropolitan statistical area (for comparative population figures *see* table in PENNSYLVANIA: *Population*).

The borough developed with the growth of Andrew Carnegie's steel empire in the last quarter of the 19th century. Part of its history was the noted Homestead strike of July 1892, which occurred in the huge steelworks, now in Munhall borough, when company guards (Pinkerton detectives) hired by Henry C. Frick, a Carnegie associate, fought a pitched battle with the strikers who controlled the town. State militiamen were sent to quell the trouble. The strike directly influenced the re-election of Grover Cleveland over Benjamin Harrison in 1892 (*see* UNITED STATES [OF AMERICA]: *History: Homestead Strike*). The strikers' defeat retarded the unionization of steelworkers for more than 40 years. Homestead was laid out in 1871 as Amity Homestead and was incorporated and renamed in 1880. With Braddock (*q.v.*) it was the centre of the world's most advanced steel production in the 1890s. The steel mills are now chiefly located in adjacent communities. Industries include the manufacture of heavy mill machinery, tools, cement blocks and bricks. (P. R. J.)

HOMESTEAD AND EXEMPTION LAWS, enacted mainly in the United States, were based on the belief that the public domain belonged to the people and that each head of a family was entitled to a home or farm, the possession of which should be protected against seizure for debt. This theory developed gradually for half a century after 1785. The earlier laws were intended primarily to procure revenue for the federal government, and for several years before the financial panic of 1837 they were successful in that regard. But up to that time the main result was encouragement of sales in large blocks for the benefit of speculators. In the original 13 states with their later subdivisions of Maine, Vermont and West Virginia, and in the trans-Appalachian states of Kentucky, Tennessee and Texas, the public lands belonged to the states and were not affected by federal land policy. In the rest of the original territory, and in new areas as they were annexed, the land not already in private possession constituted the federal public domain.

By 1835 the sale of these lands had extinguished the public debt, and thereafter there grew an increasing clamour for legislation to relieve the condition of tenant farmers and hard-pressed city labourers through the adoption of a general homestead law. Labour parties in the east were the first to urge that such legislation be adopted, to relieve the eastern labour market of a surplus that was causing distress and to give both industrial and rural toilers the chance to work on their own land. The Pre-emption act of 1841 gave some relief to actual and prospective squatters on the public domain, but the continuation of a minimum price of $1.25 an acre defeated the main purpose of the advocates of free farms. Between 1845 and 1860 various homestead bills were introduced in congress, that of 1860 being vetoed by Pres. James Buchanan. Before 1856 the support for the measure came from the states west of the Appalachians, while the opposition centred in the Atlantic seaboard states. The contest was essentially between western farmers, seeking easy expansion, and eastern landlords and industrialists, eager to preserve high rents and cheap labour. But when the eastern Republicans of 1856, in order to cement relations with western Republicans, gave up opposition to a homestead law and combined free farms with the issue of antislavery expansion, the contest became one between north and south.

Homestead Act of May 20, 1862.—This act secured easy adoption because of the secession of the southern states. It provided that any citizen or alien who had declared the intention of becoming a citizen, if 21 years old or the head of a family, or if a veteran of at least 14 days' service in the armed forces of the United States during an actual war, and if he or she had never engaged in war against the United States or assisted in such a war, on payment of $10 might file claim to not more than 160 ac. of the surveyed public domain. After having "resided upon or cultivated" this land for the following five years, and if by then a citizen, the settler could receive a patent on payment of additional fees. This homestead could not be seized by any creditor to satisfy any debts previously contracted.

In the next 40 years there were numerous amendments to the law. In 1866 the bar against former Confederates was dropped. Before long there was a prohibition against separate homesteads for both husband and wife. The choice between residence or cultivation for the first five years gave way to the requirement of both residence and cultivation. Also, in time, the various states provided that homesteads should not be seized for debts contracted after the land was patented. These are known as exemption laws, and they vary widely in their protective features.

Shortcomings of the Law.—The Homestead act failed signally in its purpose of relieving labour pressure in the cities. The bulk of fertile land with abundant rainfall was already in private hands. Such tracts as remained were far removed from the congested labour market, and there was no legal provision for free transportation to the land. Nor was there any offer of sustenance or training in successful farming practices during the dreary years of making a beginning. Day labourers and tenants could not even acquire the necessary capital for investments in housing, implements, fences and livestock necessary for successful ventures. Even practised farmers usually failed on their raw homesteads, and to 1890 only one in three of the homesteaders managed to remain long enough to get deeds to their farms. Also, the Homestead act did not put an end to the granting of land in large blocks to monopolists. By 1900 fewer than 600,000 farmers received patents, totaling about 80,000,000 ac., while railroad companies alone were given 183,000,000 ac., after all reductions for failure to live up to contracts. P. W. Gates (see *Bibliography*, below) listed many other forms of land monopoly. Furthermore, the "commutation clause" of the Homestead act made petty speculators of many of the homesteaders. Six months after settlement they could buy the land at $1.25 an acre. By acting as agents for persons wanting huge estates, many of them made a neat profit without ever becoming actual homesteaders. This reduced the number of bona fide homesteaders before 1900 to probably around 400,000 and the aggregate acreage of their farms to possibly 55,000,000. In the 40 years between the passage of the Homestead act and the beginning of the 20th century, about one new farm in ten in the United States was a free homestead, while many more were purchased from speculators.

Later Homestead Laws.—Later acts were less beneficial to settlers than was the original act of 1862. In the west only the arid and semiarid lands were left for disposal by 1900. The Kinkaid act of 1904, applying only to western Nebraska, allowed 640-ac. tracts, which were enough for meagre subsistence at dry farming. But the Mondell act of 1909 gave only 320 ac. in the rest of the west. This was just enough to lure farmers to their doom, unless they acted as agents for land monopolists. The same was true of the Stock-Raising Homestead act of 1916, which granted 640 ac. in a region where one cow needed from 50 to 100 ac. of pasture and 10,000 ac. were barely enough for successful livestock raising.

In Alaska the Homestead act of 1898 limited claims to 80 ac. and required homesteaders to pay for their own surveys. The limit was expanded to 320 ac. in 1903 and reduced to 160 ac. in 1906. Leasing for fur farming was authorized in 1926 and for grazing in 1927.

By the second half of the 20th century about 250,000,000 ac. had been patented under the various U.S. homestead laws, but a good share of this had been turned over at a profit to the owners of large estates. The Taylor Grazing act of 1934 helped remedy the situation by removing nearly all the remaining pasture land of the far west from homestead entry and allowing its use only under lease from the government.

Canadian Laws.—Canada provided for the acquisition of homesteads on its public lands through the Free Land Homestead act of 1872, and the provinces adopted exemption laws similar to those of the United States. Homesteads were generally a quarter section (160 ac.), which claimants were required to reside upon and cultivate or otherwise improve; homesteaders meeting the requirements became eligible to pre-empt a second quarter section. *See* also AGRICULTURE: *United States;* LAND TENURE: ECONOMIC AND AGRARIAN ASPECTS: *The United States;* NEBRASKA: *History;* SMALL HOLDINGS: *United States.*

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(F. A. S.)

HOME STUDY: *see* CORRESPONDENCE INSTRUCTION; UNIVERSITY EXTENSION.

HOMICIDE is the general term for the killing of one human being by another. The term, therefore, contains no implications as to the legal liability of the actor for the killing. The nature of the responsibility of the slayer to the state and to the relatives of the slain has been a primary concern of all legal systems and has been considered from the various points of view of those engaged in efforts to preserve the public order and those concerned with religious, ethical or scientific evaluations of homicidal behaviour.

One initial question relates to the determination of the point at which a fetus becomes a distinct human entity and hence capable of being the subject of homicide. At the common law there is no homicide unless the child is born alive. This occurs when parturition is complete and an independent circulation is established. Evidence that the infant breathed is relevant, but not conclusive, to the issue. Statutes in some states of the U.S. make the killing of an unborn quick child manslaughter or even murder; and the Infant Life (Preservation) act, 1929, in England, creates the distinct offense of child destruction, which consists of the killing of a child capable of being born alive. Once it is established that the child was born alive, the rules of criminal homicide are no different from those employed in any other case. But the difficulties of proving live birth have prompted enactment of statutes in the Anglo-American countries that punish concealment of the birth of an infant or, in some instances, the death of an illegitimate child. In England the Infanticide act, 1938 (modifying a previous act of 1922 with the same title), reduces to manslaughter the killing of an infant under the age of 12 months (the 1922 act applied to "newly-born" children without further definition) by a mother suffering from mental disorder associated with childbirth.

Criminal and Noncriminal Homicide.—Delineation of the distinctions between criminal and noncriminal homicide required many centuries of development in the English law. Noncriminal homicides are ordinarily classified as justifiable or excusable. Justifiable homicide was never punishable and consists of killings permitted or required by the state. Examples include authorized executions by the public hangman and killings required to prevent commission of a felony (*q.v.*). Excusable homicides, on the other hand, include killings by misadventure (*per infortunium*) and, under some circumstances, those in self-defense. Although excusable homicides were never considered felonies at common law, they required the king's pardon and resulted in the forfeiture of the killer's goods. Eventually pardons and restitution of goods were granted as a matter of course. It was not until 1828 that these common-law incidents of excusable homicide were expressly removed by statute.

The common-law distinctions between justifiable and excusable homicide have largely lost their significance for the modern criminal law. The doctrine of exculpation of greatest practical importance is that of self-defense. In general, one may kill an assailant when the killer reasonably believes that he is in imminent peril of losing his life or of suffering serious bodily injury and that killing the assailant is necessary to avoid the peril. This statement means that a killing is not criminal if the actor mistakenly, but reasonably, believed it necessary to avoid imminent peril. A few U.S. jurisdictions, however, base exculpation on the actor's belief without testing its reasonableness by an objective standard. The doctrines of self-defense are qualified by the requirements of retreat. The common-law rule, and that recognized in perhaps a majority of U.S. jurisdictions, is that an unoffending party subjected to a felonious assault by another may stand his ground and kill when the conditions necessary to lawful self-defense are otherwise satisfied. A minority of U.S. jurisdictions hold that even in this case the party claiming exculpation must avoid danger by retreat when this can be done without increasing his peril. When the actor has contributed in some measure to the altercation giving rise to a killing in self-defense, the retreat requirement is generally recognized. A few U.S. states appear to hold that such a party loses the privilege of employing deadly force and, if he kills, is guilty at least of manslaughter. If the actor initiates the quarrel by launching a felonious assault on the deceased, rights of self-defense are forfeited until the actor wholly withdraws from the altercation and clearly communicates to the party originally assaulted a purpose to desist from further attack.

The rules relating to the use of deadly force to save a third party from death or serious injury bear an obvious relation to the doctrines of self-defense. It is generally held, at least in cases in which the party defended is a member of the actor's household or one to whom the actor owes special obligations of protection, that homicide is excused when the actor reasonably believed the deceased to be the aggressor and the killing to be necessary to save the third party's life. In some U.S. jurisdictions the scope of the privilege has been unfortunately limited so as to grant exculpation to the actor only when the defended party would have been privileged to use deadly force in his own defense. Under this view, the reasonableness of the actor's belief that the deceased was the aggressor is rendered irrelevant; and the actor "stands in the shoes" of the party defended when the question of exculpation is determined. Despite this qualification of the rules relating to defense of third parties, it is generally held, as in English law, that one may kill to prevent commission of a violent felony when he reasonably believes that such use of deadly force is necessary. So also, it is usually held that deadly force may be employed to prevent a felon from escaping a valid arrest. Some U.S. cases state that the killing of an innocent victim is not excused when committed by one acting under threats of imminent death or serious injury by a third party. There is some judicial and statutory authority in countries of the Anglo-American legal system that the killing of an unoffending victim may be excused when necessary to save the life of the actor or of another if the homicide occurs in a situation of extreme emergency produced by natural forces, as in cases of shipwreck or imminent starvation. In most jurisdictions, however, the courts have not been called upon to resolve the issue.

Murder and Manslaughter.—The common law recognized two crimes of homicide: murder and manslaughter. The Norman word *morth* described secret killings. After the Conquest, the latinized form of the term, *murdrum*, was applied both to the killing of a Norman and to the fine levied by the king on the hundred or other district in which the crime occurred if the slayer was not brought to justice. By the middle of the 14th century the distinctions between killing Normans and Englishmen had disappeared, and murder acquired the meaning of a willful and unjustified homicide. At least as early as the 13th century the language of verdicts returned in cases of excusable homicide distinguished the pardonable homicide from one committed with

"malice aforethought." By the 17th century Lord Coke could describe "wilful murder" as that which is committed "when a man of sound memory, and of the age of discretion, unlawfully killeth . . . any reasonable creature in being and under the king's peace with malice fore-thought, either express . . . or implied" (3 Co. Inst. 47). The definition is essentially that still recognized in most Anglo-American jurisdictions.

The phrase "malice aforethought" in the modern law has meanings wholly distinct from those given the words in ordinary usage. Thus "malice" in law does not require a showing of ill will or a motive of revenge, and the word "aforethought" does not imply an appreciable period of premeditation. The clearest case of a killing with malice aforethought is that of an accused who intends to kill the victim, when the killing is not one excused or justified by the law or is not subject to mitigation by the doctrines of manslaughter. Thus in most Anglo-American jurisdictions a "mercy" killing is murder even though requested by the victim and prompted by motives of compassion. In many European codes, however, such factors provide grounds for mitigation. In England the Homicide act, 1957, reduces the offense committed by the survivor of a suicide pact to manslaughter. A homicide may be with malice aforethought if the accused acts with intent to kill someone other than the victim ("transferred intent") or when there is a purpose to inflict serious bodily harm short of death on the person killed. Malice aforethought also encompasses killings by one who lacks a purpose to kill or to inflict serious injury but acts in wanton disregard of human life. The older authorities sometimes describe such an offender as possessing an "abandoned and malignant heart." At the common law one who inadvertantly kills another while committing some other felony is guilty of murder. "Felony-murder" is recognized in all U.S. jurisdictions, but various devices have been employed to reduce the breadth of its scope. In England, such cases are eliminated from the definition of malice aforethought by express provision of the Homicide act, 1957. There is some common-law authority for regarding as murder the accidental killing of a peace officer by one resisting a lawful arrest. These cases have also been excluded from murder by the 1957 act, but the house of lords has held that, where a reasonable man would have judged that death might result from his conduct and it does so, the killer is guilty of murder irrespective of any intent either to kill or to inflict grievous bodily harm.

At common law all murder was punishable by death, and this remained the law of England until passage of the Homicide act, 1957. That act limits capital punishment to specified types of murder: *e.g.,* murder committed by shooting or the killing of a police officer acting in execution of his duty. In the United States, legislatures have divided murder into degrees, reserving capital punishment and other severe penalties for murder in the first degree. First-degree murder typically consists of premeditated and deliberated killings and those occurring in the course of commission of certain violent felonies. The first of these statutes was the Pennsylvania act of 1794. At the beginning of the 1960s all but ten of the states had enacted similar legislation. The continental European codes generally define elements of aggravation and mitigation, including references, in some instances, to premeditation or to the motives prompting the killing or to the means employed.

The early English law did not distinguish between grades of criminal homicide. These distinctions in the modern law have their origins in a series of statutes enacted in the late 15th and early 16th centuries, which excluded "murder upon malice prepensed" from benefit of clergy. Thus two categories of criminal homicide came to be recognized: murder (those committed with malice aforethought) and manslaughter (all criminal homicides that are not murder). Being essentially a residual category, manslaughter encompasses many types of killings. In the modern law two divisions of manslaughter are recognized: voluntary and involuntary. The most important type of voluntary manslaughter consists of sudden killings in anger or "heat of passion" by one who has suffered serious provocation from the deceased. Not all provocations are legally adequate to reduce a homicide from murder to manslaughter. Blows or other physical injuries inflicted on the accused by the deceased may be regarded by the jury as adequate. The killing of one found committing adultery with the slayer's wife may also amount to voluntary manslaughter. In most Anglo-American jurisdictions mere words, however insulting, do not constitute adequate provocation; but in a few U.S. jurisdictions, as well as in England and Wales since the Homicide act, 1957, a contrary rule obtains.

The proper definition of involuntary manslaughter has been the subject of considerable controversy in the modern period. It was asserted by the common-law commentators that any killing resulting from commission of an unlawful act is a criminal homicide. This offense was murder if the unlawful act was a felony, but manslaughter if a misdemeanour. Thus, under the broadest statement of the "misdemeanour-manslaughter" rule, an accidental killing provides the basis of a felony conviction if the actor was committing a minor offense when the injury to the deceased was inflicted. The severity of the rule has prompted judicial efforts to limit it, with the result that the scope of the doctrine in modern law defies precise statement. Involuntary manslaughter may also be committed when, without intent to kill, the actor engages in unjustifiably dangerous behaviour resulting in death to another. The U.S. jurisdictions are not agreed as to the standard of culpability in these cases. Some require recklessness, which imports conduct in disregard of the actor's knowledge that he is creating peril to the life or limb of another. Others require only that the accused act in circumstances that would lead a reasonable man to be aware that his conduct is creating a serious and unjustifiable risk. The latter approximates to the English rule, though mere carelessness such as will found a civil action for negligence will not suffice for this purpose. In view of the difficulty experienced in obtaining convictions for manslaughter in motoring cases, sec. 1 of the Road Traffic act, 1961, constitutes, in Scotland as well as in England and Wales, the offense of causing death by reckless or dangerous driving.

Other crimes of homicide are created by the statutory law of some jurisdictions. Many U.S. states have enacted "negligent homicide" laws relating to deaths in automobile accidents. Ordinarily these offenses are punished less severely than manslaughter.

At the common law the relatives of one killed by the tortious conduct of another had no cause of action against the tort-feasor. Such a claim was created in England by Lord Campbell's act (9 and 10 V., c. 93, 1846). In the United States, legislation, some of it modeled on the English act, has everywhere made the "death action" available to relatives of the deceased or to his executor or administrator.

See CRIMINAL LAW: *Substantive Criminal Law; see* also references under "Homicide" in the Index volume. (F. A. A.)

HOMILETICS is the application of the general principles of rhetoric to the specific department of public preaching. Thus it treats of the analysis, classification, preparation, composition and delivery of sermons. *See* PREACHING.

HOMILY, an edifying discourse or a religious address, is a term applied chiefly to sermons that expound a biblical passage. Homilies by Fathers of the Church (or erroneously attributed to them) were collected and arranged according to the church year for regular redelivery in times when original preaching was not encouraged through fear of heresy or lack of educated clergy. Hence the reading of such homilies became part of liturgical worship in the Roman Catholic and Eastern Orthodox churches. The two Books of Homilies issued for the Church of England in the 16th century contain sermons by contemporary clergy. *See* PREACHING.

HOMING PIGEON: *see* PIGEON FLYING.

HOMMA, MASAHARU (1888?–1946), Japanese army officer, was born in Niigata prefecture, Honshu. He was convicted after World War II of permitting atrocities against prisoners under his command.

During World War I he was an observer with the British forces in France, and in 1925 he served as Japanese resident officer in India. In 1930 Homma was appointed military attaché in London, where he was decorated with the military cross of the British empire. In 1939 he commanded Japanese forces at Tientsin, China,

when the Japanese army blockaded the foreign concession there.

In Dec. 1941, a few days after the Japanese air attack on Pearl Harbor, Homma, then a lieutenant general, led the Japanese invasion of the Philippine Islands. Although it was commonly supposed that Homma had been superseded by Gen. Tomoyuki Yamashita after the campaign had bogged down at Bataan and Corregidor, subsequent evidence suggested that Homma held the supreme command throughout the campaign. He also directed "mopping up" actions against stray U.S. and Filipino forces in the Visayas and Mindanao areas.

Homma, who arrived in Tokyo to surrender to U.S. forces on Sept. 14, 1945, was brought to trial in December. He was formally charged with having been responsible for the "death march" on Bataan, which occurred shortly after the Japanese conquest. It was estimated that more than 17,000 Filipino and U.S. troops died during the forced march. The trial opened in Manila, Jan. 3, 1946, with a military commission presiding. Convicted Feb. 11 for ordering the death march and for condoning other atrocities, Homma was sentenced to be shot. An appeal to the U.S. supreme court was rejected, and Homma was executed by a firing squad at Los Banos, Luzon, on April 3, 1946.

HOMOLOGY, in biology, is the similarity of structure, physiology, development and evolution of organisms based upon common genetic factors. It is contrasted with analogy, which is a similarity of function not based upon common genetic factors, but appearing independently in convergent evolution. Biological analogy should not be confused with chance resemblances. (*See* EVOLUTION, ORGANIC: *Evidence of Evolution;* VARIATION.)

A British biologist, Sir Richard Owen (1804–92), is given the credit for defining both homology and analogy in precise terms. Confusion between the two is the largest source of error in modern systematic biology. Homologues and analogues may be present in the same structures or processes. The two can be separated only by considering the relations of whole patterns and systemic units and discovering, comparing and statistically analyzing each similarity and difference.

Genetic Homology.—The complicated gene structure, consisting of large molecules bonded together in a pair of chains, can be modified (undergo a mutation). Homology is based upon the postulated identity both of units within the molecules in the chain and the linear arrangements of the molecular units in the larger chain. Parallel and independent identical mutations may take place within the same or different species, but the mathematical probabilities of independent origin of complex genetic patterns are slight.

Ontogenetic Homology.—Genetic factors determine the nature and sequence of many events beginning with the earliest stages of embryonic development and continuing throughout life. So there are homologues in the life histories of genetically related individuals. Special subcategories of homology are set up to cover cases where similar structures appear in the same individual (each of the arms of a starfish or the legs on each segment of a lobster), or in different individuals in a genetically related population (sexual homologues or castes of social insects).

Phylogenetic Homology.—Homologues in different species are theoretically inherited from a common ancestry and are presumably initiated by identical genes or gene parts. The number and complexity of such homologues indicate the degree of relationship between phylogenetic groups. Hence homologues are the foundation for "natural systems" of classification and form the basis for evolutionary theory and interpretation.

Because of gross evolutionary changes and analogous functions, homologues are not always apparent to the casual observer, particularly in cases involving vestigial organs and extreme adaptations. For example, dog's paws, bat's wings, whale's flippers and man's hands have many homologues in common. Study of embryonic development is often helpful in establishing obscure homologies in relatively unrelated branches of the evolutionary tree.

See also references under "Homology" in the Index volume.

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HOMOPHONY in the strict sense is chordal style in part music, where all parts move together rather than as independent melodies. It can also refer to music in which one part, usually the highest, predominates while the accompaniment is more or less chordal. Note-against-note writing originated in the earliest part-music known as organum (9th–12th centuries) but was then displaced by contrapuntal styles. The secular frottola (*q.v.*) in Italy at the end of the 15th century led to the recultivation of homophony in 16th-century secular music, but it was not until the 17th century that homophony dominated musical style.

(G. RE.)

HOMOPTERA, one of the two suborders of the insect order Hemiptera, the other being the Heteroptera (some consider Homoptera and Hemiptera [in this case coextensive with Heteroptera] as separate orders). All homopterans are sap suckers, many of them being serious pests of cultivated plants. They include cicadas, leafhoppers, aphids, scale insects, mealy bugs and spittle bugs. *See* HEMIPTERA: *Suborder Homoptera.*

HOMOSEXUALITY, also called SEXUAL INVERSION, is usually defined as the sexual attraction of a person to one of the same sex (from Gr. *homo-,* "same"; not from Lat. *homo,* "human being," "man"). This usually, but not necessarily always, leads to various physical activities culminating in orgasm or sexual climax. Female homosexuality is often referred to as lesbianism (*q.v.*). The term pederasty implies sexual relations between men and boys.

Occurrence.—Contrary to the popular belief, homosexual behaviour can be seen not only in human beings but also in animals, sometimes in immature ones but more often in those deprived of a normal sexual outlet. It is believed that conditioning may have a great deal to do with such behaviour, although much arises spontaneously.

Apes appear to pass through a stage of undefined sexual activity, and S. Zuckermann noticed mutual masturbatory activities that would be regarded as overt homosexuality in humans. R. M. and A. Yerkes state that heterosexual, homosexual, exhibitionistic and masturbatory activities occur in immature animals. Sodomy (*i.e.,* anal intercourse) in apes has been noted.

Many human societies disapprove of homosexuality, but some, for example the ancient Greeks, accepted it as normal. C. S. Ford and F. A. Beach, who studied primitive societies, state that 49 out of 76 (*i.e.,* 64%) accepted homosexuality as being normal. In some of these, persons were allowed to wear clothes of the opposite sex and to form homosexual unions that were accepted as "marriages." In some cases this was related to shamanism, and the homosexual was considered as having magical powers. In other societies (the Siwans of north Africa, the Arunta or Aranda of Australia, the Keraki of New Guinea, etc.) men and boys indulge in anal intercourse. Homosexuality is then common and even universal. Sometimes it is related to initiatory rites.

Such behaviour in primitive societies occurs among females as well as among males and is usually confined to mutual masturbation, but an artificial phallus may be employed. It is probably not so common among females as males.

Lest it be thought that homosexuality appears in such preliterate societies because it is permitted, it must be pointed out that even in those where it is harshly repressed it still makes its appearance; the death penalty itself has failed to stamp it out.

Theories of Causation.—There appear to be four possibilities in the causation of homosexuality in human beings: (1) a genetic aberration; (2) an endocrine disorder; (3) a psychological condition; or (4) a mixture of two or more of these.

The view that homosexuality is a genetic aberration is frequently advanced. The homosexual often says that he was born with the tendency and has been a homosexual as long as he can remember. Such genetically produced intersexuality (that is, male homosexuals regarded as more or less feminized males or as real male intergrades) has been worked out extensively. Thus in in-

sects (butterflies, for example) it is possible to demonstrate series with males and females at the extremes but with a very gradual transition between. Physical intersexuals can be found in practically all animals, and the condition is often due to disease of the adrenal glands. The possibility that the homosexual is a psychical manifestation of such a condition at once suggests itself. Unfortunately for those who hold this view, its application to human beings has not been confirmed. No one has ever been able to prove that it occurs, and homosexuals certainly do not show any physical signs of the concomitants that might be expected.

An endocrine causation has always seemed a likely one, but here again unfortunately there is no proof. Most homosexuals show no evidence of glandular disease. Castration does not cause the condition, nor does the injection of female hormones into the male (or vice versa) do so. In some cases the injection of male hormones in a male has increased his homosexuality (by increasing the sexual urge). The excretion of hormones in homosexuals is usually normal.

No discernible difference between the physique of the homosexual and that of the heterosexual has been shown by any recorded tests, microscopical, macroscopical, biochemical or endocrine.

There remains the psychological causation. A view is often advanced that homosexuality is pure degeneracy. This is used as a vehicle of abuse but has little scientific meaning. It has been suggested, for example, that the ancient Romans became degenerate and lost their world dominance through perverted sex, or alternatively that homosexuality was a symptom of their degeneration; but it is now thought that any deterioration in the Romans that cannot be explained by political or economic causes is better attributed to malaria than to perversion. Since homosexuality appears to be determined before puberty, the hypothetical degeneracy would have to have set in very early, and usually no other evidence can be found either of physical or of intellectual degeneracy in homosexuals. In fact, some of them are fine creative artists and almost all are physically normal.

It is probable that sexual inversion goes much deeper than degeneracy and is related to development. This is suggested because it rarely appears by itself and is frequently associated with other paraphilias (*i.e.*, abnormal immature ways of obtaining sexual pleasure). Moreover, sexuality in the human being is not clear-cut but shades off. Thus A. C. Kinsey found that 35.5% of all individuals in a series of 1,058 males had had one or more homosexual experiences. He thought that between one-quarter and one-third of all males in any middle-aged group had had some homosexual experience and that in the course of a lifetime 50% would be involved in this behaviour. These statistics belong to the United States, and there are no comparable ones for Europe, but it is believed that a somewhat similar result would be obtained there.

It is generally accepted by psychologists that men who in normal circumstances will behave heterosexually and enjoy a normal life with women may become inverted if deprived of female company (in prison, in prison camps, in warfare, at sea and so on). The percentage of cases in which this occurs is not known.

The idea of psychological causation was first developed by Sigmund Freud, who put forward the view that homosexuality was due to aberrations of the emotional development. He thought that the main factor was an overattachment of the boy to his mother and hostility to his father, which would result in his molding his personality too much on his mother and so acquiring too many feminine reactions and thus tending to behave as a woman. Freud's view is upheld by the fact that a large number of inverts give a history of an unhappy home in which the father has been unsatisfactory or else died when the patient was young (and so had not been available to shape his personality). Other views of Freud's regarding the development of the libido, or sexual interest, from oral through anal to phallic stages explain the behaviour of inverts who indulge in oral and anal perversions. They explain, also, the association of homosexuality with other sexual abnormalities such as bisexuality, transvestitism (or the wish to dress as a member of the opposite sex) and transsexuality (the desire to change sex). Bisexuality is usually considered to be undeveloped sexuality, with the patient fixated between heterosexual and homosexual stages; transvestitism as somewhat similar but limited to an identification with the mother only as far as clothes are concerned; and transsexuality as a wish to be as like her sexually as possible. Unconscious fear of castration also plays a part.

Social Aspects.—Although medically inversion must be considered an illness, there is no doubt that, particularly in large towns and cities, it becomes exploited as a vice. Thus homosexual prostitutes exist and maintain souteneurs much as in heterosexual prostitution. These exploit the less sophisticated and frequently blackmail them. This explains the fact that homosexuals sometimes sink down in the social scale, as suggested by G. W. Henry and A. A. Gross.

Not all male homosexuals are of the outwardly effeminate type, and some can be dangerously violent. Crimes of jealousy, sometimes leading to murder, are caused by this abnormality. But other homosexuals have made valuable contributions to society, notably in the field of the arts, though it is improbable that it is the sole or even the main cause of genius, as some homosexuals assert. Freud suggested that inversion is the cause of paranoid insanity (in which the patient suffers from delusions of persecution).

A certain number of homosexuals are curable by psychological treatment, a fact that invalidates the view of its causation by genetic or glandular aberrations. Treatable cases are those who suffer from excessive timidity with members of the opposite sex or who have painful symptoms. Excessively feminine men are not suitable for psychological treatment. *See* also SEXUAL BEHAVIOUR: *Legal Aspects;* SEXUAL DEVIATIONS.

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HOMS (AL KHUMS; formerly LEBDA), a town of Tripolitania in Libya, Africa, lies on the Mediterranean coast at the foot of the northern spurs of the Jabal Nafusah 65 mi. E.S.E. of Tripoli. Pop. of Homs (Al Khums) district (1954 census) 62,272, almost all Arabs. The seat of a prefecture, Homs has well-kept public gardens, many Turkish buildings, mosques, a Roman Catholic church, schools and a modern hotel. Near the town is the military area, occupied in the mid-20th century by British troops. Local industries comprise the Sidi Miftah tunny-fish enterprise, a soap factory and the esparto pressing plant. The district produces dates and olive oil, and the good sea fishing is well exploited.

The town of Homs was founded by the Turks and gained importance about 1870 when the British started the esparto industry there. In the environs are the ruins of several Italian forts from World War I. Less than 2 mi. to the east is the ancient city of Leptis Magna (Labdah), with its extensive Roman remains. *See* LEPTIS. (E. V. CI.)

HOMS (HIMS; HEMS; HUMS), a town of Syria, and the administrative centre of the *muhafaza* (district) of Homs, is situated at 1,624 ft. above sea level on a pass near the Asi (Orontes) river, north of the lake of Homs, and 31 mi. S. of Hamah. Pop. (1960) 136,474. The town, set in the midst of gardens and vineyards, comprises two quarters, the older built of basalt and the newer largely of concrete. Modern buildings include banks, hotels, hospitals, an agricultural research station and a sugar refinery. A government-owned oil refinery, with an annual capacity of 1,000,000 tons, was opened in 1959. The ancient tell rises above the town and was formerly crowned by a citadel which Ibrahim Pasha destroyed in the early 19th century.

Homs is a thriving market centre. Barley and onions are the chief local crops and the main manufactures are silks, cottons, woolen goods, belts and cloaks. It is an important road and rail junction; the desert route from Palmyra and the main Aleppo-Damascus road pass through the town, which is also linked through the mountains by road with Tripoli, Lebanon and Beirut. Homs is connected by rail with Aleppo, Damascus, Tripoli and Beirut.

Homs (anc. Emesa) is near the site of Kadesh (modern Tall

Nabi Mand) which was the moving spirit behind the Syrian confederacies of the 2nd millennium B.C. and was the scene of the famous battle between Muwatallis, king of Hatti, and Ramses II of Egypt in 1299 B.C. The battle was indecisive and led later to a peace treaty between Ramses II and Muwatallis' successor, Hattusilis III (Khattushilish).

Emesa was the site of the sun temple to Elagabalus (Heliogabalus) and was ruled by a line of priest-kings throughout the Roman period. The Emesene nobility achieved high office under the empire, and two of them rose to be emperor. Under Varius (emperor A.D. 218–222), who called himself Elagabalus on his elevation to emperor, the worship of the Syrian sun-god was introduced to Rome; Emesa was already the capital of Phoenicia-Lebanesia. Aurelian (270–275) made Emesa his headquarters when defeating Zenobia, queen of Palmyra. In 636 the city was taken by the Muslims and renamed Hims. A shrine and mosque erected in 1908 honours the Arab general and miracle worker Khalid, known as "the Sword of Allah," who died there in 642. The population of Hims remained largely Christian and constant disturbances culminated in the rebellion of 855 which was violently suppressed. All the churches were demolished except one, which was incorporated in the Great mosque, and the Christians who were not executed were deported. The town remained a provincial centre under the Ottoman empire and is still noted for the fanaticism and turbulence of its inhabitants. After the independence of Syria in 1946, its population increased considerably.

The district of Homs (area 16,289 sq.mi.) had a population in 1960 of 399,714. (M. V. S.-W.)

HONAN (HO-NAN SHENG), one of the most densely peopled and historically one of the most famous of the provinces of China. Area 64,479 sq.mi. (167,001 sq.km.). Pop. (1957 est.) 48,670,000. Its name signifies "south of the river," *i.e.*, of the Yellow river, but a part of the province lies north of the river. Honan comprises the southwestern portion of the great plain of north China, broken in the west by mountains, eastward extensions of the Tsinling Shan (*q.v.*) axis, which have a general elevation of about 3,000 ft. (914 m.). The northern section of Honan was separated in 1949 to form the short-lived province of P'ing-yüan which was abolished and restored to Honan in 1952. The southern boundary of Honan follows in part the crest of the Ta-pieh Shan (Huai-yang Shan) which divides the Huai Ho (*q.v.*) from the Yangtze basin, but in the southwest it includes the upper valley of the Han river which affords direct communication with the tri-city conurbation of Wu-han (*q.v.*).

Honan was the chief centre for the spread and dispersion of early Chinese culture and civilization. The open lands above the marshy levels of the Yellow, Huai and upper Han rivers were not only valuable settlement sites but controlled the lines of movement either along the Huai-Yellow river wasteland to Shantung province or by the Huai-Yangtze divide to the culture centres of the Yangtze valley. Honan was also the terminus of the corridor route from the west between the Shansi plateau and the easterly spurs of the Tsinling Shan. In earlier Chinese history sites along the right bank of the Yellow river, between the cities of Lo-yang to the west and K'ai-feng (*q.v.*) to the east, frequently served as political centres, these two cities often being the capitals. Hence, much of the political history of China prior to about A.D. 1200 focused upon the Honan area. An-yang (*q.v.*), north of the Yellow river, has notable archaeological sites.

Honan is mainly rural in character, with a large percentage of the population living in villages and small towns. The chief urban settlements are located along the Lunghai and Peking-Hankow railways. The densest grouping is in the eastern section on the higher agricultural land. A secondary focus of population occurs in the upper Huai basin with Nan-yang as its centre. Honan normally leads China in wheat production and ranks high in the production of cotton, millet, tobacco, soybeans, peanuts and sesame. But the danger of drought and flood (from both the Yellow and Huai) constantly menaces the countryside. The Chinese Communists have done much river reclamation work on the upper Huai system, building detention dams, canals and irrigation systems in an effort to decrease flood dangers and mitigate drought problems.

The main earlier industrial development had been the growth of coal mining in northern Honan and the establishment of agricultural processing industries in the towns along the rail systems. After 1952 the old cities along the Yellow river, K'ai-feng, Chengchow (Cheng-Chou; *q.v.*) and Lo-yang (*q.v.*), began to expand industrially. Chengchow (pop., 1957 est., 766,000), at the intersection of the Lunghai and Peking-Hankow rail systems, became the provincial capital in Oct. 1954 and is growing rapidly, a new industrial suburb taking shape in the western outskirts. Textile mills, machinery plants, power plants at dams along the Yellow river and added agricultural processing factories were built in the late 1950s and early 1960s. Some of these projects were designed to serve both power development and flood-navigational control on the Yellow river. The 30-mi.-long People's Victory canal, an irrigation and communication project, links the Yellow river north of Chengchow with the Wei Ho at Hsin-ch'iang (Sinsiang). Despite industrial developments, Honan's manufacturing patterns still continue to revolve around the processing of agricultural products, notably cotton, flour and oilseeds. If the trend of industrialization continues, however, Honan is certain to show increasingly complex industrial patterns and a marked shift in population distribution through increased urbanism. (J. E. SR.)

HONDECOETER, MELCHIOR D' (1636–1695), Dutch painter who specialized in bird studies, was born at Utrecht. Old historians say that he was the grandson of Gillis and son of Gysbert Gillisz d'Hondecoeter, as well as the nephew by marriage of J. B. Weenix who certainly influenced his style. As to Gysbert and Gillis, however, it is uncertain that they were father and son, since both were registered as painters at Utrecht in 1637. Melchior lived at The Hague (1659–63) and at Amsterdam, where he married in 1663 and lived till his death on April 3, 1695.

Melchior d'Hondecoeter chose birds as his subject, perhaps because his father had painted birds or because his uncle Weenix taught him to study the feathered tribe. Melchior, however, began his career with a different specialty from that by which he is usually known. De Stuers affirmed that he produced sea studies. He acquired celebrity, however, as a painter of birds, which he represented vividly. Without the brilliant tone and high finish of Jan Fyt, his birds are full of action; and it was said that he displayed the maternity of the hen with as much tenderness and feeling as Raphael, the maternity of Madonnas. Few of his pictures are dated, though more are signed. Among the former should be noted the "Jackdaw Deprived of His Borrowed Plumes" (1671); "Game and Poultry" and "A Spaniel Hunting a Partridge" (1672); and "A Park With Poultry" (1686). Hondecoeter's earliest works are more conscientious, lighter and more transparent than his later ones. At all times he is bold of touch and sure of eye, giving the motion of birds with great spirit and accuracy.

Hondecoeter, in great favour with the magnates of the Netherlands, became a member of the painters' academy at The Hague in 1659. William III employed him to paint his menagerie at Loo, and the picture, acquired by The Hague museum, shows that he could overcome the difficulty of representing India's cattle, elephants and gazelles. But he is better in homelier works, with which he adorned the royal châteaux of Bensberg and Oranienstein at different periods of his life.

HONDO, Central American stream with headwaters in British Honduras (Belize), northeastern Guatemala and southern Mexico. Its northeast or east-trending course marks the frontier between Mexico (Quintana Roo territory) and British Honduras. In the 30 mi. above its outlet on Chetumal bay (Caribbean sea) it is navigable for small craft. High-water navigation extends to the confluence of the Xmoscha and Azul rivers. (J. T.)

HONDURAS (REPÚBLICA DE HONDURAS), a republic occupying the central portion of Central America, with a coast line of 400 mi. (644 km.) on the Caribbean sea and a frontage of about 50 mi. (80 km.) on the Gulf of Fonseca, on the Pacific ocean. It is bounded on the north by the Caribbean sea, on the southeast by Nicaragua, on the south by the Pacific ocean and El Salvador and on the west by Guatemala. Area 43,277 sq.mi. (112,088 sq.km.). Pop. (1961) 1,883,480.

The name is Spanish (translated "depths") and is explained with

equal insistence as referring either to the deep waters found by Columbus offshore or to the deep, wavelike valleys and ridges that traverse nearly the entire country, excepting for the relatively narrow coastal plains. The country faces on the sea to the north and shares frontage on the Gulf of Honduras with British Honduras and Guatemala, which has a short Caribbean coast line. The strategic Bay Islands (*q.v.*; Islas de la Bahia), about 30 mi. off the north coast, became part of Honduras in 1859 after a long dispute with Great Britain.

The easternmost extension of Honduras is Cape Gracias a Dios, where the Caribbean coast line of Central America turns abruptly southward. The frontier with Nicaragua, which was delineated in 1906 and reaffirmed by a decision of the International Court of Justice in 1960, runs through a sparsely inhabited territory along the Rio Segovia (or Coco or Wanks). (See *History*, below.) The boundary continues southwestward from an upper tributary of the Segovia across the continental divide to the eastern end of the Gulf of Fonseca. There, for a short distance, Honduras fronts on this great arm of the Pacific, holding sovereignty over the islands of Tigre (where its Pacific port, Amapala, is situated), Zacate Grande and Gueguensi. The boundary line with El Salvador starts at the mouth of the Goascorán river and follows an irregular line through the mountains, first in a northerly and then in a westerly direction, to a point directly west of Ocotepeque; there the boundaries of Honduras, El Salvador and Guatemala meet.

The boundary line between Honduras and Guatemala was in dispute from the early days of the Spanish regime until the 20th century. With the development of the banana industry, conflicting concessions by the two governments brought the issue to a head in 1927, but threatened hostilities were averted by United States mediation and an eventual arbitration by that country, Costa Rica and Chile.

This article is divided into the following sections:

I. Physical Geography
II. Geographical Regions
III. The People
IV. History
V. Population
VI. Administration and Social Conditions
VII. The Economy

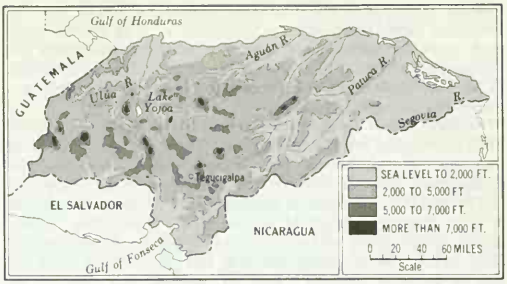
Further aspects of Honduras may be found in short articles on the departments and more important cities. *See* also CENTRAL AMERICA.

I. PHYSICAL GEOGRAPHY

The general aspect of the country is mountainous. Although the southern part of the country close to the Pacific is of volcanic origin, no active volcanoes exist. No clear-cut pattern of mountain trends is apparent. Some tendency for ranges in the northern part of the country to trend southwest-northeast is apparent, enveloping extensive valleys, but many transverse ranges also exist. In the southern part, mountains are prolonged commonly toward the north and northwest, whereas the central part is constituted in general by a dissected upland with numerous small peaks.

Geology.—In general the geological formations in Honduras have roughly an east-west orientation. Except for a narrow plain of Pleistocene alluvium, bordering the Gulf of Fonseca, the mountains of southwestern Honduras consist of alternating series of andesitic tuffs and lava flows of Tertiary age. From west of Tegucigalpa eastward are broad areas of Triassic and Cretaceous crystalline (granite) and metamorphic rocks, forming the many mountain ranges. The northern mountains, east of the Ulúa basin, consist of Pre-Cambrian, or possibly Paleozoic, crystallines with alternate bands of Cretaceous sedimentary rocks and Cretaceous granitic intrusions between ranges of older rocks. Northwestern Honduras has large areas of Tertiary andesitic tuffs and lavas, older Cretaceous sedimentaries and, in the sierras near Guatemala, Cretaceous granitic intrusions. Narrow stretches of northern coastal plains, the broad Ulúa-Chamelecón and Aguán valleys and the wide eastern coastal plains consist chiefly of Pleistocene sediments and Recent alluvium.

Relief and Drainage.—Flat to undulating plains comprise about 20% of Honduras. Bordering the Gulf of Fonseca, low plains, 10 to 25 mi. wide, are fairly well drained by many short streams and the Goascorán, Nacaome and Choluteca rivers, whose sources lie in high mountains. Narrow, poorly drained coastal plains in the north, separated by mountain spurs that reach the ocean, merge with the alluvial plains of the Ulúa-Chamelecón, Comayagua and Aguán rivers. The Ulúa-Chamelecón plains, 30 mi. wide in the lower portion, extend 65 mi. inland. The Ulúa and tributary Jicatuyo, rising near El Salvador, are over 250 mi. long and navigable by light-draft boats for 150 mi. The Aguán-Mangulile may be ascended by small boats for 50 mi. The low-level eastern plains, 70 mi. wide in places, have large coastal swamps and lagoons; Laguna de Caratasca is 41 mi. long and 14 mi. wide. Long rivers are the Patuca and Segovia or Coco (*q.v.*); the latter, rising within 50 mi. of the Gulf of Fonseca and flowing eastward for 300 mi. (491 mi. including headwaters), is navigable by small vessels for 200 mi. Highlands, comprising 80% of Honduras, consist of many high mountain ranges, reaching 8,000 ft. in the west, and deep structural basins in which are canyonlike valleys and intricately ramifying tributaries—all contributing to the very rugged relief. Many basins, the largest being the Humuya, 32 mi. by 16 mi., lie 2,000 to 5,000 ft. above sea level.



SURFACE FEATURES OF HONDURAS. THE COUNTRY IS CHIEFLY MOUNTAINOUS, WITH WIDE FRONTAGE ON THE CARIBBEAN SEA AND A NARROW PACIFIC OCEAN SHORE LINE

Climate.—The climate is generally hot, with high humidity in the tropical coastal lowlands becoming modified by altitude toward the interior. Lowlands below 1,500 ft. have mean annual temperatures between 26° and 28° C. (79° and 82° F.). The north coast is occasionally affected from October to April by "northers"—cool northern winds of continental origin. Mountain basins and valleys, from 2,000 to 4,000 ft., have mean annual temperatures between 19° and 23° C. (67° and 74° F.). At Tegucigalpa, located on hilly terrain at an altitude of 3,200 ft., the rainy season starts in May and continues until the middle of November with temperatures sometimes reaching 32° (90°) in May and dropping to 10° (50°) in December, the coolest month. Around 7,000 ft., mean annual temperatures are about 14° (58°). In the northern and eastern coastal and alluvial plains and on adjacent mountains mean annual precipitation ranges from 70 to 110 in. or more, with a less rainy (but not rainless) season from March to June; these areas occasionally have summer hurricanes with strong winds and heavy rains. Pacific plains and mountain slopes get 60 to 80 in. of rain annually, but there the months December to April receive little or no rain. Interior sheltered mountain basins and valleys get 40 to 70 in. annually, with December to April having little rain. Interior higher mountains have a longer wet season and receive considerably more rain.

Vegetation.—In eastern Honduras the coastal and lagoon swamps have mangrove and palm forests, and west of these are low rainy sandy plains with pine-savanna (*Pinus caribaea*) forests, extending inland for 40 mi. or more. West of the pine-savanna forests, in low valleys and on lower mountains, rainy all year, and on the low rainy northern mountains, are broad belts of dense evergreen broadleaf forests with many species of large trees including mahogany, lignum vitae, Spanish cedar, balsa, rosewood, ceiba, sapota (yielding chicle used for the base of chewing gum),

Castilla rubber, etc. The high rainy mountain slopes of highland Honduras support excellent oak-pine forests. The interior highland basins and valleys have open, dry deciduous woodlands and temperate grasslands. The Pacific plains and adjacent mountain slopes have deciduous tropical forest and savanna. Mangrove occupies the low coastal swamps.

Animal Life.—In the native animal life of Honduras insects, birds and reptiles are most numerous. There are many species of butterflies, moths, beetles, bees, wasps, spiders, ants, flies and mosquitoes. Most of these are beautifully coloured. Many species of land birds are common throughout the country. Waterfowl in large numbers inhabit the coastal areas. Crocodiles, snakes, lizards (giant iguana and others) and turtles are in the tropical forest areas. Bears, pumas, leopards and panthers are rarer but may be found in the hills. Fish and mollusks are abundant in lagoons and coastal waters, but the annual catch does not exceed 400,000 lb.

II. GEOGRAPHICAL REGIONS

Honduras may be divided into four distinct geographical areas: (1) the eastern lowlands and eastern mountain slopes; (2) the northern coastal and alluvial plains and coastal sierras; (3) the central highlands; and (4) the Pacific lowlands and lower mountain slopes.

The Eastern Lowlands and Eastern Mountain Slopes.—These are hot and rainy all the year and densely forested. This region embraces about 20% of the country's area but its population, all rural, comprises only 5% of the national total. It has no highways or railways, depending entirely on boat transportation on the rivers, lagoons and coastal waters. Chief economic activities are lumbering, forest gathering, primitive subsistence agriculture and fishing. The lagoons and coastal waters are the chief fishing grounds of the country.

The Northern Coastal and Alluvial Plains and Coastal Sierras.—The plains are artificially drained in part and the entire region embraces about 13% of Honduras. The coastal settlements are inhabited by about 20% of the nation's population. The three railways are confined to this north coastal region which has four of the five important ports of the country; Puerto Cortés, the leading port, is connected with Tegucigalpa in the highlands via the Inter-Ocean highway. The coastlands with their productive clay loam and sandy loam soils produce all the bananas exported from Honduras and at least half the rice and cassava. The area is significant in the production of corn, beans, cattle, poultry and swine and manufactured articles, the last especially in San Pedro Sula (*q.v.*), the second city in Honduras.

The Central Highlands.—Extending northwest-southeast from Guatemala to Nicaragua, the highlands comprise about 65% of the national territory and have 70% of its population. This region consists of rugged mountain ranges and intermontane basins and deep valleys between 2,000 and 5,000 ft. in altitude. The population is concentrated chiefly in basins and valleys, many of which have fertile soils derived from lavas and volcanic ashes. There are road connections with both coasts via the Inter-Ocean highway. The region produces all the nation's coffee, tobacco, potatoes and wheat and the bulk of its corn, sorghum, beans, fruits, vegetables, cattle, poultry, swine, minerals, hardwood-pine forest products used in Honduras and manufactured commodities.

The Pacific Lowlands and Lower Mountain Slopes.—These comprise only about 2% of the national area and have only 5% of the population. The region, level to hilly, has fertile alluvial and other soils derived from lava and volcanic ashes. Although small, it produces all the country's sesame seed, the bulk of its cotton and small amounts of corn, sorghum, and cattle, swine and poultry products. The Inter-American highway from El Salvador to Guatemala crosses the region and Tegucigalpa can be reached via the Inter-Ocean highway. (C. F. J.)

III. THE PEOPLE

Honduras is predominately a mestizo (mainly Spanish-Indian) country. According to the 1950 census, ethnic distribution was as follows: mestizos 91%; Indians 6%; Negroes 2%; and whites 1%. Although there is no racial discrimination of an institutional or governmental nature and very little in social relations, the ruling upper middle classes tend to be lighter skinned than the lower classes. The mestizos of Honduras are generally darker and more Indian in appearance than those of certain other Latin-American countries such as Chile, Uruguay and Argentina. Mestizos predominate in every department but Intibucá and the Bay Islands. The greatest concentrations of Indians live in Intibucá (about 30% of the national total) and La Paz (about 18%). These two departments, located in the southwest near the Guatemalan border, coincide roughly with the important Indian centres of the pre-Spanish period. There are small, isolated groups of non-Spanish-speaking Indians, such as the Jicaques, Mosquito, Zambos and Payas, but they are declining in numbers. The Bay Islands of the Atlantic coast are populated mainly by descendants of Negroes and Caribs and by white Protestants of English extraction, who dominate the political, social and economic institutions. Negroes, mostly from Jamaica, were introduced in the northern coastal area to work on the banana plantations, where English is now widely spoken. Their immigration is now illegal. There are very few Negroes in the urban centres of the interior. A pronounced shift in population took place in the early decades of the 20th century from the cool, pine-forested mountains and plateaus and fertile valleys of the interior to the hot, humid north coast where economic opportunities were afforded by the United Fruit company. In later years, shifts back to the area of more pleasant climate took place.

Roman Catholicism is the predominant faith, and freedom to all creeds is guaranteed by the constitution. No religion is state supported. *See* also INDIAN, LATIN-AMERICAN. (W. S. Ss.)

IV. HISTORY

Centuries before the white man came to the new world, Honduras was the original homeland, along with Guatemala, of the remarkable Maya people, the pioneers of higher civilization in the Americas. But when Columbus, on his fourth voyage, touched the Honduras coast (1502) the Mayas had deserted Copán, Quiriguá and other Honduran sites for lands in the Yucatán peninsula, where the conquistadors found them a short time later. (*See* MAYA INDIANS.)

Honduras, though largely unexplored, became a bone of contention between the Spaniards of Mexico and the Spaniards of Panama. Hernán Cortés (*q.v.*), conqueror of Mexico, considered that it lay within his sphere and when word came that Gil González Dávila, acting under orders of Gov. Pedrarias Dávila of Panama, was colonizing the area, Cortés countered by sending his lieutenant, Cristóbal de Olid, to expel the intruder. Olid arrived, bested Dávila and then set himself up as independent of Cortés. This brought Francisco de las Casas from Mexico. Then Cortés, fearing that Casas might succumb to a like temptation, made his memorable overland march to Honduras. After some exploration and looting he returned to Mexico the next year (1526). Spanish rule was inaugurated but settlements were soon engaged in rivalries for wider authority. Pedro de Alvarado (*q.v.*), another of Cortés' lieutenants, was sent in 1536 to restore order. He founded San Pedro Sula in the valley of the Ulúa, and later Comayagua (*q.v.*), the first capital of Honduras, was established in the Comayagua valley by Alonso de Cáceres. This period was marked by bloody struggles against Lempira, the Indian chieftain who for a time successfully resisted the Spanish advance into the interior. His name now designates the monetary unit of Honduras and is a national symbol of liberty and valour.

Colonial Period.—In 1539 Honduras, along with the four other provinces of the Central American strip, was incorporated into the captaincy general of Guatemala, and it remained a part of that administrative division of the Spanish Indies through the colonial period. In the 1570s a silver strike in the highlands brought a rush of prospectors which resulted in the rise of an important population centre at Tegucigalpa (*q.v.*). The coastal area along the Caribbean became a rendezvous for the pirates and buccaneers who preyed on the Spanish treasure ships and attacked the colonial ports. Later the region, with its fine logwood forests, attracted

English cutters, who by the end of the 18th century controlled the Mosquito Coast (*q.v.*) from the San Juan river, in Nicaragua, to Belize, and also the Bay Islands offshore. The Spanish resented this trespass but were unable to oppose it effectively.

Independence.—In 1821 Mexico won its independence from Spain, and on Sept. 15, 1821, the Central American provinces comprising the captaincy general of Guatemala also announced their independence. In 1822 they became part of the Mexican empire of Agustín de Iturbide (*q.v.*), but following the latter's downfall in 1823 they broke away to form the Central American federation (*q.v.*). Manuel José Arce, the first president, faced an almost impossible task in trying to weld the five states (Honduras, Guatemala, El Salvador, Nicaragua and Costa Rica) into a functioning unit. Serious unrest began to show as early as 1826 and in 1829 Arce resigned. In 1830 Francisco Morazán was elected to head the union. Morazán was a Liberal whose impact on his native Honduras and on the confederation was in terms of liberalism, one of whose principal goals was the curtailment of the power and age-old privileges of the church and the clergy. By the late 1830s the Conservative opposition proved too much for Morazán. The confederation collapsed and the Central American states assumed the status of independent nations. Honduras declared its absolute independence Nov. 5, 1838. Rafael Carrera (*q.v.*) assumed the leadership in Guatemala; the Conservatives in Honduras took control under the leadership of Francisco Ferrera, who was inaugurated as the first consitutional president Jan. 1, 1841; Morazán, who had gone to El Salvador, finally withdrew.

The domination of the Conservatives, in Honduras and generally throughout Central America, lasted until the 1870s. The church was restored to its former commanding position. In 1861 the Honduran government signed a concordat with the Holy See, as Guatemala had done a few years before. The ascendancy of Justo Rufino Barrios (*q.v.*) in Guatemala (1871–85) influenced a return to liberalism in Honduras where Marco Aurelio Soto, a Liberal, assumed the presidency (1876). A new constitution (1880) sought to undo the work of the Conservatives. Five years later, Barrios attempted to revive the old Central American union but in resorting to force he overstepped himself. Liberals in Honduras and elsewhere proved to be nationalists first and blocked this attempt at domination by Guatemala. This resulted in a return to power by the Conservatives almost everywhere.

Later Developments.—During the turbulent second half of the 19th century, Honduras was often disturbed by interference from Guatemala. In the first decade of the 20th century meddling came from another quarter, the current strong man in Nicaragua, José Santos Zelaya (*q.v.*), who put Manuel Bonilla into the Honduran presidency. This interference led in 1911 and 1912 to something more serious than the periodic revolutions. Pres. William Howard Taft was pressured to send in marines to protect U.S. banana investments which by this time had grown considerably. The earlier Cuyamel company had been joined first by the Standard Fruit company and then by the United Fruit company in exploiting this Honduran product; all three had made large capital outlays in the form of improved port facilities, railroads, workers' settlements and similar developments in the plantation area, the lowland region along the Caribbean coast.

In 1918 Honduras followed the lead of the United States and declared war on Germany but took no active part. Political upheavals continued after World War I. In 1932, after years of unrest, a strong man, Gen. Tiburcio Carías Andino, was elected president, an office which he held until 1949. Carías dealt with several abortive revolutions during his term of virtual dictatorship.

Honduras declared war on Japan Dec. 8, 1941, and on Germany and Italy Dec. 13. Lack of shipping during World War II occasioned much economic distress. Export surpluses of bananas, coconuts and copra piled up, leading to widespread unemployment and consequent unrest. However, the government was able to maintain itself and promulgated some beneficial reforms. The United Fruit company increased wages for its employees and inaugurated several new enterprises, such as the planting of improved Hevea rubber trees and the raising of the tropical fibre-yielding plant abacá. Carías survived a revolution in 1947, but two years later the combination of two rival parties proved his undoing. Juan Manuel Gálvez assumed control and sought to restore constitutional guarantees.

Between 1954 and 1956 there was the short-lived dictatorship of Julio Lozano Díaz. A ten-week strike among the workers of the United Fruit company was fomented quite openly by Communist elements. The reform interest, thus aroused, led to the formulation of a new labour code which gave the workers the right to organize and to bargain collectively.

Despite impressive gains on the labour front, Hondurans were restive under the Lozano Díaz regime. He was unseated by a bloodless coup in Oct. 1956, and a three-man junta took control of the country. The junta, headed by Col. Héctor Caraccioli, quickly won the confidence and support of the people and very soon had the recognition of almost all other governments. It ruled with moderation and, according to its promise, took steps for the election of a constituent assembly, set for Sept. 1957. Earlier in that year there was a border dispute with Nicaragua over rival territorial claims to an area north of the Segovia river which flows eastward to the Atlantic. Prompt and effective action by the Organization of American States prevented hostilities. A decision in 1960 by the International Court of Justice awarded the area to Honduras.

In the September election there was a minimum of official interference and a lack of disturbance throughout the country. The constituent assembly met in October, drafted a constitution and availed itself of the power, written into the constitution, to choose the first president. The Liberal leader, Ramón Villeda Morales, was elected. He took office on Dec. 21, 1957. His first official act was to proclaim the new constitution in force; this replaced the 1936 constitution, suspended in Dec. 1954. A minor revolt against the government was suppressed in May 1959.

On Oct. 3, 1963, ten days before the scheduled presidential elections, Morales was deposed by a military coup led by Col. Osvaldo López Arellano. Declaring that Morales and his party had failed to recognize the dangers posed by "Communist agitators," López declared himself head of state, dissolved the legislature and canceled the elections. (J. F. Bx.)

V. POPULATION

The official census of population of 1950 was 1,368,605, with a density of 31.6 to the square mile; the census of 1961 was 1,883,480, with a density of 43.5. The rate of increase (doubled in 30 years, from 892,887 in 1927 to 1,768,906 in 1957) was more than twice that of the world in general. As in Latin America generally, this population growth is greater in the cities than in the rural areas. Tegucigalpa (*q.v.*), the picturesque capital, had a population (1961) of 133,887. The second city is San Pedro Sula with a population (1961) of 58,126. Among the smaller cities are Puerto Cortés, Choluteca, La Ceiba, Santa Rosa de Copán, Tela and Comayagua.

The liberal agrarian laws of Honduras encourage most of the people (about 69%) to live in the rural areas and exploit subsistence farms or engage in small cattle-producing enterprises.

Population of Honduras (1961)

Departments (capitals in parentheses)	Area (sq.mi.)	Population (preliminary census)	Density (per sq.mi.)
Atlántida (La Ceiba)	1,641	92,832	56.6
Bay Islands (Roatán)	101	9,060	89.7
Choluteca (Choluteca)	1,626	149,205	91.8
Colón (Trujillo)	3,426	40,570	11.8
Comayagua (Comayagua)	2,006	96,420	48.1
Copán (Santa Rosa)	1,237	126,191	102.0
Cortés (San Pedro Sula)	1,527	199,215	130.5
El Paraíso (Yuscarán)	2,787	106,891	38.4
Francisco Morazán (Tegucigalpa)	3,068	283,607	92.4
Gracias a Dios (Brus Laguna)	6,421	10,920	1.7
Intibucá (La Esperanza)	1,186	72,981	61.5
La Paz (La Paz)	900	60,698	67.4
Lempira (Gracias)	1,656	111,757	67.5
Ocotepeque (Nueva Ocotepeque)	649	52,989	81.6
Olancho (Juticalpa)	9,402	110,706	11.8
Santa Bárbara (Santa Bárbara)	1,975	147,222	74.5
Valle (Nacaome)	604	80,924	134.0
Yoro (Yoro)	3,065	131,292	42.8
Total	43,277	1,883,480	43.5

VI. ADMINISTRATION AND SOCIAL CONDITIONS

Constitution and Government.—Since acquiring independence, Honduras has been described constitutionally as a democratic, representative, unitary state with power divided among legislative, executive and judicial branches. The country has had 15 constitutions, the latest having gone into effect on Dec. 21, 1957. As in most Latin-American countries, there is frequently a wide gap between what the constitution says about government and politics and what happens in practice. Thus power has frequently been mobilized and changed by violent, undemocratic means. Peaceful methods have included *imposición* ("rigged election"), *candidato único* ("single candidate") and *continuismo* (continuing the president in power beyond his legal tenure). Although the legislature is given the power to pass laws, practically all important legislation is drafted by the executive and his assistants. The congress in theory has great authority to check the administrative activities of the president, but only in the period 1925–31, when several cabinet ministers appointed by the president were forced to resign through censure, was such authority effective. The election of Carías in 1932 re-established strong, centralized dictatorial government and the constitutions of 1936 and 1957 forbade congress to censure any cabinet member appointed by the president. Honduras has a single-house legislature with single-member districts based on a ratio of one deputy for each 30,000 inhabitants. The constitution of 1957 fixes the number of deputies at 58. The congress convenes each year on Nov. 21 for 100 days. The sessions can be extended to 150 days, and special or extraordinary sessions can be called. All men and women who are citizens and over 18 years of age are permitted to vote, and a national electoral council, created in the constitution of 1957, supervises elections. Suffrage was extended to women in 1955. The president is elected directly by popular vote for a period of six years with a second term prohibited (art. 199).

The justices of the supreme court are elected by the congress (art. 217) for six years. The supreme court exercises centralized control over the lower courts, including the appointment of the justices of the appellate courts, the judges of letters (courts of original jurisdiction), labour judges and others. The supreme court has original and exclusive jurisdiction to declare acts of the legislature unconstitutional (art. 237). The departments are subject to the control of the central government, but the constitution declares that the municipalities are autonomous. Although U.S. influence was strong in certain aspects of the early constitutions, Spanish influence has always been great.

By the 1960s Honduras, like most other Latin-American countries, had moved more and more in the direction of the interventionist or welfare state. There are a number of provisions in the constitutions of 1936 and 1957 which give the central government great power to direct and regulate social relations and the economic system. In Feb. 1955 the Honduran basic labour code came into effect. It granted the right to work, minimum wages, an eight-hour day and 48-hour week, freedom of unionization, collective bargaining, conciliation and the right to strike.

CHARLES PERRY WEIMER

TEGUCIGALPA VIEWED FROM SURROUNDING HILLS

Education.—The Honduran educational system follows the European model of centralized control through the ministry of education. According to law, education is free and compulsory for all children from ages 7 to 15. Efforts have been made to combat illiteracy, which in the 1960s was probably more than 60% for those 10 years of age and over. In the late 1950s there were about 400,000 children of school age and according to official statistics less than half were attending school. There were approximately 2,400 primary schools that had about 150,000 pupils and 4,500 teachers, and about 50 secondary, normal and technical schools with over 100,000 pupils and 1,350 teachers. The National university in Tegucigalpa (founded 1847) with six faculties (judicial and social sciences, medicine and surgery, physical and mathematical sciences, chemistry and pharmacy, economics, odontology) had an enrollment of about 1,000 and 130 faculty members.

(W. S. Ss.)

VII. THE ECONOMY

Production.—The economy of Honduras is essentially agricultural. The two large U.S. banana companies (United Fruit—operating through its subsidiary the Tela Railroad company—and Standard Fruit company) on the north-coast plantations hold about 5% of the nation's agricultural lands, provide 20% of the national income, 50% of all agricultural production, 60% of all export value and 13% of government income. But Panama disease, affecting the roots, and sigatoka (leaf spot) have hampered cultivation. The industry, perforce, is tied intimately to railways and ocean shipping.

Corn (maize) is the chief staple foodstuff grown by Honduran farmers and occupies more than one-half of all cultivated land. Sorghum, beans and rice are also common crops. Although wheat is grown in the highlands, considerable quantities of grain and flour are imported to meet domestic requirements.

Important export crops, other than bananas, are coffee beans, abacá fibre (manila hemp), tobacco and coconuts. Pasture uplands are very extensive in the interior; exports of cattle and swine go principally to El Salvador. Large expanses of coniferous forest as well as other kinds of forest exist, but exploitation has been relatively small. Mahogany had been the traditional timber exported, but in the 1960s pine far exceeded mahogany in quantity and value. Largely unexploited mineral resources are considerable and include lead, antimony, zinc, iron, coal, mercury and copper. Production of silver and gold, however, has remained of some importance for many years.

Foreign Trade.—Exports average more than $70,000,000 (140,000,000 lempiras) annually. Imports are slightly less. Somewhat more than 50% of the exports generally go to the United States, while slightly less of the imports come from that country. Bananas account for about 45%–60% of the exports, coffee 20%–25%, wood 7% and silver 2%.

Finance.—The Honduras monetary unit is the lempira, stabilized after 1934 at two to the U.S. dollar. For calendar 1960 the budget balanced revenue and expenditure at 95,697,000 lempiras. The debt, in lempiras, amounted to more than 25,000,000. Two private banks operate in Honduras: Banco de Honduras, locally controlled, and Banco Atlántida, which is U.S. capitalized. In 1950 two Honduran government banks, the Banco Central de Honduras and the Banco Nacional de Fomento, were inaugurated. The former centralized the financial operations of the state and became the only bank of currency issue. The Banco Nacional de Fomento was intended primarily to grant loans for agricultural development.

Transport and Communications.—Honduras has only 63 mi. of public-service railroads. The two fruit companies own an additional 272 mi. of railroad trunk lines and about 725 mi. of branch lines, which are confined to the north coastal banana region and also provide some passenger transport facilities.

The Inter-American highway, running from El Salvador to Nicaragua, cuts across southern Honduras for about 100 mi.; a

branch highway, not entirely in good condition, leaves it at Jícaro Galán and runs north through Tegucigalpa to the north coast.

Air transportation is of great importance within Honduras and is frequently the normal means of conveyance for passengers and freight. International service also is important.

See also references under "Honduras" in the Index volume.

(W. C. Gn.)

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HONDURAS, BRITISH: *see* British Honduras.

HONE, PHILIP (1780–1851), U.S. businessman, civic leader and diarist, was born in New York city on Oct. 25, 1780. His first venture in business, as a partner in his older brother's auction house, enabled him to build up a fortune by 1821. He then turned his interest to politics and to the anthracite-coal industry in eastern Pennsylvania, and during the late 1820s he became a pioneer in the development of canals and railroads. Hone saw the need for promoting the Delaware and Hudson Canal and Railroad company to provide for the shipment of coal from Pennsylvania to New York. He imported the first locomotive to be run on an American railroad, the famous "Stourbridge Lion," built at Stourbridge, Eng. It made its trial run on Aug. 9, 1829, but failed because of the weakness of the tracks. Nevertheless, the effort encouraged later successful experiments in railroad transportation. The Pennsylvania terminus of the railroad and of the Delaware and Hudson canal was named Honesdale in his honour.

Hone's main distinction in politics lay in his election as mayor of New York city in 1825, the year the Erie canal was opened. But more important than his holding office for one term was his role in promoting the growth of the Whig party in New York state. He was an outstanding figure in New York city social and civic affairs, and encouraged the arts, letters, music and drama. His voluminous diary in 28 volumes of no less than 2,000,000 words is preserved by the New York Historical society and is considered to be the best single body of source material on New York city from 1828 to 1851. Hone died in New York on May 5, 1851.

See Allan Nevins (ed.), *The Diary of Philip Hone,* 2 vol. (1927).

(H. E. Bar.)

HONE, WILLIAM (1780–1842), English writer and bookseller who in his works attacked contemporary social and political abuses, was born at Bath on June 3, 1780. An autobiographical fragment, written in 1838 (published 1841), gives details of Hone's first 20 years. He had no systematic education and was taught to read from the Bible. From his 13th year he worked in various solicitors' offices in London and Chatham and in 1800 married Sarah Johnson. By 1796 he had become interested in radical politics and joined the London Correspondence society, which advocated political reform. He opened in 1800 a circulating library, with books and prints for sale, in Lambeth; but his business ventures never prospered. In the next few years he was twice bankrupt. In 1806 he and a Dutch friend, John Bone, having studied the theory of savings banks, opened a combined bank, insurance office and employment agency, but this failed, as did their next venture, a bookselling business. Hone then became clerk to a book auctioneer and, in 1811, auctioneer to the trade.

Despite indifferent health and constant financial troubles, Hone became increasingly concerned with reform. In 1814–15 he investigated conditions in the lunatic asylums and in 1815, in his newspaper the *Traveller,* attempted to exculpate Eliza Fenning, a servant girl who was executed, almost certainly unjustly, for attempted poisoning. From Feb. 1, 1816, to Oct. 25, 1817, Hone published the *Reformists' Register,* a 2*d.* weekly attacking political abuses. In it he continued to support his hero William Cobbett (*q.v.*) after the latter's flight to America. In 1817 he published political satires in the form of parodies of the Prayer Book: *The Late John Wilkes's Catechism of a Ministerial Member, The Political Litany* and *The Sinecurist's Creed.* Ostensibly for "profane publication," really for political reasons, Hone was prosecuted. He continued to write his *Register* while in prison awaiting trial. The three trials—held on successive days before special juries, the first (Dec. 18) presided over by Justice Abbott, the others by Lord Ellenborough—have been called a landmark in the history of the press. Despite adverse summing up, Hone's spirited defense of himself was successful, and he received a great ovation on his acquittal.

Hone co-operated with the artist George Cruikshank in several popular political satires. *The Political House That Jack Built* (1819) went into 54 editions; other squibs include *The Queen's Matrimonial Ladder* (1819), supporting Queen Caroline, and *Non mi Ricordo* (1820). But Hone remained an antiquarian at heart and published various compilations of recondite information. *The Every-Day Book,* dedicated to Charles Lamb, appeared in 104 weekly parts in 1825–26, the *Table Book* from Jan. to Nov. 1827 and the *Year Book* in 1831–32. Despite their popularity, these entertaining works were not financially successful and Hone was lodged in the King's Bench prison for debt from April 1826 until the end of 1828, when he was declared bankrupt and released. In 1830 friends set him up in a coffeehouse but this too failed, and most of Hone's remaining working life was spent as subeditor of a nonconformist weekly. He had experienced a religious conversion in 1832 and became a prominent Congregationalist. He died at Tottenham on Nov. 6, 1842.

See F. W. Hackwood, *William Hone: His Life and Times* (1912).

(R. P. C. M.)

HONEGGER, ARTHUR (1892–1955), French-born Swiss composer closely associated with the modern movement in French music during the first half of the 20th century. Born at Le Havre, March 10, 1892, he studied at the Paris conservatoire under André Gédalge, Charles Widor and Vincent d'Indy. He first came into prominence immediately after World War I as a member of the group of young composers known as "Les Six" (the others being Germaine Tailleferre, Francis Poulenc, Darius Milhaud, Georges Auric and Louis Durey); but he was bound to them more by ties of friendship than by any real aesthetic affiliation and was soon to assert his own strong personality in the work that was to bring him international fame, the "dramatic Psalm" *Le Roi David,* first performed at Mézières, Switz., on June 11, 1921. This was followed by two of his best-known orchestral works, *Pacific 231* (1924), an inspired impression of a locomotive in action, and *Rugby* (1928), both of which reflect the composer's love of speed and virile sports. He was a prolific composer and made notable contributions to opera (*Judith, Antigone, Amphion*), ballet (*Skating Rink, Sémiramis, L'Appel de la montagne*), choral and symphonic music (*Cantique des Cantiques, La Danse des morts* and five symphonies), chamber music (three string quartets and sonatas for violin, viola and cello) and music for films (*La Roue, Pygmalion, Cavalcade d'amour,* to cite only a few). He also wrote a number of songs, mostly settings of works by contemporary French poets, such as Jean Cocteau, Guillaume Apollinaire and Paul Claudel. Other works by which he is remembered are *Jeanne d'Arc au bûcher,* a stage oratorio on a text by Claudel (Basel, May 12, 1938); the early *Pastorale d'été* for chamber orchestra; and the striking fifth symphony "Di tre re," composed in 1951, which was almost the last work he wrote. In all his music a strong personality expresses itself in a bold and uninhibited musical idiom that, while indebted for certain harmonic audacities to the French *avant-garde,* was nevertheless more Germanic than Gallic in its essence. He died in Paris on Nov. 27, 1955.

Bibliography.—Arthur Honegger, *Je suis compositeur* (1951); Marcel Landowski, *Honegger* (1957); Willy Tappolet, *Arthur Honegger* (1957).

(R. H. Mv.)

HONESDALE, an industrial borough in northeastern Pennsylvania, U.S., seat of Wayne county, is situated at the confluence of the Lackawaxen and Dyberry rivers, about 30 mi. N.E. of Scranton. An important hub of early turnpikes, it is located in a region noted for recreational facilities. Honesdale, named for Philip Hone, who pioneered construction of the Delaware and

Hudson canal, was settled in 1827 and incorporated in 1831. From 1828 to 1898 it was the transfer centre for coal brought over the Moosic mountains by gravity railroads from the Lackawanna valley to the canal barges. The town is the site of one of the world's largest coal storage markets. In 1829 the "Stourbridge Lion," the first locomotive to run on rails in America, was initially tested there. Condensers, refinery equipment, knitted goods and shoes are manufactured. For comparative population figures *see* table in PENNSYLVANIA; *Population*. (A. D. S.)

HONESTY (*Lunaria annua*), a hardy biennial of the family Cruciferae, suitable for garden cultivation. It is an attractive everlasting plant two feet to four feet high, with a silvery dissepiment. The similar but less ornamental perennial honesty (*L. rediviva*) is also cultivated.

HONEY is a sweet, viscid liquid obtained by honeybees from nectar secreted by plants. The nectar is ripened into honey by the inversion of the greater portion of the sucrose sugar of nectar into levulose (fructose) and dextrose (glucose) and by the removal of excess moisture. During the summer period, if plant nectar is not available, bees may also collect insect honeydew (*see* APHID).

This article deals with the uses of honey, the forms in which it is marketed, its composition and physical properties and world production. Production practices and races of bees cultivated in various countries, and the extraction of honey, are discussed in the article BEEKEEPING.

Uses of Honey.—Honey was of great importance as an article of diet to the ancients, being almost their only available source of sugar. It was valued also for its medicinal virtues; was used for making mead (*q.v.*); and was mixed with wine and other alcoholic drinks. In Egypt it was valued as an embalming material; in India and other eastern countries for the preservation of fruit and the making of cakes, sweetmeats and other foods. Honey is mentioned in the Bible, *e.g.*, references to "a land flowing with milk and honey" (Ex. iii, 17; Num. xiii, 27), and in the Koran, and is alluded to by Homer, Herodotus, Euripides and other ancient writers.

Honey still is used to sweeten and give special flavour to foods such as breakfast cereals, fruits, candies and baked goods. With candies, the tendency of honey to absorb moisture offers slight problems, but with bakery goods this hygroscopic property causes them to absorb and retain moisture for a long time and thousands of pounds of honey are used annually in making breads and cookies (biscuits). Honey is used in ice cream manufacture to replace all or a part of the sugar. It gives further variety to flavours but has the slight objection of requiring a lower freezing and storage temperature. Honey is used as a vehicle for medicines, such as honey cough syrups. Some physicians have recommended honey with milk for feeding infants, especially those suffering from rickets, scurvy, malnutrition, anemia, inflammation of the intestine and the effects of prematurity. For athletes and others engaging in strenuous physical labours honey has been widely used: since the dextrose portion of honey is quickly absorbed into the blood stream while the levulose must be changed first to glycogen and then into dextrose, honey provides an immediate as well as an extended source of energy. This particular characteristic of honey is the basis for its recommendation by some doctors for diabetics. Honey fortified with particular pollens has been employed successfully in alleviating the symptoms of hay fever.

Honey has slight antiseptic properties and has been used in treating wounds, cuts, bruises, lacerations, sore nipples and burns. It has been used as a plant stimulant and for feeding animals, including fish and dairy cows (especially for the prevention and cure of acetonemia, a disease of cows at calving time). It also has been used as a facial pack in the beauty parlour, in hand lotions, in curing pipe bowls, in cigarettes, chewing tobacco and gums, as a spray adherent, as a centre for golf balls, as an antifreeze mixture for auto radiators and as a preservative for eggs in cold storage.

Forms of Honey Marketed.—Extracted or liquid honey, sometimes called strained honey, is produced in medium- to large-sized combs provided with heavy wax foundations wired into wooden frames. The cappings are removed from the cells and the honey is taken out with a centrifugal extractor. Extracted honey may be sold in the original liquid form or in a granulated form as creamed honey, spun honey and candied honey.

Comb honey, less common in the markets, may be found as section comb honey, bulk comb honey, cut comb honey and chunk honey. Section comb honey is produced in small lots weighing 11 to 15 oz., the original comb being contained in a square wooden frame. For bulk comb honey, a frame is provided with a thin surplus foundation, as also in section honey. When well capped, it is removed and sold as produced; or the contained comb may be cut up into pieces and sold as cut comb honey; or one or more of these pieces may be placed in a jar and liquid extracted honey poured over it, the product being known as chunk honey.

Composition.—Honeys vary in composition according to floral source, environmental conditions (chiefly relative humidity), ripeness when extracted, methods used in processing and conditions of storage. A general idea of the variations in composition may be obtained from the table of the analyses of 92 U.S. honeys (U) and 106 California honeys (C) by C. A. Browne and by J. E. Eckert and H. W. Allinger, respectively.

Other substances occurring in honey in minute amounts are pollen, a partial source of vitamins; minerals and amino acids; beeswax (*q.v.*); proteins and related compounds; and colour substances containing plant pigments, chlorophyll decomposition products, colloidal particles and tannic acid. Aroma and flavour substances contain essential oils, terpenes, aldehydes, methyl anthranilate, diacetyl and volatile and nonvolatile acids. Traces of higher alcohols include mannitol, dulcitol, etc. Sugars include maltose, melezitose, erlose, etc. In addition, honey contains other minute amounts of enzymes, vitamins, acetycholine and yeasts. Substances indicated by biological activities include a plant-rooting hormone, an estrogenic factor, a guinea pig antistiffness factor and antibacterial substances. Honey from heather, *Calluna vulgaris*, contains a peculiar protein that makes it thixotropic; *i.e.*, it becomes jellylike on standing and is only fully liquid for a short time after being stirred. Chromatographic analyses by J. W. White and others have shown that maltose must be included among the major constituents of honey and have greatly added to the list of sugars identified as minor constituents.

The table shows the average mineral or ash content of the two groups of honey to range from 0.18% to 0.21%. Tables (by H. A. Schuette *et al.*) of the mineral content in groups of light and dark honeys list the following minerals: potassium, chlorine, sulfur, calcium, sodium, phosphorus, magnesium, silica (SiO_2), silicon (Si), iron, manganese and copper. White has listed the most plentiful ash constituents as calcium, magnesium, iron, manganese, copper, phosphorus, silicon, nickel, boron, aluminum and potassium.

Major Constituents of Honey
(in percentages)

Constituent	Average		Maximum	Minimum
	U.S.	Calif.		
Water	17.70	16.50	U 26.88	U 12.42
Levulose (fruit sugar)	40.50	40.41	U 48.61	U 24.35
Dextrose (grape sugar)	34.02	34.54	U 46.40	U 24.73
Invert sugars	74.98	74.95	U 83.36	C 60.52
Sucrose (cane sugar)	1.90	2.53	C 11.00	UC 0.00
Dextrins	1.51	0.91	C 11.91	C 0.02
Ash (minerals)	0.18	0.21	C 1.14	C 0.02
Acid	0.08	0.16	C 0.45	U 0.04
Undetermined	4.9	4.72	C 7.51	U 0.04

All honey is acid. Contrary to early suppositions, it contains little, if any, formic acid, but acetic, malic, butyric, valeric, caproic, capric, lactic, tartaric, oxalic, succinic, citric and phosphoric acids have been identified in it. Many of these may originate in nectar, but bees also insure the acidity of honey by providing an enzyme that oxidizes dextrose, probably to gluconic acid. Some honeys such as buckwheat contain tannic acid, which in addition to giving a stringent taste is probably responsible for the dark colour. The vitamins in honey include minute amounts of A but more significant and nutritional amounts of various components of the B complex, several of which are involved in carbohydrate and amino-acid metabolism. The amount of vitamin C (ascorbic acid) in honey seems to be quite variable, with indication of its decrease with age.

Among the plant pigments found in honey are carotin (yellow), xanthophyll (yellow) and some of unknown composition (bright yellow and dark green). A sugar derivative, anthocyanin, is thought to be responsible for the rose-red colour of white clover honey at high altitudes and the dark colour of willow herb honey of Alaska.

The enzymes of honey, present only in minute traces and not significantly important in human nutrition, do have a pronounced effect on the nature and character of honeys. They are commonly listed as invertase, diastase or amalyase, catalase and inulase.

Physical Properties.—The weight per gallon of honey is primarily dependent upon the water content, which in turn is related to the degree of ripeness when stored by the bees and the atmospheric conditions to which later exposed. The specific gravity, water content and weight per gallon of honey can be determined by means of a hydrometer, by determination of the refractive index, by means of a refractometer or by carefully weighing a given volume. Tables are available for converting a particular measurement to corresponding equivalents. The minimum weight per U.S. gallon (0.833 imperial gallons or 3.785 litres) at 68° F. (20° C.) of U.S. grade A or U.S. fancy and U.S. grade B is 11 lb. 12 oz. This corresponds to a specific gravity of 1.4129, a refractive index of 1.4900 and 18.6% moisture. Other countries have similar standards, except for heather honey, which usually contains more water than other honeys.

Heating is commercially used to control certain physical and chemical changes which may occur in honey and which may have a tendency to impair the quality of the product. These more or less interrelated changes are granulation, fermentation, discoloration or darkening and loss of or masking of the original delicate flavour and aroma of the honey.

Granulation (crystallization or sugaring) of honey results when the dextrose sugar is unable to stay in solution. The tendency of a honey to granulate is primarily dependent upon the concentration of its sugars in relation to its water content and the relative proportion of levulose and dextrose; *i.e.*, its L/D ratio. A water content of more than 20% seems to be sufficient to inhibit all but a trace of granulation in most honeys, but this is not a practical means of control. Honeys with an L/D ratio between 1:0 and 1:2 usually crystallize rapidly, while there is much delay where the ratio exceeds 1:3. The temperature most favourable for granulation seems to be between 50° and 65° F., with 55° to 57° F. suggested for most honeys. When the water content is above 21.5% rapid aerobic growth of honey-fermenting yeasts takes place. While fermentation of honey may be controlled by destroying the contained yeasts by heating to 145° F. for 30 minutes, then straining the honey and placing it in containers while hot and sealing to prevent recontamination, it is evident that heating to higher temperatures to prevent granulation will also control fermentation. While the degree of heating varies with the L/D ratio, usually 155°–160° F. for 30 minutes is suggested for quick granulating honeys, whereas a lower temperature will suffice for honeys with relatively high levulose content such as tupelo and most fall honeys. Overheating tends to darken honeys and to impair or mask their original flavour and aroma due to the breakdown of the levulose content. A similar result occurs in storage at high temperatures and even at room temperature over a long period of time.

World Production.—In the second half of the 20th century the leading honey-producing countries, as reported by the United Nations Food and Agriculture organization, were the United States, Canada, Australia and Argentina. Annual production in the United States averaged more than 100,000 metric tons and that in Canada more than 10,000 metric tons. Annual production both in Australia and Argentina averaged about 15,000 metric tons. Other leading producing countries included the United Kingdom, Spain, Poland, Italy, West Germany, France, Denmark and East Germany. Germany had been a leading producer before World War II. Countries producing lesser quantities included Yugoslavia, Czechoslovakia, Bulgaria, Austria, Switzerland and Greece. Honey was also produced in Brazil, Chile and Uruguay in South America; in Formosa and South Korea in Asia; in Turkey (a major producer), Israel, Egypt and Syria and on Cyprus in the middle east; and in New Zealand, the British West Indies and Guatemala. Production in the U.S.S.R. and mainland China was not reported. Local consumption of honey produced by domestic and wild bees was important in many places.

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HONEYCOMB, a term used to describe cloth woven in an arrangement, also called waffle weave, in which the warp and weft threads interlace to form rectangular cells or depressed areas resembling a honeycomb. The bottom of the cell is formed by the sections of plain weave while the sides and tops of the figure are formed by floats of warp and weft yarns.

The term was also used in the U.S. during the 18th and early 19th centuries for a different weave in which a heavy weft thread was used between sections woven with a fine weft to produce a dimpling or depressing of the fine areas. There were long weft floats on the back of the fabric which made it distinctly one-sided. The weave was used mostly for white cotton counterpanes.

By the late 19th century honeycomb or waffle weave was used almost entirely for cheap varieties of counterpanes or quilts and, because it is highly absorbent, for cotton toweling and dishcloths. During the 20th century it became much used in the manufacture of soft, heavy woolens for coatings and for fancy goods.

(V. P. P.)

HONEYDEW, a sweet, sticky substance produced by some sap-eating insects. In hot, dry weather certain species of aphids and scale insects, which puncture plant tissues for sap, excrete an excess of modified sap in large amounts from their intestines. Sometimes this honeydew is deposited in such quantities that it coats the leaves, especially of maples, lindens and roses, with a film from which droplets rain down in a fine mist. Several kinds of insects, particularly ants, feed upon honeydew. (*See* ANT; APHID.)

"Honeydew" is also the name for a type of muskmelon (*q.v.*).

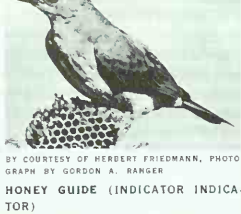
HONEY EATER (HONEYSUCKER), any of about 160 species of nectar-feeding songbirds constituting the family Meliphagidae, confined to the southwest Pacific region, where they are common and conspicuous. They range in size from that of a warbler to that of a jay and have a curved bill and protrusible, brushlike tongue for procuring nectar and insects from flowers. Because of their feeding habits, honey eaters are thought to be important pollinators of eucalypts. They may be dull black, brown, gray or olive or may have conspicuous marks and brilliant colours; the females are duller and smaller than the males. They live along forest edges and about plantations, building a cup-shaped nest of twigs, fine roots and fibres, usually high in the fork of a tree, and lay one to three eggs. Both parents share the rearing of young. They usually have loud musical calls and good songs.

Well-known species are the wattlebirds (*Anthochaera*) of Australia, especially the red wattlebird (*A. carunculata*), grayish-brown with thin white stripes on the upper parts and tail tipped white; they possess fleshy, red, pendulous ear wattles. The bellbirds of Australia (*Manorhina melanophrys*) and New Zealand (*Anthornis melanura*), the four-o'clock (*Philemon corniculatus*) of Australia, also known as friarbird, and the rare stitchbird (*Notiomystis cincta*) of New Zealand, belong to this family. The crow honey eater (*Gymnomyza aubryana*), 16 in. long, black with red-orange or yellow wattles, is one of the largest. One of the smallest and most brilliant among the many species in the southwest Pacific islands is the cardinal honey eater (*Myzomela cardinalis*), four to five inches long, the male black with scarlet head, breast and middle back. One genus (*Moho*) ranged to the Hawaiian Islands, where the several species were relentlessly hunted to extinction for their feathers, which were used as adornment by the nobility.

(G. F. Ss.; X.)

HONEY GUIDE, the name for a dozen species of small old-world birds, grouped in two to four genera, constituting the family Indicatoridae, closely related to the barbets (*q.v.*) and placed with the woodpeckers in the order Piciformes. They are yoke-toed and

have short legs and short, stout, somewhat blunted bills. They are inconspicuously coloured, brown or olive-gray, with considerable white in the tail. The largest (eight inches long) and best known is the black-throated honey guide (*Indicator indicator*) from Senegal and Ethiopia to the Cape of Good Hope except in tropical forests. It chatters loudly and guides people, especially woodchoppers, and the honey badger or ratel to wild bees' nests. It then waits for its companions to open the hives, and after they have taken what they want, it comes down and feeds on the bits of comb left strewn about, for the digestion of which it has special wax-breaking bacteria in its digestive tract. It also catches insects on the wing, like a flycatcher. It lays its white eggs in the nests of hole-nesting birds, on which it is a brood parasite. The young, on hatching, have a pair of sharp bill hooks with which they kill their nestmates, ensuring more food for themselves.



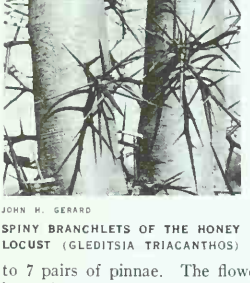
BY COURTESY OF HERBERT FRIEDMANN, PHOTOGRAPH BY GORDON A. RANGER

HONEY GUIDE (INDICATOR INDICATOR)

A number of other species are found in Africa, one in the Himalayas (*I. xanthonotus*) and one in the Malay peninsula and Borneo (*I. archipelagicus*). The smallest are the sharp-billed honey guide (*Prodotiscus insignis*), 4½ in. long, and the pygmy honey guide (*I. pumilio*) of Congo and west African forests, with the slightly larger *P. regulus* in the grasslands of east and south Africa. The lyre-tailed honey guide (*Melichneutes robustus*) and rare *Melilgnomon zenkeri* occur in the Congo and Cameroons forests.

(G. F. Ss.; Ht. Fn.)

HONEY LOCUST, the popular name of a North American tree (*Gleditsia triacanthos*), of the pea family (Leguminosae), native to fertile soils from western Pennsylvania through Ohio and Ontario to Michigan and Minnesota and southward to Alabama and Texas, and also naturalized from cultivation eastward of this range. It reaches from 75 to 140 ft. in height with a trunk 2 or 3 or sometimes 5 or 6 ft. in diameter, and develops slender spreading branches which form a broad, flattish crown. The branchlets bear numerous simple or chiefly three-forked (whence the species name *triacanthos*) sharp, stiff thorns three to four inches long, at first red in colour, then chestnut brown; they are borne above the leaf axils and represent the undeveloped branchlets; sometimes they are borne also on the trunk and main branches. The long-stalked leaves are seven to eight inches long. Both pinnate and bipinnate leaves are usually found on the same tree. The former have from 7 to 15 pairs of oblong leaflets and the latter, 4 to 7 pairs of pinnae. The flowers, which are of two kinds, are borne in racemes in the leaf axils; the staminate flowers in larger numbers. The brown pods are often 12 to 18 in. long, have thin, tough walls and contain a quantity of sweetish, succulent pulp between the numerous seeds; when drying they contract into spiral-like structures which are often driven by winter winds over snow for considerable distances before releasing their seed.



JOHN H. GERARD

SPINY BRANCHLETS OF THE HONEY LOCUST (GLEDITSIA TRIACANTHOS)

The tree was first cultivated in Europe toward the end of the 17th century by Bishop Compton in his garden at Fulham, near London, and is now extensively planted as an ornamental tree. The much smaller water locust (*G. aquatica*), with shining brown pods, one to two inches long and containing only one or two seeds, inhabits deep swamps in the Mississippi valley from Illinois southward, ranging also eastward to South Carolina and Florida. The name of the genus commemorates Johann Gottlieb Gleditsch (1714–86), a friend of Linnaeus and the author of one of the earliest works on scientific forestry.

HONEYSUCKLE, a common name for *Lonicera,* a genus of climbing, erect or prostrate shrubs, of the family Caprifoliaceae, so named after the 16th-century German botanist Adam Lonicer.

There are about 175 species, widely distributed in the northern hemisphere, about 50 of which, together with numerous varieties, are more or less cultivated. About 25 species, inclusive of several naturalized from the old world, are found in the United States and Canada.

The North American subevergreen *L. sempervirens,* with its fine heads of blossoms, is commonly called the trumpet honeysuckle; the most handsome of all the cultivated honeysuckles, it is a distinct and beautiful species producing both scarlet and yellow flowered varieties. The Japanese *L. flexuosa* variety *aureoreticulata* is esteemed for its charmingly variegated leaves netted with golden yellow.

The common British species is *L. periclymenum,* the woodbine; *L. caprifolium* and *L. xylosteum* are found in a few counties in the south and east of England. Some of the garden varieties of the woodbine are very beautiful and are held in high esteem for their delicious fragrance, even the wild plant, with its pale flowers, compensating for its sickly looks "with never-cloying odours."

ROCHE

TRUMPET HONEYSUCKLE (LONICERA SEMPERVIRENS)

The name fly honeysuckle is applied to *L. xylosteum* and *L. tatarica,* both European and both hardy shrubs of dwarfish, erect habit; they are among the oldest English garden shrubs and bear axillary flowers of various colours, occurring two on a peduncle. There are numerous other species, many of them grown in gardens and well worth cultivating in shrubberies or as climbers on walls and bowers, either for their beauty or the fragrance of their blossoms.

Honeysuckles flourish in any ordinary garden soil. Pruning should be done about March, cutting out some of the old wood and shortening back some of the younger growths of the preceding year.

In the western counties of England the name honeysuckle is applied to the red (meadow) clover, *Trifolium pratense.* Another plant of the same family (Leguminosae), *Hedysarum coronarium,* a very handsome hardy biennial, is called the French honeysuckle. The name is moreover applied with various affixes to several other totally different plants. Thus white honeysuckle and false honeysuckle are names for the North American *Azalea viscosa;* Australian or heath honeysuckle is the Australian *Banksia serrata;* Jamaica honeysuckle, *Passiflora laurifolia;* dwarf honeysuckle, the widely spread *Cornus suecica;* Virgin Mary's honeysuckle, the European *Pulmonaria officinalis.* The name West Indian honeysuckle is applied to *Tecoma capensis* and also to *Desmodium.*

HONFLEUR, a seaport of northern France, in the *département* of Calvados, lies on the Seine estuary opposite Le Havre, 74 km. (46 mi.) by road W. of Rouen. Pop. (1962) 8,822. The town, which dates from the 11th century, changed hands many times in the Hundred Years' War, the last English occupation ending in 1450. In 1562 the Protestants besieged the St. Léonard quarter. Henry IV took Honfleur in 1590 and had to do so again in 1594 after the surrender of the rest of Normandy. From the 16th to the 19th century it was an important maritime and commercial town trading with the American continent and the East Indies. Samuel de Champlain (*q.v.*) sailed for Canada from the port in 1608. In the 19th century it began to decline and was supplanted by Le Havre.

The picturesque harbour was built in 1684–90 from the old forti-

fications, and round it stand 15th- and 16th-century houses and other buildings, among them the harbour master's house, which is part of the ancient drawbridge, and St. Stephen's church (1369, enlarged 1432) now a museum of local maritime history and ethnography. The timber church of St. Catherine (15th century) is separated from its wooden bell tower by the Place du Marché. St. Léonard's church, originally 12th-century, was destroyed many times and finally rebuilt in the 17th century. The municipal art gallery has a fine collection of Normandy costumes, mostly 18th-century. Above Honfleur stands the sailors' pilgrimage chapel of Nôtre-Dame-de Grâce (1600–15, originally 1023) where an annual festival is held at Whitsun with a procession of boats.

After World War II two new embankments were built. Honfleur's chief industries are timber, coal and chemical products and its exports are mainly agricultural produce. In the summer it is a centre for yachtsmen and tourists. The names of many well-known sailors, artists and writers are connected with Honfleur.

HONG KONG, a British crown colony off the Kwangtung coast of southern China, comprising the island of Hong Kong and adjacent islets, Kowloon peninsula and Stonecutters Island (Ngon Shun Chau) and the leased New Territories on the mainland with surrounding islands. The total area of the colony is 398¼ sq.mi., of which Hong Kong Island (including small adjacent islets) is 29 sq.mi., Kowloon and Stoncutters Island 3¾ sq.mi., and the New Territories 365½ sq.mi. Hong Kong Island is 11 mi. long and from 2 to 5 mi. wide, and lies 90 mi. S.E. of Canton and 40 mi. E. of Portuguese Macao. It is separated from the mainland by a channel which is about one mile broad between Victoria, the island's capital, and Kowloon, and ½ mi. at its narrowest point. The harbour formed by the channel can take ocean-going ships up to 40,000 tons, and compares in size and beauty with any in the world.

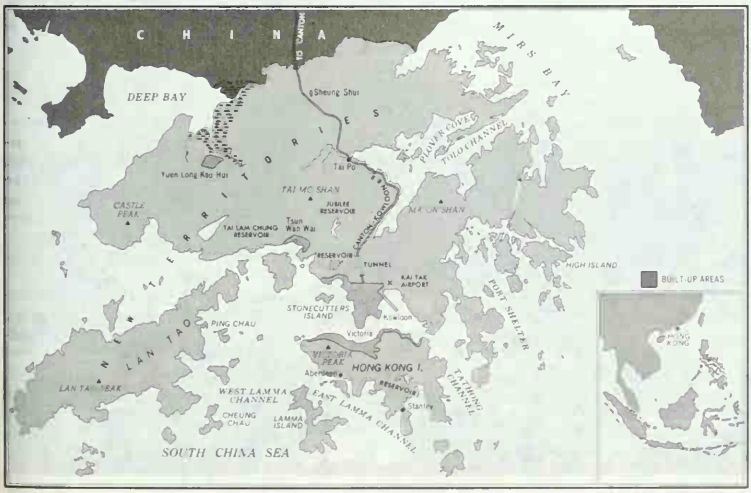
PHYSICAL GEOGRAPHY

Geology, Structure and Relief.—Hong Kong and the New Territories are part of the great batholith of granitic rocks which covers southeast China from Chekiang to Cambodia. The age relationships of the major groups of rocks are associated with the intrusions and mountain building of the Jurasside, Laramide and Alpine revolutions. Apart from small areas of sedimentary rocks belonging to the Lias (Early Jurassic) and Eocene systems, the rest of the colony (approximately 90%) is composed of acid volcanic, porphyritic and granitic rocks. The general structure of the region is that of an asymmetrical anticline which strikes northeast to southwest and is parallel in trend with the China coast. The axis of the monocline passes almost exactly through the centre of Hong Kong and is marked by a depression which is the Tolo channel.

Generally the area consists of numerous rugged and irregular islands with deeply dissected peninsulas. A general picture is that of an upland terrain which has been invaded by the sea. The uplands and mountains are eroded remnants of rock formations. Weathering is almost entirely caused by chemical action aided by the alternation of wet and dry seasons. As a result, decay to a mantle of laterite is common, often to depths exceeding 100 ft. The highest peaks and the most prominent ranges of hills are composed of either porphyries or volcanics. They are in contrast to the granite hills which occur generally at lower elevations but which have well-etched peaks and sharp ridge lines. The plains are all recent alluvial deposits. Benches, marking former sea levels up to 400 ft. or more, indicate the deep submergence of the whole region within recent geological times. Submerged weathered rock surfaces overlain by peat deposits have been discovered by boring in the harbour. The highest peaks are: Tai Mo Shan (3,140 ft.) and Ma On Shan (2,300 ft.), both on the mainland; Lan Tao (Fu Yung Shan) peak (3,061 ft.) and Sunset peak (2,857 ft.), both on Lan Tao; and Victoria peak (1,805 ft.) on Hong Kong Island. There are many steep-sided slopes which, with the exception of those on the island, are barren or covered by a very coarse, scrub-like vegetation for the most part.

Soils.—In general the natural residual soils of Hong Kong are acid. The igneous rocks from which they are derived have a silica content higher than 65%. There is a wide variation in the natural soil types. Typical are a grayish sandy loam, yellow-gray loam, pinkish-brown loam and black clay-loam. Most soils have a ratio of silica to alumina which is less than two. By comparison with soils in more temperate climates, they are low in fertility and need the addition of lime, potash and superphosphates.

Climate.—Lying only just inside the northern tropic, the colony has a climate classed as subtropical. It has highly contrasting seasons which range from a hot, humid summer (June to August, mean 27.78 C. [82° F.]) to a cool, temperate winter (January to February, 15.56 C. [60° F.]). The climate is controlled by the northeast monsoon, which blows from October to April, and the southwest monsoon, from June to August; the area receives three-quarters of its annual rainfall during the latter period. In summer there are periods of bad weather caused by typhoons as well as strong winds and heavy rains caused by tropical depressions. The mean relative humidity exceeds 80% in the summer, but occasionally falls to as low as 20% in early winter. The average daily duration of sunshine ranges from three hours in March to seven hours in October. There is a wide range of annual rainfall: the average is 84.76 in., but in 1889, 119 in. was recorded, and in 1895, only 45.83 in. The Tai Lam Chung reservoir, completed in 1957, and a number of other reservoirs provide water during dry periods and help to prevent flooding during the monsoons.



THE BRITISH CROWN COLONY OF HONG KONG

Vegetation and Animal Life.—Centuries of exploitation through cutting and burning have removed all traces of the natural vegetation cover. Today, owing to intensive programs of reforestation, the island is well wooded with a wide range of trees such as banyan, eucalyptus, cotton, camphor, acacia, olive, palm and coniferous species. Cultivated land, mainly for rice and vegetables, covers about 50 sq.mi. Marshland with mangroves, coarse grassland which is of little use as pasture and bare, eroded badlands make up the rest of the area. Apart from snakes, lizards, frogs and a few wild deer,

monkeys, boars and an occasional tiger or leopard on the mainland, the animal life of the colony is domestic, the stock comprising principally fowl, ducks, pigeons, pigs and cattle.

HISTORY

Archaeological remains of pottery, stone implements, rings and bronzes found on more than 20 sites throughout the colony are evidence of settlements in Neolithic times. One characteristic design found nowhere else in Asia, the double F, belongs to the 3rd century B.C. The earliest peoples in Hong Kong are thought to have come from north China on their way to Borneo, the Philippines and Formosa in the 2nd millennium B.C. The Cantonese appear to have begun to settle in the area about A.D. 500; later came the Hakka, and by the middle of the 17th century, the Hoklo, who maintained a reputation as pirates.

Hong Kong was also a scene of the last struggles of the dying Ming dynasty with the newly risen Manchus (mid-17th century). There are one or two relics that provide little but pointers to some bygone incidents, such as a Han dynasty tomb in Kowloon, and the Sung Wang T'ai, a granite boulder near the village of Ma Tau Chung, which commemorates the flight through the Kowloon area of the last emperor of the Sung dynasty late in the 13th century. In A.D. 964, about 8,000 troops were stationed at Tai Po in the New Territories to protect the pearl industry for the Sung emperor.

Before the British occupation, Hong Kong Island was inhabited only by a small fishing population and was a notorious haunt of pirates. It was used as a base for British ships during the first Opium War of 1839–42 but its harbour had been used to shelter opium-carrying vessels since 1821. The great commercial and strategic significance of this deep, sheltered harbour, possessing east and west entrances and lying right on the path of the chief trade route to China, was quickly realized. Its cession in perpetuity to Great Britain in 1841, confirmed by the treaty of Nanking (1842), was one of the chief results of the war and Hong Kong grew within less than a century to be one of the world's greatest ports. (*See* CHINA: *History.*)

At the outset, however, Hong Kong was menaced because of its proximity to the mainland, where conditions were almost always insecure. A special source of danger was the Kowloon peninsula, which dominated the harbour and threatened Victoria. In 1860, by the convention of Peking, Britain obtained possession of part of Kowloon and Stonecutters Island. In 1898 Britain was granted a 99-year lease of the mainland known as the New Territories, which included Mirs bay and Deep bay (Hau Hoi Wan) and surrounding islands. Kowloon became an outlet for the overflow population of Hong Kong and a field for its industrial development, while the New Territories were a potential source of raw material for its trade and industry.

Hong Kong afforded an impartial refuge, both for persons and capital, during the internecine struggles which followed the inauguration of the Chinese republic in 1911. The emergence of nationalism was accompanied by hostility toward foreign interests and during 1925–27 a boycott excluded British trade from all the ports of south China. After the Japanese conquest of Manchuria, however, Chinese official relations with the British in Hong Kong became increasingly friendly. From 1937 Hong Kong was once more a refuge, hundreds of thousands of Chinese fleeing there before the advancing Japanese. With the outbreak of war in Europe in 1939 the position of the colony became precarious, and when the Japanese opened hostilities on Dec. 7, 1941, they immediately attacked Hong Kong; after bitter fighting the colony was surrendered on Christmas day. It was liberated by British troops on Aug. 30, 1945, and civil government was re-established in May 1946, after which the colony made an astonishingly rapid recovery. Thousands of Chinese returned, producing a housing problem which was made more acute by the influx of refugees fleeing from the Communist armies in the Chinese civil war between 1948 and 1950. A survey made in 1954 for the United Nations estimated the number of Chinese refugees in Hong Kong at

BERNADINE BAILEY

HONG KONG HARBOUR, SEEN FROM VICTORIA PEAK, SHOWING THE BUSINESS DISTRICT OF VICTORIA AND KOWLOON PENINSULA ACROSS THE BAY

700,000. The flow, across the border and by sea via Macao, continued in fluctuating waves.

POPULATION AND ADMINISTRATION

Population.—Of the total land area, 12 sq.mi. (mainly round the harbour) are developed for residential, commercial or industrial purposes; 50 sq.mi. are cultivated; and the rest is largely hillside or swamp which is unsuitable for agriculture and could not be developed for other purposes without an unwarrantably heavy expense. Thus the immediately usable land is 62 sq.mi. From this area and the fishing grounds around Hong Kong about 850,000 people obtained a livelihood in 1931. By Dec. 1941, when the Japanese invaded the colony from the mainland, the population had increased to 1,600,000. On the British reoccupation in 1945 the number had decreased to about 600,000. By the end of 1946 it was again around 1,600,000; by 1955, 2,400,000, and by the 1961 census it was 3,128,044. Not all of the increase was immigrant population; much was due to natural increase.

Chinese comprise more than 99% of the population. The bulk are from Kwangtung, Cantonese being the largest group followed by Hakka, Hoklo and Tanka. Since 1949 many have come from Shanghai. At the end of 1958 the number of British subjects (United Kingdom and commonwealth), excluding armed forces personnel, numbered about 15,000. Other nationalities were: American 2,147; Portuguese 1,630; Filipino 581; Japanese 359; Dutch 354; French 312; Italian 281. English is the official language.

A great variety of Chinese languages and dialects are spoken in the colony, but Cantonese is universally understood. Others widely used are Hakka, Chiuchow, Mandarin and Shanghai. The main religion is Buddhism, but Christian denominations are well represented and there are small groups of Muslims.

Administration.—Hong Kong is administered, under letters patent of 1917, by a governor, an executive council and a legislative council; the two councils include Chinese members. An urban council has statutory responsibility for such matters as public health and sanitation. The New Territories are in the hands of a district commissioner aided by four district officers. Direct taxation on incomes and profits was begun in 1947 and the standard rate of tax has remained at 12½% since 1950. There are estate and stamp duties and entertainment, betting and sweepstake taxes.

Living Conditions.—The daily wage in Hong Kong dollars (H.K.$ 1 = U.S. $0.17½) in 1959 was as follows: skilled workmen H.K.$ 7 to H.K.$ 12; semiskilled H.K.$ 4 to H.K.$ 8; unskilled H.K.$ 2.50 to H.K.$ 6. A bonus of one month's wages is normally paid at Chinese New Year. Some Chinese firms provide free food and accommodation for full-time employees. The average daily hours of work are 9 hours for men and 9½ hours for women. In European undertakings the 48-hr. week is standard. Because of the constant flow of refugees from China there is no shortage of labour, but the refugees have accentuated the housing problem. The majority of the population lives in overcrowded tenements along the fringing settlements of the harbour in Victoria and Kowloon. Domestic buildings damaged during World War II were replaced by 1950 and about 1,000 new buildings a year have been constructed. Rents are higher than in most other places in the world and the average workman pays from 25% to 45% of his wages in rent. There are many thousands of roof dwellers, squatters and street sleepers who cannot be housed. The results of a housing survey by the University of Hong Kong in 1957 showed that 79% of all households were sharing their accommodation with others; 95,000 households lived in cubicles; 43,000 in bed spaces; 8,000 in attics; and 4,000 on verandas. Out of the 267,000 households surveyed, only 20,400 had a living room not used for sleeping.

Welfare.—The voluntary welfare organizations and the government social welfare department co-operate closely. More than 40 voluntary organizations are federated in the Hong Kong Council of Social Service. In the fields of housing, education and public health great efforts have been made, but in the face of the high rate of population increase, the problem has remained a very formidable one.

The government controls or performs antiepidemic and antimalarial work, tuberculosis control, maternity work, infant welfare, social hygiene, public health propaganda, food and drug control and other health measures. It maintains and operates 12 general and special hospitals and many dispensaries, and provides grants to several others. There are also 19 private hospitals run by charitable and missionary institutions.

Justice.—The courts of Hong Kong include the supreme court, district court, magistrates' courts, marine court and tenancy tribunals. The laws of England with modifications for local conditions are used. The judiciary and the courts are independent of the government administration. The police force has an establishment of over 7,000. Only about 300 are British officers and the rest, except for a few Indians and White Russians, are Chinese. There is an auxiliary police force and villages are policed by locally selected village guards.

Education.—Since World War II education has made enormous progress. While in 1945 there were roughly 4,000 children in schools, by 1959 there were 435,000. The number of schools of all types was about 1,500. Private schools represent 65% of all schools in Hong Kong. All education is voluntary, but not free. It is controlled under the Education ordinance of 1952, amended by a 1958 ordinance. Schools run by missionary bodies receive grants, and vernacular primary schools, mainly in the rural areas, are subsidized. Postsecondary education has received attention, since most graduates from the secondary schools no longer return to China to study at university level. A Chinese colleges' joint council was set up in 1958 to further the growth of these colleges, and scholarships to them are awarded by the government. A professional teachers' training board controls teacher training.

The University of Hong Kong, founded in 1911, is an independent body, mainly supported by government grants but with some endowment funds. There are four faculties: arts, science, medicine and engineering, and architecture. With students of the Institute of Oriental Studies and the social study course, the undergraduate and postgraduate student body numbers about 1,000. The standard of teaching is that reached in the United Kingdom, and the minimum qualification for entry is the matriculation examination.

Local Forces and Civil Defense.—The colony's auxiliary services comprise the Royal Hong Kong defense force, the auxiliary police and the essential services corps. The latter is split into four autonomous services: essential services corps proper, civil aid services, auxiliary fire service and auxiliary medical service. All these services, which consist partly of volunteers and partly of persons enrolled since 1951 under compulsory service for locally resident citizens of the United Kingdom, are financed locally. Volunteer service in Hong Kong first began in 1854. In 1941 the Hong Kong volunteers proved their value by their gallant resistance to the Japanese.

THE ECONOMY

The foundation of Hong Kong in 1841 as a free port was the response of the government of Great Britain to the need of merchants for a trading centre on the China coast that could offer protection and safety. The only safe deep-sea anchorage between Shanghai and Indochina, Hong Kong became the entrepôt for trade throughout southern China and the western Pacific, with its own banking and insurance institutions; its prosperity depended on the freedom of trade. But the colony later added to its earlier function that of a manufacturing and industrial area. This movement received its first impetus during World War I when supplies from Europe were reduced; but the greatest impetus began about 1935, with the establishment of factories as a result of the disturbed conditions in southern China and of imperial preference (*q.v.*) under the Ottawa agreements. After World War II, industrial expansion continued rapidly. In 1949 refugees from China streamed in, with money, technical knowledge and new ideas. It was this that saved Hong Kong from financial disaster, since its position as an entrepôt had seriously declined. In 1950–51 Hong Kong fur-

ther stifled its trading activity when it supported a United Nations' resolution and banned all exports to North Korea and the export to China of about 200 items of strategic importance. The switch from trade to manufacture was so rapid that few at first realized its significance. By the end of the 1950s locally manufactured goods accounted for approximately 40% of the entire value of the exports.

Agriculture.—Before Hong Kong became a British colony, agriculture, together with a little fishing, was its sole basis of livelihood; but trade and industries have almost obscured this aspect of its life. Rice, the chief crop, occupies about two-thirds of all farm land. Six to eight crops of Chinese vegetables are harvested annually and vegetables are sold through the government marketing organization. In the cool months cauliflower, cabbage, lettuce and tomatoes are grown in large quantities. Sweet potatoes, peanuts, taro, radishes, yams, sugar cane and ginger are also grown. Fruit production is rapidly developing. In favourable locations there are plantations of pineapples, oranges, bananas, litchis, papayas, figs, grapefruit, apricots and peaches.

Forestry.—The forestry division of the agriculture, fisheries and forestry department encourages forestry generally and is directly concerned with afforestation of water catchment areas, village forestry and scenic beauty. For nearly 75% of the colony, forestry is the only economic form of land development. In the New Territories about one-quarter of the entire area has been set aside for forestry reserves. The main species planted are of pine (*Pinus massoniana*), *Casuarina* and *Eucalyptus*.

Mining.—The chief economic minerals mined and worked are iron, lead, graphite, tungsten, kaolin clay, feldspar, sand and crushed granite. The most active concern is the iron mine at The Hunchbacks (Ma On Shan), and a monthly average of about 9,000 tons of ore is shipped, mainly to Japan.

Fisheries.—Marine fish is the main primary product of Hong Kong and its volume is the largest of any port in the British colonies. The industry employs over 8,500 junks of various sizes and 20 Japanese-type trawlers. A government fish marketing organization (nonprofit) controls the landing and wholesale marketing. Fish is exported to other countries in the far east and to the United States.

Industries.—Heavy industries include more than 20 shipbuilding and repair yards, steel rolling and processing mills and cement factories. The following well-established light industries are responsible for about one-third of the entire value of the colony's exports: electric bulbs, canned goods, ceramics, cotton goods, enamelware, flashlights, matches, paint, plastics, rattanware, rope, rubber, shirts, shoes, sugar and textiles.

Trade.—From 1945 to 1948 trade expanded rapidly because of the general shortage of consumer goods. Trade with China improved in 1949 but after the imposition of the embargo on certain strategic articles in 1951 the tonnage of goods handled for China fell by 17½% compared with the previous year. By 1957 when the embargo was modified, the Chinese government had begun to make bulk deals direct with foreign governments. The economic effects of the Korean War brought one compensation, however: the United States enacted in 1952 its Foreign Assets Control regulations whereby the importation of goods into the U.S. originating from China and North Korea was prohibited. Many Chinese-style products could still be imported by American firms and the market for these goods became extremely valuable to Hong Kong. Certificates of origin were instituted. Over 56% of the value of all exports was taken by six countries: United Kingdom (the most valuable customer), Malaya, United States, Thailand, Indonesia and China. Of the value of total imports, 64% came from China (the principal source), Japan, the United States and the United Kingdom. The main imports from China were foodstuffs, vegetable oils, Chinese medicines, glassware, tea, coal, cement, feathers, hides and silk.

Banking, Currency and Finance.—The unit of currency is the Hong Kong dollar, divided into 100 cents. Its exchange value fluctuated with the price of silver until 1935. Since then it has been tied to the English pound and an exchange fund has kept its value remarkably steady at 1*s*. 3*d*. (U.S. $0.17½). Besides locally incorporated banks there are also branches of many foreign banks, and insurance companies of international standing are well represented. There is a local stock exchange and facilities are also available for the buying and selling of stocks and bonds on the American and European markets.

Apart from the cost of external defense, to which a local contribution is made, Hong Kong is financially self-supporting. Since 1947 the budget has been balanced each year, often with a surplus, and at the close of the 1950s annual revenue and expenditure each amounted to between H.K.$ 589,900,000 and H.K.$ 629,300,000. The public debt in the form of repayable loans totalled nearly H.K.$ 85,000,000.

Transport and Communications.—Almost all the 479 mi. of roads in Hong Kong and the New Territories are of concrete or asphalt and are classified as first class. There are many motor vehicles of all types. A government-owned railway connecting with Canton and Peking runs from Kowloon for 22 mi. to the frontier. Ocean-going ships of all nations maintain regular services to the port, which is equipped with modern navigation aids. Ferries operate between Kowloon and Victoria and to outlying districts. The Hong Kong international airport at Kai Tak is located alongside the harbour on the mainland and a modern runway, constructed on a promontory extending into Kowloon bay, was opened in 1959. Letter and parcel post external services and efficient cable and radio services keep Hong Kong in touch with the world. Wired radio and television broadcast daily programs. Weather observation and forecasting is done by the Royal observatory.

See also references under "Hong Kong" in the Index volume.

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HONITON, a market town and municipal borough in Devon, Eng., the centre of a dairy-farming area, lies among high hills in the valley of the Otter river, 17 mi. E.N.E. of Exeter by road. Pop. (1961) 4,724. Honiton (Honetona, Huneton, meaning "Huna's farm") was probably the site of an early settlement but does not appear in history before the Domesday survey. It was then a considerable manor held by Drogo of Montacute under the count of Mortain. The borough was founded between 1194 and 1217 by William de Vernon or de Redvers, earl of Devon. From the early 14th century until 1807 the manor belonged to the Courtenay family. In 1221 Falkes de Bréauté, then custodian of the borough, paid tribute of a palfrey to the king for the right to hold a fair at the feast of All Hallows; it is now held annually on the first Wednesday after July 19. The borough was represented in parliament by two members in 1300 and 1311, and then not again till 1640, from which date it returned two members until disfranchised by the act of 1868. The town was incorporated by charter in 1846, a mayor replacing the portreeve as the chief official of the borough. The restored church of St. Michael, formerly the parish church, was built by Peter Courtenay, bishop of Exeter, about 1480; it contains the tomb of Thomas Marwood, physician to Elizabeth I. The manufacture of wool flourished in the town up to the beginning of the 19th century when the trade entirely ceased.

Honiton was formerly the centre of a famous lace industry established by refugees from Flanders toward the end of the 16th century. Genuine Honiton lace is still made in the neighbourhood, and there has been a pottery in the borough since the 18th century. (J. R. W. C.)

HONOLULU, capital and principal port of Hawaii and seat of the city and county of Honolulu, at 21° 18′ N., 157° 51′ W., is on the south coast of Oahu Island, 2,091 nautical miles S.W. of San Francisco. A modern city in mid-Pacific, with a special picturesqueness of its own, it is the crossroads of transpacific steamer and air routes, the centre of similar interisland services and the main port of trade with the U.S. mainland. During World War II

and the Korean War it was a staging area of prime importance. Not only is the city the gateway to the other Hawaiian islands but is itself, along with its suburbs of Waikiki and Pearl Harbor, a sight-seeing goal for thousands of tourists annually.

The city extends about 10 mi. along the Oahu shore and 4 mi. inland across a plain a mile wide and up ridges and valleys to a mountain range from 2,000 to 3,100 ft. high. Near the middle are the modern harbour, business section, civic centre and, a mile back, Punchbowl crater (500 ft. wide, containing the National Memorial Cemetery of the Pacific); at the east end, like a lion couchant, stands Diamond Head crater (760 ft. wide); at the west end the lower Salt lake craters separate the city from the naval base of Pearl Harbor. With its ocean front, colourful vegetation and background of mountains and blue sky, Honolulu is considered one of the most beautiful of cities. Tempered by cool trade breezes, the plain has a temperature range of from 56° to 88° F. (13° to 31° C.), with a mean of 74.6° (23.4° C.), while annual rainfall averages 28.6 in., the temperature decreasing and rainfall increasing with altitude.

The residential area spreads between mountains and sea and includes homes in a dozen architectural traditions. Business buildings rise near the busy harbourside, centre of trade and shipping for all Hawaii. The civic centre, a spacious park, contains or is bordered by: the federal building; the territorial capitol (Iolani palace, the only former royal palace now under the U.S. flag); city hall; judiciary, library, archives, tax and armoury buildings; and the residence of the governor, Washington Place. The city has a stock exchange and a chamber of commerce and there are pineapple canneries, ironworks and a few light industries.

History.—Honolulu means "sheltered harbour." It was overlooked by James Cook in 1778 and by other early explorers, and was not discovered until 1794. Thereafter it became a place of resort for vessels (especially whalers and sandalwood traders) and merchants from the beginning of the 19th century. Kamehameha I (the Great) lived there from 1803 to 1811. In 1820 the city became the principal residence of the sovereign and soon afterward of foreign consuls, but it did not become the permanent capital until 1845.

Russian forces arrived at Honolulu in 1816 and the city was later occupied by Great Britain (1843) and France (1849), but was returned to the independent kingdom of Hawaii each time. After about 1820 the city assumed first importance in the islands and its history is closely comparable with that of Hawaii as a whole. Honolulu continued as the capital city when Hawaii was annexed to the U.S. (1898) and when it became a state (1959).

The most critical day of the 20th century in Honolulu was Sunday, Dec. 7, 1941, when the city was under sporadic attack by Japanese planes, which bombed military installations on the island of Oahu, particularly the naval base at neighbouring Pearl Harbor. Civilian casualties in Honolulu numbered at least 57 dead and many injured. Thereafter Honolulu became the spear point for the steady attack against the Japanese forces in the Pacific during World War II. The Korean War lent further emphasis to the strategic importance of the city. In the second half of the century, Honolulu became an increasingly important centre for tourist travel and an expanding residential area, marked also by an expansion of light manufacturing.

Administration, Area and Population.—The centre of government for the executive, legislative and judiciary branches of Hawaii, Honolulu is also the seat of the city and county of Honolulu, set up in 1907 by the territorial legislature. The area of the city and county covers a total expanse of 540,000 sq.mi., in a roughly triangular region of the Pacific ocean running northwest almost to Midway Island and south to Palmyra Island. However, for most purposes the city-county area is that of the island of Oahu.

Pop. (1960) city 294,194; county (the standard metropolitan statistical area) 500,409. For comparative population figures *see* table in HAWAII: *Population*.

Transportation.—As the "crossroads of the Pacific," Honolulu is a main stop on all world steamer and air routes. Many bus routes connect with lines over the concrete and macadam roads of rural Oahu, and two tunnels through peaks of the Koolau range behind the city lend speedy access to the growing residential areas of the north shore. Honolulu and its hinterland are supplied with light and power, gas, water and sewer systems. The region is connected to the rest of the world by interisland telephones, ship-to-shore radio, transpacific cable and interisland and transpacific radio. The chief exports are sugar and pineapple products.

Cultural Activities.—The University of Hawaii is in Honolulu (*see* HAWAII). There are numerous civic, scientific, historical, literary, art, dramatic, musical, professional, industrial, religious and social welfare organizations. Churches include those of Christian and several oriental denominations. Periodicals are published in several languages. Honolulu has a number of radio stations and television stations and two daily newspapers in English. People of many cultural and racial backgrounds mingle freely and harmoniously in various activities.

Recreation.—There are many drives, parks and playgrounds, the largest parks being Kapiolani, between Diamond Head and Waikiki, and Ala Moana, along the shore. Much was done for beautification, including the elimination of billboards from roadsides. There is a profusion of introduced plants, particularly flowering varieties. Most mainland sports can be enjoyed 12 months of the year.

Waikiki, a beach resort 4 mi. from downtown Honolulu, is a centre for water sports, surfboard riding and canoeing in particular. There rise many hotels, some of which are quite elaborate. Facilities include a yacht harbour and an aquarium.

Pearl Harbor, an important base for the U.S. navy for many years, adjoins Honolulu to the west, centred on a cloverleaf-shaped, improved harbour which is one of the largest and safest in the world. The right to use Pearl Harbor as a coaling and repair station was granted to the U.S. by the Hawaiian monarchy in 1887, but congress did not authorize funds for construction of a naval base until 1907. Ships may tie up at Ford Island or anchor in the arms of the harbour. There are fueling and repair docks, dry docks, a submarine base, shops, supply depots and training centres. From 1947 Pearl Harbor was the headquarters for the unified command of the U.S. army, navy and air force for the Pacific area.

See also HAWAII; PEARL HARBOR ATTACK; WORLD WAR II.

(A. G. DY.)

HONORIUS, the name of four popes and one antipope.

HONORIUS I (d. 638), pope from 625 to 638, a member of a distinguished Campanian family, was elected pope Oct. 27, 625. In his government of the church Honorius continued the policies of St. Gregory the Great. He sent missionaries to Anglo-Saxon England, admonished the Christian Celts to conform to the Roman rite and, in co-operation with several councils, reorganized the recently converted Visigothic Spain. He was less successful in his attempts to convert the Arian Lombards. He died Oct. 12, 638.

Honorius I was condemned in 681 by the third council of Constantinople as a heretic because in the Monothelite controversy he had assumed a conciliatory policy out of practical considerations. Leo II in 682 confirmed the condemnation, saying that Honorius had "permitted the faith to be stained." That Honorius was actually a heretic is open to question, for he seems to have misunderstood the point at issue and his language is quite unscientific. His lapse was much discussed at the time of the Vatican council (1870) in connection with the promulgation of the doctrine of papal infallibility; that doctrine, however, requires that only when a pope speaks *ex cathedra* is he infallible, and it has not been shown that any opinion of Honorius was an *ex cathedra* definition of faith or morals.

See J. Chapman, O.S.B., *The Condemnation of Pope Honorius* (1907).

HONORIUS II (Peter Cadalus) (d. 1072), antipope from 1061 to 1072, was born in the territory of Verona. Bishop of Parma *c.* 1045, he was an opponent of the reform movement in the church. When Hildebrand (afterward Pope Gregory VII) and his fellow reformers, in virtue of the decree on papal elections of 1059, brought about the election of Alexander II on Sept. 30, 1061, without imperial sanction, Agnes, regent for Henry IV, was able with the aid of Lombard and German bishops to have Cadalus chosen

at Basel as Honorius II, on Oct. 28, 1061. He was installed at Rome by force of arms in April 1062. Duke Godfrey of Tuscany succeeded in persuading both contenders to await the imperial decision. Agnes in the meantime had lost the regency and Anno of Cologne, who succeeded her, ordered an investigation which resulted in a decision favourable to Alexander. Cadalus in May 1063 again established himself in Rome but had to depart the following year when the council of Mantua again decided in favour of Alexander. Cadalus lived in obscurity till 1072, apparently maintaining his claims till the end.

HONORIUS II (Lamberto Scannabecchi) (d. 1130), pope from 1124 to 1130, was born of a humble family at Fagnano near Imola, rose to be cardinal bishop of Ostia (1117) and was Calixtus II's legate to Germany. His pacific temperament helped to close the investiture controversy (*q.v.*) by the concordat of Worms (1122) and won him the good will of the imperialists. In the conclave that met to elect a pope on the death of Calixtus, the Frangipani won the people for Honorius after Theobald had been chosen as Celestine II. When Honorius offered to resign, the cardinals renewed his election (Dec. 15, 1124). His reign, which was an era of peace and reform, saw the pope come to an understanding with the rulers of the period. As a result his position was greatly strengthened. Henry I of England accepted a papal legate; Louis VI of France settled his contests with the French hierarchy; Lothair of Supplinburg owed his election as emperor to papal support and paid his debt by deferring to the pontiff. Honorius was forced, however, to recognize the claims to Apulia of Roger II of Sicily. He died at Rome on Feb. 13, 1130.

HONORIUS III (Cencio Savelli) (d. 1227), pope from 1216 to 1227, was a Roman aristocrat who became treasurer of the Holy See in 1188 and a cardinal in 1193. He was elected to succeed Innocent III as pope on July 18, 1216, and gathered the fruits of the reign of that great pontiff at least in the spiritual sphere. Under him, the Dominicans, Franciscans and Carmelites were approved and church life revitalized. Honorius resisted the emperor Frederick II, once his pupil, but avoided an open break in the hope that the emperor would take the crusade seriously. But Frederick outmaneuvered the elderly prelate in this as in other matters. The activities of Honorius, however, in the interests of justice and peace were felt throughout the west. He was, among other things, instrumental in securing the crown of England for the minor Henry III. He died March 18, 1227.

HONORIUS IV (Giacomo Savelli) (*c.* 1210–1287), pope from 1285 to 1287, was a grandnephew of Honorius III. Cardinal in 1261, he was elected unanimously on the first ballot (April 2, 1285) although aged, infirm and only a deacon. During his short reign he favoured the mendicant orders and promoted the study of oriental languages in order to effect a union with the Eastern churches. He intervened against Aragon in the dispute over Sicily. He died at Rome on April 3, 1287. (J. V. HN.)

HONORIUS, FLAVIUS (A.D. 384–423), west Roman emperor from 393 to 423, in whose reign Rome was captured and plundered by the Goths. The younger son of Theodosius I (*q.v.*) and Aelia Flaccilla, he was born on Sept. 9, 384. Elevated to the rank of Augustus (for explanation of this title *see* EMPEROR) by his father in Constantinople on Jan. 23, 393, he became sole ruler of the west when Theodosius died in Milan on Jan. 17, 395. Until 408 the effective ruler of the west was Flavius Stilicho (*q.v.*), who in 398 married his elder daughter, Maria, to Honorius. Maria appears to have died before her father's downfall in 408, and Honorius next married her younger sister, Thermantia. When Stilicho was murdered on Aug. 22, 408, Thermantia was sent back to her mother. During the next two or three years Honorius' generals overthrew Constantine III, who had usurped power in Britain and was now reigning in Gaul; but Alaric and the Visigoths three times besieged Rome and succeeded in occupying it in Aug. 410. Honorius spent this period safe behind the defenses of Ravenna, which was his residence for the rest of the reign. In the meantime the Vandals, Alani and Suebi had broken across the Rhine frontier on Dec. 31, 406, had plundered Gaul and in 409 had crossed the Pyrenees into Spain. The Visigoths under Ataulphus settled in southern Gaul in 412, but were driven to Spain and reduced to submission by starvation in 415 (for their subsequent history *see* GOTHS). Effective control of Britain was lost, and in 409 Honorius wrote to the cities there bidding them look to their own defense.

Besides Constantine III, numerous usurpers and rebels—Priscus Attalus, Maximus, Jovinus and others—were overthrown. In 417 the patrician Constantius married Honorius' half sister Placidia (who had already been married to the Visigothic chieftain Ataulphus) and on Feb. 8, 421, was proclaimed Augustus; but he died on Sept. 2 of the same year. Honorius himself died childless on Aug. 15, 423, and was succeeded as emperor of the west by Constantius' son Valentinian III.

Few of the Roman emperors were so weak and feeble as Honorius. When he decided to intervene in politics his intervention was usually disastrous; thus, if he had been less obstinate in rejecting the terms offered by Alaric before 410, Rome might have been spared the Gothic occupation.

See J. B. Bury, *History of the Later Roman Empire*, vol. i (1923). (E. A. T.)

HONOS, the Roman deified abstraction of Honour, particularly as a military virtue. The earliest shrine of this deity in Rome, not earlier than the 3rd century B.C., was located just outside the Colline gate. A double temple of Honos and Virtus stood outside the Porta Capena and another, built by Marius, was probably located on the Capitoline.

See also VIRTUS. (R. B. LD.)

HONOUR, a word with various meanings all of which derive ultimately from those of the Latin *honos* or *honor*. This Latin word meant: (1) esteem or repute; (2) concrete marks of esteem (rewards, ceremonies, etc.); and (3) public offices, as in the expression *cursus honorum*, the course or career of a Roman magistrate from lesser functions toward the consulate. Hence the word came to be applied to mean a personal character, consciously maintained, such as might deserve or expect esteem, with various special senses according to social environment. Thus "a woman's honour" is a reputation for chastity or marital fidelity; "an affair of honour" is a euphemism for a duel (*q.v.*); "courts of honour" are courts to settle disputes that might give rise to a duel or disputes over the marks of honour such as precedence or coats of arms (*see* HERALDRY; PROTOCOL AND PRECEDENCE); "debts of honour" are gambling debts that are not legally enforceable but that must be paid if the gambler is to keep up his position; and "the honours list," in Great Britain, is the list of new recipients of peerages, baronetcies, knighthoods or orders, published twice annually, on the sovereign's birthday and at the New Year. Under feudalism (*q.v.*) the word honour was also used to mean a fief or benefice, whether land, money or a public office.

HONOURABLE ARTILLERY COMPANY, the senior regiment of the British territorial army and is probably the oldest regiment in the world (*see* TERRITORIAL ARMY). It is privileged to fire royal salutes from the Tower of London and to provide guards of honour in the City of London for royal visitors. Its headquarters are at Armoury house, London.

The history of the company goes back to a charter of incorporation granted by Henry VIII on Aug. 25, 1537, to three overseers of the fraternity or guild of St. George to form a perpetual guild. Its possible earlier existence remains unproved. As all kinds of archery were then classified as "artillery," this guild of archers became known as the "artillery company." The prefix "honourable," used by courtesy since 1685, was confirmed by Queen Victoria in 1860.

Four months after incorporation, the company obtained a lease of the Teasel ground off Bishopsgate, London, as the artillery ground or garden. It leased the modern artillery ground, off Finsbury square, London, in 1641 and began using it in 1657.

The artillery company soon became the training centre for the City when troops were required. The year of the Spanish Armada it not only trained citizens of London in the science of "small artillery," but sent many of its members, as officers, to other parts of the kingdom to set up "trained bands." Many corporations followed the example of London by forming artillery companies, especially in the early 17th century. None of these survive, but

an offshoot flourishes in Boston, Mass., the Ancient and Honorable Artillery Company of Massachusetts, the oldest military body in the new world. Of the founder members to whom Gov. John Winthrop granted a charter in 1638 several had been trained in the Artillery Company of London. The company's "ancient vellum book" contains the roll of members from 1611 to 1682 and all new members continue to sign on vellum.

At the outbreak of the English Civil War, the London trained bands, officered and trained by the artillery company, were the only efficient ones in the country; they distinguished themselves at the battle of Newbury (Sept. 1643). Capt. Phillip Skippon, whom Charles I had appointed captain of the company in 1639 and later commander of the City forces with rank of sergeant major general, joined the parliamentary forces and served as major general chief of staff to the earl of Essex and as general of the foot. Cromwell nominated him in 1655 to revive the artillery company.

At the restoration of the monarchy in 1660, the duke of York was elected commander in chief of the company, which came into great favour at court. Many nobles and gentry of the royal household enrolled. Among its distinguished members were the duke of Marlborough, Christopher Wren and Samuel Pepys. From 1682 the duke of York was referred to as "captain-general" and his successor, William III, used the same title, which continues to be held by Queen Elizabeth II.

The infantry battalion of the Honourable Artillery Company changed its composition as it developed from crossbows and longbows to pikes and muskets and to modern infantry weapons. In 1781 the City authorities presented two brass field guns which, first used as battalion guns, in 1853 formed the nucleus for a field battery. A short-lived horse artillery troop was formed in 1860; a light cavalry squadron, formed in 1861, was converted into a horse artillery battery in 1891. This and the field battery continue an unbroken existence in 1st Regiment H.A.C. (R.H.A.). A regimental colonel with a small headquarters (formed in 1961) commands the infantry and artillery units.

The company served with distinction in three wars, gaining 60 battle honours. In the South African War an artillery battery and infantry and mounted infantry detachments joined the City imperial volunteers. In 1914 and 1939 the company expanded greatly. In World War I two infantry battalions and five artillery batteries, and in World War II four artillery regiments, fought overseas; in each war more than 4,000 officers were supplied to other units. In 1939 the infantry battalion reverted to the company's original role of producing officers.

The honourable artillery company maintains a veteran reserve that furnishes the company of pikemen and musketeers (with establishment fixed by royal warrant from Queen Elizabeth II) and acts as escort to the lord mayor of London. The company also provides a detachment of the metropolitan special constabulary.

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HONSHU, the largest island of the four main islands of Japan, regarded as the Japanese mainland, lies between the Pacific ocean on the east and the Sea of Japan on the west. It forms a northeast-southwest arc extending about 800 mi. (41° 21′ N. 141° 28′ E. to 33° 56′ N. 130° 56′ E.) and varies greatly in width. Pop. (1960) 71,354,357, including minor offshore islands. The area (88,976 sq.mi.) is approximately the same as that of England, Scotland and Wales and also comparable to that of the U.S. states of Ohio and Pennsylvania. Of the 46 prefectures of Japan, 34 are on Honshu.

For geology, climate, animal life, etc., *see* JAPAN: *Physical Geography.*

HONTHEIM, JOHANN NIKOLAUS VON (1701–1790), German historian and theologian, chiefly remembered as the author of Febronianism, was born at Trier, Jan. 27, 1701. He was educated at Trier, Louvain and Leiden, and traveled extensively in Europe, subsequently spending three years in Rome, where he was ordained priest in 1728. Four years later he became professor of civil law at Trier and in 1739 archiepiscopal official in Coblenz. In 1748 he was appointed auxiliary bishop and vicar-general and became in effect responsible for the spiritual administration of the diocese of Trier, the bishop himself having the duties of a secular prince. He was also pro-chancellor of the university. He died at his château at Montequentin, Luxembourg, Sept. 2, 1790.

Hontheim's contribution to historical studies lies in two books on the history of Trier, *Historia Trevirensis diplomatica et pragmatica* (3 vol., 1750) and *Prodromus historiae Trevirensis* (2 vol., 1757). A third collection, *Historiae scriptorum et monumentorum Trevirensis,* remained in manuscript in the city library. These works show Hontheim as an exceptionally careful and critical editor for his time. Under the pseudonym "Febronius" he published in 1763 his most important work *De statu ecclesiae et legitima potestate Romani Pontificis.* Moved by concern over a divided Christendom and influenced by 18th-century rationalism, Hontheim urged the limitation of papal power and its subjection to the bishops as represented by the general councils. (For a further discussion *see* GALLICANISM.) The book had a wide success, with a new edition in 1765 and several translations. In spite of Hontheim's avowed intention not to attack papal power but to strengthen it by defining its limits, it was condemned in Rome. In 1781 he published a formal retraction, but this was silent on the question of the political power of the papacy, and the completeness of his retraction was doubted in many quarters.

See O. Mejer, *Febronius* (1880).

HONTHORST, GERARD VAN (1590–1656), Dutch historical, portrait and genre painter, born at Utrecht on Nov. 4, 1590, was brought up in the school of Abraham Bloemaert. He then went to Italy, where he was influenced by the realism and chiaroscuro of the great Michelangelo da Caravaggio. Home again in 1622, he entered the Guild of St. Luke, becoming dean in 1625–26–28 and 1629. The queen of Bohemia, sister of Charles I and electress palatine, being an exile in Holland, asked him to teach her children drawing; and Honthorst, thus approved, was invited by Charles I to England. There he painted several portraits and a vast allegory, now at Hampton Court, of the king and queen of Bohemia as Diana and Apollo in the clouds receiving the duke of Buckingham as Mercury and guardian of the king of Bohemia's children. In his home at Utrecht Honthorst finished, in 1631, a large picture of the king and queen of Bohemia "and all their children." For Lord Dorchester about the same period he completed some illustrations of the *Odyssey;* for the king of Denmark he composed incidents of Danish history, of which one example remains in the gallery of Copenhagen. In 1637 he settled at The Hague, and became court painter (1641).

His most attractive pieces are those in which he cultivates the style of Caravaggio, those, namely, which represent taverns peopled with players, singers and diners. He shows great skill in reproducing scenes illuminated by candlelight (*e.g.,* "Christ Before Pilate"), and he liked to transmute every subject into a night scene. He died on April 27, 1656.

HOOCH, PIETER DE (1629–after 1683), Dutch genre painter noted for his interior scenes, was born in Rotterdam. He was a pupil of N. Berchem at Haarlem. From 1653 he was in the service of Justus de Grange, and lived at Delft, The Hague and Leiden. In 1654 he married a girl of Delft, Jannetje van der Burch. From 1654 to 1657 he was a member of the painter's guild of Delft, but after that date we have no traces of his doings until about 1667, when his presence was recorded in Amsterdam. His dated pictures prove that he was still alive in 1683. His work shows affinity with the painting of Vermeer, who was living at Delft at the same period as De Hooch. De Hooch only once painted a canvas of large size, and that unfortunately perished in a fire at Rotterdam in 1864. But his small pieces display perfect finish combined with great power of discrimination. Though he sometimes painted open-air scenes, these were not his favourite subjects. He was most at home in interiors with the radiance of the day, in different intensities, seen through doors and windows. He thus brought together the most delicate varieties of tone. His simple household scenes, done while he lived in Delft, are con-

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"THE COURTYARD OF A HOUSE IN DELFT" BY PIETER DE HOOCH. IN THE NATIONAL GALLERY, LONDON

sidered his best works. After moving to Amsterdam he attempted more elegant scenes of society life that lack the homely charm and intimacy of his earlier works.

Over 320 works of De Hooch are located in European and American galleries.

HOOD, JOHN BELL (1831–1879), Confederate general in the American Civil War, was born at Owingsville, Ky., on June 1, 1831. He graduated from West Point in 1853 and served as a cavalry officer until he resigned in 1861 to accept a colonelcy in the Confederate army. He won rapid promotion, and at Gettysburg commanded a division of Gen. James Longstreet's corps that assaulted the Union left at Round Top, where he suffered a serious arm wound. He accompanied Longstreet west in 1863 to strengthen Gen. Braxton Bragg. At the battle of Chickamauga he was again wounded and lost a leg. The following spring, now a lieutenant general, he fought under Gen. Joseph E. Johnston as Gen. W. T. Sherman pushed toward Atlanta and became the Confederate commander when political pressure forced Pres. Jefferson Davis to remove the retreating Johnston. In a vain effort to save Atlanta Hood promptly attacked, but was forced back into the city. He held Atlanta for five weeks until it was nearly cut off. (*See* ATLANTA, BATTLES AROUND.) Hood then took his army out, determined to turn the tide against Sherman and revive Confederate fortunes in the west by striking in Sherman's rear. Hood led his men on a long and rapid march north and west only to be confronted by the army of the Cumberland, under Gen. George H. Thomas, which had moved back to check him. Two battles ensued, Franklin (Nov. 30, 1864), and Nashville (Dec. 15–16), both defeats for Hood. Thomas pursued the retreating Confederates and virtually destroyed Hood's army. Hood's command ended at his own request in Jan. 1865. He spent the postwar years in business in New Orleans, and writing his military memoirs. He died on Aug. 30, 1879, in New Orleans. (WI. E. B.)

HOOD, SIR SAMUEL (1762–1814), British vice-admiral, entered the navy in 1776. His first engagement was the battle off Ushant in 1778, and he was present in the West Indies, under the command of his cousin Sir Samuel Hood, at all the actions which culminated in Lord Rodney's victory of April 12, 1782. After the peace, he spent some time in France, and on his return was given the command of a sloop, from which he proceeded in succession to various frigates. Early in 1793 the "Juno" went to the Mediterranean, and Hood distinguished himself by an audacious feat of seamanship in extricating his vessel from the harbour of Toulon, which he had entered in ignorance of Lord Hood's withdrawal. Soon afterward he was put in command of a frigate squadron for the protection of Levantine commerce, and in 1797 was given the "Zealous" (74 guns), being present at Nelson's unsuccessful attack on Santa Cruz. He conducted the negotiations which relieved the squadron from the consequences of its failure. At the battle of the Nile the "Zealous" put her first opponent out of action in 12 minutes, and Hood immediately engaged other ships, the "Guerrière" being left powerless. When Nelson left Egypt, Hood commanded the blockading force off Alexandria and Rosetta. Later he rejoined Nelson on the coast of the two Sicilies.

In the "Venerable" Hood was present at the action of Algeciras, and the battle in the Straits of Gibraltar (1801) when his ship suffered heavily. A year later Captain Hood was employed in Trinidad as a commissioner and, upon the death of the flag officer commanding the Leeward station, succeeded him as commodore. Island after island fell to him and soon, outside Martinique, the French had scarcely a foothold in the West Indies. In command next of the squadron blockading Rochefort, Hood had a sharp action on Sept. 25, 1805, with a small French squadron which was trying to escape. On this occasion he lost an arm. Promoted rear admiral, Hood brought the operations against Madeira to a successful conclusion (1807) and a year later took part, in the "Centaur," in the war between Russia and Sweden. Present in the roads of Corunna at the re-embarkation of the army of Sir John Moore, Hood thence returned to the Mediterranean, where for two years he commanded a division of the British fleet. In 1811 he became vice-admiral. He died at Madras, Dec. 24, 1814.

ALEXANDER HOOD (1758–98), brother of Adm. Sir Samuel Hood, entered the navy in 1767, and accompanied Capt. James Cook in his second voyage round the world. Under Lords Howe and Rodney he distinguished himself in the West Indies, and at the victory of April 12, 1782, was in command of one of Rodney's frigates. Under Sir Samuel Hood he then proceeded to the Mona passage, where he captured the French corvette "Cérès." It was not until 1797 that he went afloat again. His first experience was bitter; his ship, the "Mars," was unenviably prominent in the mutiny at Spithead. On April 21, 1798, occurred the famous duel of the "Mars" with the "Hercule," fought in the dusk near the Bec du Raz, in which, though successful, Hood lost his life.

HOOD, SAMUEL HOOD, 1ST VISCOUNT (1724–1816), British admiral who served during the Seven Years' War and the American and the French Revolutionary wars, was born on Dec. 12, 1724. He entered the navy on May 6, 1741, served part of his time as midshipman with Capt. George Rodney in the "Ludlow Castle" and became lieutenant in 1746. In 1754 he was made commander of the "Jamaica" sloop, and served in her on the North American station, where in 1756 he was posted to the "Lively." He returned to England later in the year in the "Grafton," to which he had been appointed by Commodore C. Holmes. In 1757, while in temporary command of the "Antelope" (50 guns), he drove a French ship ashore in Audierne bay and took two privateers. In recognition of his services he was given command of the frigate "Bideford." In 1759, when captain of the "Vestal" (32), he captured the French "Bellona" (32) after a sharp action off Cape Finisterre. During the war his services were wholly in the English channel, and he was engaged under Rodney in 1759 in destroying the transports collected by the French for the proposed invasion of England. In 1760 he was sent by his own request to the Mediterranean. In 1778, after further service in North America, he became commissioner of the dockyard at Portsmouth and governor of the naval academy; and in 1780 was promoted rear admiral and was sent to the West Indies as second in command under Lord Rodney (*q.v.*).

Hood joined Rodney in Jan. 1781, and remained in the West Indies or on the coast of North America until the close of the American Revolutionary War. The turn taken by the campaign of 1781 was largely due to Rodney's neglect of his advice. If he had been allowed to choose his own position, there seems to be no doubt that he could have prevented the comte de Grasse from reaching Ft. Royal with the reinforcements from France in April. When the fleet went on to the coast of North America during the hurricane months of 1781, he was sent to serve with Adm. Thomas Graves in the unsuccessful effort to relieve the army at Yorktown. When he returned to the West Indies he was for a time in independent command because of Rodney's absence in England, and the British islands of St. Kitts and Nevis were attacked by the French admiral, De Grasse, with a force much superior to Hood's squadron. Hood's attempt to save it from capture, Jan. 1782, with 22 ships to 29, failed, but the bold movements by which he first turned the French out of their anchorage at the Basseterre of St. Kitts, and then beat off the attacks of the enemy, were the most brilliant things done by any British admiral during the war. He was made an Irish peer for his share in the defeat of De Grasse on April 9 and 12 near Dominica.

On the outbreak of the French Revolutionary War Hood was sent to the Mediterranean as commander in chief. His period of command (May 1793–Oct. 1794) was very active. In August he occupied Toulon on the invitation of the French royalists, and in co-operation with the Spaniards. In December of the same year the allies, who did not work harmoniously together, were driven out, mainly by the generalship of Napoleon, and Hood now occupied Corsica, which he had been invited to take in the name of the king of England by Pasquale Paoli. Meanwhile the French at Toulon had recovered sufficiently to send a fleet to sea. In June Hood sailed in the hope of bringing it to action. The plan which he laid to attack it in Juan gulf in June may possibly have served to some extent as an inspiration, if not as a model, to Nelson for the battle of the Nile, but the wind was unfavourable, and the attack could not be carried out.

In October, Hood, who was now full admiral, was recalled to England. He held no further command at sea, but in 1796 he was named governor of Greenwich hospital, a post which he held until his death on Jan. 27, 1816. A peerage of Great Britain was conferred on his wife as Baroness Hood of Catherington in 1795, and he was himself created Viscount Hood of Whitley in 1796.

HOOD, THOMAS (1799–1845), English comic writer celebrated for his use of puns and figurative language, was born in the Poultry, London, on May 23, 1799. His father was a Scotsman who settled in London and became a successful bookseller. When he died in 1811 the family became poor and Hood had a brief spell as a clerk before becoming apprentice to an engraver. In 1815 he was sent to Dundee for his health's sake (throughout his life he suffered from ill-health). A letter written there describes "a scene . . . worthy the pencil of Hogarth" and shows how early his powers of humorous description developed. In 1817 he returned to London and resumed work as an engraver. On the death of John Scott he became a "sort of sub-editor" of the *London Magazine* and so met many of the brilliant group of men who contributed to it. As he himself relates, "the bowl had at last found its natural bias." Both by his own contributions and by the tact with which he handled the other contributors he did a great deal for that memorable periodical.

In 1827 he published a volume of poems, *The Plea of the Midsummer Fairies*, containing dedications to Coleridge, Lamb and John Hamilton Reynolds (his brother-in-law). Several of the poems in this volume, in which the influence of Keats is ubiquitous, suggest that Hood might possibly have become a poet of some distinction; but this was a bad time for serious poetry and the success of the *Odes and Addresses to Great People* (1825), in which Hood had collaborated with J. H. Reynolds, virtually obliged him to concentrate on humorous writing for the remainder of his life. Coleridge praised the lack of sting in Hood's poems, but this very absence of mordancy may be one reason why they do not survive as major satire. In form these odes represent the last indignity inflicted on the battered corpse of the "pindaric," and for all their technical expertize they remain brilliantly jocose journalism. There is something sinister about Hood's sense of humour: his pages are thronged with comic mourners and undertakers, and a corpse is always good for a horselaugh. At times his punning appears as a nervous tic: it is also a form of defensive mechanism. Like Byron, Hood will follow an emotive passage with lines in which he laughs at himself, as when he writes that he will "die in harness like a Hero—or a horse." The result is a juxtaposition of sentiment and humour rather than a fusion of passion and wit. Of his later poems mention must be made of "The Dream of Eugene Aram" and "The Last Man," which is even more impressive. "The Song of the Shirt" (like "The Lay of the Labourer" and "The Bridge of Sighs") is a moving protest against the terrible social conditions of the day. Until his death Hood worked on with remarkable courage and produced a great mass of work, such as his *Comic Annual* (1830–39, 1842). From its foundation he was associated with *The Athenaeum*, and for some time he edited Henry Colburn's *New Monthly Magazine*. He died in London on May 3, 1845.

BIBLIOGRAPHY.—*Works*, ed. by his son (T. Hood, Jr.) and daughter (F. F. Broderip), 10 vol. (1869–73), vol. x is a revised edition of the *Memorials* (1860). This edition omits Hood's novel, *Tylney Hall*, first published in 3 vol. (1834). *Poetical Works*, ed. by W. Jerrold (1906); *Thomas Hood and Charles Lamb*, (includes Hood's *Literary Reminiscences*), ed. by W. Jerrold (1930); *Letters From the Dilke Papers*, ed. by L. A. Marchand (1945). (I. J.)

HOOD, a covering for the head and neck, usually attached to an outer garment. Some form of hood as a loose covering easily drawn on or off the head has formed a natural part of outdoor costume both for men and women at all times and in all quarters of the globe where climatic conditions called for it. In the middle ages it was a common item of dress for both men and women, and from this general practice there developed the modern special uses of hoods in academic dress (*see* ROBES) and in liturgical garments (*see* VESTMENTS, ECCLESIASTICAL). For a general discussion *see* also DRESS.

HOOD MOLD, in architecture, a molding projecting from the face of the wall, immediately above an arch or opening whose curvature or outline it follows. It originated in the Romanesque period (*see* ROMANESQUE ARCHITECTURE) as a protection to the moldings below and to throw water away from the opening, and was later developed into an important decorative feature. It is almost universal over exterior arches in the Gothic work (*see* GOTHIC ARCHITECTURE) of France, Germany and Spain; in England it was, furthermore, common in interior work, especially in nave arcades. In profile, the hood mold has, usually, a downward sloping upper surface, and a hollow below to act as a drip; at its lower end, near the spring of the arch, it is either received upon the capital of a column or ends in a projecting, carved, ornamented boss. When used in a place other than an arch or opening, it is known as a drip mold. *See* MOLDING.

HOOF-AND-MOUTH DISEASE: *see* FOOT-AND-MOUTH DISEASE.

HOOFT, PIETER CORNELISZOON (1581–1647), Dutch dramatist and poet, the most brilliant representative of the Renaissance in Dutch literature, was born in Amsterdam on March 16, 1581. In him were combined the learning and aristocratic bearing of the humanist culture and democratic society of the new republic. When, after a classical education, his merchant father sent him south (1598–1601) to gain experience for a training in law, Hooft came so completely under the spell of the new learning and art in France and Italy that he returned with one purpose: to do for Holland what the Florentines had done for Italy. The impact of this experience on his writing is shown by the contrast between the letter in pre-Renaissance (*rederijker*) verse sent from Florence to his fellow members of the Egelantier (the Amsterdam Chamber of Rhetoric; *see* DUTCH LITERATURE) and the first poetry he wrote after his return, love lyrics and the pastoral *Granida* (1605). This play, in the manner of Tasso and Guarini, enhances a well-worn theme with the delicacy of its poetry and the simplicity of its moral—that individuals and nations can be at peace only when rulers and subjects alike shun ambition and seek only to serve.

His personal and pragmatic ethic is more explicit in the so-called *Stichtrijmen* and two Senecan tragedies. *Geeraerdt van*

Velsen (1613) is a quasi-historical dramatization of the murder of Count Floris V near the castle at Muiden which had become Hooft's home. *Baeto* (1617), which takes its name from the legendary founder of the Dutch race, portrays an Aeneas-like hero who goes into exile rather than cause civil war. Both plays, which can be read as "schools for princes," reveal Hooft's tolerance and pacifist hatred of tyranny, derived from Montaigne. His democratic concern for the commoner enabled him to adapt and even improve on Plautus' *Aulularia* in his *Warenar* (1616), a farce depicting Amsterdam life almost as vividly and humorously as Gerbrand Bredero's *Spaanschen Brabander*.

In *Nederlandsche Historien* (begun in 1628; 20 volumes, published 1642, a continuation in 1654) the glory of the epic hero, the prince of Orange, is reflected in Hooft's affection for the commoners who fought for the new democracy. Tacitus was his model for this monument to his lifelong dedication to the ennoblement of his mother tongue, but death intervened after he had spent 19 years chronicling only the period from 1555 to 1585. The influence of Hooft's prose style was still noticeable 200 years later in E. J. Potgieter (*q.v.*), and nowhere more clearly than in his own biographer, Gerard Brandt.

The Muiderslot (the castle which he restored) is the most striking monument to the gallant philanderer of the early songs and (Petrarchan) sonnets, who, in 1610, finally married one of his dulcineas, Christina van Erp. It was, however, after his second marriage, to Heleonora Hellemans in 1627, that the castle became the centre of the *Muiderkring*, a circle of accomplished and cultured friends, including Constantijn Huygens, Barlaeus (Caspar van Baerle), Isaac Vossius and occasionally Joost van den Vondel. Hooft died at The Hague on May 21, 1647.

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HOOGHLY (HOOGHLY-CHINSURAH), headquarters of Hooghly district in the Burdwan division of West Bengal, India, is situated on the right bank of the Hooghly river, 24 mi. N. of Calcutta. Pop. (1961 census) 83,104. To the west of the railway is Chinsurah, originally a suburb of Hooghly but later combined with it in the joint municipality of Hooghly-Chinsurah. The principal buildings are the *imam-bara* (a Muslim meeting place used especially during the Muharram ceremonies), the church built in 1660 by the Portuguese in the suburb of Mandel, the Armenian church and the temple of Sandeswar. The three colleges (including a women's college) are affiliated to Calcutta university. The town is an industrial centre on the Calcutta-Delhi Grand Trunk road and is served by the railway.

Hooghly was founded by the Portuguese in 1537, following the decline of Satgaon (the mercantile capital of lower Bengal) caused by the silting of the Saraswati river. The Portuguese were driven out by the Mogul emperor Shah Jahan in 1632 but returned a year later. Hooghly was also the first settlement (1651) of the English in lower Bengal; they abandoned it for Calcutta in 1690. It was sacked by the Marathas in 1742, and Robert Clive took it in 1757. In the 17th century Chinsurah became an important settlement of the Dutch, who built a fortified factory there in 1656. The British took it in 1781, but it was restored to the Dutch in 1783. During the Napoleonic Wars the settlement was garrisoned by the British, but it was again restored to the Dutch in 1814. In 1825 Chinsurah (with other Dutch settlements in India) was ceded to the British in exchange for their possessions in Sumatra.

HOOGHLY DISTRICT consists mainly of low-lying alluvial plains dotted with marshes and abandoned river channels, at an elevation of 24 to 50 ft. from east to west. Pop. (1961 census) 2,231,418. Area 1,216 sq.mi. Drained by the Damodar (which flows through the middle) and the Rupnarayan, the district is agriculturally very productive. Rice, jute and potatoes are the main crops, with many banana and mango orchards. The bank of the Hooghly river (to the east) is densely populated and heavily industrialized, with jute and cotton mills. Bhadreswar and Champadani are the principal jute manufacturing towns. Other industries include rubber factories at Shahganj and Uttarpara and chemical factories at Rishra. Baidyabati, Konnagar, Kotrung and Uttarpara are mainly residential towns. There are colleges at Chandernagore, Serampur and Uttarpara. A large *mela* ("fair") is held annually at Tarakeswar, a temple town. (S. P. C.)

HOOGHLY (HUGLI), an important waterway in West Bengal, India, gives access to Calcutta from the Bay of Bengal (90 mi.). Formerly the most westerly of the channels by which waters from the Ganges (Ganga) reached the sea, it originated as the lower part of the Bhagirathi, a distributary taking off from the Ganges soon after it enters west Bengal; it is given the name Hooghly at Nabadwip, about 144 mi. inland. Like other deltaic distributaries the Bhagirathi and the channels it receives on its left (east) side are subject to sudden changes and silting, and they carry little Ganges water to the Hooghly. The main outflow comes from several rivers rising to the northwest on the Chota Nagpur plateau, the Ajay, the Damodar (location of the large power and irrigation project), the Rupnarayan and the Haldi (Kasai). For 40 mi. above Calcutta the Hooghly is silted up, yet it was there that all the once famous ports of Bengal were situated. Navigation up to Calcutta is kept open by dredging and the scour of a bore that rushes up at high tide. The channel, well buoyed and lighted, is safe for large ocean-going vessels. From Calcutta the Hooghly flows west and south to the Rupnarayan estuary; then twists east, south and southwest, entering the Bay of Bengal in 21° 41′ N., 88° E. Places of note on the Hooghly include Hooghly town, Chandernagore, Serampur and Howrah, all on the right bank. On the left bank Barrackpore, Kidderpore and Diamond Harbour are important. Calcutta was for long connected with Howrah by the "bridge of boats," a roadway on pontoons of which sections could be swung out to permit the passage of vessels. This was replaced by a high-level road bridge in the 1930s; upstream the Hooghly is also spanned by a railway bridge. (L. D. S.)

HOOGSTRAETEN, SAMUEL VAN (1627–1678), Dutch painter of interiors and religious subjects, was born in Dordrecht, Aug. 2, 1627. He studied first under his father Dirck and then, after his father's death in 1640, under Rembrandt. From 1651 to 1654 he traveled in Germany, Austria and Italy, staying for some time in Rome and Vienna. His name appears in The Hague painter's guild in 1668. In 1671 he bought a house in Dordrecht, where he died on Oct. 19, 1678. As a painter Hoogstraeten produced biblical and classical subjects, portraits, landscapes, genre and still life. His style was not profoundly influenced by Rembrandt, although an exception is the fine early head of a youth. His genre pieces are probably his most successful works, but he is best known for his ingenious perspective and *trompe l'ocil* (deceptively realistic) designs. In the latter class is "Peep Box: Dutch Interior," at the Detroit Institute of Arts. Hoogstraeten also wrote on painting techniques. (R. E. W. J.; X.)

HOOK, JAMES (1746–1827), English organist and composer, was born at Norwich, probably on June 3, 1746. He studied music in Norwich and performed keyboard concertos in public concerts when still a child. His father died when Hook was 11, and he then began earning his living by music. About 1763–64 he went to London, where he became organist at White Conduit house, one of the numerous teahouses in the London area. When Samuel Arnold took over the management of Marylebone gardens he appointed Hook organist and composer; from there the young man went to a similar appointment at Vauxhall gardens. It was for Vauxhall that he wrote most of his 2,000 songs, as well as a number of organ concertos. He composed numerous operas—some produced at the gardens—including *The Double Disguise* (1784), for which his wife wrote the libretto. Later operas had librettos by their sons, James (1772–1828) and Theodore (1788–1841). Hook was a fashionable pianoforte teacher and his popular textbook, the *Guida di Musica* (1785), went into many editions and was a standard work for many years. Hook died in Boulogne, France, in 1827. As a composer he is notable for his melodic gifts, which are best exemplified in songs such as "The Lass of Richmond Hill." (Cs. CH.)

HOOK, THEODORE EDWARD (1788–1841), English novelist and playwright whose gifts for witty improvisation, word play and daring practical jokes made him much sought after in London fashionable circles, was born in London, Sept. 22, 1788, the son of James Hook (composer of "The Lass of Richmond Hill" as well as many forgotten songs). Hook was educated at Harrow and studied law at Oxford for two terms only in 1810. By the age of 16, however, under his father's aegis, he was becoming a popular figure in London theatre greenrooms. He wrote farces for the actor Charles Mathews, comic operas and melodramas, one of which, *Tekeli* (produced at the Drury Lane theatre in 1806), from a French original, was a phenomenal success and was attacked by Byron in *English Bards and Scotch Reviewers*. He ran into debt, and his dissolute life led Sir Walter Scott to refer to the "raffish . . . Theodore Hook squad," but the prince regent obtained him a post as treasurer to Mauritius, with a salary of over £2,000 a year. However, Hook had made political enemies, and when about £12,000 was found stolen, although guilty only of negligence, he was recalled under arrest, subjected to a protracted trial, later imprisoned for two years and saddled with a huge debt for costs that hung over him until death.

In 1820 he began editing, anonymously, the scurrilous Tory journal *John Bull*, largely devoted to maligning Queen Caroline. Its circulation reached 10,000, twice that of the *Times* at that period. Under the pressure of debt he also edited *The New Monthly Magazine* from 1837 to 1841, wrote numerous short pieces, light verses and, in 17 years, published over 40 volumes of fiction. The most important of these were the highly successful *Sayings and Doings* (9 vol., 1824–28), stories illustrating proverbs which helped to create a vogue for novels about high society; *Maxwell* (1830); and the partly autobiographical *Gilbert Gurney* (1836).

His weaknesses are stereotyped plots, unconvincing main characters and excessive punning. Everywhere his haste is evident. However his wit, his brilliant minor characters, his social realism and attention to detail opened the way for Dickens and Thackeray. He regained his popularity in society, but continued financial strain probably contributed to the degeneracy shown in fictional characters modeled on him, such as Thackeray's Mr. Wagg (*Vanity Fair*) and Benjamin Disraeli's Lucian Gray (*Coningsby*). He died in Fulham, London, on Aug. 24, 1841.

See M. F. Brightfield, *Theodore Hook* (1928). (W. L. G. Ja.)

HOOKE, ROBERT (1635–1703), English experimental physicist who discovered the first law of elasticity for solid bodies, known as Hooke's law, was born July 18, 1635, at Freshwater, Isle of Wight. After 1655 he was employed by Robert Boyle, who used his skill in the construction of his air pump. On Nov. 12, 1662, he was appointed curator of experiments to the Royal society, of which he was elected a fellow in 1663, and filled the office during the remainder of his life. In 1665 he was appointed professor of geometry in Gresham college. He was secretary to the Royal society between 1677 and 1683, publishing in 1681–82 the papers read before that body under the title of *Philosophical Collections*. He died on March 3, 1703, in London.

Hooke's scientific achievements would probably have been more striking if they had been less varied. He originated much, but perfected little. His optical investigations led him to adopt in an imperfect form the undulatory theory of light. He was the first to state clearly that the motions of the heavenly bodies must be regarded as a mechanical problem, and he approached in a remarkable manner the discovery of universal gravitation. He invented the wheel barometer, discussed the application of barometrical indications to meteorological forecasting and originated the idea of using the pendulum as a measure of gravity. He is credited with the invention of the anchor escapement for clocks, and of the application of spiral springs to the balances of watches (1676). (*See* WATCH.)

His principal writings are *Micrographia* (1665); *Lectiones Cutlerianae* (1674–79); and *Posthumous Works*, containing a sketch of his "Philosophical Algebra," published by R. Waller in 1705.

See also references under "Hooke, Robert" in the Index volume.

See M. 'Espinasse, *Robert Hooke* (1956).

HOOKER, JOSEPH (1814–1879), Union general in the American Civil War, was born in Hadley, Mass., Nov. 13, 1814. He graduated from the U.S. Military academy in 1837 and entered the artillery. In the Mexican War he served as a staff officer and rose to the rank of lieutenant colonel. In 1853 he left military service and bought a large farm near Sonoma, Calif. At the beginning of the Civil War he was commissioned brigadier general of volunteers. He took part in all the major eastern campaigns of 1862 and earned the nickname "Fighting Joe."

At the head of the 1 corps, army of the Potomac, he opened the battle of Antietam (Sept. 1862) and was severely wounded. When Gen. A. E. Burnside resigned command of the army of the Potomac after the battle of Fredericksburg (Nov.–Dec. 1862), Hooker succeeded him and effected a much-needed reorganization of the army. In this task, as in subordinate commands in battle, Hooker was excelled by few. But his grave defects as a commander in chief became obvious when he was defeated at the battle of Chancellorsville in May 1863. (*See* WILDERNESS.) When Gen. R. E. Lee advanced into Pennsylvania in June, Hooker followed him closely until, sensing that his superiors in Washington distrusted him, he resigned the command on the eve of the battle of Gettysburg (July 1–3, 1863).

Three months later, when Gen. W. S. Rosecrans was besieged in Chattanooga, and Grant with all the forces of the west was hurried to the rescue, two corps of the army of the Potomac were sent over by rail, and Hooker went with them in command. On Nov. 24, 1863, he won the "battle above the Clouds" on Lookout mountain, which cleared the way for the crowning victory of the army of the Cumberland on Missionary ridge. He took part in all the battles and combats of the Atlanta campaign of 1864. When Gen. J. B. McPherson was killed before Atlanta, the command of the army of the Tennessee fell vacant. Hooker, as senior to the other army commanders, was normally entitled to receive it, but General Sherman feared to commit a whole army to a man of Hooker's peculiar temperament, and the place was given to Gen. O. O. Howard. Hooker thereupon left the army. He retired with the rank of major general on Oct. 15, 1868. He died at Garden City, Long Island, N.Y., on Oct. 31, 1879.

HOOKER, SIR JOSEPH DALTON (1817–1911), English botanist, noted for his botanical travels and studies on geographical distribution and for his encouragement to Charles Darwin, was born on June 30, 1817, at Halesworth, the son of Sir William Jackson Hooker (*q.v.*). He took his M.D. at Glasgow university in 1839 and then joined Sir James Ross's antarctic expedition as assistant surgeon. On his return in 1843 he published *Flora Antarctica* (1844–47), *Flora Novae Zelandiae* (1853–55) and *Flora Tasmanica* (1855–60). His next expedition was to the northern frontiers of India (1847–51), where he made a survey of previously unexplored regions. In 1855 he was appointed assistant director of Kew gardens and in 1865 succeeded his father as director. He was president of the Royal society from 1873 to 1878. It was to him that Darwin first imparted his theory of natural selection in 1844, and he, with Sir Charles Lyell, induced Darwin to make public his views on the origin of species (1858) after A. R. Wallace had communicated similar ideas.

Hooker's works, in addition to those already mentioned, include *Outlines of the Distribution of Arctic Plants* (1862); a standard *Student's Flora of the British Isles* (1870); a monumental work, the *Genera plantarum* (1862–83), in collaboration with G. Bentham; and *Flora of British India* (1855–97). Among other honours he was awarded the Order of Merit in 1907.

He continued his botanical studies until his death at Sunningdale, Berkshire, on Dec. 10, 1911.

See L. Huxley, *Life and Letters of Sir J. D. Hooker*, 2 vol. (1918), with list of works; W. B. Turrill, *Pioneer Plant Geographer* (1953).

HOOKER, RICHARD (1554–1600), English theologian, author of *The Laws of Ecclesiastical Polity* and aptly known, in his own time and since, as the "judicious Hooker," was born of middle-class parents at Heavitree, near Exeter, in March 1554. Educated at Exeter school, he secured the patronage of John Jewel, bishop of Salisbury, through whose influence he entered Corpus Christi college, Oxford. Elected a foundation scholar in 1573,

Hooker became a fellow in 1577. In his earlier years he was not without some Puritan sympathies, since his patrons—Jewel and his uncle John Hooker—had been fellow exiles in Mary's reign. In 1584 he vacated his fellowship for the benefice of Drayton Beauchamp, Buckinghamshire, but in the next year became master of the Temple. His appointment created a difficult situation, since Walter Travers, a popular preacher, was already established as reader; the master was loyal Anglican, the reader firm Presbyterian, so that on Sundays "the pulpit spake pure Canterbury in the morning and Geneva in the afternoon." The inevitable partisanship "turned to his extreme grief," for Hooker was of gentle disposition; also Travers' brother had married Hooker's sister. He sought release in order to examine in peace and quiet the principles underlying the establishment of the Church of England. In 1591 therefore he accepted the living of Boscombe in Wiltshire and a prebend in Salisbury cathedral. But he probably continued to live in London and there wrote the first four books of his imperishable *Of the Laws of Ecclesiastical Polity* (published 1593). He had married Joan Churchman in 1588 and probably lived in her father's house till appointed to the rectory of Bishopsbourne, near Canterbury, in 1595. The legend, repeated by Thomas Fuller, John Gauden and Izaak Walton, that Joan was an unpleasant shrew of a wife, was accepted until disproved by C. J. Sisson in 1940. Hooker died at Bishopsbourne on Nov. 2, 1600, and was buried in his own chancel.

The *Laws of Ecclesiastical Polity* was planned to include eight books. There is evidence that Hooker completed these manuscripts: William Covell, writing in 1603, says that Hooker told him so. After his death they were entrusted to John Spenser, president of Corpus Christi college, who bequeathed them in 1614 to the bishop of London; about 20 years later George Abbot, archbishop of Canterbury, placed them in the Lambeth library. The fifth book had been published in 1597, but the last three books did not appear in their author's lifetime. Of these the present book 6 (which seems not germane to Hooker's general purpose) and book 8 (on the royal supremacy) did not appear until 1648; while book 7 (devoted to an examination of episcopacy) remained unknown until published in 1662, by Gauden, the unscrupulous bishop of Exeter.

This long delay in publication has aroused doubt about the authenticity of the last three books. Izaak Walton on hearsay evidence 40 years old alleged that Puritan friends of Joan mutilated the manuscripts. It is equally reasonable to assert, with Henry Hallam and Coleridge, that the enemies of Puritanism tampered with the two books on episcopacy and the royal supremacy, for in book 7 particularly the necessity of monarchical episcopacy is much more strongly urged than in the earlier books.

The Laws of Ecclesiastical Polity, a masterpiece of Elizabethan literature for its balanced, dignified style, is of great importance in theology, in political philosophy and as an exposition of the Tudor constitution. Hooker set himself to defend the Elizabethan settlement in church and state against Roman Catholics and Puritans. The safety of the realm demanded unity among its subjects, and as "Religion is the chiefest stay of the Commonwealth," Hooker's basis and outlook are theological. His most important single contribution was to affirm the Anglican tradition as that of a threefold cord not quickly broken—Bible, Church and Reason. Roman Catholics put Bible and tradition on a parity, while Puritans looked to Scripture as sole authority. Hooker avoided both extremes, allowing to Scripture absolute authority where it spoke plainly and unequivocally; where it was silent or ambiguous, wisdom would consult the tradition of the church in an interpretative role; but he insisted that a third element in religion lay in man's reason, itself part of the universal law and illuminated by God, which should be obeyed whenever both Scripture and tradition needed clarification, or failed to cover some new circumstance. Thus he not only avoided the "either-or" of Scripture *versus* tradition, but introduced a third and new element, human reason.

Consistently, therefore, Hooker distinguishes between "things necessary" in religion (*i.e.*, the great Christian truths contained in or deducible from Scripture, which must be believed) and "things accessory and dependent," which merely must not be contrary to Scripture. Thus, as an orthodox believer defending some ancient Catholic doctrines and explaining Anglican teaching—*e.g.*, finding auricular confession "profitable"—he resists the excesses of earlier reformers. But on the inflammatory though "accessory" topics of church polity, rites and ceremonies, he held that as Scripture prescribes no particular form of church government, reason permits that "the public society of God" in any land is free to erect its own polity and choose its own rites, for the church is an organic institution, in which the Holy Spirit still leads men into further truth by the light of reason. Thus, for example, while the Church of England has retained episcopacy, Hooker cannot deny validity to those reformed churches which reject it.

The core of Hooker's arguments on the relations of church and state is unity, the great concept of medieval thinking. In his view, the Puritans adopted an impossible position; they claimed to be loyal to the queen while repudiating the queen's church. "When they strike at the State Ecclesiastical, they secretly wound the Civil State." By law and by reason an Englishman must be an Anglican, pledged to serve Elizabeth as the supreme magistrate of his country and the supreme governor of his church. Both offices came to her through the wisdom of God and the laws of parliament, representing the authority of the whole realm. The church is the same society as the state, organically one, differing only in function. To preserve that identity and consequent unity—the alternative is division and ruin—there must be a supreme head over both; and Scripture, history and reason teach that this must be the sovereign. The church is not less divine by being organically bound with the state, but more so, because the state itself is of divine origin existing to a divine end (*i.e.*, to make "good" citizens).

Hooker's thesis necessarily introduced the question of authority and obedience, and these may only be harmonized by law.

> Of Law there can be no less acknowledged, than that her seat is the bosom of GOD, her voice the harmony of the world: all things in heaven and earth do her homage, the very least as feeling her care, and the greatest as not exempted from her power.

Thus, law is far from being mere command; it emanates from God and so is apprehended by man through reason. This natural reason directs individual men how to order their lives; and thus when men come to live together in a political society or commonwealth (itself natural as guaranteeing the satisfaction of human needs and fellowship) reason dictates that commonwealth must be inspired by law, which must establish government, or anarchy would prevail. Thus authority and obedience in society are natural as partaking of divine law.

It is not surprising that Sir W. S. Holdsworth declares that the *Ecclesiastical Polity* provides the best summary of the actual state of the law of sovereignty in the 16th century, and that in it the theory of the English state in that century can most clearly be seen. It is, therefore, of great historical interest because it is the only book which not only describes Tudor polity in church and state but also explains its underlying principles; while its constitutional importance is enhanced because the results of the controversies of the 17th century were to give practical effect to the theory of the state outlined in it.

Yet Hooker's apology is not wholly consistent: at one moment he asserts the sovereign's supremacy, at another the necessity of the subject's consent. Consequently people in opposite camps have cited him. Thus in 1932 and 1933 studies of his teaching on the Tudor state appeared in Italy and Germany, while in England republican writers such as Milton, Sidney and Locke have accepted his emphasis on the supremacy of the law as above prerogative rule, and have drawn from him the doctrines of the original freedom of man, of the contract by which he conditionally surrendered his freedom and of the resultant necessity for his real consent to proposals for law and of government: but conservative Hooker denies what they logically affirm, man's right to resist tyranny in the sovereign power.

BIBLIOGRAPHY.—The standard edition of the *Laws of Ecclesiastical Polity* is that by John Keble, 3 vol. (1836; rev. ed. by R. W. Church and F. Paget, 1888), to which is prefixed Izaak Walton's *Life*, written

in 1665 to correct the *Life* by John Gauden in his 1662 edition of the *Works*. An account of Hooker's life is also prefixed to R. W. Church's 2nd edition of book 1 of the *Ecclesiastical Polity* (1876). C. J. Sisson's *Judicious Marriage of Mr. Hooker* (1940) challenged and superseded all these lives but is not in itself a complete biography. Contemporary criticism included William Covell's *Just and Temperate Defence of the Five Books* (1603). A. P. d'Entreve, *Ricardo Hooker* (1932), and G. Michaelis, *Richard Hooker als politischer Denker* (1933), show that Hooker was studied under the Fascist and Nazi regimes. *See* also R. A. Houk's introduction to his edition of book 8 (1931); P. Munz, *The Place of Hooker in the History of Thought* (1952); F. J. Shirley, *Richard Hooker and Contemporary Political Ideas* (1949); W. S. Holdsworth, *History of English Law*, vol. iv (1924), which deals with Hooker's philosophy of the Tudor state.

(F. J. Sy.)

HOOKER, THOMAS (1586–1647), American clergyman, through his piety, zeal and wisdom unquestionably one of the foremost of colonial pastors, was born, probably on July 7, 1586, at Marfield, Leicestershire, Eng. He took his M.A. in 1611 at Emmanuel college, Cambridge, the intellectual centre of Puritanism; remained there as a fellow for a few years; and then preached in the parish of Esher in Surrey. About 1626 he became lecturer to the church of St. Mary at Chelmsford, Essex, delivering on market days and Sunday afternoons evangelical addresses which were notable for their moral fervour. In 1629 Archbishop William Laud took measures to suppress church lectureships, which were an innovation of Puritanism. Hooker was placed under bond and retired to Little Baddow, near Chelmsford. In 1630 he was cited to appear before the court of high commission, but he forfeited his bond and fled to Holland, whence in 1633 he emigrated to the colony of Massachusetts Bay in America. He became pastor at Newtowne (now Cambridge, Mass.) of a company of Puritans who had arrived from England in the previous year and, in expectation of his joining them, were called "Mr. Hooker's Company."

Hooker publicly criticized the limitation of suffrage to church members, and, according to a contemporary historian, William Hubbard (*General History of New England*), "after Mr. Hooker's coming over it was observed that many of the freemen grew to be very jealous of their liberties." He was a leader of the emigrants who in 1636 founded Hartford, Conn. (*see* CONNECTICUT). He declared, before the Connecticut general court of 1638, that "the choice of public magistrates belongs unto the people by God's own allowance" and "they who have the power to appoint officers and magistrates, it is in their power, also, to set the bounds and limitations of the power and place unto which they call them." Though this theory was in advance of the age and caused many historians to call him "the father of American democracy," Hooker had no idea of the separation of church and state—"the privilege of election, which belongs to the people," he said, must be exercised "according to the blessed will and law of God." Hooker was pastor of the Hartford church until his death on July 7, 1647.

See G. L. Walker's *Thomas Hooker* (1891), the best biography, which contains a bibliography of Hooker's published works.

HOOKER, SIR WILLIAM JACKSON (1785–1865), English botanist famous for his work as the first director of the Royal Botanic gardens at Kew, Surrey, was born at Norwich on July 6, 1785, and educated at the high school there. The natural history specimens of his first botanical expedition to Iceland in 1809 were lost on the homeward voyage through the burning of the ship, but Hooker was able to publish an account, mainly from memory, of the island and of its inhabitants and vegetation (*Tour in Iceland*, 1811). In 1814 he spent nine months botanizing in France, Switzerland and northern Italy; and in 1815 he married Maria Turner and settled at Halesworth, Suffolk, devoting himself to systematic botany and the analysis of his herbarium, which became of world-wide renown among botanists. In 1816 he published the *British Jungermanniae*, succeeded by a new edition of William Curtis' *Flora Londinensis;* by the *Muscologia Britannica*, prepared in conjunction with T. Taylor (1818; 2nd ed., 1827); and by his *Musci Exotici* (2 vol., 1818–20), devoted to new foreign mosses and other cryptogams. In 1820, on the recommendation of Sir Joseph Banks, he was offered and accepted the regius professorship of botany in Glasgow. In 1821 he brought out the *Flora Scotica*. In 1841 he was appointed director of the Royal Botanic gardens at Kew; and under his direction the botanical collection expanded sixfold. By his energy and influence he greatly advanced knowledge of the higher plants and ferns, algae, lichens and fungi. He died on Aug. 12, 1865. One of his sons, Sir Joseph Dalton Hooker (*q.v.*), followed his father's lead in botany.

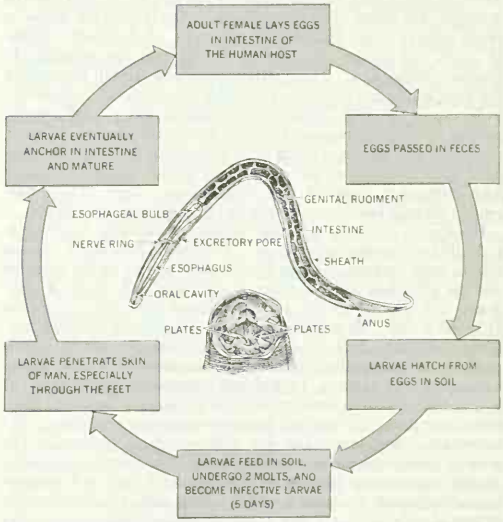
Hooker's most important works besides those mentioned above include: *Exotic Flora* (1822–27); *Botanical Magazine* (1827–64); *Icones Filicum*, with R. K. Greville (1829–31); *British Flora*, with G. A. W. Arnott *et al.* (1830; 8th ed., 1860); *Flora Borealis Americana* (1829–40); *Journal of Botany* (1830–42); *Icones Plantarum* (1836–54); *The Botany of Captain Beechey's Voyage to the Pacific and Behring's Straits*, with G. A. W. Arnott (1830–41); *Genera Filicum* (1838–42); *London Journal of Botany* (1842–48); *Species Filicum* (1846–64); *Journal of Botany and Kew Garden Miscellany* (1849–57); *Niger Flora* (1849); *Filices Exoticae* (1857–59); *British Ferns* (1861–62).

See J. D. Hooker, *Sir William Jackson Hooker* (1903).

HOOKWORM is a parasitic roundworm. When present in excessive numbers, two important parasites, *Ancylostoma duodenale* and *Necator americanus*, cause hookworm disease in the human being.

A malady resembling hookworm disease was described in Egypt as early as 1600 B.C. *A. duodenale* was discovered in Europe and associated with the disease in the middle of the 18th century. *N. americanus* was discovered in America in 1901–02 by Charles W. Stiles. It probably originated in Africa and was introduced into the new world by slaves.

The female worm deposits eggs in the intestine of the host. Each egg contains a two- to eight-segmented embryo, when passed in the feces. The embryo grows in the soil and hatches in 24 to 48



(CENTRE TOP AND CENTRE BOTTOM) FROM ASA C. CHANDLER, "INTRODUCTION TO PARASITOLOGY," NINTH EDITION, REPRODUCED BY PERMISSION OF JOHN WILEY & SONS, INC.

LIFE CYCLE OF HOOKWORM. THE CENTRE DRAWINGS SHOW A THIRD-STAGE (INFECTIVE) LARVA OF NECATOR AMERICANUS AND AN ENLARGED VIEW OF THE ORAL CAVITY SHOWING THE DORSAL AND VENTRAL PAIRS OF CUTTING PLATES WITH WHICH THE WORM ATTACHES ITSELF TO THE INTESTINAL MUCOSA

hours as an immature, noninfective larva. After two to three days it molts and develops into a mature, infective, nonfeeding larva. On contact with the human skin it molts again and penetrates the deeper skin layers, often causing "ground itch." It then invades lymph and blood vessels, is carried to the lungs, passes up the respiratory tree to the mouth and is swallowed. The larva undergoes a third molt, anchors itself to the intestinal mucosa, molts for a fourth time and becomes an adult worm. The worms live in the small intestine, and eggs are passed in the feces as early as

five to six weeks after the larvae enter the skin.

The average sizes of adult worms are: *A. duodenale:* males 7-11 × 0.45 mm., females 9-14 × 0.6 mm.; *N. americanus:* males 6-9 × 0.25 mm., females 8-12 × 0.4 mm. The worms live in the intestine for many months. A few may persist for six to seven years or longer. Continual reinfection and acquired partial resistance result in a more or less constant number of worms harboured. Infective larvae when swallowed can develop in the intestine without preliminary lung passage, but this mode of transmission is not common in nature. There are two dog hookworms, *A. brasiliense* and *A. caninum*, which may infect man. Usually they cause an aberrant infection, "creeping eruption" or larva migrans. This disease is characterized by serpiginous tunnels in the skin caused by migrations of larvae that are unable to penetrate the innermost layers.

Hookworm infection occurs in a zone from approximately latitude 38° N. to 34° S. and may be encountered in cooler regions, particularly in mines and tunnels. The geographical distribution is determined by temperature and rainfall, which influence development of free-living larvae. Other important factors are drainage, type of soil, social habits and customs, poverty and bad sanitation. Optimum temperature for larval development is between 70° and 85° F. (about 21°–29° C.), *A. duodenale* being better adjusted to the lower range than *N. americanus*, which predominates in warmer regions.

Fully developed eggs and newly hatched larvae die in a few days if kept below 43° to 46° F. Mature larvae can resist freezing temperatures as long as six days; developmental time is tripled at temperatures of 55° to 60° F. Under optimum conditions, infective larvae may remain viable in the soil for several months or longer, but under natural conditions in the tropics the majority rarely survive longer than five or six weeks. A minimum rainfall of 40 in. per annum is required to maintain the infection in endemic proportions. The distribution of the rainfall throughout the year is also important; *e.g.*, a long dry season is detrimental to larvae in the soil. Drainage and subsoil water level are important in irrigated regions, or where canals are present. Coarse, sandy soil with humus is much more favourable for larval development than fine clay or silt loam, since larvae migrate vertically with changes in moisture and temperature. They cannot pass rapidly through fine-textured soils and thus become dry and die.

Hookworm disease is a scourge of tropical climates, resulting in a debilitated anemic population. Anemia in hookworm disease results from sucking of blood by the adult worms in the intestine and the attendant inflammation of the bowel. A single *A. duodenale* can remove, on the average, almost one cubic centimetre of blood a day. As a bloodsucker, *N. americanus* is about one-fifth as efficient. Infected individuals on adequate diet have been classified in four groups, according to numbers of *N. americanus* harboured: (1) carriers, 25 or fewer worms—no symptoms; (2) light infections, 26 to 100 worms—few or no symptoms; (3) moderate infections, 101 to 500 worms—moderate symptoms; (4) heavy infections, more than 500 worms—severe symptoms. In general, the symptoms in classical, heavy infections include pallor of skin and mucous membranes, edema of the face and extremities, constipation alternating with diarrhea, abdominal tenderness, increased appetite for bulky foods or unusual substances (clay eaters), sexual derangements (delayed puberty, impotence, irregular menstruation), endocrine insufficiency, stunted growth, cardiac weakness, palpitation, hypersensitiveness of the skin to cold, physical debility, fatigue, dullness, apathy and melancholia.

Microscopic laboratory diagnosis is made by searching for characteristic eggs in feces. In moderate or heavy infections, eggs are easily found. In light infections, so few eggs may be present that concentration by brine or zinc sulfate flotation methods should be used. Egg-counting techniques are useful in estimation of the number of worms harboured by an individual. Parasitism with a very few eggs in feces is harmless. The laboratory report, therefore, should indicate the degree of infection, as determined by the egg count.

Treatment and Control.—Treatment involves removal of the worms and reduction of anemia. Worm removal in severe cases requires great skill. The vermifuge may be harmful if given before the patient is improved physically. Thus preliminary blood transfusion may be required with dietary and iron therapy before the vermifuge is given. Many vermifuges have been used. Thymol, oil of chenopodium and carbon tetrachloride are effective but also toxic. They were supplanted by tetrachlorethylene and hexylresorcinol. The former is a safe drug and removes 90% or more of the worms on a single treatment. It may, however, cause migration of the roundworm *Ascaris lumbricoides*. Hexylresorcinol has no serious contraindications, is effective against 80% of the worms and removes 90% of *A. lumbricoides* on a single treatment. "Creeping eruption" caused by the larva of the dog hookworm is treated by freezing the migratory larvae in the skin with carbon dioxide snow or ethyl chloride spray. Mass treatment of large groups of heavily infected persons has been successful in reducing the incidence of hookworm, especially during the dry season when the soil contains few larvae and reinfection is minimal. Repetition of treatment every two to three years may be required.

Transmission of infection depends upon indiscriminate disposal of human infected excreta. Where all workers in the soil go barefoot, there is ample opportunity for intimacy of contact with polluted soil. The wearing of shoes would eliminate the disease, but in most hookworm regions the people cannot afford shoes and are ignorant of the dangers of bad sanitation. Without proper education and improvement in standard of living, little can be accomplished in securing satisfactory, permanent hookworm control. The International Health board of the Rockefeller foundation pioneered in hookworm control and pointed the way for adequate control programs. The essentials of this program are: (1) education in the principles of sanitation, emphasizing the importance of adequate disposal of feces, and aid in construction of simple sanitary toilets; (2) establishment of full-time local health services staffed by trained competent personnel; (3) examination and treatment of persons infected with hookworm disease; (4) continuous observation of the area to prevent the return of former unsanitary conditions. The success attained indicates the possibility of global control of this insidious tropical disease.

See Parasitology; Tropical Medicine.

See also references under "Hookworm" in the Index.

(I. R.)

HOOLOCK, the common name for an Indian gibbon, one of the group of manlike apes. *See* Gibbon; Primates.

HOOPER, FRANKLIN HENRY (1862–1940), editor of the *Encyclopædia Britannica* from 1932 to 1938, was born at Worcester, Mass., Jan. 28, 1862, a brother of Horace Everett Hooper (*q.v.*). He graduated from Harvard in 1883. He was associated with the Century company from 1883 to 1896, being one of the editors of the *Century Dictionary*. He was literary adviser and manager for James Clarke and company, publishers, 1897–99, and became an editor of *Encyclopædia Britannica* in 1899. He was connected with five different editions of the *Britannica:* associate editor of the 10th edition (1902); managing editor of the 11th edition (1910); and American editor of the 12th (1922), 13th (1926) and 14th (1929) editions. In 1932 Hooper became editor in chief. He edited and planned *These Eventful Years* (1924) and was also editor of *Britannica Junior* and the *1938 Britannica Book of the Year*. He retired in April 1938 and died near Saranac Lake, N.Y., on Aug. 14, 1940.

HOOPER, HORACE EVERETT (1859–1922), publisher of the *Encyclopædia Britannica*, was born in Worcester, Mass., on Dec. 8, 1859. He was of English descent; his father's ancestors included "King" Hooper, who had controlled much of the Massachusetts fishing interests in the 1700s, and his mother was a descendant of John Leverett, governor of Massachusetts, 1672–79. Hooper ended his formal education at the age of 16, after attending schools in Worcester and Washington, D.C. He clerked in bookstores, then went to Denver, Colo., where, with others, he organized the Western Book and Stationery company to sell books in western states. In 1893 he shifted his headquarters to Chicago, Ill., where he organized, among other enterprises, a highly successful sale of the *Century Dictionary* through colourful and aggressive

advertising. On a vacation trip to London in 1897, he became cognizant of an opportunity to market the ninth edition of the *Encyclopædia Britannica* by similar methods. With three others—Walter Montgomery Jackson and the Clarke brothers, James and George—he secured reprint rights from A. and C. Black, the work's publishers, then persuaded the *Times* (London) to lend its reputation and imprimatur to the reprint edition. He reduced the price and revolutionized the sale of the set by instituting an installment payment plan. *Times* officials anticipated meagre results, but the sale was astounding; in the first three months of 1898 some 10,000 sets were sold and in the subsequent five years another 50,000.

The success of this venture led Hooper to prepare, in 1902, a supplement of 11 volumes (under the joint editorship of Sir Donald Mackenzie Wallace, Arthur T. Hadley, president of Yale university, Hugh Chisholm and Hooper's brother Franklin) which, added to the ninth, formed the tenth edition. Again the sale, sparked by flamboyant advertising and promotional techniques, was large. Consequently, Hooper's influence at the *Times* expanded; he took an active part in its management as advertising director and was instrumental in organizing the *Times* Book club, a move that led him into rancorous controversy with various book publishers. Shortly after Lord Northcliffe became proprietor of the *Times* in 1908, Hooper's connection with that paper ended. He continued to live in England, but also maintained homes in the United States.

In 1903 Hooper had organized the preparation of an entirely new edition of the *Encyclopædia Britannica,* the 11th. Unlike previous editions, this one, edited by Hugh Chisholm, was to be issued as a single unit and not volume by volume. Despite difficulties occasioned by Hooper's separation from the *Times* and his subsequent legal wars with his erstwhile partner, Jackson, the edition was published, under an arrangement with Cambridge university, in 1910–11. It was successful, its sale reaching some 75,000 in the next few years. In the years immediately preceding and during World War I, Hooper initiated other publishing projects, notably an edition of the *Encyclopædia Britannica* in smaller and cheaper form known as the Handy Volume issue, of which some 200,000 copies were sold. His final enterprise was the publication early in 1922 of the three war volumes of the *Encyclopædia Britannica* which, with the 29 volumes of the 11th edition, constituted the 12th edition.

A master salesman and a daring innovator, Hooper was passionately devoted to the educational product he offered. He was convinced that the *Encyclopædia Britannica,* as a medium of popular education, was without a peer. When he died in Bedford Hills, N.Y., on June 13, 1922, the *New York Times* offered apt estimate: "In the view of the public, his success lay in the originality, boldness and brilliance of his operations. But that was merely the surface. The deeper source was his faith in the intelligence and the ambition of a great mass of citizens. Many professional educators of note have done less than he toward popular enlightenment."

See Janet E. Courtney, *Recollected in Tranquillity* (1928) and *An Oxford Portrait Gallery* (1931); Herman Kogan, *The Great EB* (1958). (Hn. K.)

HOOPER, JOHN (*c.* 1500–1555), bishop of Gloucester and Worcester and English martyr, was a man of unknown family probably born in Somerset. Late in 1518 he took his B.A. at Oxford, and he then joined the Cistercian order as a monk of the small house of Cleeve, Somerset, dissolved in 1536. By 1539 he had moved to the household of Sir Thomas Arundel where for a time he lived, as he himself said, "too much of a court life." However, in that year he encountered the writings of the continental reformers, especially of Huldreich Zwingli and Heinrich Bullinger. Arundel, a conservative in religion, in vain asked Bishop Stephen Gardiner to talk Hooper out of his growing Protestantism; the passage of the repressive Six Articles in 1539 drove him to seek refuge abroad, and for nearly ten years he lived in a variety of Reformed communities, ending up in Bullinger's Zürich. During this exile he signaled his total conversion by marrying Anne de Tserclas at Strasbourg.

In 1549 Hooper returned to England as chaplain to the reforming duke of Somerset and at once made his name by the zeal and skill of his preaching. He survived his patron's fall in 1550 to become chaplain to Somerset's triumphant rival the duke of Northumberland, and at Easter 1550 was offered the bishopric of Gloucester. Hooper, who had already expressed entire disapproval of some of the ceremonies and vestments preserved by the Edwardian Reformation, refused consecration by the rites of the 1550 ordinal. Both Thomas Cranmer and Nicholas Ridley vainly argued with the obstinately Zwinglian Hooper on the validity of vestments and oaths; it took a prolonged controversy, much pressure from the council and a few weeks in the Fleet prison to persuade him that he could be more useful to his faith as an active bishop than as an impotent dissenter. Consecrated bishop of Gloucester on March 8, 1551, he had Worcester added to his charge on May 20, 1552, Gloucester having been reduced to an archdeaconry. The reason for this lay less in his ability or influence than in the vigorous despoiling of bishoprics carried out by Northumberland and his associates, which left neither see capable of supporting a bishop. Hooper, so determined in matters of doctrine, raised no protest against these attacks on episcopal wealth; none would in fact have availed him. He proved a most active and energetic bishop in a diocese that badly needed instruction and discipline, carrying out a searching and necessary visitation and sitting regularly in his own consistory court.

The accession of the Catholic Queen Mary put Hooper, as the most notorious Protestant of the day, in obvious jeopardy. He was at once arrested (Sept. 1, 1553), and after the repeal of the Edwardian religious legislation was deprived of his bishopric as a married priest. Imprisoned in the Fleet until the revival of the heresy laws should make possible his final prosecution, he was condemned on Jan. 29, 1555, and burned at Gloucester on Feb. 9, the first prominent victim of Mary's Counter-Reformation.

Hooper was a man without graces—stiff, gloomy, severe, upright. As far as can be judged, he came from a lower social stratum than the generality of Reformers and acted quite often the rather self-conscious "man of the people." An ardent Zwinglian, he fought throughout Edward VI's reign against the moderate policies of Cranmer; a single-minded believer, he was ever willing to invite martyrdom at anybody's hands. However, while his temperament was typically Puritan and some of his notions were of the sort later described as "precise" (*i.e.,* hostile to ritual and ceremonies), he respected the episcopal office and held neither with Calvinism nor incipient Presbyterianism. Though his narrow intolerance and joyless views must repel, he deserves respect for his martyrdom and credit for his diocesan work. His writings, which include *A Godly Confession and Protestation of the Christian Faith* (1551), had much influence on later Puritans.

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HOOPER, JOHNSON JONES (1815–1862), U.S. humorist and author of a series of tall tales describing "Some Adventures of Captain Simon Suggs," a shifty backwoods frontiersman. He was born in Wilmington, N.C., and at the age of 20 moved to the frontier town of Lafayette, Ala., to read law under an elder brother. In 1842 he accepted the editorship of the *East Alabamian,* a weekly newspaper, for which he wrote "Taking the Census," a humorous essay, and the Simon Suggs series. Copied by the New York *Spirit of the Times* and widely quoted, these stories quickly brought Hooper national fame. In 1845 they were first published in book form. A second volume, *A Ride With Old Kit Kuncker,* was issued in 1849.

Meantime, Hooper had become known as a fearless journalist and, after editing several smaller papers, he became co-owner and editor of the *Montgomery Mail.* An ardent secessionist, in 1861 he was elected secretary of the provisional congress of the Confederate states and, when the capital was transferred from Montgomery, he moved to Richmond, where he died 13 months later.

See W. Stanley Hoole, *Alias Simon Suggs: the Life and Times of Johnson Jones Hooper* (1952). (W. S. He.)

HOOPOE, the name given to birds of the old world family Upupidae of the order Coraciiformes, and comprising a single species (*Upupa epops*) found over much of Europe, Africa, Mada-

gascar and from Asia to Japan. It is a close relative of the hornbill (*q.v.*), but wholly different in general appearance. The several geographical varieties are 10–12 in. long, mainly pinkish-cinnamon to reddish-chestnut in colour and boldly barred with black and white on the wings and back. Especially striking are the long slender, slightly curved bill and the very conspicuous black-tipped crest, which is raised when the bird is disturbed. Essentially terrestrial in habits, and notably fearless of man, hoopoes characteristically frequent open or semi-open country but are also common in city parks. They are migratory in part and sometimes are found in small bands. The flight is slow, undulating and somewhat erratic. Hoopoes subsist chiefly on insects, spiders and worms. They lack a true song but make various hawing and mewing sounds. During courtship the male feeds the female and, during the breeding period, the young as well. They nest in holes, which may be in trees, earth banks or termite nests. Usually there is no nest lining. The 4–12 pale blue or olive-brown eggs are incubated by the female. (E. R. BE.)

ERIC HOSKING

HOOPOE (UPUPA EPOPS) FEEDING ITS YOUNG

HOORN, a town in the province of North Holland, Neth., lies on a bay of the IJsselmeer, 37 km. (23 mi.) N.N.E. of Amsterdam by road and rail. Pop. (1962 est.) 16,311 (mun.). The town was founded *c.* 1300 and received a charter in 1357. Two medieval churches survive, the Gothic Noorderkerk (1441–1519) and the 15th-century Oosterkerk. There are two relics of the original fortifications, the St. Mary tower (1508) and the east gate (1578). The double-fronted town hall (1613) has stepped gables; a replica of one of these in Lewes, Del., U.S., commemorates D. P. de Vries, a citizen of Hoorn who played an active part in the colonization of 1631. Other notable buildings are the Hospital of St. John (1563), the 17th-century Bossu houses, the St. Pietershof (an almshouse established 1617), the weighhouse (1609), the West Friesian museum (1632) and numerous stately dwellings. The celebrities of Hoorn include Willem C. Schouten, who discovered in 1616 the passage round Cape Horn, or Hoorn, which he named in honour of his birthplace, and J. P. Coen, governor general of the Dutch East Indies and founder of Batavia (now Jakarta) in 1619. The first great net for herring fishing was made in Hoorn in 1416. The people are employed in commerce, in fishing and in industries, including printing and plastic boat building, and the manufacture of textiles and electrical machinery (for telecommunications). Cheese is exported.

(H. O. J. DE R. DE W.)

HOOTON, EARNEST ALBERT (1887–1954), U.S. physical anthropologist, was a leading anthropometrist, known for both his scientific and his popular writings. Born Nov. 20, 1887, in Clemansville, Wis., he was educated in the classics at Lawrence college in Appleton, Wis. (A.B., 1907), and at the University of Wisconsin in Madison (M.A., 1908; Ph.D., 1911), where he also taught. He went to Oxford university as a Rhodes scholar in 1910. There his interest suddenly shifted from classical writers to the tribes they had described, and Hooton took up physical anthropology, largely independent of the continental traditions. He received his Ph.D. at Wisconsin in 1911, a diploma in anthropology at Oxford in 1912, and in 1913 a research degree from Oxford. He became an instructor at Harvard in the same year and was named professor in 1930, a position he held until his death in Cambridge, Mass., on May 3, 1954.

His originality in an undeveloped field, his avidity for the courses he taught, and a clear and witty delivery made him an outstanding teacher. The majority of professional workers in physical anthropology for a generation were his students, so that the influence of his formulations and methods was exceptional. His early research was on the craniology of Guanches and of American Indians. Out of his monumental study of the skeletons from the extinct Pecos (New Mexico) pueblo (1931), he developed a scheme of racial types that he believed composed the Indian stock as a whole, suggesting non-Indian components such as Mediterranean and Negroid. He was editor of the Harvard "African Studies" series (1918–33) and organized and directed the Harvard Irish survey after 1932, from which stemmed a large number of publications in various fields of anthropology. His interest in types was carried further in his investigation of American criminals, but in the later part of his career he turned to the bodily constitution of the individual, being a major supporter of the method of body typing developed by W. H. Sheldon (*see* PERSONALITY: *Morphological or Physical Types*). His criminal studies provoked considerable controversy, since he stressed the biological component of behaviour and the notion of the constitutional inferiority of criminals at a time when these ideas were in particular conflict with contemporary criminological opinion.

He was a writer of grace and precision, for which he credited his classical education. Beginning with *Up From the Ape* (1931; rev. ed., 1946), he published a series of popular books for laymen, including *Apes, Men and Morons* (1937), *Crime and the Man* (1939), *Why Men Behave Like Apes and Vice Versa* (1940) and *Man's Poor Relations* (1942), all notable for the presentation of information with humour and strength of personal view.

(W. W. H.)

HOOVER, HERBERT CLARK (1874–1964), 31st president of the United States, was born on Aug. 10, 1874, in West Branch, Ia., and died in New York city on Oct. 20, 1964. He was the second of three children of Jesse Clark and Huldah Minthorn Hoover, both Quakers with a long American Quaker ancestry. His father, a blacksmith who had established a farm-implement business, died when Herbert was six. His mother, an unusually gifted woman, was a school teacher. She spoke frequently at Quaker meetings and took part in local "prohibition" campaigns. After Jesse's death she kept the family, taking in sewing, and carefully saving the life insurance left by her husband toward the education of the children. Herbert attended the public school at West Branch, but upon the death of his mother when he was eight, he was sent to the home of an uncle, Henry John Minthorn, a country doctor living in Newberg, Ore.

When he was 15, his uncle established a land settlement business in Salem, Ore., and for two years Herbert worked as office boy. He picked up the rudiments of typewriting, and in a business college in Salem developed a knowledge of mathematics. From a public library a friend brought him a copy of *Ivanhoe,* which opened to him the world of literature. A chance encounter with an engineer caused him to think of the importance of a college education and he determined to become a mining engineer. Declining scholarship aid at Earlham college (Quaker) because it had no engineering course, he turned his attention to Stanford university, which was about to open in California. Hoover entered Stanford as a member of its first freshman class on Oct. 1, 1891, and worked his way to graduation (A.B.) by typing and by operating a laundry agency and a newspaper route. During summer vacations he served as an assistant with a state geological survey in Arkansas, and with the U.S. geological survey in California and Nevada. Despite his working to earn his living, he participated in extracurricular activities, including a term as football team manager. He records in his *Memoirs* his contacts with Sen. Leland Stanford and, on one occasion, with former president of the United States Benjamin Harrison, who was at Stanford delivering a special series of lectures on government.

Career as Engineer.—After graduation from Stanford in 1895, Hoover worked for a brief time as a labourer in California mines. He then joined the staff of Louis Janin, a mining engineer in San Francisco, Calif., and in Oct. 1897, on his nomination to Bewick, Moreing & Co. of London, was placed in charge of their projects in Australia. Meanwhile, he had been reading books on economics in his spare time. While visiting England, he was deeply impressed by the historic landmarks in the long history of the British people. His work in Australia, filled with adventure and experience for himself, was profitable for his employers. They transferred him to China, where he became chief engineer in the newly organized bureau of mines of the Chinese government. Returning to Lon-

don from Australia and then journeying to California in 1899, he married Miss Lou Henry (1874–1944), whom he had known as a fellow student at Stanford. He and his bride reached Peking in March 1899. Caught in the Boxer rebellion in June 1900, they were active in relief work until the arrival of international forces who rescued all foreigners in August.

In Nov. 1901 Hoover became a partner of Bewick, Moreing & Co., from which he withdrew after seven years to take up an independent career. He engaged in mining activities throughout the world, maintaining offices in New York city, San Francisco and London. Until 1914 he spent much of his time in England, but he also acquired a house at Stanford university, because he and Mrs. Hoover wished to spend more time in the U.S. as their two sons grew up.

Hoover gave much thought during those years to engineering, which, in his lifetime thus far, had been transformed, as he put it, "from a trade into a profession." Lectures he gave at Columbia and Stanford universities were published in 1909 under the title *Principles of Mining*. He had also become interested in earlier writings on applied science, especially in Georgius Agricola's *De re metallica*, printed in Latin in 1556. For five years he and Mrs. Hoover spent their spare time in its translation, which was published privately by them in 1912. A trade edition was published in 1950.

Always retaining a close interest in his native land, Hoover had thought of entering public service in some capacity, but his contacts in engineering and in government transcended national boundaries and his association with those active in politics were few, even in California, where he retained his residence. The factional political struggles that rocked the U.S. in the first decade of the 20th century apparently left little impression on him. Prior to World War I he had for 18 years lived abroad, working as an administrative engineer on industrial projects in Russia, China, India, Australia, New Zealand, South Africa, Canada, Great Britain, Belgium and Mexico, as well as in the United States. Everywhere he went he participated in the daily life and work of the people.

Relief Work in World War I.—As a U.S. citizen long resident in London, Hoover at the outbreak of World War I in Aug. 1914 organized and served as chairman of an "American committee" in London which aided in securing passage home for more than 100,000 U.S. tourists. The Commission for Relief in Belgium, a voluntary organization to which U.S. officials and residents in London gave full support, was started in Oct. 1914 with Hoover as chairman. Soon afterward he made the first of many visits to observe the problem of destitution in Belgium. Hoover concluded agreements with the British which permitted passage of food, clothing and medical supplies through the Allied blockade. The Germans, in turn, gave protection to the distribution of these supplies to the 10,000,000 people of Belgium and northern France. He ultimately secured subsidies for support of the commission from the governments of France, Great Britain and the United States. Under his direction, the commission expended nearly $1,000,000,000.

When the United States entered the war in April 1917, Hoover returned to the United States and in August Pres. Woodrow Wilson appointed him U.S. food administrator. In this work of stimulating production and conserving supplies, he called upon and obtained voluntary action from the American people. He organized the U.S. Grain corporation, Sugar Equalization board and Food Purchase board, agencies which, under his direction, handled over $8,000,000,000 in supplies for the United States and the Allies. During the critical year July 1, 1918–July 1, 1919, Hoover's Food administration furnished 18,500,000 tons of food, more than three times the normal export, to the Allies and to famine areas of Europe. He served at this time as a member of President Wilson's War Trade council and as chairman of the Inter-allied Food council.

Hoover served also as alternate chairman of the Supreme Economic council and as a member of the advisory economic committee of the U.S. delegation to the peace conference. Establishing his headquarters in Paris, he co-ordinated the continuing work of the Food administration, the Belgian and Northern France Relief commission and the Relief and Reconstruction of Europe commission, of which he had been appointed director general by the Allied governments. These operations spread over 30 European countries where, with the authorization of congress and an appropriation of $100,000,000, Hoover established a special relief program for 10,000,000 undernourished and homeless children.

Altogether at this time he directed, on behalf of the Allies and the United States, the handling of $3,254,000,000 in relief funds and the distribution of more than 23,000,000 tons of foodstuffs, medical supplies and clothing. In order to carry on this work effectively, Hoover obtained the mandate of the Allied powers to manage the railways and coal mines, waterways and ports in eastern Europe. With the termination of official activities at the signing of the peace, he set up a volunteer organization to continue relief work among European children and support for the people of Austria, Hungary, Armenia and Russia, raising over $250,000,000 for this purpose.

Historical Interests.—During the war Hoover had been gathering historical material and had professional collectors in all belligerent countries engaged in gathering and holding material on the war. With the armistice he embarked upon an enterprise which he refers to in his *Memoirs* as a side issue, but which resulted in one of his great contributions to the writing of the history of the modern world. The large body of manuscript and particularly fugitive material dealing with the years of the war comprised the documentary story of both the established and revolutionary governments of western Europe. These materials were deposited for the use of scholars in a newly established war library at Stanford university. Later known as the Hoover Library on War, Revolution and Peace, it was enlarged to include materials on World War II and the history of governments and peoples throughout the world, finally becoming the Hoover Institution on War, Revolution and Peace.

His experiences during the war and reconstruction years (1914–21) had left deep impressions on Hoover's thinking, and he gave expression to these in a little book, *American Individualism* (1922). He wrote that, "Our individualism differs from all others because it embraces these great ideals: that while we build our society upon the attainment of the individual, we shall safeguard to every individual an equality of opportunity to take that position in the community to which his intelligence, character, ability, and ambition entitle him; that we keep the social solution free from frozen strata of classes; that we shall stimulate effort of each individual to achievement; that through an enlarging sense of responsibility and understanding we shall assist him to this attainment; while he in turn must stand up to the emery wheel of competition."

Secretary of Commerce.—These reflections help in explaining the later developments in Hoover's thought and action as he entered upon his long public career in 1921 as secretary of commerce, first in the cabinet of Pres. Warren G. Harding and later in the cabinet of Pres. Calvin Coolidge. Secretary Hoover undertook the reorganization of the department on the basis of voluntary co-operation among the commercial, agricultural and labour interests of the nation. He organized a multitude of committees representative of business and labour whose functions were to reduce wastes in manufacturing and distribution. He organized new divisions in the department to cover radio broadcasting and commercial aviation, and other divisions to answer the growing need of the country for better housing and greater highway safety. He also expanded the department's foreign trade activities.

During this period he served as a member of the advisory board of the Conference on Limitation of Naval Armaments (1921–22) and as a member of the World War Foreign Debt commission. He served also as chairman of the Colorado River commission and the St. Lawrence Waterway commission. The work of these latter commissions culminated in the erection of the Hoover dam (1930–36) and the construction of the St. Lawrence seaway.

In 1922 Hoover organized the American Child Health association and became its first president. Likewise, in 1923 he organized the Better Homes in America association. He served as chairman of a National Research fund established by the National Academy

of Sciences for the support of research in pure science and raised over $5,000,000 for this purpose.

While secretary of commerce, he was placed in charge of relief at the time of the disastrous Mississippi flood of 1927. For this project he raised over $34,000,000 in charitable funds, directed the removal of 1,500,000 persons from danger areas to temporary camps and afterward restored them to their homes.

Election as President.—Prior to his cabinet service under Presidents Harding and Coolidge, many indications appeared that Hoover's services during World War I had produced in the public mind a growing belief that he had unusual qualifications for the presidency of the United States in the postwar world. This was demonstrated by members of both political parties who discussed his availability during the preliminary canvass of 1920. But his appeal as a national figure was not regarded with favour by the leaders in control of either party. In the course of the discussion it was revealed that he had been and was a registered Republican. Despite activity for his nomination by many friends, his possible candidacy was scarcely considered at the Republican national convention of 1920. The well-known opposition of his fellow Californian, Sen. Hiram Johnson, which influenced many progressives, and the final nomination of Warren G. Harding, an old-line conservative, were indicative of the moderate position Hoover appeared to occupy. In the Republican national convention of 1924 he was given 300 votes for the vice-presidency. All this provided significant background for his entrance upon an active canvass when President Coolidge chose not to be a candidate in 1928. Hoover was strong in the presidential primary contests, and in the convention of 1928 overcame the opposition candidates backed by senate leaders, as well as the candidacy of Gov. Frank Lowden of Illinois. Yet the nomination was not enthusiastically supported by experienced party leaders, for they were divided on the issues of prohibition and farm relief, on each of which the presidential nominee had his own program. With some marked defections, Hoover nevertheless held the Republican electoral vote of the previous two campaigns and added votes from southern states that would not support Alfred E. Smith (*q.v.*), the Democratic nominee. Although he polled 21,391,993 votes, 4,500,000 more than had his predecessor, Calvin Coolidge, it became clear that many progressive Republicans distrusted Hoover and the regular Republican organization still considered him an outsider.

Presidency.—Aware of these conflicting elements—for he had lived in the midst of them for eight years as a cabinet member and had seen the results of their existence in the trying days of President Wilson's war administration—Hoover bent every effort to make the transition from the Coolidge administration as painless as possible. At the same time, his cabinet appointments made it clear that his was to be a personal administration.

Beneath the surface of the highly emotional presidential campaign of 1928 were evidences of the impending crisis in party government that had threatened the disruption of the Republican party ever since the disappearance of the Progressive party in 1916. The choice of Hoover, who stood apart from factions in the party, had obscured the issues in this factionalism and the importance of the personalities involved. But these were at once revealed in the new congress that met to deal with farm relief and with limited revision of the tariff. The centre of the fight was in the senate.

President Hoover presented his program for what he had termed in his campaign "The New Day," a realization of the great economic and social potentialities of the American people in an age of developing science. He pushed toward the enactment of this program throughout his four years in office.

Three developments forced him repeatedly into activities in other fields: (1) the overwhelming need of new federal action on prohibition; (2) the growing importance of an energetic U.S. program overseas to meet rising tides of economic and political uncertainty; and (3) the long train of demands upon the president caused by the stock market crash in the autumn of 1929 and the ensuing widespread depression. On each of these, the president's program as it developed was the object of attack by his Democratic opponents, by a large body of U.S. public opinion, and particularly by members of his own party in the senate.

Despite continuous strife among Republican congressmen Hoover succeeded in establishing the Federal Farm board to serve agriculture, and in increasing the powers of the Tariff commission, thus protecting the principle of a flexible tariff. He also obtained senate approval of the London Naval treaty on July 22, 1930.

The defeat of the Republicans in the congressional elections of 1930 signalized not only the downfall of effective party government in congress, but also the rise to first place in public estimation of a great need for partisan leadership in the presidency. In the ensuing two years of his term in office, Hoover offered that leadership, and in the campaign for re-election more vigorously defended and explained his program for the termination of depression at home and abroad.

The U.S. had been making a slow but certain recovery from the recession when, in 1931, inflation in Europe, unbalanced budgets, unlimited currency issues and excessive borrowing by European nations from U.S. banks resulted in the gigantic European financial collapse of that year. The president proposed to the European governments a moratorium upon all debt payments for one year, obtaining in record time support for his proposals not only from U.S. financial leaders but from senate and house members of both political parties.

Frequently at odds with independent members of his own party and opposed vigorously throughout his administration by Democratic congressmen and the Democratic national committee, Hoover nevertheless obtained a considerable amount of constructive legislation during his administration. The Reconstruction Finance corporation was created (1932) to save building and loan organizations and savings banks and to prevent the collapse of weaker banks, trust companies, railways and industries. Home loan banks were set up to aid homeowners in meeting their mortgages, and agricultural aid banks to help farmers.

The Republican national convention of 1932 renominated Hoover on a platform of his own choosing, and he was supported by the party organization in the ensuing campaign. Despite his extensive and constructive program for dealing with the problems of the depression, and his defense of that program in the campaign, the electorate failed to return him to office, and the Republican party returned to congress a smaller number of representatives than at any time since 1897. Hoover was defeated by Franklin D. Roosevelt by 22,821,857 to 15,761,841 popular votes—in effect a reversal of the vote of 1928. For further details of the Hoover administration, *see* UNITED STATES (OF AMERICA): *History*.

Retirement.—Having served his nation continuously since April 1917, Hoover retired on March 4, 1933, taking an apartment in New York city and reopening his home on the Stanford campus near Palo Alto, Calif. There a trustee of the university since 1912, he had established not only the Hoover institution, but also had led in establishing a graduate school of business and a food research institute.

At no time during the 12 years of Franklin D. Roosevelt's administration was former President Hoover called into service by his successor. Hoover opposed most of the measures, domestic and foreign, of the Roosevelt administration. He opposed the involvement of the United States in World War II and on June 29, 1941, in discussing a tacit alliance with Soviet Russia, he said in a radio broadcast: "If we go further and join the war and we win, then we have won for Stalin the grip of communism on Russia. . . . Again I say, if we join the war and Stalin wins, we have aided him to impose more communism on Europe and the world. At least we could not with such a bedfellow say to our sons that by making the supreme sacrifice, they are restoring freedom to the world. War alongside Stalin to impose freedom is more than a travesty. It is a tragedy."

Hoover continued to be sharply critical of the foreign policies of the Roosevelt administration, yet continued to address his countrymen in discussions of the ends of peace to be achieved in the course of the war. In particular did he attack radical influences in the U.S. government, distinguishing, however, between socialist attack by ballot and communist attack by secrecy and violence.

In view of Hoover's record as relief administrator during World War I, it was not surprising that the former president organized relief for Poland, Finland and other European states after World War II. Pres. Harry S. Truman summoned him to aid in the organization of relief during the great famine of 1946. In order to co-ordinate the work, Hoover visited 39 countries. In 1947 he undertook a mission to Germany and Austria for President Truman to advise upon U.S. policies in the administration of those occupied countries. In response to requests from both Pres. Dwight D. Eisenhower and Chancellor Konrad Adenauer, Hoover repeated his visit to Germany in 1954.

For more than 35 years Hoover had called attention to the inefficiency, waste and rising costs of government services. During his administration, he had made marked contribution to improvement under the difficult conditions of depression. In 1947 congress by unanimous action created a bipartisan Commission on Organization of the Executive Branch of the Government, and Hoover was selected as its chairman. Known popularly as the Hoover commission, this group, after extensive hearings and research, made 270 specific recommendations, of which, with President Truman's aid, 70% were adopted in the interest of reducing expenditures by eliminating overlapping and waste. In 1953 a second Hoover commission was created with wider power. Hoover was again chosen chairman and after two years reported on his exhaustive inquiry. The commission brought in 375 recommendations, many of which were adopted.

In the course of his long public career, Hoover gathered about him a host of admirers and supporters. He twice received the distinction of joint resolutions of appreciation from congress. He was honoured by more than 80 universities and received medals, awards and testimonials from all parts of the world.

In 1958 he published *The Ordeal of Woodrow Wilson,* based upon his own observations of the struggle over the treaty of peace ending World War I and the establishment of the League of Nations. Hoover had dealt with some of the details of this theme first in a small volume, *America's First Crusade* (1941), and again at greater length in the first volume of his *Memoirs,* published in 1951. In this and the following year, he published three volumes of his *Memoirs.* His other works include *The Challenge to Liberty* (1934); with Hugh Gibson, *The Problems of Lasting Peace* (1942); seven volumes of his *Addresses Upon the American Road* (1938–55); and *American Epic,* 2 vol. (1959–60). *See* also references under "Hoover, Herbert Clark" in the Index volume.

Bibliography.—W. S. Myers (ed.), *State Papers and Other Public Writings of Herbert Hoover* (1934); W. S. Myers and W. H. Newton, *The Hoover Administration* (1936). R. L. Wilbur and A. M. Hyde, *The Hoover Policies* (1937), provides further information on the developments of the Hoover administration. (E. E. R.)

HOOVER, HERBERT WILLIAM (1877–1954), U.S. industrialist, was for 26 years president of the Hoover company of North Canton, O., pioneer manufacturer of electric vacuum cleaners. Born near Canton, Oct. 29, 1877, Hoover joined his father in the leather goods business in 1898 after attending Hiram college, Hiram, O. He saw the potentialities in the electric suction sweeper and with his father developed the product which later became the Hoover vacuum cleaner. From maker of 400 cleaners in 1908 the Hoover company grew to be a major producer of vaccum cleaners with plants in several countries. Hoover died in North Canton, Sept. 16, 1954. (J. N. Bl.)

HOOVER, J(OHN) EDGAR (1895–), U.S. public official who, as director of the Federal Bureau of Investigation, was credited with making the initials FBI a symbol of U.S. law enforcement, was born in Washington, D.C., Jan. 1, 1895.

On his graduation from Washington Central high school in 1913, Hoover became a messenger in the Library of Congress and enrolled as a night student in the law school of George Washington university. He received the bachelor of laws degree in 1916 and the master of laws in the following year. He entered the department of justice as a file reviewer in 1917 and two years later was promoted to the post of special assistant to Atty. Gen. A. Mitchell Palmer. He was named acting director of the Bureau of Investigation (as it was then called) in May 1924 and confirmed as director seven months later.

Finding his organization in disrepute because of the scandals of the Harding administration, Hoover instituted rigorous methods of selecting and training personnel. He established a fingerprint file that became the world's largest, a scientific crime-detection laboratory and the FBI National academy, to which police departments from all parts of the country sent selected personnel for special training.

In the early 1930s the exploits of gangsters were receiving glamorous publicity. To counteract this influence Hoover authorized publicity on the achievements of his agents. He explained: "If there is going to be publicity, let it be on the side of law and order." Under his leadership the FBI became noted for its integrity and freedom from political control.

He wrote *Persons in Hiding* (1938) and *Masters of Deceit* (1958). *See* also Federal Bureau of Investigation. (J. Ay.)

HOOVER, THEODORE JESSE (1871–1955), U.S. mining engineer, naturalist and educator, elder brother of Herbert Clark Hoover, was born in West Branch, Ia., Jan. 28, 1871, the son of Jesse Clark Hoover, village blacksmith, dealer in agricultural machinery, and Huldah Minthorn Hoover, Quaker minister. He was educated in the public schools and at Penn college in Iowa and received his A.B. degree in mining engineering from Stanford university in 1901. From 1903 to 1919 he was manager or consulting engineer in the gold mines of California, west Australia, Mexico and Alaska; was an engineer or administrator of lead and silver mines in Burma, copper mines in Finland and Russia, and had offices in London and San Francisco.

In 1919 he returned to Stanford university as professor of mining and metallurgy, becoming dean of the school of engineering in 1925 until his retirement in 1936. Thereafter he lived at his ranch in Santa Cruz county, Calif. As a writer, conservationist and naturalist, he directed a definitive study of the life cycle of the Pacific coast steelhead trout, assisted by the California fish and game commission. He was the author of *Concentrating Ores by Flotation* (1912), *Economics of Mining* (1933), *The Engineering Profession* (1941) and of numerous articles in technical publications. He was a member of the American Society of Mining and Metallurgical Engineers, a life member of the Cooper Ornithological society and colonel in the U.S. army reserve. He died near Santa Cruz on Feb. 4, 1955. (Ht. H.)

HOP, the name given to several species of *Humulus,* twining perennial plants commonly placed in the hemp family (Cannabinaceae); the hops of commerce, used in brewing beer, are the mature "cones" (inflorescences) derived from the common hop (*H. lupulus*) and its varieties. *Humulus* species are of common occurrence in temperate North America, in the southern counties of England, in Europe extending into Asia and to a limited extent in temperate South America. Besides the common hop, there is a related annual species called the Japanese hop (*H. japonicus*); it is a quick-growing vine of little use in the garden as a screen. Two types native to North America have been called *H. americanus* and *H. neomexicanus,* respectively, but botanists are not in universal agreement with respect to this classification.

Hops have been used almost exclusively for brewing purposes for 1,200 years or more. They are also reputed to have certain medicinal properties and are of value as a bitter stomachic for stimulating appetite and aiding digestion.

The brewing value of the cones is based on their content of bitter (soft) resins, essential oils and perhaps tannins. These constituents, which are extracted from hops by boiling in wort (an aqueous infusion of malt), impart the desired mellow bitterness and delicate hop aroma to brewed beverages and aid in their preservation. There is a wide range in brewing value among the many commercial varieties of hops. The content of total soft resins ranges from 15% to 22% in American and British hops and from 11% to 16% in the inherently milder continental European hops. The percentage of the essential oil that contributes to aroma varies from 0.2% to 2.5% or more in commercially dried hops.

Description of the Plant.—The common hop is a long-lived herbaceous perennial with rough twining stems often 25 ft. long which always wind in a clockwise direction. New vines (*i.e.,* stems; called "bines" in England) are produced each season and

die following maturity. An extensive root system penetrates the soil to a depth of 15 ft. or more. Young vines have been observed, under favourable conditions, to grow six inches or more in 24 hours. Strong hooked hairs help the stem cling to its support. The leaves, dark green, hairy, heart-shaped and deeply three- to five-lobed with serrated margins, are borne oppositely on long petioles.

The plant is dioecious; *i.e.*, the male and female flowers are produced on separate plants. The male flowers form panicles two to six inches long and consist of a small, greenish five-parted perianth enclosing five stamens. The female flowers are in short axillary spikes or catkins. During the development of the inflorescence the stem elongates and the bracts enlarge greatly to form the scales or petals of the mature cones (strobiles). The mature cones, two to four inches long, are yellowish-green, oblong or ovoid and loose and papery to the touch. Mature, dried strobiles constitute the hops of commerce.

The pollen is carried by the wind to the female flower. Following fertilization a single ovule develops. The fruit is an achene which contains a spirally coiled embryo.

The fruits and the bases of the bracts forming the mature cone are covered with sticky, yellowish granules consisting of glandular hairs or glands called lupulin. These glands contain an oleoresin consisting of essential oils and resins which possess the characteristic aroma and bitter taste to which the brewing and medicinal properties of hops are attributable.

Geographical Distribution and Production.—Hops are grown commercially over a wide range of climatic and soil conditions. In general, rich alluvial soils or deep sandy or gravelly, well-drained loams are preferred. Soils that are heavy and wet, unduly shallow, or stiff and clayey should be avoided. Hops are produced successfully in milder regions which have abundant rainfall or where adequate moisture can be supplied through irrigation. They are not adapted to regions which are subject to long and severe winters. Prolonged cold, damp and foggy weather in the spring, excessive winds during the growing season and excessive rainfall during the harvest months usually cause damage to the crop.

ROCHÉ

FIG. 1.—HOP VINE AND CONES (HUMULUS LUPULUS)

In North America the hop is cultivated extensively in Washington, Oregon, California and Idaho and to a lesser extent in New York and British Columbia. It is grown commercially in England, Germany, Czechoslovakia, the U.S.S.R., France, Australia, Yugoslavia, Belgium, Spain and Poland and to a limited extent in Japan, New Zealand, South America and South Africa. The United States leads all countries in production, followed closely by Germany and then by England; the combined annual production of these three countries ordinarily account for about three-quarters of the world's total production.

Culture.—The production of hops is a complex and highly specialized industry. The time at which the various cultural and management operations are performed and the care with which they are done can have great influence on the yield and market acceptability of the crop. In all regions the growing areas tend to become localized. As a result, certain practices have tended to become traditional within areas but to vary from one area to another.

Commercial hop fields are propagated from "root cuttings" (actually sections of underground stems), not from seeds, to ensure uniformity of characteristics. Planting is done during the winter or early spring months when weather conditions permit. A common practice in the United States is to plant the cuttings in rows 7 to 8 ft. apart with the hills in the rows spaced 6½ to 8 ft. apart (680–1,000 or more hills per acre). In England one-year-old plants are commonly set in rows 6 to 9 ft. apart and spaced 3 to 7½ ft. apart in the rows according to the system of training to be used (774–2,420 hills per acre).

Each spring the young vines are commonly trained to climb strings suspended from wire trellises and attached to stakes at the hills, or, in some countries, they are allowed to climb poles located at the hills. The heights of the trellises vary from 8 to 25 ft. from one country to another. Practically all of the crop in the United States is grown on trellises 16 to 18 ft. in height, which facilitates harvesting by machinery. In the United States two strings are commonly attached at each hill and two vines are trained up each string. In England two or four strings are attached at each hill, according to the system of training used, and two vines are usually trained up each string. As a result, two to three times as many vines are grown per acre in England as are grown in the United States.

Hops are heavy users of calcium, nitrogen, phosphorus and potassium. In most regions the natural fertility of the soil is supplemented by additions of these and other elements in organic or inorganic form. In the U.S. much needed organic matter is commonly supplied by applications of farmyard manure and harvesting residues, or by the growing of a cover crop of cereal grain or legume which is planted in the fall and plowed under in the spring. English growers apply relatively large amounts of organic matter in farmyard manure, hoof-and-horn meal, fishmeal and other materials which are plowed under in the spring.

Hops are commonly produced under irrigation in the United States where summertime precipitation is low. Irrigation is not practised in England where rainfall during the growing season is usually sufficient.

Hops may be produced either with or without seeds. Their dioecious or unisexual character enables the grower to produce either type by exclusion of male plants from the hop fields or by planting one male plant to about every 100 or 200 female plants. Seeded cones are larger than those of the seedless type and, for this reason, seeded hops produce higher yields. Their lupulin content, however, does not differ materially from that of seedless hops. Seedless hops are considered to be superior to the seeded type for brewing purposes. Male plants are excluded in most of continental Europe, and seeded hops are not produced there. The production of seeded hops is a common practice in England and in some areas of the United States.

Diseases and Insect Pests.—Two fungus diseases (downy mildew and progressive verticillium wilt) and several virus diseases are perhaps the most destructive diseases of hops. All commercial varieties are susceptible in some degree to downy mildew, which attacks the plants in all stages of growth, reduces yields, causes discoloration of the cones and affects their quality. By repeated removal and destruction of the diseased portions of the vines and frequent applications of liquid sprays or dusts containing copper sulfate (Bordeaux mixture) or zinc, the disease usually can be held in check.

Verticillium wilt, an important disease in England, invades the soil and infects all parts of the plants, plugging the water-conducting tissue and subsequently causing death. There are no control measures once the fungus has been introduced into the field, although some commercial varieties are more tolerant to the disease than others.

The various types of virus diseases cause various symptoms in the plants. A diseased plant cannot be cured. Virus diseases can, however, be kept in check by prompt removal of infected hills, which are replaced with cuttings from healthy plants. Control of insect vectors retards spread of virus diseases.

Sooty mold can cause serious damage if hop aphids (plant lice) are not controlled. The aphids secrete a sticky substance called honeydew on which the mold grows and produces discoloration and undesirable flavour in the cones. Red mold attacks the leaves and later infects the inflorescences of the hops, which reduces yield and lowers quality. Both these fungus diseases can be controlled, especially by controlling the insect vectors.

MUSTOGRAPH AGENCY

FIG. 2.—HOP KILNS, OR OASTHOUSES, AT EAST FARLEIGH, ENG.

Many different species of insect pests have been known to infest hops, but only a few of them present a persistent problem. The most important of these are the aphids and the spider mites. The hop aphid, already mentioned in regard to sooty mold, is a sucking insect which devitalizes the plant by extracting the sap from the leaves. Excessively moist and damp weather encourages the attack of hop aphids.

The spider mite is prevalent in all growing regions, especially during seasons of high temperature and drought. It injures the plant by puncturing the leaves and withdrawing the sap. Each puncture usually results in the appearance of a small light-coloured spot on the leaf surface. As the spots become more numerous the infested leaf will gradually shrivel and die. The spider mite may also attack the cones, causing them to turn reddish-brown, adversely affecting their marketability.

Both spider mites and hop aphids can be controlled by spray applications of contact-type insecticides containing organic phosphate or chlorinated hydrocarbon formulations. Systemic insecticides, *i.e.*, those which are absorbed by the plant and transported in the sap, have been used to provide effective protection over a considerable length of time.

Harvesting, Drying and Baling.—Hop cones (or simply, hops) should be harvested when fully mature. Full ripeness is indicated by bright, yellowish-green, sticky, resilient cones that are crisp and papery to the touch, and by hard purple-red seeds. In this condition they possess a maximum of lupulin, which contains the resins and essential oils so important in the brewing of beer and ale. Unripe cones are smaller and contain more moisture and less lupulin. Overripe cones become darker yellow or reddish and shatter easily, resulting in some loss of lupulin. The date of maturity depends upon the variety and environmental conditions but is fairly constant from year to year within a region for any particular variety.

Hops are picked either by hand or by machine. In the United States they are picked almost entirely by machine; in England, by machine to a large extent, but a considerable portion is picked by hand. Hand-picking predominates in the remaining hop-growing countries of the world. Picking begins shortly before the middle of August in some regions and continues until late September in others.

The machines used for picking are of various designs, but most of the machines in large scale use have wire picking fingers or loops mounted on bars which travel against the vines, plucking the cones as they pass. Picking machines are either stationary, being housed in large sheds, or are portable. The former have a larger capacity and require a larger labour force.

Freshly picked hops contain 65% to 80% moisture, depending on the variety and climatic conditions. Drying to approximately 10% moisture is accomplished in kilns, usually referred to in England as oasts. The size and construction of the kilns and the methods of conducting the heated air through the hops differ. American kilns are usually of frame construction, although some are built of concrete and brick. Individual kiln floors are usually square or rectangular, 32 by 32 ft. being a common size. The freshly picked hops are loosely and evenly scattered on the slatted floor of the kiln, which is covered with burlap to prevent the hops from falling through. Air which has been heated by a stove or furnace passes through the hops from below. Air passage is accomplished by natural draft (convection) or by forced draft. In the forced-draft kilns a current of heated air from the outside is forced through the hops by means of bottom blower fans or by suction fans placed in the cupolas of the kilns. The forced draft kilns are by far the more common because of greater capacity, since a bed of hops up to 40 in. in depth may be dried at one time. Heating is accomplished by burning wood, oil or gas.

The typical kiln in England is either a square (16–20 ft.) or a circle of 16–20 ft. diameter. Most oasthouses are built of brick and have a tapering roof which is surmounted by a pivoted wooden cowl. The cowl assists in preventing a back draft in windy weather, particularly in natural-draft kilns. All modern kilns are equipped with fans, and fans have been installed in many old natural-draft kilns. Many kilns are heated by open anthracite fires; the products of combustion pass through the hops. Other systems of heating in England employ oil flame or steam radiators.

Low drying temperatures are recommended for production of hops of best quality. Temperatures exceeding 66° C. (150° F.) are discouraged because the hops are likely to darken in colour, with destruction of their resinous and aromatic constituents. The time required for drying a particular lot of hops depends upon humidity, temperature, air velocity and moisture content of the hops, and will vary from 6 to 20 hours.

After hops have been dried sufficiently in the kiln they are removed to a cooling house where they are stored in large heaps for a period of 1 to 12 days, depending upon the capacity of the coolers. During this time they undergo a curing process which equalizes the moisture content, modifies the pleasant aroma and causes them to become tougher and more pliable for baling.

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FIG. 3.—FRESHLY PICKED HOPS ENTERING A KILN; THEY ARE DRIED BY HEATING FROM BELOW

Baling is the last step preparatory to marketing. After drying and curing, the common procedure in the United States is to compress the hops into rectangular bales of approximately 18 cu.ft. weighing about 200 lb. and finally to wrap them in heavy burlap for marketing. In England they are compressed into "pockets"—large bags made of jute sacking about six feet in length and two feet in diameter—containing slightly more than 1½ cwt. of hops. (S. N. B.)

HOPE, ANTHONY, the pen name of SIR ANTHONY HOPE HAWKINS (1863–1933), English novelist, known chiefly as the author of *The Prisoner of Zenda,* who was born at Clapton, London, on Feb. 9, 1863. Educated at Marlborough and at Balliol college, Oxford, he was called to the bar at the Middle Temple in 1887. The immediate success of *The Prisoner of Zenda* (1894), his fourth work—and its sequel, *Rupert of Hentzau* (1898)—turned him entirely to writing. These novels tell of the perilous adventures of the Englishman Rudolph Rassendyll in (imaginary) Ruritania: they were imitated and dramatized, and remain popular light reading, eclipsing his more realistic work. This includes the witty high-society conversations *The Dolly Dialogues* (1894) and a series of novels which often pose an outstanding figure against English society, *The God in the Car* (1894), based on Cecil Rhodes's career, *The King's Mirror* (1899), *Quisanté* (1900) and others. He wrote 32 novels and two dramas. In 1918 he was knighted for war

work. He died at Walton-on-the-Hill, Surrey, July 8, 1933.

See C. E. Mallet, *Anthony Hope and His Books* (1935).

(W. L. G. Ja.)

HOPE, THOMAS (1769–1831), English writer, designer and connoisseur, born in London in 1769, eldest son of John Hope, one of a wealthy family of Scottish merchants and bankers settled in London and in Amsterdam, where Thomas grew up. About the age of 18, Hope traveled widely in Europe, Asia Minor and Egypt, studying and sketching architecture. About 1795 he settled in England, and in the following years he designed the furniture and decoration of his London house in Duchess street and his country house at Deepdene, Surrey, to provide a suitable background for his fine collection of ancient and modern sculpture. In 1807 he published his furniture designs in a folio entitled *Household Furniture and Interior Decoration*. This work, though much criticized by his contemporaries, exercised considerable influence on Regency furniture. It provided a wide range of furniture based on "correct" classical and Egyptian models. In 1819 Hope anonymously published a novel, *Anastasius, or Memoirs of a Modern Greek, written at the close of the 18th century*. It was at first generally attributed to Lord Byron, but Hope later revealed his authorship. Hope died in London on Feb. 3, 1831.

See M. Jourdain, *Regency Furniture*, rev. ed. (1948). (J. E. Le.)

HOPE, in Christian thought, one of the three "theological virtues," together with faith and charity (*qq.v.*). It is distinct from these other virtues because it is directed exclusively toward the future, as fervent desire and confident expectation. A definition of hope as faith oriented toward the future would therefore be a satisfactory, if rather oversimplified, way to include much of what the Bible and the Christian tradition have meant by the term; or, in the more nearly adequate formulation of Augustine, "hope deals only with good things, and only with those which lie in the future, and which pertain to the man who cherishes the hope." When hope has once attained its object, it ceases to be hope and becomes possession; therefore, while "love never ends," hope is confined to man's life on earth.

One important function of the idea of hope in Christian thought has been to characterize the faith of ancient Israel, the messianic hope (*see* Messiah). Throughout the New Testament, Christian hope is closely tied to the ultimate hope of the return of Jesus Christ as the judge of the living and the dead. Yet this eschatological hope does not eliminate intermediate hopes for lesser goods, even for material blessings. It seems safe to generalize that the analyses of faith, hope and charity in manuals of Christian doctrine and ethics have usually devoted more space to faith and charity and to the relation between them than to a detailed delineation of hope as such (as distinguished from the objects of hope, which are the topic of Christian eschatology). Only when the Christian expectation of "the resurrection of the dead and the life of the world to come" has become especially vivid, has the theological discussion of hope acquired a status comparable to that of faith and of charity. *See* also Eschatology.

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HOPEH (Ho-pei Sheng), the most northeasterly of the historic 18 provinces of China proper, situated between the lower Yellow river and the Great Wall. The name Hopeh, meaning "north of the (Yellow) river," was given to the province in 1928. Previously, the province was known as Chihli, meaning "directly controlled," for it contained the city of Peking (Peiping) which was, before 1928 and again from 1949, the capital of China.

Before 1949 Hopeh had an area of 54,000 sq.mi. Under the Communist regime, after 1949, the province increased its area to 81,479 sq.mi. as a result of annexations from the former provinces of Chahar (1952) and Jehol (1956). The population of Hopeh within its expanded borders was about 44,720,000, based on a 1957 est. Another administrative change took place in 1958, when the seat of the provincial government was transferred from Paoting, the historic provincial capital, to Tientsin.

The greater part of the province lies in the north China plain, which shelves almost imperceptibly toward the shallow Gulf of Po-Hai, an arm of the Yellow sea. The surface of the plain consists of alluvium, river sands and loess, which form a fertile though thin veneer over a subsurface made up of infertile marine gravels. Hopeh is one of China's leading producers of winter wheat and cotton. Other crops are soybeans, peanuts and other oilseeds. In the newly annexed territory north of the Great Wall, extending to the windswept Mongolian plateau, livestock herding becomes more important. In that area of low rainfall and cold winters, hardier crops such as spring wheat, millet and potatoes are grown.

Coal is Hopeh's leading mineral resource. The Kailan basin, centred on T'ang-shan, is one of China's main coal producers. Kailan coal is suitable for power-station fuel and other steam-generating uses. The Men-t'ou-kou mine, west of Peking, yields anthracite. Fengfeng, near the city of Han-tan, is a coking-coal centre that was expanded by the Communist regime after 1949. Iron ore is mined in the Lung-yen district near Hsüan-hua in former Chahar province, and at Wu-an, west of Han-tan. Other mineral industries are based on gold and copper deposits in the P'ing-ku-Tsun-hua area near the Great Wall, and on coastal salines, centred on the town of Han-ku on the gulf of Po-Hai.

The coal and iron-ore resources furnished the basis for an integrated iron and steel industry at Shih-ching-shan, a western suburb of Peking. The pig iron produced is converted into steel at Shih-ching-shan itself, as well as at smaller steel plants in Tientsin and T'ang-shan. Before Communist rule, Tientsin was the province's only metal-fabricating and manufacturing city. After 1949 industrial expansion was promoted in Peking, the national capital, which built new plants and factories in industrial suburbs. Peking's metal industries produce automobiles, tractors, locomotives and bridge girders. As a leading cotton-growing province, Hopeh has been developed also as a textile producer. Large cotton mills operate at Peking, Shihkiachwang and Han-tan.

Hopeh's population is made up almost entirely of Chinese speaking the northern Mandarin dialect, China's national language. The only national autonomous areas reserved for ethnic minorities are two autonomous *hsien* (counties) of the Hui (Chinese Muslims) at Ta-ch'ang, east of Peking, and at Meng-ts'un, near the Shantung border in the southeast. Both autonomous *hsien* were established in June 1956.

The province's largest cities, with 1957 estimated populations, are Peking (4,010,000), Tientsin (3,220,000), T'ang-shan (800,000), Shihchia-chuang (598,000), Kalgan, Paoting, Ch'in-huang-tao and Hsüan-hua. (T. Sd.)

HOPEWELL. This name is given to a spectacular cultural development shared by prehistoric American Indians from about 500 B.C. to A.D. 500 in what is now the southern part of Ohio. Typical monuments—groups of burial mounds with extensive enclosures of banked earth—are the M. C. Hopewell, Mound City, Harness and Seip groups, all in Ross county; Turner in Hamilton county; Tremper in Scioto; the Ft. Ancient hilltop enclosure in Warren; and the works at Marietta and Newark. Archaeological excavations have been carried out since 1846 by various institutions, notably the Ohio State museum and the Ohio State Archaeological and Historical society. Across the northern United States from western New York to Kansas City are concentrations of other prehistoric sites called Hopewellian but representing coordinate cultural developments not necessarily tributary to Ohio. Southward to the Gulf of Mexico a number of cultural groups were variously affected by the spread of Hopewellian ideas.

Some Hopewellian sites yielded considerable evidence of domestic occupation and data concerning the economic systems upon which contemporary societies were based. The major sites, especially in Ohio, have the character of mortuary precincts, however, and since excavators have not been unmindful of the occurrence of fine museum specimens deposited as offerings in mounds and graves, there is even more information about burial customs.

Some details of architectural and building practices are known from the remains of charnel houses and log tombs found under the burial mounds as well as from the occasional remains of domestic dwellings. The relics of costumes and objects deposited with the dead reveal something about technology and kinds of raw mate-

rials. Differential placement of burials contrasting in regalia and wealth of offerings suggests distinctions of social status and permits some inferences about the kind of society in which such differences could occur. It is also possible that Hopewellian communities included specialist artisans. The wealth of objects buried with the dead required constant replacement. While virtually nothing is known concerning religion, it appears from grave offerings that the status granted in life was expected to be maintained in the hereafter. The elaborations of mortuary and probably other ceremonies may have required a specialized priesthood to look after such matters.

Reconstruction of the lifeways of the various Hopewellian peoples is an engrossing task. The economy—to judge from preserved food remains—was based on hunting, fishing and gathering wild plant foods. That cultivation was known is attested by occasional finds of carbonized corn, and of corn and beans at a site near Kansas City. Yet the basic orientation may have been toward hunting and gathering rather than toward agriculture. There is better information concerning technology. Tools and weapons were of chipped and ground stone, bone, wood and cold-hammered copper. The art of smelting was unknown. Ground stone axes were used to fell the timbers for domestic and mortuary buildings. Chipped flint drills, knives, scrapers and projectile points had many uses at home as well as in hunting. Woven textiles have been found with burials, preserved by the salts of copper objects placed with them, and small painted pottery figurines also show details of dress and hair style.

The Hopewellians excelled in crafts and so skillful was the workmanship on many of the objects deposited with the dead that these are often sought by museums and collectors of art objects. These include copper "Panpipes," breastplates, headdresses, bracelets and many other items, but especially noteworthy are stone pipes carved in the forms of birds and animals.

Other information—stylistic changes in artifact forms—permits tentative conclusions concerning the origin, spread and eventual disappearance of the cultural efflorescence achieved by the Hopewellian societies. Most features of Hopewellian life had a gradual historical development in the northern United States east of the Mississippi and the people themselves were a longheaded physical type indigenous to the region. The basic mortuary practices also had a long history in the area, but many specific details in Ohio Hopewell were borrowed from a related culture—Adena—that lay immediately southward in Kentucky, began earlier and ended sooner. The various northern Hopewellian groups possessed their own cultural traditions, but at about the time of the great Ohio development they are found to share similar burial habits, some kinds of artifacts, and their economies were probably based upon similar adjustments to natural resources. All these societies were historically related, and there was much interaction and trade among them that would have promoted the spread of ideas, furthering the likenesses among the various groups. This trade extended far beyond the borders of the northern Hopewellian societies, however, and was at least in part the instrument through which cultural linkages were established with the south. From the Lake Superior region came native copper which was cold-hammered into ornaments; from the Carolinas, mica which was carefully cut in abstract and naturalistic forms and attached to costume; from the Atlantic coast and Florida came seashells for other ornaments and the large *Cassis* shells for cups; evidently it was the west which supplied obsidian for manufacture of fine black spearheads. Although most Hopewellian ceramics were of local origin, simple wide-mouth pots decorated with impressions of cord, fabric or a cord-wrapped stick, there was widespread in the north at this time a finely made and tastefully decorated pottery that may have been manufactured in only one or a few places.

The offerings in the Ohio mounds were the most varied and elaborate, but there is no evidence that Ohio exercised political domination over the other northern areas although it must have been a major hub of Hopewellian trade. After about A.D. 500 the more spectacular features of Hopewellian burial practices gradually disappeared and were replaced by simpler rites. It is uncertain whether this represented some kind of total cultural decline or simply an unwillingness to continue to devote so much wealth and effort to the care of the dead in the hereafter. Whatever the case, there was a corresponding decline in the quantity and quality of the fine articles immolated with the dead and a virtual disappearance of the trade in the materials from which these had been made. Important social changes may have taken place at this time; some of the later sites are smaller and show much less in the way of material equipment, suggesting a simpler kind of social organization and a more unsettled way of life.

See also INDIAN, NORTH AMERICAN: *Culture Provinces: Eastern North America;* NORTH AMERICA: *Prehistory and Archaeology: Early American Planters.*

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HOPI, the westernmost tribe of Pueblo Indians (*q.v.*), situated in northeastern Arizona, on the edge of the Painted desert. Known also as the Moki or Moqui, they speak a Shoshonean language of the widely distributed Uto-Aztecan stock. In the early 1960s there were about 4,000 Hopi, living in typically terraced pueblo structures of stone and adobe and clustered into a number of independent towns. Most of their settlements were on high mesas.

Atop First or East Mesa is the Tewa-speaking community of Hano, as well as the Hopi town of Walpi and its "suburb," Sitcumovi. Middle or Second Mesa holds the three villages, each under its own chief, of Shipaulovi, Mishongnovi and Shungopovi. Third Mesa until Sept. 1906 contained only the unofficial "capital" of Oraibi (Old Oraibi) but thereafter successive splits led to the founding of Hotevilla and Bakavi. About 40 mi. to the west of Third Mesa is Moenkopi, a former farming colony and offshoot of Oraibi. On the plain below Third Mesa is the autonomous village of New Oraibi (Kikötcmovi), and other settlements lie at the feet of First and Second Mesas.

The precise origin of the Hopi is unknown, nor is it known why they live in so many independent communities. Their own origin myths merely state that their ancestors climbed upward through four underground chambers called kivas and lived in many places before reaching their present locations. And, indeed, archaeology has revealed that some abandoned pueblos, such as Sikyatki and Awatovi, were once occupied by Hopi people.

Mother descent is the tribal rule. Oraibi's populace, for example, used to be divided into 30 or 31 matrilineal clans, that were grouped into nine larger social units or phratries, some of which are now extinct. Formerly, too, the Hopi were strictly matrilocal, which meant that a bride remained in her mother's house. This custom no longer prevails.

The Hopi support themselves by farming and sheepherding. Their chief crop is corn, but they also grow beans, squash, melons and a variety of other vegetables and fruits. Men farm and herd, in addition to building houses, performing most of the ceremonies, making moccasins and weaving garments and blankets. The women, besides performing the usual domestic tasks, make baskets and pottery, fetch water, do supplementary gardening and help with housebuilding.

Like all Pueblo Indians, the Hopi are peaceful, monogamous, diligent, self-controlled and very religious. Both sexes begin their ceremonial careers soon after reaching six years of age by being inducted into the katcina (*kachina*) cult. Hopi katcinas are masked impersonations, always by men, of a wide variety of gods, spirits, departed ancestors or clouds. Katcina masks and costumes are usually elaborate and bright, bringing colour and warmth into lives that are otherwise somewhat drab.

Women seldom took active part in ceremonies, except as voluntary members of one or more of three feminine secret societies. However, in each village men had the option of joining a wide number of secret societies, including those that conducted a strenuous tribal initiation, and which staged an annual winter solstice (*Soyal*)

celebration. So important was the *Soyal* that its leadership was always entrusted to a high official, usually the town's chief.

Most widely publicized of Hopi rituals is the Snake dance, held in late August, during which the performers dance with live snakes in their mouths. Actually the public sees only a brief, though exciting, portion of a lengthy ceremony, most of which is conducted secretly in kivas.

With the breakdown of isolation, growing numbers of Hopi have abandoned the ways of their ancestors. Caught up in a process of rapid culture change, they no longer turn their efforts inward, toward their pueblos, but outward, toward the white man's towns and cities and economic and recreational systems. As a result the traditional culture of the Hopi is steadily disintegrating.

See also references under "Hopi" in the Index volume.

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HÖPKEN, ANDERS JOHAN, Count von (1712–1789), Swedish statesman, was the son of Daniel Niklas Höpken, one of Arvid Horn's most determined opponents and a founder of the Hat party. When in 1738 the Hats came into power the younger Höpken obtained a seat in the secret committee of the diet, and during the Finnish war of 1741–42 was one of the two commissioners appointed to negotiate with Russia. During the diet of 1746–47, it was chiefly through Höpken's efforts that the estates issued a "national declaration" protesting against the arrogant attitude of the Russian ambassador, who attempted to dominate the crown prince Adolphus Frederick and the government. This spirited policy restored the waning prestige of the Hat party and firmly established their anti-Muscovite system. In 1746 Höpken was created a senator. In 1752 he succeeded Carl Gustaf Tessin as prime minister, and controlled Sweden's foreign policy for the next nine years.

On the outbreak of the Seven Years' War, he contracted an armed neutrality treaty with Denmark (1756), but in 1757 acceded to the league against Frederick II of Prussia. During the crisis of 1760–62, when the Hats were at last compelled to give an account of their stewardship, Höpken retired from the senate and from the premiership. After the revolution of 1772 he reentered the senate, finally retiring in 1780.

See Carl Silfverstolpe, *Grefve Höpkens Skrifter* (1890–93); Olof Jägerskiöld, *Den Svenska utrikepolitikens historia . . . 1721–1792* (1957). (E. O. H. J.)

HOPKINS, EDWARD WASHBURN (1857–1932), U.S. philologist and outstanding Sanskrit scholar, was born at Northampton, Mass., Sept. 8, 1857. Receiving his training in classics at Columbia university and in Sanskrit at the University of Leipzig (Ph.D. 1881), Hopkins later taught at Columbia (1881–85), Bryn Mawr (1885–95) and at Yale (1895–1926), where he became Edward E. Salisbury Professor of Sanskrit and Comparative Philology. Hopkins' monograph on "The Social and Military Position of the Ruling Caste in Ancient India," in the *Journal of the American Oriental Society* (1889), is still the best account of its subject. In *The Great Epic of India* (1901) he furnished the first statistical and scientific evidence for distinguishing the chronological layers of the *Mahabharata*. More widely read were his books: *The Religions of India* (1895), *Epic Mythology* (1915), *The History of Religions* (1918), *Origin and Evolution of Religion* (1923) and *Ethics of India* (1924). Hopkins died at Madison, Conn., on July 16, 1932.

See *Journal of the American Oriental Society*, 52:314–315 (1932), for a bibliography of Hopkins' work. (D. H. H. I.)

HOPKINS, ESEK (1718–1802), first commodore of the American navy, was born in Scituate, R.I., April 26, 1718, and went to sea at the age of 20. Ability as a seaman and trader and a wealthy marriage placed him at the head of a large merchant fleet prior to the French and Indian War. Successful privateering during that war added to his opulence and gave him a naval reputation. Rhode Island named him a brigadier general of its land forces at the outbreak of the American Revolution, but a call from the continental congress, where his brother was chairman of the naval committee, induced him to forsake the army and, on Dec. 4, 1775, accept the command of the first continental fleet then outfitting at Philadelphia. Instructed to attack Lord Dunmore's British fleet in the Chesapeake, Hopkins considered his orders discretionary, and the enemy too strong. He sailed his fleet of eight armed vessels, therefore, to the Bahamas, captured considerable war material at New Providence, and, upon his return, fought an inconclusive action with the British ship "Glasgow," April 6, 1776. Dissatisfaction with the achievements of the fleet and its subsequent inactivity in Rhode Island, brought an investigation in congress where Hopkins, in Aug. 1776, was ably defended by John Adams, who sensed an anti-New England spirit behind the attack upon the commodore. Censured for disobedience of orders, but saved from dismissal, Hopkins returned to Rhode Island, his command restricted to only "the fleet formerly put under his care." At loggerheads with most of his officers, and unable to man his ships and dispatch them as a fleet, he soon lost the confidence of congress. When a group of officers preferred formal charges against him, congress, on March 26, 1777, suspended him from his command. Hopkins managed to have several of his principal accusers court-martialed and "broken," but he never regained his command. Dismissal from the navy came on Jan. 2, 1778. Thereafter, until his death at Providence, Feb. 26, 1802, he played a prominent part in Rhode Island politics.

See *Journals of Continental Congress, 1775–1778* (1905–1908); *Esek Hopkins Letter Book* and *Correspondence of Esek Hopkins* (1932, 1933); Edward Field, *Life of Esek Hopkins* (1898). (W. B. Ck.)

HOPKINS, SIR FREDERICK GOWLAND (1861–1947), English biochemist and Nobel laureate, was born on June 30, 1861, at Eastbourne, East Sussex. In 1888 he began his medical studies at Guy's hospital. He combined activities in research with clinical work and after taking his degree at the University of London in 1894 became a member of the staff of the medical school of Guy's. In 1899 he was called by Sir Michael Foster to Cambridge, where he joined the illustrious school of physiology which Foster was founding. Trinity college created the post of prelector in physiological chemistry specially for him.

Hopkins showed that the wing pigments of certain butterflies were derivatives of uric acid, and gave a new turn to thought concerning animal pigmentation by demonstrating that excretory substances may function in ornament. He early realized that one of the urgent needs of biochemistry, then entering its modern phase under E. Felix Hoppe-Seyler and Franz Hofmeister, was accurate knowledge of the proteins. He succeeded (with S. W. Cole) in isolating from proteins the amino acid tryptophan. In 1906, in collaboration with W. Fletcher, he laid the foundation of modern knowledge of the chemistry of muscular contraction by his researches into lactic acid production in muscle. In the same year he published preliminary reports of experiments involving "pure diets" which proved the existence of essential amino acids and of those accessory factors in foods which were afterward to be known by the name of vitamins; full results of the vitamin experiments were published in 1912. Another important research was that of 1910 (with G. Savory) on Bence-Jones protein. In 1921 Hopkins made his most fundamental contribution by isolating from living tissues the sulfur-containing dipeptide glutathione and by showing its great importance for oxidation in living cells.

Among the many honours Hopkins received were the Royal medal (1918) and the Copley medal (1926) of the Royal society; the Nobel prize (jointly with Christiaan Eijkman; *q.v.*) for physiology (1929); and the Order of Merit (1935). He was knighted in 1925. Hopkins died on May 16, 1947, at Cambridge, Eng. (J. Ne.; X.)

HOPKINS, GERARD MANLEY (1844–1889), English poet and Jesuit priest, was one of the most individual of Victorian writers. His collected poems were not published until 1918, and at first were little appreciated; but the second edition in 1930 found a generation ready for his original style and fresh vision, and quick

to respond with imitation. His impact on subsequent verse was widespread and fundamental.

He was born at Stratford, Essex, on July 28, 1844, the eldest child of Manley Hopkins, an Anglican who was for a time British consul general in Hawaii. From the Cholmondley grammar school, Highgate, he won an exhibition to Balliol college, Oxford, which he took up in 1863. At the university, in the atmosphere of the Oxford movement, he became a Roman Catholic (1866). The following year he left Oxford with a double first (Honour Moderations and Greats); Benjamin Jowett, then a lecturer at Balliol, and later master, called him "the star of Balliol." In 1868 Hopkins entered the Jesuit novitiate. He was ordained priest in 1877, and subsequently did parish work in London, Oxford, Liverpool and Glasgow, and taught classics at Stonyhurst college, Lancashire. He was appointed professor of classics at University college, Dublin, in 1884. A very patriotic Englishman, he found Ireland uncongenial, and suffered from ill-health and overwork. He died there of typhoid fever on June 8, 1889, and was buried in the Glasnevin cemetery.

On entering the Society of Jesus, Hopkins burned his youthful verses. While a novice in Wales, he began writing poetry again and produced his remarkable long poem "The Wreck of the Deutschland." It was rejected by the Jesuit magazine *The Month*, and his subsequent poems were read only in manuscript by his friends, the Rev. R. W. Dixon, Robert Bridges and Coventry Patmore, whose appreciation of them was imperfect. After his death, Bridges tentatively published some in anthologies, but judged the public not ready for a collected edition until 1918.

Much of Hopkins' best poetry arises from complex tensions between his delight in the sensuous world and his ascetic sense of religious vocation. In Duns Scotus (*q.v.*) he found philosophical support for his own sense of the particularity of all natural things. He used the word "inscape" to denote this "selfness"; each scene was to him a "sweet especial scene"; each sensuous impression had its own elusive individuality. His poems, vibrating with an intense feeling for nature, attempt to capture these inscapes in a form that has its own inscape; hence the vigour and originality of his style.

Hopkins' compound words (such as "beak-leaved," "earl-stars," "firedint," "dapple-dawn-drawn"), his syntactical compressions, his alliterations, which serve to enlarge the meaning, and other stylistic and metrical devices, some adapted from Welsh poetry, are all used to project profound personal experiences, including his keen awareness of the actuality of good and evil, and his delight in "all things counter, original, spare, strange." The poems are energized by what he called "sprung rhythm," which had Old English verse and nursery rhyme as precedents, and which used the principle of stress instead of traditional syllabic rhythm. A single stress makes a single metrical foot, and can act either by itself or with a number of unstressed syllables, while the scanning runs on unbroken from beginning to end of the stanza. The result is an organic form, in which all the elements aim at sensory vividness.

Hopkins' poetry combines acuteness of vision, imaginative exactness, sincere emotion and intellectual depth. His letters show a brilliant critical faculty, generous humanity, deep religious feeling, scrupulous self-criticism and a powerful will. Those who knew him paid tribute to his personal integrity, and his rare "chastity of mind."

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See also G. F. Lahey, *Gerard Manley Hopkins* (1930); John Pick, *Hopkins: Priest and Poet* (1942); W. H. Gardner, *Gerard Manley Hopkins, 1844–1889*, 2 vol. (rev. ed. 1948–49); W. A. M. Peters, *Gerard Manley Hopkins: A Critical Essay* (1948); Alan Heuser, *The Shaping Vision of Gerard Manley Hopkins* (1958); Jean-Georges Ritz, *Robert Bridges and Gerard Manley Hopkins, 1863–1889* (1960). (J. C. RE.)

HOPKINS, HARRY LLOYD (1890–1946), administrator of federal relief during the New Deal and Pres. Franklin D. Roosevelt's close adviser and personal emissary during World War II, was born at Sioux City, Ia., on Aug. 17, 1890. He entered social work in New York city immediately after his graduation from Grinnell (Ia.) college in 1912. In 1931 when the acuteness of the depression forced large-scale state aid to the unemployed, he became executive director, then chairman, of the New York state temporary emergency relief administration under the then governor Roosevelt. In 1933 after Roosevelt was inaugurated president, he appointed Hopkins administrator of the new Federal Emergency Relief administration. Hopkins immediately began distributing an initial $500,000,000 in federal grants-in-aid to establish state relief programs. He tried to resist political pressures and laboured vigorously to establish relief agencies of high professional standards. He combined crusading moral fervour with hardheaded executive ability. Worrying about the moral erosion and loss of skills of those who had not worked for years, he persuaded President Roosevelt to establish a work relief program, the Civil Works administration (CWA), in the fall of 1933. Criticism of the makeshift nature of many of the projects led to the abolishment of the CWA in the spring of 1934. Heavy Democratic victories in the fall elections of that year encouraged Hopkins to pressure the president to recommend extensive reforms in 1935. These included the establishment through an act of congress of a more substantial work relief program, the Works Progress administration (WPA). Some parasitism, and by 1938 much politics, entered into the WPA. Republicans charged that the enormous relief funds were being spent to influence elections and claimed Hopkins had remarked, "Spend and spend, tax and tax, elect and elect." Yet Hopkins altogether spent a total of $8,500,000,000 for unemployment relief with the record marred by a few relatively insignificant scandals compared with many substantial public works achievements, and the aiding at one time or another of about 15,000,000 people. By the time of the election of 1936 Hopkins had become deeply interested in politics and increasingly served as an adviser to Roosevelt. In the late 1930s he developed presidential ambitions. Roosevelt appointed him secretary of commerce in 1938. A serious stomach operation leaving him in permanently precarious health put an end to his political ambitions but, if anything, made him more valuable to Roosevelt as a trusted confidant. He acted as personal manager for Roosevelt at the Democratic convention in July 1940. In Aug. 1940 he resigned as secretary of commerce to devote himself fully to working on the problems of the defense crisis and aiding Great Britain. He made several trips to London, and after the U.S.S.R. entered the war, to Moscow, to discuss assistance, and after the United States entered the war, strategy. Hopkins was head of the lend-lease program in 1941 but until the end of the war functioned for the most part informally as the president's adviser, so close to Roosevelt that he even lived in the White House. His final service after Roosevelt's death was to visit Moscow in the spring of 1945 to help arrange the Potsdam conference for Pres. Harry S. Truman. Hopkins had long been thin and wracked by pain; he died in New York city on Jan. 29, 1946.

See Robert Sherwood, *Roosevelt and Hopkins* (1948). (FR. F.)

HOPKINS, MARK (1802–1887), U.S. educator and moral philosopher, of whom it was said that "The ideal college is Mark Hopkins on one end of a log and a student on the other," was born in Stockbridge, Mass., on Feb. 4, 1802. He became identified with a philosophical outlook that combined 18th-century puritanism and 19th-century progress. His teachings at Williams college, Williamstown, Mass., where he was in charge of instruction of the senior class from 1830 to 1887 and president from 1836 to 1872, and his four series of lectures before the Lowell institute, Lowell, Mass., gave him an opportunity to preach the "gospel of wealth," which emphasized the importance of striving to possess property and of treating wealth with the responsibility of Christian stewardship.

Hopkins was firmly established in the folklore of U.S. education by the above-quoted aphorism, attributed to Pres. James A. Garfield, his former student. This aphorism may be considered to define the purposes of the liberal arts college in the United States, suggesting an emphasis on self-education, close student-faculty relations and moral as well as intellectual training. Hopkins' retire-

ment from the Williams presidency in 1872 meant an acceleration of those tendencies toward secularism, intellectualism and professionalism that he deplored. He died at Williamstown on June 17, 1887.

Hopkins is sometimes confused with a contemporary Mark Hopkins, who was associated with Theodore Judah, Collis P. Huntington and Leland Stanford in California railroad development.

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HOPKINS, SAMUEL (1721–1803), American Congregational theologian, a disciple of Jonathan Edwards (*q.v.*), was born in Waterbury, Conn., on Sept. 17, 1721. He was graduated from Yale college in 1741; studied divinity at Northampton, Mass., under Edwards; and in Dec. 1743 was ordained minister of the Congregational church in frontier Housatonick (later named Great Barrington, Mass.), where he continued his contacts with Edwards and served until 1769. From April 1770 to his death on Dec. 20, 1803, he was minister of the First church in Newport, R.I. He and Joseph Bellamy were Edwards' most important and creative disciples, Hopkins being the more arresting, controversial and influential of the two. His uningratiating manner and severe views on unregeneracy, church membership and baptism led to his dismissal at Great Barrington and to much dissatisfaction at Newport; but "Hopkinsianism" flourished despite the ravages of imperial wars and the Revolution. *A System of Doctrines Contained in Divine Revelation* (1793) is Hopkins' masterpiece, a closely reasoned dogmatics developing the great Edwardsean themes yet adjusting them to the growing humanitarian temper of the times. His most widely discussed contentions were these: that God's permission of sin stemmed from his concern for the happiness of the whole and hence is "advantageous"; that human virtue consists in a similar concern for the whole, with disinterested benevolence or complete submission to God's will being the supreme motive, even unto willingness to be damned; that sin consists essentially in self-love; and that there is no promise of salvation but in the exercises of holiness of regenerate men. His work had great effect in expanding missionary activity in America and abroad (particularly Africa) and in developing philanthropic social attitudes. Beginning in the early 1770s he began to speak and write actively for Negro emancipation and against the slave trade, being one of the first New England Congregationalists to do so.

BIBLIOGRAPHY.—Hopkins' *Works*, 3 vol. (1852) contains a good biography by E. A. Park; Stephen West's *Sketches of . . . Hopkins* (1805) is largely Hopkins' autobiography. *See* also Williston Walker, *Ten New England Leaders* (1901); F. H. Foster, *Genetic History of the New England Theology* (1907); Joseph Haroutunian, *Piety Versus Moralism* (1932). (S. E. A.)

HOPKINSON, the name of two English engineers and physicists, father and son.

JOHN HOPKINSON (1849–1898), chiefly known for his work in the electrical field and in particular for his analysis of the magnetic circuit, was born in Manchester on July 27, 1849. After a brilliant career at Cambridge and London universities he entered, as a pupil, the engineering works in which his father was a partner. In 1872 he became engineering manager in the glass manufactories of Chance Brothers and Co. at Birmingham, where he studied the problems of lighthouse illumination and advocated the group-flashing method of differentiating lights. He also undertook researches on electrostatic capacity, the phenomena of residual charge and other problems arising out of James Clerk Maxwell's electromagnetic theory.

In 1878 Hopkinson established in London a successful practice as a consultant engineer. His work was mainly electrical: he acted, for instance, as consultant to the English Edison Co., to the Metropolitan Electric Supply Co. and to Mather and Platt on the City and South London railway. He was also in great demand as an expert witness in patent cases. In the early 1880s Hopkinson was almost alone in his grasp of the correct principles underlying the new application of electricity to "the electric light." In conjunction with his brother Edward he worked out the general theory of the magnetic circuit in the dynamo, making great improvements in its design and efficiency; he analyzed the process of commutation; and he took a leading part in the development of the three-wire system of distribution. He also elucidated the theory of alternating current, and the parallel operation of alternators.

In 1890 Hopkinson took charge, with the title of professor, of the newly founded Siemens laboratory at King's college, London. He received, among other distinctions, a Royal society medal, and was twice president of the Institution of Electrical Engineers. His death occurred on Aug. 27, 1898, when, together with one son and two daughters, he was killed in an accident while climbing the Petite Dent de Veisivi, Switz. (M. K. W.)

BERTRAM HOPKINSON (1874–1918), distinguished for his work in aeronautics and for his researches on the process of explosions, was born at Birmingham, Eng., on Jan. 11, 1874, the eldest child of John Hopkinson (*see* above). When his father was killed, Bertram took up his unfinished work, designing electric tramways at Crewe, Newcastle and Leeds. In 1903 he succeeded Sir J. Alfred Ewing (*q.v.*) as professor and head of the engineering department, Cambridge, and under his leadership the department grew in numbers and reputation. He was an effective teacher with a passion for research, covering such diverse subjects as the properties of steel, the dynamics of explosions and the "hunting" of alternators. He was elected a fellow of the Royal society in 1910 and a fellow of King's college, Cambridge, in 1914. In 1915 he was appointed to the department of military aeronautics of the royal flying corps, taking charge of the design of bombs and establishing an armament experiment station at Orfordness. In 1916 the testing of airplanes was put under his charge and his influence on the general development of aeronautics steadily increased. On Aug. 26, 1918, he was killed while piloting a Bristol fighter. (J. F. BR.)

HOPKINSON, FRANCIS (1737–1791), U.S. author, musician and statesman, one of the signers of the Declaration of Independence, was born in Philadelphia, Pa., Sept. 21, 1737. His father, Thomas Hopkinson, a lawyer, was first president of the American Philosophical society and trustee of the College of Philadelphia, predecessor of the University of Pennsylvania. Francis Hopkinson was enrolled as the first student in the college, from which he received his bachelor's degree in 1757, his master's in 1760 and the degree of LL.D. in 1790. He aided the revolutionary movement and the later struggle for the adoption of the constitution by a series of prose and poetic satires, which were widely reprinted and most effective. Among them are *A Pretty Story* (1774) and *The Battle of the Kegs* (1778). He published *A Collection of Psalm Tunes* (1762) and composed *Seven Songs for the Harpsichord or Forte-Piano* (1788). He died May 9, 1791. His *Miscellaneous Essays and Occasional Writings* was published in 1792.

HOPLITE, the name given to ancient Greek heavy-armed troops whose function was to fight in close formation. The introduction of the hoplite marked a revolution in tactics and heralded the eclipse of feudal aristocracy and cavalry dominance.

In the Mycenaean age chariots and cavalry played a considerable part in warfare and there was place and need for individual combat. At some time, probably in the late 8th century B.C., a new type of fighting was introduced, based on new and heavier armour. The foot soldier was now strongly protected by metal helmet, breastplate and greaves. The shield, which previously was hung on a strap round the neck, leaving both hands free at need, was now carried on the left forearm by means of an arm band inside at the centre. It gave better protection but was useless in flight. The offensive weapons were a thrusting spear (instead of a throwing spear) about six feet in length and a sword. The hoplites relied on their compactness rather than on a series of individual actions. It was the combined weight of the massed line that won battles rather than the brilliance of aristocratic champions. The normal depth of the line was 8 ranks, but the Thebans in the 4th century developed the principle of concentrating strength on one flank to a depth of up to 50 ranks. The aim of the hoplite phalanx, as it was called, was to break through the enemy ranks and throw their line into disorder. But since the formation was unwieldy and the equipment heavy, pursuit was difficult. Thucydides notes the likelihood of the line's moving to the right as a result of the natural tendency to withdraw the exposed side from danger. He also re-

cords the importance of flute players in the Spartan ranks "not as an act of religion, but in order that the army might march evenly and in true measure, and that the line might not break, as often happens in great armies when they go into battle."

After the introduction of the new armour and tactics, Greek hoplites became the best fighters in the Mediterranean world and were in great demand as mercenaries in Lydia, Babylonia and Egypt. At home they gave force and impetus to the rise of the middle class and the undermining of exclusive aristocracies.

See H. Lorimer, "The Hoplite Phalanx," in *Annual of the British School at Athens,* vol. xliii, pp. 76 ff. (1947); A. Andrewes, *The Greek Tyrants,* ch. 3 (1956). (R. ME.)

HOPPE-SEYLER, ERNST FELIX (IMMANUEL) (1825–1895), German physician and scientist, one of the pioneers in the field of physiological chemistry (now commonly called biochemistry), was born at Freyburg an der Unstrut on Dec. 26, 1825. In 1872 he was appointed professor of physiological chemistry at Strasbourg university and made many contributions to the chemistry of hemoglobin, of proteins and of chlorophyll, and to the analysis of body fluids and body tissues. In 1877 he founded the first scientific journal specializing in biochemistry, the *Zeitschrift für physiologische Chemie,* which he edited until his death and which is still one of the leading journals in the field.

Apart from numerous scientific papers, he published a textbook, *Physiologische Chemie,* four volumes (1877–81), and a reference book, *Handbuch der physiologisch- und pathologisch-chemischen Analyse* (1858). The latter was translated into many languages. Hoppe-Seyler died at Wasserburg am Bodensee on Aug. 10, 1895.

See E. Baumann and A. Kossel in *Zeitschrift für physiologische Chemie,* vol. 21 (1895), for a biography of Hoppe-Seyler. (H. A. K.)

HOPPNER, JOHN (1758–1810), English portrait painter, who emulated the style of Sir Joshua Reynolds, probably was born on April 4, 1758, at Whitechapel. His father was of German extraction, and his mother was one of the German attendants at the royal palace. Hoppner received the patronage of George III, whose regard for him gave rise to the report that he was the king's natural son. As a boy he was a chorister at the royal chapel, and in 1775 entered as a student at the Royal Academy. In 1778 he took a silver medal for drawing from life, and in 1782 the Academy's highest award, the gold medal for historical painting, his subject being King Lear. He first exhibited at the Royal Academy in 1780. His earliest love was for landscape, but necessity obliged him to turn to the more lucrative business of portrait painting. At once successful, he had throughout life the most fashionable and wealthy sitters, and was the greatest rival of the king's painter, Thomas Lawrence. The prince of Wales especially patronized him, and many of his finest portraits are in the state apartments at St. James's palace, the best perhaps being those of the prince, the duke and duchess of York, of Lord Rodney and of Lord Nelson. Among his other sitters were Sir Walter Scott, Wellington, Frere and Sir George Beaumont. A *Series of Portraits of Ladies* was published by him in 1803, and a volume of translations of eastern tales into English verse in 1805. Ideal subjects were very rarely attempted by Hoppner, though a "Sleeping Venus," "Belisarius," "Jupiter and Io," a "Bacchante" and "Cupid and Psyche" are mentioned among his works. Hoppner died on Jan. 23, 1810.

He was confessedly an imitator of Reynolds. When first painted, his works were much admired for the brilliancy and harmony of their colouring, but the injury due to destructive mediums and lapse of time which many of them suffered caused a great depreciation in his reputation. The appearance, however, of some of his pictures in good condition has shown that his fame as a brilliant colourist was well founded.

HOPSCOTCH, a children's game played on a diagram drawn on the ground or other flat surface, having named or numbered spaces. The game is world-wide and has many variations. In a common form, each player tosses or kicks some small flat object into each division, in sequence, and then hops on one foot through the spaces to get the object and return. When he misses (by stepping on a line, putting both feet down, etc.), he forfeits his turn until the other players have played. The winner is the player who moves through all the spaces first. (N. F. J.)

HOPTON, RALPH HOPTON, BARON (1596–1652), royalist commander in the English Civil War, was born at Witham, Somerset, in 1596. He appears to have been educated at Lincoln college, Oxford, and to have served in the army of the elector palatine in the early campaigns of the Thirty Years' War. In 1624 he was lieutenant colonel of a regiment raised in England to serve in Mansfeld's army. Charles I, at his coronation, made Hopton a knight of the Bath. Hopton, as member of parliament successively for Bath, Somerset and Wells, at first opposed the royal policy, but after the earl of Strafford's attainder (for which he voted) he gradually became an ardent supporter of Charles, and at the beginning of the Civil War he was made lieutenant general under the marquess of Hertford in the west. He first rallied Cornwall to the royal cause and then carried the war from that county into Devon. In May 1643 he won the brilliant victory at Stratton, in June he overran Devon and on July 5 he inflicted a severe defeat on Sir William Waller at Lansdown. In the last action he was severely wounded by the explosion of a powder wagon and he was soon after shut up in Devizes by Waller, where he defended himself until relieved by the victory of Roundway Down on July 13. He was created Baron Hopton of Stratton on Sept. 4, 1643. After this he served in the western campaign under Charles's own command, and toward the end of the war he succeeded to the command of the royal army. It was no longer possible to stem the tide of the parliament's victory, and Hopton, defeated in his last stand at Torrington (Feb. 16, 1646), surrendered to General Fairfax. Subsequently he accompanied the prince of Wales in his attempts to prolong the war in the Scilly and Channel islands. He died in exile, at Bruges in Sept. 1652. *See* also CIVIL WAR, ENGLISH.

HOR, MOUNT, the scene of Aaron's death, according to the Bible (Num. xxxiii, 38–39), and, since the time of Josephus, generally identified with Jabal Harun (4,381 ft.) near Petra in modern Jordan. A shrine on the summit, said to cover the grave of Aaron, is an object of pilgrimage to the surrounding tribes, but it is obviously of comparatively modern construction. This identification is challenged by many, and other localities have been suggested, among them Jabal Madara and Mt. Hermon.

HORACE (QUINTUS HORATIUS FLACCUS) (65–8 B.C.), the celebrated Roman poet, was born on Dec. 8, 65 B.C., at Venusia, a small town of southeast Italy. He was a contemporary and friend of Virgil. His work comprises short meditative personal poems, in which irony of observation and reflection are combined with the more lyrical qualities of poetry in a way more common in modern literature than in antiquity, and longer, more discursive hexameter verse essays dealing in a sophisticated and personal fashion with everyday ethics and manners and with literary criticism. There are extant 121 lyric poems (*Odes, Epodes* and *Carmen saeculare*) and 41 verse essays (*Satires,* sometimes called *Sermones; Epistles* and *Ars poetica*). It is not likely that Horace published more. The verse essays have always been popular, though few place them in the front rank of literature. The reputation of the lyric poems has fluctuated. Horace's ability to embody conspicuously sane pronouncements on the problems and follies of his fellow men, or succinctly evocative vignettes of city life and scenes of natural beauty, in memorable phrases that have the impact of epigrams while retaining an unmistakable note of serene high seriousness has established his position among the general lettered public of all ages as the best-loved Roman poet. A reputation so founded, on the striking turn of phrase (Quintilian's *felicissime audax*) and evident quality of craftsmanship (Petronius' *curiosa felicitas*) rather than on the merit of complete poems (their development of thought is often elliptical and elusive), has often led to some disparagement by those whose poetic standards are exacting. This has been true particularly at times when imagination and spontaneity have been the prized qualities of poetry, at the expense of structural strength and subtlety of technique. Moreover, the charm of Horace's personality that pervades his work and his evident warm humanity have hindered recognition of his claims as a serious and original artist. In the

mid-20th century, when technical accomplishment and the more intellectual qualities of poetry again came to the fore, and, as a result of sympathetic revaluations by scholars, the reputation of Horace's lyric poetry seemed more secure than it had for 150 years.

Horace lived in one of the best-documented periods of Roman history. Moreover, several of his poems are directly autobiographical and more about him can be gathered from remarks scattered through his work. However, this material needs critical handling. The information provided by the *Satires* is incidental and scattered, but contemporary and probably reliable. Certain of the *Epistles* are more consciously autobiographical, but what Horace says about his poetic formation should be accepted with caution, since he is looking back over a period of 20 years. In the lyric poems there is a good deal of attitudinizing and probably a certain amount of poetic fiction. Further information, about the later part of his life especially, can be derived from a condensed version of a biography by Suetonius, an undiscriminating mixture of gossip and fact which, however, preserves valuable quotations from contemporary documents.

Horace's father, a freed slave, held a minor official post as collector of market dues (*coactor argentarius*) in Venusia, which was the seat of a Roman garrison and colony. Culturally the influence of Greece was perhaps as strong as that of Rome, for Venusia was on the periphery of the centuries-old Greek civilization of south and southwest Italy. His southern upbringing may have contributed to that easy familiarity with Greek culture with which his work is penetrated, in contrast to the more flamboyant Hellenism of Catullus or Propertius, though the ambition of his father contrived soon to provide him with the expensive standardized education that his betters enjoyed, first at Rome and later at Athens. Horace's first sojourn in Rome was short and fell in the unquiet years following Julius Caesar's crossing of the Rubicon in 49 B.C. By the time of the assassination of the dictator in 44 B.C. Horace was already in Athens. He was acquiring, he later tells us, that moralistic approach to literature which constantly recurs in his poetry, when he was engulfed by the march of events. Out of idealism, or through personal friendships, he joined the armies of Brutus. For perhaps two years he moved about in Greece and the near and middle east until the inevitable trial of strength came with Antony and the future emperor Augustus. Brutus' defeat at Philippi (autumn, 42 B.C.), in which Horace states he took part as a *tribunus militum*, ended this episode in his career. To his intellectual development it contributed a personal acquaintance with the greater Roman world and that sense of personal involvement in the fortunes of the state which adds occasionally deeper and more passionate overtones to his lyric poetry, leaving him midway between the frivolous antimilitarism of Propertius or Tibullus and the intellectual idealism of Virgil.

Horace returned to Rome after Philippi, as those who wished were permitted to do by a liberal amnesty. He was now about 25 years old, reasonably rich in experience, but destitute in a city he had known only as a schoolboy. He resisted despondency and bitterness with a resilience and determination worth bearing in mind as correctives to the humorously self-depreciatory autobiographical sketches which he affects. He obtained a moderately important administrative post (*scriba quaestorius*) and began writing verse. His early work shows talent rather than genius. But the new regime supported literature generously, and within about five years Horace was able to claim publicly (*e.g.*, *Satires* i, 5, and i, 10, 81 ff.) that the greatest political figures in Rome, above all Maecenas, were his friends, as well as the leading personalities of literature, especially Virgil.

Horace's devotion to literature continued for nearly a quarter of a century more. He became perhaps the first example in Roman society of a professional man of letters, claiming freedom to write as he chose. He accepted patronage (his small farm in the Sabine hills northeast of Tibur given him by Maecenas some time before 31 B.C. is the most famous example), but resisted vocally all that seemed to him an attempt to restore the old relationship between patron and poet (familiar in Roman society from the 2nd century B.C. onward, and still existing in Horace's day) which imposed on the artist the task of his master's glorification. It is likely that Horace's refusal to attempt epic poetry (the commonest genre in his day) sprang less from the diffidence in his ability that he professes than from the suspect integrity of a form which at Rome had become too exclusively devoted to the eulogy of statesmen. Horace's stand was new and his position delicate: Maecenas (to judge from the surviving scraps of his verse) possessed enthusiasm for literature rather than taste and, in applying pressure to the poets of the Augustan age to serve the regime, he was probably unaware of the artistic problems involved for the writer scrupulous about his integrity.

The decade which followed the battle of Actium (31 B.C.) and the final overthrow of the opponents of the new regime undoubtedly appeared to those like Virgil and Horace who had lived through the horror of almost constant civil war lasting from their early childhood as a new era of peace and hope. The term "Augustan poets," often applied to Horace and Virgil (and their contemporaries), is historically misleading. Both were grown men already writing before the civil wars ended and their intellectual formation was largely complete before the Augustan age began. Virgil (d. 19 B.C.) did not live to see the more ruthlessly totalitarian character of the emperor fully emerge, and the *Aeneid* reflects the genuine enthusiasm aroused by the beginnings of Augustan rule. Horace's poetry of that period occasionally expresses similar feelings (particularly *Odes* iii, 1–6), but his position during the decade by which he survived Virgil is less clear. He became the emperor's friend, and in his later works references to Augustus become more frequent and tinged with flattery and those to Maecenas rare. It is perhaps not coincidental that at this time Augustus and Maecenas were estranged, though we are told that all his life Maecenas regarded Horace as a loyal friend. In Horace's latest works (*Epistles* ii, *Odes* iv) open adulation of the emperor and his family appears. How far the need for this decided Horace to give up writing is not clear. At all events, he appears to have written no lyric poetry during the last 5 years of his life and little during the last 15, while, in the three long verse essays which he wrote after Virgil's death, though they deal with literature, his attitude to poetry at times seems curiously sour. As an artist of the highest literary standards, Horace may have felt he had exhausted his genius, though in a poet whose genius was for detailed craftsmanship rather than spontaneity this is not an immediately convincing explanation. He died in Rome on Nov. 27, 8 B.C., after a sudden illness, a few days before the completion of his 57th year.

WORKS

The 30 years of Horace's writing life fall into three periods: a period of rapid development from his return to Rome after Philippi to about the battle of Actium (roughly 40–30 B.C.); the period of his finest work in both styles, covering the next decade; a period, covering probably another decade, of decline in his creative and imaginative powers.

First Period.—*Satires and Epodes.*—The *Satires:* Book i contains work down to about 35 B.C.; Book ii to about 30 B.C. The writing of the *Epodes* seems to have extended over the whole decade.

Horace's initial ambitions as a writer were limited. He began with experiments in two distinct styles. One was a loose form of hexameter verse which he made the vehicle of something very like the modern prose essay. In the space of about 100 lines he argued ethical and literary questions, usually from a very individual viewpoint forcibly maintained, the whole varied by moralizing anecdotes and marked by abrupt transitions intended to create the appearance of spontaneity, though scrutiny shows the essays were in fact carefully composed. The Romans called this *satura.* Horace says (*Satires* i, 10, 46 ff.) that he chose the form in order to have no serious contemporary rival. He expected little difficulty in doing better than the originator of the genre, Lucilius (whose talent he freely admits), by avoiding Lucilius' slipshod methods of composition and the roughnesses of expression which the evolution of the Latin language and technical improvements in the hexameter had eliminated in the 60 years since Lucilius' death. His honesty is disarming and no doubt sincere.

It is clear from *Satires* i, 4, 41 ff. that he originally regarded his essays as something more like prose than poetry. At this stage poetry meant for Horace the high style and impassioned diction of epic and tragedy. His view of the nature of poetry quickly became more subtle and his recipe for satire more exacting. In a fine appraisal of the genre in *Satires* i, 10, 7–14 he claims it can rise, at least occasionally, to the status of real poetry. Of the ten satires of Book i, two deal with literary criticism, four are sermons delivered from a practical unintellectual standpoint in general adherence to the current Epicurean philosophy, while the remaining four have a loose narrative form displaying that interest in character and situation which is also a feature of Horace's lyric poetry. The eight satires of Book ii include a number of experiments in dramatic form and a good deal of that argument about rival ethical theories which (as the treatises of Cicero on popular philosophy show) fanned among the Romans of this period something akin to the heat of religious controversy. The sixth satire of Book ii and the fifth, ninth and perhaps sixth of Book i are those which can be read today with the greatest pleasure. After about ten years of experiment, Horace seems to have felt his poetic intentions and abilities had outgrown this form and he gave himself over exclusively to the kind of lyric poetry which had also begun to take shape during this first period.

The collection called *Epodes* contains 17 poems from 16 to 102 lines in length. The form and, to some extent, the style are based on the iambic poems of Archilochus, a Greek poet of the 8th or 7th century B.C. Horace probably took him as his model mainly to break away from contemporary trends. The influence of Catullus (who died when Horace was about ten) is clear, though unacknowledged. Horace avoids the actual iambic metres used by Catullus, wishing perhaps to disassociate himself from Catullus' successors in his own day. Most of the poems show a pleasant talent and technical competence with some flair for the grotesque and gruesome, spoiled occasionally by a precarious sense of humour. The *Epodes* also contain the first examples of Horace's use of poetry for impassioned commentary on political issues. He admits difficulty in completing the collection; presumably, as with the *Satires*, he outgrew the limitations of the form. Four poems (11, 13–15), which differ sharply from the rest, are better regarded as early odes, included to bring the book up to the minimum dimensions for publication. These four also contain the best writing.

Second Period.—*Odes i–iii and Epistles i.*—To the seven or eight years after the battle of Actium belongs Horace's most ambitious and permanent contribution to literature. Three books of *Odes* were probably published together in 23 B.C. It was a period of national resurgence after 30 years of civil strife. During most of it, Virgil was working on his national epic, the *Aeneid*. Both factors are likely to have added stimulus to Horace's poetic concentration. *Odes* i–iii comprise 88 poems mostly from 16 to 50 lines long, with a few shorter and a few longer pieces.

The predominating formal theme of rather more than a third is friendship (a friend is normally addressed), with which are mixed in varying proportions counsel, encouragement or philosophical reflection. The hortatory tone adopted by the adherents of Epicureanism in their letters to one another may have contributed to the formal layout, but often the poetic intent obviously transcends the philosophical. For example ii, 10 (*Rectius uiues, Licini, neque altum, . .*) is primarily hortatory though with serious poetic qualities as well; whereas in i, 4 (*Solvitur acris hiems . . .*) the philosophical commonplace formally provides a thread to link the rich imagery of the first part of the poem with that of the second part, tuning the simple sensuousness of the imagery with pervading attitudes of irony and melancholy. The famous ode ii, 14 (*Eheu fugaces, Postume, Postume, labuntur anni . . .*) on the other hand, while dealing with a similar commonplace, is one of a group of odes (compare, for example, i, 27; ii, 3; iii, 13) in which a dramatic context is discreetly suggested.

Nearly another third of the odes deal with love. Horace treats this theme differently from either Catullus or Propertius and contemporary poets. Where they are concerned more with the analysis of emotions arising out of a single affair and the effect on the poet of his involvement in it, Horace chooses typical situations. The emphasis is not on the facts of the situation, but on the possibilities of irony, pathos or charm they offer to the poet as observer. These love poems are characterized therefore by a high level of detachment, in contrast to the open and forceful personal comment of his earlier period. Judgment of the situation does not go beyond a slightly ironical or melancholy implication. As a result of this humanist and realist standpoint, the themes chosen for study are more often trivial than heroic. In solving the problems raised by the need in such short poems for maximum concentration of complex data, Horace drew upon the formal conventions of Greek epigram: the technique, for example, of writing a poem as a fragment of a story with only enough of the facts given to form a sketched-in background to the real point —a humorous remark, a pathetic situation, etc. To the conventions of epigram Horace makes two notable contributions. He writes a rather longer poem which can study fairly complex emotional patterns instead of a single point. Secondly, he exploits a technique of oblique description of scene. The poems become a kind of puzzle, setting the task of fitting together the relevant data, which are suggested rather than overtly presented. As in the philosophical odes, some poems are dramatic monologues rather than poems actually directed to their addressee—studies, as it were, in the process of the unwinding of the speaker's thoughts (*e.g.*, especially i, 5; iv, 13).

The remaining odes deal with the practice of poetry and miscellaneous topics, including short formal hymns to gods and goddesses. The six great Roman odes that begin Book iii form a group on their own. On the whole Horace's attempt to adapt his intimate personal style to the grander themes of patriotic poetry is successful. He stresses the moral seriousness of the new regime with a severe sobriety that scrupulously avoids adulation. Some of Horace's best imaginative writing (the picture of traditional rustic life in iii, 6; the superb episode of Regulus in iii, 5) is found here.

About three-quarters of the collection are written in one or other of two types of four-line stanza associated with the Greek lyric poets of the 7th century B.C. (His sapphics and alcaics are written to stricter rules than obtained in Greek. Long syllables are regularized where shorts had been permitted, an effect more congenial to Latin and to the serious tone of Horace's poetry. He made similar modifications in his asclepiads and other metres and in general regularized the use of *caesurae*.) It is in this technical metrical sense that the ancients called the poems lyrics. They are, of course, no more songs than modern meditative lyric poems are. In an epilogue poem (iii, 30) Horace claims that he re-created aeolic poetry (*i.e.*, Sappho and Alcaeus) in Italian verse:

> dicar, . . .
> princeps Aeolium carmen ad Italos
> deduxisse modos.

Elsewhere (*Epistles* i, 19, 32 ff.) he indicates that his main indebtedness was to Alcaeus. In both places Horace seems to suggest affinity in style and spirit as much as in metrical form. His words are allusive rather than specific and, as Alcaeus' poetry survives only in fragments, the nature and validity of Horace's claim are hard to fix. Modern critics differ sharply. According to a view popular among German critics, Horace, after beginning as a Hellenistic poet in spirit (*Epodes* and early *Odes*), became increasingly "classical." Others follow Giorgio Pasquali's theory of a tension in Horace between the essentially Roman-Hellenistic background and subject matter of the *Odes*, and their consciously pre-Hellenistic, classical form. The predominating 19th-century view that the content of the *Odes* is trivial perhaps stems from an often-quoted remark attributed to Goethe allowing the technical perfection of the *Odes*, but denying them any status as real poetry. The harshness of this criticism is probably due to their lack, in Goethe's view, of worthwhile personal experience (*Erlebnis*).

A book containing 20 hexameter epistles was published about 20 B.C. Horace, who was 44, describes himself as "a little baldish man, easy-going though quick-tempered, fond of the sun." The *Epistles* in many ways resemble the *Satires*, but show, too, the influence of the literary development of the short personal letter as shaped by Catullus in verse and Cicero in prose: compare, for

example, i, 5 (an elegant discursive invitation to dinner) with Catullus, 13. About six more of the epistles are of this kind, the best perhaps being 9—a delightfully tactful letter of introduction. The tone is not unlike that of the lighter odes.

In a second group the jerky allusive style of the *Satires* persists with little progress stylistically beyond the point Horace reached a decade earlier. The quality varies: i, 18 is a piece of advice, opportunist in tone, on how to win influential friends; 7 an altogether delightful letter to Maecenas (and, incidentally, an eloquent testimony to the ease of their relationship). The epistolary form is sometimes an obvious fiction: in 16 the charming opening paragraph describing Horace's farm is obviously sewn on to the dullish sermon which follows it.

A third group attempts the exposition of an essentially practical philosophical attitude toward life: *uirtus est uitium fugere, et sapientia prima stultitia caruisse*, "Virtue consists in avoiding vice. To be free of folly is the first step to wisdom" (*Epistles* i, 1, 41 f.); and, *mihi res non me rebus subiungere conor*, "To be the master of circumstance, not its slave, that is my aim" (*Epistles* i, 1, 19). The quality of the style in this third group is high. The sentences, though often free of any ornament, possess a dry, terse quality and a serenity of tone that makes them admirable writing. The book, however, has few essentially poetic qualities.

Third Period.—*Odes iv, Carmen saeculare, Epistles ii* and *Ars poetica.*—Horace implies that the odes won him recognition as Rome's leading poet (after Virgil's death) rather than popularity. The poetry was perhaps too uncompromisingly hard. In 17 B.C. Horace was commissioned to compose a choral hymn for the secular games, which heralded the start of a new century. The *Carmen saeculare*, in sapphics, is diligent rather than inspired work, an elaborate invocation of the appropriate deities. It is more a hymn for an official occasion than a poem. Also at the emperor's suggestion a fourth short book of odes appeared about 13 B.C., comprising partly poems attempting but not achieving, the old style (the best are the Spring ode, 7, and the fine dramatic monologue, 13), and partly very competent laureate writing (4, 5, 14, 15), more openly laudatory than hitherto. Some odes look like work written earlier (*e.g.*, 12; perhaps 7); others (*e.g.*, 8; 9) have a straight expository style almost devoid of imagery and verbal poetry that makes them read like epistles done into lyric metres. A weakness of Horace's lyric writing is that little springs from his own fancy, experience or intellectual strength. The core is the delicate handling, with just the right mixture of approbative and satirical attitudes, of external everyday incidents. This gives a context too limited for extensive repetition.

About this time, Horace published three more long epistles dealing more or less loosely with literary criticism, though his personal attitude to poetry became progressively less sympathetic. A public letter to Augustus on the state of poetry in Rome vigorously defending contemporary writers and a sermon on *auaritia* introduced by a diffuse discussion of his abandonment of lyric make up *Epistles* ii. The date of composition is uncertain. The third, usually called *Ars poetica*, is Horace's longest single composition. Its date (whether early or late in the last decade of Horace's life) is debated. The work has acquired in the history of criticism a fame and at times an authority it hardly deserves. It lacks the intellectual calibre of Aristotle's *Poetics* and was aimed presumably at a more modest target, though the circumstances of its writing are unknown. It is a kind of practical survey of the history and theory of dramatic poetry, glancing occasionally at lyric and epic, and drawing heavily on Greek theory as propounded by Neoptolemus of Parium and Philodemus, though the issues were contemporary and Roman. The essay, though obviously laid out with care, makes difficult reading. It suffers seriously from Horace's habit of expressing himself in vigorous precepts (many have become famous) and aphoristic illustration, rather than connected argument. There is much good sense, but little fresh criticism, not enough evidence he had fully thought out his critical standpoint, or himself appreciated the complexity of his own poetic achievement.

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HORAE, in Greek and Latin mythology the Seasons. In the *Iliad* they are the custodians of the gates of Olympus. In the

ALINARI

THE GOD PAN AND THE HORAE FROM A GREEK BAS-RELIEF IN THE CAPITOLINO MUSEUM, ROME

Odyssey they are represented as bringing round the seasons in regular order. The brief notice in Hesiod's *Theogony*, where they are called the children of Zeus and Themis who superintend the operations of agriculture, indicates by the names assigned to them (Eunomia, Dike, Eirene; *i.e.*, Good Order, Justice, Peace) the extension of their functions from nature to the events of human life, and at the same time invests them with moral attributes.

At Athens they were apparently two in number: Thallo and Carpo, the goddesses of the flowers of spring and of the fruits of summer. In honour of the Horae a yearly festival (Horaea) was celebrated.

In later mythology, under Alexandrian influence, the Horae became the four seasons, daughters of Helios and Selene, each represented with the conventional attributes. Subsequently, when the day was divided into 12 equal parts, each of them took the name of *hora*. *See* also GRACES.

HORAPOLLON (HORUS APOLLO) (4th century A.D.), of Phaenebythis in Egypt, a Greek grammarian said to have written commentaries on Sophocles, Alcaeus and Homer, dramas, a work on consecrated places (*Temenica*) and a history of Alexandria. None survives and they may have been written by different persons of the same name. The extant *Hieroglyphica* may be by still another writer of the period as it claims to have been translated into Greek from Coptic by one Philippus. It deals with the meanings of individual Egyptian hieroglyphs, but not phrases or sentences, and rests on a sign list from a much earlier date. It gives no transcriptions or phonetic values and was insufficient to enable hieroglyphs to be read. But after the decipherment of hieroglyphs by J. F. Champollion it was seen to contain genuine material.

See edition by F. Sbordone (1940); Eng. trans. by G. Boas (1950). *See* also Pauly-Wissowa, *Real-Encyclopädie*, vol. 8, col. 2313–19 (1913). (G. B. KD.)

HORATII AND CURIATII, in Roman legend, two sets of triplet brothers. The Horatii were Roman and the Curiatii Alban, although an alternative version reversed this order. During the war between Rome and Alba Longa in the reign of Tullus Hostilius (traditionally 672–640 B.C.) it was agreed that the issue should depend upon a combat between the two groups. Two of the Hora-

tii were soon killed, but the third cleverly feigned flight so that the Curiatii, all of whom were wounded, were separated in pursuit by the degree of their injuries. He was thus able to dispatch them individually.

When he entered Rome in triumph, his sister recognized among his trophies a cloak she had made for one of the Curiatii to whom she was betrothed. When she displayed grief her brother killed her with the words, "So perish any Roman woman who mourns the enemy." For this act Horatius was condemned to death, but was saved by an appeal to the people. The story, obviously a fiction, seems to have been fashioned either to provide an august origin for the right of popular appeal, or to explain the ritual of the *sororium tigillum* ("sister's beam") as the yoke under which Horatius had to pass to be purified of his crime.

The story forms the subject of Pierre Corneille's tragedy *Horace* (1640), and of the painting in the Louvre by J. L. David.

See Livy, i, 24–26; Dionysius of Halicarnassus, iii, 13–22.
(R. B. Ld.)

HORATIUS COCLES, a Roman hero traditionally of the late 6th century B.C. but undoubtedly legendary, who first with two companions and finally alone defended the Sublician bridge against Lars Porsena (*q.v.*) and the entire Etruscan army, while the Romans cut down the bridge behind. He then threw himself into the Tiber to swim to the other shore. Versions differ as to whether he reached it in safety or was drowned. The myth quite possibly arose in explanation of a statue in the temple of Vulcan representing a crippled, one-eyed man, said to be Cocles ("the one-eyed") with the wounds he had sustained in his battle. It was in all probability, however, a statue of Vulcan, who, like the Greek Hephaestus, was both lame and traditionally associated with the (one-eyed) Cyclopes. The traditional story is dramatically related in Macaulay's *Lays of Ancient Rome.*

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HORDALAND, a *fylke* (county) in the western part of southern Norway, includes the Bergen region and the districts surrounding the Hardangerfjord (*q.v.*), together with those to the north of this fjord reaching as far as the watersheds near Sognefjord. Area 6,022 sq.mi. Pop. (1961 est.) 225,275. The administrative centre is Bergen (*q.v.*), although the city is a separate *fylke.* Narrow fjords penetrate in between steep mountains; the summit of the Folgefonn glacier is 5,449 ft. high and that of the Hardangerjokel 6,150 ft. Some of the islands and narrow strips of lowland along the fjords are densely populated. The geological structure is complicated, consisting mainly of Pre-Cambrian bedrock and Caledonian plutonic rocks in thrust masses. In some of the fjord and coastal districts Cambro-Silurian schists yield fertile soil. About one-third of the population is occupied with fishing or farming (animal husbandry and the growing of grass and potatoes and, in the dry interior areas, fruit). About the same proportion is engaged in manufacturing, especially in the Bergen district and in villages such as Odda and Aalvik which are attached to big power plants and have electrometallurgical and electrochemical industries. Roads and ferries connect the various localities to Bergen. (L. H. Hg.)

HORDEUM, a genus of perhaps 25 species of annual or perennial grasses, mostly weeds but including also barley, widely distributed in temperate regions. *See* Barley; Squirreltail Grass.

HOREB, MOUNT, in the Old Testament, is the name preferred by the Elohist and Deuteronomist writers (*see, e.g.,* Ex. iii, 1; Deut. iv, 10 ff.) for the mountain called Sinai by the Jahwist and Priestly writers. (For terminology, *see* Pentateuch.) The latter form became the more usual. *See* Moses; Sinai.

HORE-BELISHA, LESLIE HORE-BELISHA, 1st Baron (1893–1957), British statesman, who gave his name to the "belisha beacons" used to mark pedestrian crossings on British roads, and secretary of state for war at the outbreak of World War II, was born in London on Sept. 7, 1893. He was educated at Clifton college, served overseas with the British army in World War I and went to St. John's college, Oxford. He was called to the bar in 1922 and was elected Liberal member of parliament for Devonport in Dec. 1923. This constituency he continued to represent, as a National Liberal from 1931 and as an Independent from 1942, until 1945. He later joined the Conservative party and fought Coventry South unsuccessfully in 1950. In 1954 he was raised to the peerage. Hore-Belisha helped to form the National Liberal party in 1931 in support of the national coalition government. He became minister of transport in 1934 and was made a privy councilor in 1935. In 1937 the prime minister, Neville Chamberlain, appointed him secretary of state for war with instructions to effect "drastic changes." He introduced conscription shortly before the start of World War II, but some of his changes and methods so antagonized senior army officers that he was removed from the war office in Jan. 1940, even though Chamberlain valued highly the work he had done. In May 1945 he was minister of national insurance in the short-lived caretaker government. He died at Reims, France, on Feb. 16, 1957, during a visit there.

See R. J. Minney (ed.), *The Private Papers of Hore-Belisha* (1960).
(J. F. B.)

HOREHOUND (Hoarhound). Common or white horehound (*Marrubium vulgare*) is a white-wooly, perennial herb of the mint family (Labiatae). Native to Europe, north Africa and central Asia, it has become widely naturalized in North America from Maine southward to North Carolina and westward to northern Mexico and British Columbia. It is cultivated in Britain and is occasionally found as an escape on drier soils. The plants are coarse, strongly aromatic, from one to three feet tall with roundish-oval, bluntly toothed leaves, which are white and woolly below and pale green and downy above. The flowers are small, whitish and densely clustered in axillary whorls; the calyx has ten short teeth, each terminating in a hooked spine. The leaves and flowering tops of white horehound are in some demand as a crude drug. Infusions or extracts of horehound in the form of syrup, beverage or lozenges are favourite domestic remedies for coughs and minor pulmonary disturbances.

JOHN TOPHAM LTD.
WHITE HOREHOUND (MARRUBIUM VULGARE)

Black horehound (*Ballota nigra*) is a hairy perennial herb with a fetid odour, belonging to the same family. It does not have the white-woolly appearance of white horehound and has rose-purplish flowers with five broad calyx teeth. It is occasionally found as an adulterant of white horehound in the crude drug form. It is native to the same regions as white horehound and has become naturalized in North America from southern New England to Maryland. (Q. J.)

HORGAN, STEPHEN HENRY (1854–1941), U.S. inventor and pioneer in the development of the halftone engraving process, was born Feb. 2, 1854, near Norfolk, Va. He studied photography in his youth and in 1874 went to New York to join the old *Daily Graphic* as a photographer.

While on the *Graphic,* he developed a process for making halftone pictures, using a glass screen made up of fine parallel lines. Using this method, the *Graphic* in March 1880 printed the first halftone to appear in a newspaper, from an original plate run on a slow-speed press. In 1893 Horgan became art director of the *New York Herald* and studied ways to apply the halftone to high-speed presses. He sold the idea to the *New York Tribune,* which became the first paper to print a halftone on a high-speed press. Horgan also contributed to the technique of transmitting colour pictures by wire. He died in Orange, N.J., Aug. 30, 1941.

See also Photoengraving.

HORIA, NICOLAE (properly Vasile Nicola Ursu) (1730–1785), Rumanian peasant, leader of the Transylvanian revolt of 1784, was born at Zlatna, near Alba Iulia. The grand principality of Transylvania was at that time a possession of the Holy Roman emperor Joseph II, whose program of reforms led the Transyl-

vanian workers and peasants to believe that he wished to emancipate them from serfdom to the local aristocracy. In anticipation of this, Horia, with Ion Cloşca and Gheorghe Crişan, organized a rising of 20,000 or more peasants and miners, which broke out in the spring of 1784, in the region of Hunedoara and Alba Iulia; they demanded the abolition of serfdom, a redistribution of land and taxation of the nobles. Initial successes against the nobles led to an armistice, but when Horia proceeded to arrogate more powers to himself the emperor sent reinforcements to put the rebellion down. Horia was captured on Dec. 27, 1784, tried and, with Cloşca and Crişan, broken on the wheel at Alba, in the presence of thousands of other peasants, on Feb. 28, 1785.

HORIZON. The boundary where the sky seems to meet the earth or sea is called the visible horizon. Since the location of the visible horizon varies with height of the observer above sea level, a more reliable definition of horizon location is used in astronomy. The astronomical horizon is defined as the intersection on the celestial sphere (*see* ASTRONOMY) of a plane perpendicular to a plumb line. This great circle on the celestial sphere coincides with the visible horizon for an observer whose eyes are at sea level. When the point of observation is above sea level (a crow's nest atop of ship's mast, for example), the visible horizon will appear lower and farther away along the curve of the earth than does the astronomical horizon. This angular depression of the visible horizon, the dip of the horizon, may be estimated as $0.97\sqrt{h}$ minutes of arc, where h is the height of the observer's eyes in feet above sea level. Dip amounts to about three minutes of arc for an observer ten feet above sea level. Similarly, the approximate distance to the visible horizon can be computed as $1.17\sqrt{h}$ nautical

Height of eyes in feet above sea level	Distance to visible horizon in nautical miles	Height of eyes in feet above sea level	Distance to visible horizon in nautical miles
5	2.6	500	26.2
10	3.7	1,000	37.0
50	8.3	5,000	82.7
100	11.7	10,000	117.0

miles. The table expresses this relationship for various observation heights. (D. L. H.)

HORMISDAS, SAINT (d. 523), pope from 514 to his death in Aug. 523, was a native of Campania. His great achievement was the reunion of the Eastern and Western churches, separated since the excommunication of Acacius in 484. After two unsuccessful attempts under the emperor Anastasius I, Hormisdas was able to come to an understanding in 518 with Anastasius' successor Justin and with the patriarch John of Cappadocia, by means of the formula of Hormisdas. In 519 legates were dispatched to Constantinople; the names of the schismatic patriarchs were erased from the diptychs, and union was resumed with the Holy See. Hormisdas' feast day is Aug. 6.

Hormisdas' letters are in J. P. Migne, *Patrologia Latina*, vol. lxiii, pp. 367–534; for the life, *see* L. Duchesne (ed.), *Liber Pontificalis*, vol. i, pp. 269–274.

HORMIZD: *see* ORMIZD.

HORMONES, INVERTEBRATE. Certain invertebrate animals, just as vertebrates, possess specialized glandular elements which produce and liberate into the body fluids, special chemical substances called hormones. These hormones, through their specific influences upon other cells and tissues, co-operate with the nervous system in the integration of various bodily functions. Although evidence exists suggesting widespread occurrence of hormonally regulated phenomena among invertebrates, extensive investigations have been carried out chiefly on crustaceans and insects.

Hormones and Colour Change.—The walking-stick insect *Dixippus* shows striking colour changes which result from dispersion (dark phase) and condensation (light phase) of brown and red pigments contained within the general hypodermal cells. The dispersal of the pigments occurs in response to a blood-borne hormone produced chiefly in the brain of the insect but found also, in smaller amounts, in the ventral and subesophageal ganglia and in the corpora allata (*see* below). The same character of hormonal control seems also to prevail for colour changes in *Corethra* (Diptera) larvae.

Some of the most striking instances of colour changeability among animals are found among higher crustaceans, particularly certain shrimp and crabs. These changes are brought about largely by differential movement of several types of pigments within highly branched integumentary pigment cells (chromatophores) controlled almost exclusively by means of hormones.

One of the most important places of liberation of colour-change hormones into the blood in crustaceans is the sinus gland, usually located in the eyestalks when these are present. In other forms it is located in the head close to the brain. This gland consists of clusters of secretion-filled terminations of the fibres of neurosecretory cells; these clusters, termed X-organs, occur in nervous ganglia within the eyestalks. Other sinus-gland fibres originate in neurosecretory cells in the brain and possibly in still other central nervous organs. The most studied X-organ is the medulla terminalis ganglionaris X-organ (MTGX), though others have been described. The colour-change hormones are formed in the nerve cells and move along inside the fibres to the nerve terminations in the sinus gland from which they are released.

A second important place of liberation of colour-change hormones into the blood is the postcommissural organ lying just posterior to the esophagus and closely associated with the tritocerebral commissure. Like the sinus gland, this organ, too, comprises the terminations of fibres of neurosecretory cells located some distance away, in this instance, chiefly in the brain. Again, the hormones formed in the cell bodies are transported within the nerve fibres to their point of eventual discharge into the blood. In view of the attenuated character of the neurosecretory complexes and their location in the nervous system, it has generally not been possible to employ the common endocrinological technique of observing the effects upon the animal of gland removal. An exception is the case of the important MTGX sinus-gland complex; this is easily removed by eyestalk amputation, after which the endocrine basis of consequent disturbances can be established by tissue implantations or extract injections.

Such studies reveal differences among the crustaceans with respect to their responses to eyestalk removal and MTGX sinus-gland replacement. The common prawn, *Palaemonetes*, behaves like numerous other macrural decapods (lobsters, shrimp, etc.). It possesses red, yellow, blue and white pigments in its chromatophores. Eyestalk removal results in integumentary darkening by dispersion of the coloured pigments. Injection of extract of the eyestalk-gland complex results in rapid blanching by pigment concentration. The fiddler crab, *Uca*, and most brachyuran decapods (true crabs) behave differently. Eyestalk removal gives a response opposite to that seen in *Palaemonetes;* namely, a lightening by concentration of their predominating black and red pigments; eyestalk-gland implantation or extract injection produces rapid darkening. The sand shrimp, *Crago*, behaves still differently; after eyestalk removal it assumes a mottled coloration. In certain integumentary areas its dominant black and red pigments are concentrated, in others dispersed, and elsewhere in an intermediate state. Eyestalk-gland extracts produce over-all paling of these eyestalkless animals.

The observed differences among crustaceans in response to eyestalk removal and MTGX sinus-gland complex replacement reflect, in part, differences in specific responses of chromatophores. In general, the gross response of the eyestalkless animals to injection of eyestalk extract is independent of whether the extract is made from their own eyestalks, or from those of species that themselves react differently. However, comparative study of various chromatophore types in single species, and among various species—together with separation of active fractions by differential solubilities, electrophoresis and paper chromatography—has revealed the eyestalk glandular complex to contain several different chromatophore activating hormones. Studies of extracts of the post-commissural organs have indicated that these organs, also, contain two or more powerful chromatophore activators. Most of the chromatophore activators seem widely distributed among the decapod crustaceans, though some differences between species are found.

The long-known ability of certain prawns, shrimp and crabs to simulate the colour of their background appears to be approaching explanation in terms of a delicately regulated neurosecretion of a complex of hormones actively effecting both dispersion and concentration of pigments.

Hormones and Retinal Pigment Migration.—Movements of certain pigments in cells of the crustacean compound eye have been shown to be hormonally regulated. A distal, or iris, black pigment is located nearest the eye surface; a deeper, proximal black pigment lies close to the light-sensitive retinal elements, as does also a reflecting white pigment. Controlled movements of these three pigments give the eye optimal visual efficiency for each illumination level.

A hormone from the eyestalk MTGX sinus-gland complex is known to move the distal pigment to the light-adapted state in crustaceans. The distal pigment of prawns or crayfish in total darkness may be caused to assume the light-adapted position by injection of extract of eyestalk-gland complex.

Much variability appears to occur among crustaceans as to a light-adapting influence of an eyestalk hormone upon eye pigments other than the distal. In some (*e.g., Palaemonetes*) the reflecting pigment also responds; in others (*e.g.*, crayfish) the proximal pigment may respond. As with integumentary pigment cells the distal pigment has a double hormonal control; a second hormone is responsible for moving this pigment into its dark-adapted position. The state of eye adaptation is thus brought about by changing ratios of two hormones.

Hormones and Growth, Molting and Metamorphosis.—Invertebrates such as crustaceans and insects, which possess a hard or tough continuous exoskeleton, typically grow by a series of abrupt steps involving the periodic casting off, molting or ecdysis, of the old skeleton and the production of a new one. Molting and the associated phenomena of growth and differentiation are regulated by hormones in arthropods.

In crustaceans the frequency of molting, high in the young, rapidly growing individual, diminishes as the animal ages. Some species (*e.g.*, crayfish and lobsters) continue to molt and grow throughout life. Other species (*e.g.*, certain crabs) cease molting and growth once the animal is fully mature. The molt cycle, which includes many morphological and chemical changes, is initiated by the cessation of secretion by the MTGX sinus-gland complex of a molt-inhibiting hormone and the production by it of a molt-accelerating factor. The complex appears also to liberate another hormone which regulates the amount of water absorbed just prior to the hardening of the new skeleton. Molting depends also on a gland, termed the Y-organ, located in the antennary or maxillary segment of the head. There is some reason to believe that the molt-inhibiting and accelerating hormones of the eyestalks exert their action through controlling the release of the Y-organ molting hormone.

The postembryonic development of insects, including both the larval and metamorphic periods, is governed by hormones. One of the complicating factors is that the hormones act upon cells, tissues and organs which themselves become altered in time with respect to their competence to respond to the hormones. The larval period is predominantly one of growth. At each larval molt a growing insect reconstitutes its larval characteristics, including its larval skin. The fully grown insect then undergoes a metamorphic molt in which adult structures become differentiated. The stimulus which initiates the succession of events terminating in a larval molt is known in only a few cases. For example, in the bloodsucking bug *Rhodnius*, which undergoes incomplete metamorphosis (hemimetabolous), the stretching of the body by a feeding of blood is followed by a molt in a definitely predictable manner. The stretching stimulates, through nerves, certain neurosecretory cells in the dorsal region of the brain (pars intercerebralis). These cells release a hormone which activates the prothoracic gland (located in the prothorax) which in turn releases a hormone, setting into motion the processes of molt. The prothoracic-gland hormone has been called the growth and differentiation hormone; it has recently been obtained in pure chemical form and named ecdysone. Permitted to act alone, the hormone induces a metamorphic molt; but during normal larval growth, another gland begins to secrete soon after the prothoracic gland becomes active. This additional gland, the corpus allatum, liberates a factor termed the juvenile hormone, whose action is to cause the reconstructive processes during the molt to be directed to producing another larval generation.

In *Rhodnius*, in which there are typically five nymphal stages preceding the metamorphic molt, the juvenile hormone is secreted by the corpus allatum at each molt except that of the last-stage nymph. In the absence of the juvenile hormone, the insect metamorphoses into the adult. Diminutive adults have been obtained by the removal of the corpus allatum from nymphs earlier than those in the fifth-stage. On the other hand, sixth-stage nymphs which develop into giant adults have been obtained by transplanting juvenile corpora allata into otherwise normal last-stage nymphs.

This general manner of regulation of development appears to hold for all insects, with slight differences from group to group. In a completely metamorphosing (holometabolous) insect, *e.g.*, the cecropia moth, the last larval, or caterpillar, stage is followed by a pupation molt under the influence of the prothoracic-gland hormone in the absence of the juvenile one. The pupa then enters a period of inactivity known as diapause under the influence of a diapause hormone produced by the subesophageal ganglion. Diapause may be terminated, and the metamorphic molt initiated, by subjecting pupas to a period of chilling followed by return to higher temperature. Such chilling activates the neurosecretory cells in the brain to produce the hormone which stimulates the prothoracic glands.

The glands involved in the regulation of growth and differentiation in insects vary greatly in structure and in location in the body. The corpus allatum, in the head, may be paired or single. Prothoracic glands may differ greatly in size and cellular form. In the fly larva these two glands are united with a third gland of less well-known function, the corpus cardiacum, forming an organ termed the ring gland.

Hormones and Reproduction.—In many crustaceans a male reproductive hormone arises in a small organ, the androgenic gland, located on the sperm duct near its external opening. This male hormone is necessary for the development of the testes, male accessory sex organs and secondary sex characters. Removal of the gland results in gradual alteration of body form and functions, the castrate tending to resemble the female.

Activity of the crustacean ovary is regulated by an inhibitory hormone arising in the MTGX sinus-gland complex. In the breeding cycle, decrease in this hormone permits the maturing of the eggs and subsequent ovulation. In certain crustaceans which show in their life history a protandric hermaphroditism (first a functional male, later a female), the sexual transition is correlated with the disappearance of the ovary-inhibiting factor and the degeneration of the androgenic gland. Evidence also suggests that the activated ovary liberates a hormone upon which depends differentiation of such breeding accessories as brood pouches and ovigerous hairs.

The maturation of the ovaries and the activation of certain accessory reproductive glands have been shown to depend upon a corpus allatum hormone in insects as diverse as cockroaches, grasshoppers, beetles, *Rhodnius* and flies. In these insects there appears, furthermore, to be a reciprocal relationship between the corpus allatum and the ovary. Removal of ovaries results in hypertrophy of the corpus allatum. Restoration of this gland to normal size is effected by implanting mature ovaries.

That some differences may occur among insects is evident; certain moths, with corpora allata removed during the larval stage, are still able to develop fully functional ovaries and produce viable eggs. There is also evidence suggesting that a brain hormone, possibly liberated by way of the corpus cardiacum, exerts a regulatory action on the corpus allatum.

Another hormone, the prothoracic-gland hormone, is also essential to the development of functional ovaries and testes, in part in its general role in growth and differentiation of larval organs, and also through a more specific influence upon gonad maturation.

At least in the blowfly, a third hormone, found in neurosecretory

cells of the brain, and also in the corpora cardiaca, contributes directly to the normal regulation of ovarian function.

Other Hormonal Activities.—Hormones have been implicated as regulators of many other specific processes in arthropods, probably essential metabolic correlates of the foregoing phenomena. However, another hormonal mechanism in crustaceans justifies separate mention. In the wall of the pericardial cavity (enclosing the heart) lies a cluster of fibre terminations of neurosecretory cells of the ventral nerve cord. These terminations, the pericardial gland, release a heart-accelerator hormone.

In a sipunculid worm (*Physcosoma*) certain glandular structures, the internephridial organs, found in association with the large nephridial (excretory) tubules, have been reported to secrete a hormone essential for normal metabolism and viability. Removal of the glands leads to characteristic changes terminating with death; these changes are prevented by gland implantations. Colour changes in the cephalopods (octopus, squid) are effected by an unusual kind of integumentary chromatophore, small elastic sacs of pigment having radially arranged muscle fibres. Although the chromatophore changes are controlled chiefly by nerves, two blood-borne hormones, tyramine from the salivary glands, and betain influence the chromatophore state.

Many invertebrates exhibit sexual dimorphism including differentiation of accessory organs or secondary sexual characteristics. Studies of animals castrated by parasitic infection, irradiation or surgical removal, and studies showing correlations of time of certain morphological changes with states of gonadal activity have suggested that sex hormones, probably produced by the gonads, are essential for the development of these characteristics. Such studies have included animals as diverse as planarian worms, snails, earthworms, cephalopods and crustaceans.

General.—There appears to be no fundamental similarity of origin of endocrine glands between invertebrates and vertebrates, yet the parallel role of the endocrine systems of these two major divisions of the animal kingdom is striking. Furthermore, there is no established identity of any functional vertebrate and invertebrate hormone, though substances with actions resembling adrenin, estrogens, juvenile hormone and melanophore-stimulating hormone occur in both groups. Hormone secretion by nervous elements appears widespread throughout the animal kingdom.

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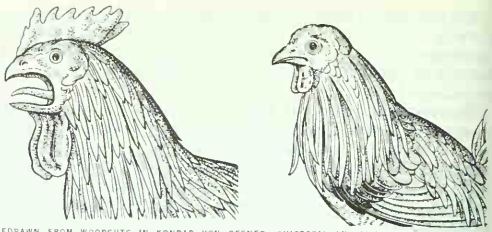
HORMONES, PLANT, like animal hormones, are complex organic substances that produce profound effects on cell metabolism and growth, even when present in minute amounts. They include the auxins, kinins, gibberellins and certain B vitamins. *See* PLANTS AND PLANT SCIENCE: *Plant Physiology: Growth: Hormones.*

HORMONES, VERTEBRATE. Hormones are organic substances, produced naturally in living organisms, that exert specific effects on the activities of definite organs. The term hormone was introduced in 1904 by W. M. Bayliss and E. H. Starling to denote in general the products of internal secretion that become distributed by the blood. It soon found wide acceptance, and its meaning was extended beyond the original limitation to blood-borne substances. Thus one speaks also of neurohormones, insect and plant hormones. There is a tendency to apply the name to any substance that carries inductive excitation from one part of the body to another.

History and Introduction.—The realization that blood is a carrier of many principles that affect mental and physical health dates back at least as far as the Hippocratic humoral theories. Also, the appearance of generalized effects after castration of men and domestic animals was well known in biblical times and through the middle ages. The documentary woodcut (fig. 1) from Gesner's *Historia Animalium* (1555) expresses correctly the consequences of orchiectomy (removal of testes) for growth of feathers, combs and wattles, and for certain behaviour patterns (fighting, crowing). However, the birth of a true science of internal secretions usually is dated only with the year 1849. At that time, the German physiologist Arnold Adolph Berthold reported on the restitution of cock characteristics by the implantation of testes into capons. He inferred that the testes produce a substance that is released into the blood stream. Generally distributed throughout the body, these substances induce reactions in specially responsive "target organs," often histologically complex systems such as combs, feather germs or the brain. In spite of much experimentation virtually no progress on testicular secretion was accomplished until 1927, when F. C. Koch and L. C. McGee extracted from bull testes an alcohol- and ether-soluble material that, after injection into capons, fully restored the male characteristics. Following this discovery various laboratories pursued work toward the chemical identification of the substance. By 1935 A. Butenandt had found the chemical structural formulas for the two most important androgens, which were named androsterone and testosterone.



REDRAWN FROM WOODCUTS IN KONRAD VON GESNER, "HISTORIA ANIMALIUM," ZÜRICH, SWITZ., 1555

FIG. 1.—COCK (LEFT) AND CAPON, OR CASTRATE, SHOWING DIFFERENCES IN COMB AND WATTLES

The progress from observations on normal and deficient, often sick, organisms to experiments of extirpation, reimplantation and injection of organ extracts is typical for investigative work on endocrine organs. The next step—chemical identification of the active principles—has been successful mostly when the chemicals involved were not of proteinic composition.

Hormones appear in the role of chemical messengers. They may remain confined within the membrane of a single cell, carrying their "message" from one district of a protozoan to another, or from the peripheral dendrites of a nerve cell to its central ganglionic body and nucleus. Also, the original restriction to substances produced naturally within the organism fell when the chemists were able to synthesize not only the naturally occurring hormones but also structurally different mimetic hormones, which, in some instances, act as almost ideal substitutes (*e.g.*, stilbestrol for the natural female sex hormones).

With such liberal acceptance of new connotations, the term hormone risked danger of becoming vague or ill-defined. However, the following survey includes only the typical and most important vertebrate hormones, their production and activities.

The hormone-producing glands are scattered throughout the body; but among them the hypophysis (pituitary) plays a dominant role, being functionally related to nearly all others. Often it controls the degree of their secretory activity. In many cases reciprocal influences result in delicately balanced equilibria.

The general principles of hormonal physiology were clearly worked out by mid-20th century; particularly well known is the participation by hormones in the highly complex sequences of reactions that sustain menstrual cycles, pregnancy or the phenomena of stress. Hormones, in astoundingly small quantities usually weighed in millionths of grams, often start reaction chains that influence the entire future course of the life process. They serve not as building stones but rather as executive officers, organizing and directing growth, differentiation and maintenance of organisms by control over enzymatic chemical transformations. Their importance becomes most evident in their failures, under pathologic con-

ditions, and in senescence. Hence their growing usefulness as therapeutic agents in medical practice.

Thyroxin.—Through release of a thyrotrophic hormone, the hypophysis stimulates production and release of thyroxin by the thyroid gland. Thyroxin produces spectacular effects in some amphibians, particularly the frog, inducing metamorphosis of the long-tailed aquatic larva into the four-legged terrestrial adult form. In the higher vertebrates, including man, it mainly intensifies the respiratory metabolism, drawing on the carbohydrate, fat and protein reserves of the body. Hyperactivity of the thyroid increases the rate of basal metabolism, establishing a condition that is typical of exophthalmic goitre. Failure of the thyroid to secrete adequate amounts of hormone leads to low metabolic rates and cretinism (*q.v.*). While the cause for either too high or too low thyroxin production often lies with abnormal thyrotrophic functioning of the hypophysis, the resulting conditions are usually treated by partial destruction of the thyroid through surgery and irradiation or by the administration of additional dosages of thyroxin. Since the thyroxin molecule contains four atoms of iodine, a deficiency of this relatively scarce element in water and food intake is probably the most common primary cause of disturbances in thyroid function. Therapeutically thyroxin is administered for the stimulation of metabolism, and also as a reducing agent. Thiourea and thiouracil inhibit the secretion of thyroxin, but their continued use leads to a goitrous enlargement of the thyroid.

Thyroxin disappears relatively quickly from the blood stream. J. Gross and C. P. Leblond, using thyroxin tagged with radioactive iodine, show that the liver is nearly eight times as active in the elimination process as the kidneys. (*See* also THYROID GLAND.)

Parathormone.—Laterally attached to the thyroids are from two to four small parathyroid bodies. Their hormone, parathormone, regulates the blood calcium and phosphorus levels. Extirpation of the glands often leads to tetany and death. Parathormone production seems not to be controlled by the hypophysis.

Duodenal Hormones.—The duodenum is not anatomically a typical endocrine gland; but upon the entrance of acid stomach contents, certain cells of its inner lining release the polypeptides secretin and cholecystokinin into the blood stream, which induce active flow of pancreatic juice and bile respectively. It was during the study of these relationships that Bayliss and Starling (1904) introduced the term hormone for blood-borne chemical messengers.

Insulin and Glucagon.—Special cell islets (of Langerhans) of the pancreas, which do not connect with the pancreatic duct system, release into the blood stream the polypeptide hormone insulin, the most important regulator of carbohydrate metabolism. Under its influence blood sugar (glucose) is built up to glycogen and stored in liver and muscle cells. Deficient insulin production leads to a rise in the blood-sugar level. Sugar is incompletely removed after meals, and the mobilization of liver glycogen by intervention of two antagonists of insulin remains uninhibited. Of the latter, the diabetogenic principle of the hypophysis counteracts the production of insulin as well as its glycogen storing activity in the liver.

The second antagonist, glucagon, is a companion hormone which is also produced in the pancreatic islets. Normally it assists in balancing and adjusting insulin activity. Glucagon and insulin are produced by separate islet cells, which are designated as α and β cells respectively. As a whole the α cells are more resistant to damage. When exposed to the chemical alloxan (used to induce diabetes in experimental animals), the α cells still persist after all β cells have been destroyed. This explains why in many diabetic animals blood-sugar levels are lowered after removal of either the hypophysis or the pancreas.

If the blood-sugar concentration rises above the so-called renal threshold, it passes into the urine and establishes the morbid condition known as diabetes mellitus (*q.v.*). This formerly dreaded and inevitably fatal sickness is now easily controlled by the injection of extracted insulin after methods developed by F. G. Banting and C. H. Best. Work by C. F. and G. T. Cori and others opened a path toward an understanding of the chemistry of glycogen formation in the liver under the influence of insulin and its hypophyseal antagonist.

Epinephrine and Norepinephrine.—The adrenals are composites of two glands of different embryologic origin and secretory functions. The adrenal medulla arises from ectodermal sympathoblasts that separate late from sister cells that differentiate into sympathetic ganglia. It is therefore not surprising that its hormones, epinephrine (adrenaline; *q.v.*) and norepinephrine (noradrenaline), produce similar effects as the activated sympathetic nervous system. In fact the latter itself releases a "neurohormone," which may be identical with noradrenaline. These medullary hormones, whose chemical constitution was cleared up as early as 1904, are, however, of uncertain physiologic importance. They constrict the capillaries in resting muscles and thus may play a role in directing the blood flow toward working muscles. They also can mobilize glycogen stores of the liver and thereby act as antagonists of insulin. Since fright and other forms of emotional stress cause an increased outpour of adrenaline, they effect a rise in the blood-sugar level, which in turn enables muscles to do increased work ("emergency function" of adrenaline, after W. B. Cannon). While apparently adrenal medullary function is not controlled by the hypophysis, it seems that adrenaline is able to influence at least one phase of hypophyseal activity, namely the release of corticotrophic hormone under conditions of stress. (*See* ADRENAL GLANDS.)

Steroid Hormones.—The adrenal cortex, testis and ovary are a complex of endocrine glands that produce about 30 known hormones, all belonging to the chemical order of steroids. One may summarily speak of the steroid glands. Embryologically they are closely related to each other and to the middle kidney (mesonephros). All are derived from the intermediate mesoderm. The proportion of kidney and endocrine gland formation from the embryonic blastema can be shifted. Some such experimental changes may even lead to partial or complex sex reversal.

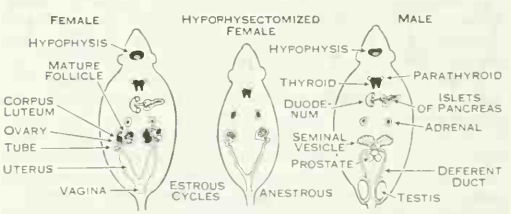
While the testis and ovary are foremost germ cell producing organs, the adrenal cortex functions exclusively as a hormone gland. Histologically it is the least differentiated of the three; but in respect to hormone production it is the most versatile. In fact, it can produce not only the characteristic corticoids but also under special conditions sex hormones, which are usually elaborated by the follicular and interstitial cells of the sex glands.

With regard to prevailing physiologic actions the 30-odd hormones fall into five groups: androgens, estrogens, gestagens, glucocorticoids and mineralocorticoids.

Androgens (*e.g.*, androsterone, testosterone) are characteristic products of the testis and maintain the male secondary sex characters.

Estrogens (*e.g.*, estradiol) are primarily produced by the ovarian follicles and support the female secondary sex characters. According to the higher or lower amounts released into the blood, an animal is in the estrous or anestrous condition (*see* fig. 2), the estrous or "heat" phase being characterized by a high development of the uterus and other parts of the female genital tract, and by a receptive behaviour toward the male.

Gestagens (*e.g.*, progesterone) typically are released by the yel-



BODY WEIGHT	260 g.	BODY WEIGHT	180 g.	BODY WEIGHT	300 g.
HYPOPHYSIS	12 mg.	THYROID	13 mg.	HYPOPHYSIS	8 mg.
THYROID	24 mg.	ADRENALS	16 mg.	THYROID	24 mg.
ADRENALS	65 mg.	ACCESSORY SEX ORGANS	150 mg.	ADRENALS	45 mg.
ACCESSORY SEX ORGANS	1,000 mg.	OVARIES	16 mg.	ACCESSORY SEX ORGANS	2,000 mg.
OVARIES	80 mg.			TESTES	3,000 mg.

E. WITSCHI

FIG. 2.—THE VERTEBRATE ENDOCRINE SYSTEM, SHOWN IN A NORMAL FEMALE, A HYPOPHYSECTOMIZED FEMALE AND A NORMAL MALE RAT, ALL LITTER MATES

low bodies (corpora lutea) of the ovaries; they direct the preparations for and maintenance of pregnancy, in the uterus. Certain gestagens, particularly the synthetic norethynodrel, are potent inhibitors of ovulation. They may become important agents in the therapeutic control of reproduction.

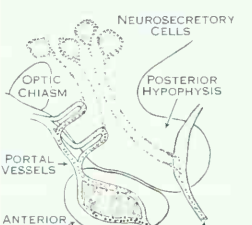
Glucocorticoids (*e.g.*, cortisone, hydrocortisone) of the adrenal cortex cause the transformation of proteins into glucose and liver glycogen. Under extreme dosages the rise in blood sugar may even lead to diabetes; but at the same time glycogen stores of the body are replenished at the expense of proteins. These hormones produce euphoric effects and give symptomatic relief in many inflammatory afflictions such as iritis and arthritis.

Mineralocorticoids (*e.g.*, desoxycorticosterone, aldosterone) are of vital importance in the maintenance of electrolyte and water balance. After pathologic shrinking of the cortex (Addison's disease; *q.v.*) or following surgical removal, the kidney thresholds for sodium, chloride and water fall very low, and excretion of urine and salt are highly increased. Patients and animals may be partly maintained with high water and salt rations. Addison's disease, once unavoidably fatal, came to be controlled by administrations of desoxycorticosterone and hydrocortisone. The important aldosterone was discovered in 1954. The production of the glucocorticoids is stimulated by the pituitary secretion ACTH (adrenocorticotrophic hormone). Quite to the contrary, mineralocorticoids are released in response to the concentration of sodium, potassium chloride and water in the blood serum. Thus, hypophysectomy (removal of the hypophysis) does not markedly upset the electrolyte and water balance; however, the effect of low salt diets is largely obviated through an immediately increased output of aldosterone.

Probably the three steroid glands prepare their hormones from the universally distributed cholesterol. By the use of cholesterol and acetate, which were both labeled with radioactive carbon, O. M. Hechter could show that perfused isolated adrenals use these materials for the biosynthesis of corticoids. Cholesterol and the steroid hormones have a common nucleus of a cyclopentane and three benzene rings. They differ in the array of attached hydrogen and oxygen atoms, short side chains and the occurrence of double bonds. (In writing the constitutional formulas it is customary to omit hydrogen atoms that are attached to the basic skeleton.) In the selection of formulas of six representative substances given below, estrane and cholesterol are not hormones, but the first is of interest as the chemically simplest parent hydrocarbon of the entire order of steroids, and the second as the probable starting base of biosynthesis of the natural hormones.

The distribution of the sites of manufacture of the steroid hormones shows many surprising features. The ovaries of most, and possibly all, vertebrates produce not only female but also male sex hormones, often in sufficient quantity to induce recognizable heterosexual effects. The reverse situation seems rather exceptional, but at least the testes of the human male and the stallion produce considerable amounts of estrogens. The adrenal cortex elaborates small amounts of male sex hormones almost regularly, and in both sexes. If the output becomes excessive in the human female, it leads to various degrees of masculinization. Prevailing symptoms are a deepening of voice and an excessive growth of body and facial hair (hirsutism). These variations and abnormalities become in a sense comprehensible through the established close embryologic relationships between the endocrine components of the three types of glands.

Hypophysis Hormones.—The hypophysis (or pituitary), master gland of the endocrine system, consists of two loosely connected parts, which are usually distinguished as the anterior and posterior lobes (fig. 3). The posterior lobe, being an outgrowth of the floor of the forebrain and consisting mainly of large bundles of nerve fibres, is also called the neurohypophysis or the nervous part. The anterior lobe, or adenohypophysis, much like the lens of the eye, starts from an embryonic epiderm plate (placode). Invaginating first as a pouch, it grows toward the nervous part, to which it becomes broadly attached. Sometimes one distinguishes between an anterior lobe proper and an intermediate lobe, the latter developing from that part of the epidermal pouch which applies itself directly to the posterior lobe.

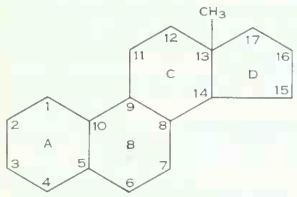


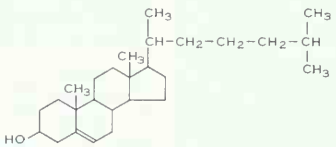
FROM E. SCHARRER, "EXPERIENTIA," VOL. X, FASC. 6, P. 266 (1954), BY COURTESY OF VERLAG BIRKHAUSER

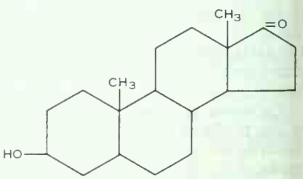
FIG. 3.—HYPOTHALAMUS AND HYPOPHYSIS

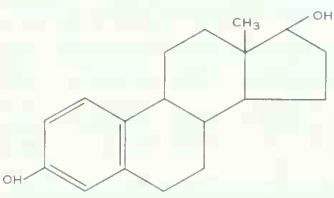
All hypophysis hormones are proteins or polypeptides. Consequently their separation presents great difficulties and even their total number is not known. Usually they are designated on the basis of a characteristic action or relationship, often with the suffix "-trophin" or "-trophic" ("-tropin" or "-tropic") attached, which, however, is without deeper meaning. Increasingly popular are abbreviations as given in the following partial list of hormones of the anterior lobe:

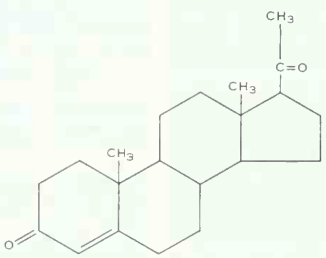
Thyroid-stimulating hormone (TSH) or thyrotrophin
Adrenocorticotrophic hormone (ACTH) or corticotrophin

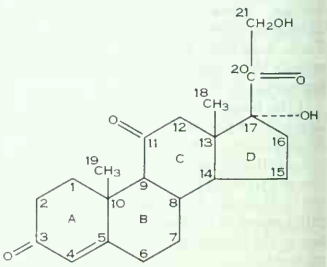

ESTRANE


CHOLESTEROL


ANDROSTERONE


ESTRADIOL


PROGESTERONE


CORTISONE

Follicle-stimulating hormone (FSH)
Luteinizing hormone (LH) or interstitial cell-stimulating hormone (ICSH)
} Gonad-controlling hormones or gonadotrophins
Luteotrophic hormone (LTH) or prolactin
Growth hormone (GH), somatotrophic hormone (STH) or somatotrophin
Melanocyte-stimulating hormone (MSH) or intermedin

The separate existence of ICSH and LH is contested; distinction rests entirely on differences in biologic reactions. On the other hand it seems possible that further work may lead to the identification of even larger numbers. Already mentioned were indications that the parathyroids and the pancreatic islets may be hormonally linked with the hypophysis.

Chemically these hormones fall in two groups: simple proteins and glucoproteins. Their molecular weights range between about 2,000 and 100,000. Only the last two of the above list act directly and exclusively on peripheral targets. Intermedin controls adaptational colour changes in many amphibians and fishes. It is just as prevalent in the hypophysis of warm-blooded animals, but in neither birds nor mammals has it a definite influence on pigmentation or on other characteristics. It is sometimes called intermedin because in frogs it was particularly found in the intermediate lobe. While the anterior lobe as a whole is the most likely place of origin, it has also been extracted from the hypothalamic region and the posterior lobe.

GH is important mainly through its protein-sparing influence on the general metabolism. Nitrogen excretion being reduced, it favours a compensatory increase of fat oxidation. It has a marked influence on epiphyseal bone growth. The deficiency or absence of this hormone, as after hypophysectomy, leads to dwarfism (*see* fig. 2); on the other hand, hypersecretion or injection of additional hormone causes gigantism in young animals and acromegalism in individuals that had already stopped growing.

The other hormones of the list have in common their effect upon endocrine glands and are recognized mainly from induced secondary effects. Thus, administered thyrotrophin is usually not evaluated from immediate effects in the thyroid but by observed changes in metabolic rates or in amphibian metamorphosis, which really are responses to thyroxin. Probably most hormones of this group exert also some peripheral influences. In the case of the African weaver finch, gonadotrophins (a, fig. 4) induce the testes to release an androgen (b, fig. 4), which in turn elicits two independent secondary reactions, namely the enlargement of the seminal ducts and melanin production in the bill; but LH stimulates also directly melanin production in certain feather germs of the nuptial plumage of the cock (a′, fig. 4). Similarly prolactin stimulates another endocrine gland, the corpus luteum of the ovary, and also peripheral end organs, the mammaries, where it initiates and sustains milk secretion.

The two-step system of hormonal control seems to facilitate the correlation and equilibration of hormonal systems, particularly within the large steroid complex. As concentration of a steroid hormone in blood rises, it slows and checks the further increase in output of the corresponding hypophyseal "trophin." These relationships are not always immediately obvious but can be demonstrated in specially arranged experiments. Fig. 2 illustrates the consequences of hypophysectomy performed on a female rat at the age of eight weeks. The animal barely gained further weight. The cortices of the adrenals are shrunk and the ovaries are in an immature condition. The secondary sex characters are underdeveloped, like those of a total castrate. If surgically united in parabiosis with a normal sister rat, the deficiencies remain unrelieved (fig. 5). This must be so, because all hormones disappear relatively fast from the blood stream and the exchange of blood through the parabiotic bridge is too slow (1 ml. per 10 min.) to carry effective amounts from the normal to the

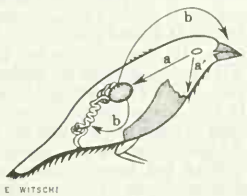
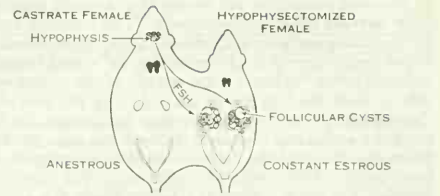


FIG. 4.—DIRECT AND INDIRECT GONADOTROPHIN REACTIONS IN THE AFRICAN WEAVER FINCH EUPLECTES



BODY WEIGHT	250 g.	BODY WEIGHT	180 g.
THYROID	23 mg.	THYROID	13 mg.
ADRENALS	64 mg.	ADRENALS	16 mg.
ACCESSORY SEX ORGANS	390 mg.	ACCESSORY SEX ORGANS	1,350 mg.
OVARIES	---	OVARIES	416 mg.

E. WITSCHI

FIG. 5.—PARABIOSIS OF A CASTRATE FEMALE AND A HYPOPHYSECTOMIZED FEMALE RAT

hypophysectomized member. But if now the normal female is castrated, its uninhibited hypophysis at once pours out FSH at an estimated fivefold rate. This is enough to spill over into the other member and cause an excessive follicular growth. The subsequent release of estrogen is sufficient to stimulate also the animal's own sex ducts, though not those of the castrate partner.

The described experiment serves also in the elucidation of the nature of the so-called antihormones. Purified FSH from sheep or beef hypophysis glands injected into rats for periods of ten days or more seems to lose its effectiveness rapidly. This observation led to the notion of antihormones, *i.e.*, a class of substances that were assumed to play a role in the defense against overstimulation. However, in parabiosis experiments, with an arrangement as shown in fig. 5, large ovaries and a condition of estrus may be maintained for indefinite times; several experiments were kept running for more than one year. This proves that the "antihormones" actually are antibodies of an immunity reaction; *i.e.*, of the rat's defense against injected beef or sheep proteins.

The posterior lobe or neurohypophysis stores and releases at least two hormones. V. du Vigneaud succeeded in identifying and synthesizing vasopressin, which increases blood pressure and causes water retention (antidiuretic effect), and oxytocin, which causes contraction of smooth muscles. The latter is used clinically to induce labour in childbirth. (*See* also PITUITARY GLAND.)

Hormones From Nerve Cells.—The research of E. Scharrer, R. Collin and others seems to establish that the posterior lobe only stores vasopressin and oxytocin, which actually are the products of neurosecretion by specialized cells of the hypothalamus, a part of the forebrain (fig. 3). This discovery also opened the door to the understanding of many long-known facts which indicate that the neural and the hormonal control systems are not absolutely separate. Obviously, the latter is in many instances governed by the former. It is well known that increases in light often cause augmented output of gonadotrophins. Jacques Benoit first presented evidence of pathways that lead from cerebral sensory centres to hypothalamic nuclei and onto the anterior lobe of the hypophysis. Apparently, substances prepared by hypothalamic cells are secreted into a small system of portal veins that drains from the hypothalamus into the anterior lobe. Here the neurosecretion, acting as a hormone, induces the release of the gonadotrophins which bring about the seasonal recrudescence of the sex glands of many wild birds and mammals, thus bringing on the chain of events characteristic of the breeding season. (*See* also HYPOTHALAMUS.)

Ovarian and Placental Hormones.—As mentioned before, the implantation of the fertilized egg, or rather of the young germ issued from fertilization, is aided by maternal ovarian hormones. First the follicular estrogens and later progesterone, the hormone of the corpus luteum, prepare the endometrium or inner lining of the uterus for the arrival of the germ. On the seventh day after fertilization the human blastocyst attaches itself to the uterine wall and immediately begins to draw nutrition from maternal tissues and circulation. The following week being the last of the normal menstrual cycle, it obviously becomes necessary to prevent shedding of the endometrium; *i.e.*, menstrual flow. This check is accomplished

by placental production and release of a chorionic gonadotrophin, CGH, into the maternal bloodstream. This hormone, substituting for the falling and soon discontinued LTH supply, stimulates continued production of progesterone by the corpus luteum of the maternal ovary. Without it the activity of the corpus would subside by about the 25th day of the cycle. By the time of the first "missed period," only two weeks after fertilization, the CGH has reached a sufficiently high level in blood and urine of the mother to become detectable by means of several pregnancy tests (Aschheim-Zondek, Allen-Doisy, Friedman, etc.). The chorionic gonadotrophin, like the hypophyseal gonadotrophins, is a glucoprotein; but it is chemically and physiologically distinct. Later a specialized area of the chorion, the disc placenta, produces not only gonadotrophin but also estrogen and progesterone. The hormonal control over the maintenance of pregnancy thus passes entirely from the ovary to the placenta. The latter also exercises control over the termination of gestation; *i.e.*, over the events that lead to the birth of the child. Another gonadotrophin appears in the blood serum of pregnant mares (PMS) during the second and third months of gestation.

A nonsteroid hormone, relaxin, extracted from ovaries by F. L. Hisaw, was found to facilitate relaxation of the pelvic bones, particularly rendering the ligament of the pubic symphysis more elastic. It has been identified in the serum of pregnant animals and women and seems to be a supporting factor in the complex birth mechanism. According to E. H. Frieden three peptides with relaxing capacities have been isolated. (*See* also REPRODUCTION: *Physiology of Reproduction;* REPRODUCTIVE SYSTEM.)

Hormone Production by Tumorous Endocrine Glands.— Some endocrine glands, particularly the thyroid, may metastasize and spread hormonally active tissues over the body, lungs, bone marrow and so on. By the use of radioactive iodine such foci can be detected and partly also destroyed.

Ovarian embryomas, usually in the form of cysts containing more or less distinct parts of an embryonic body, may produce large quantities of chorionic gonadotrophin, the same as in normal pregnancies. Most probably such tumours start from parthenogenetic ovarian eggs. Similar embryomas may develop also in testes of young men. They start early upon a definitely malignant course. Metastases of this testicular chorionepithelioma locate particularly in the lungs and the brain but also in other parts of the body. Often CGH is produced and poured into the blood stream of these patients in quantities larger than those observed in women during typical pregnancies.

See ENDOCRINOLOGY; *see* also references under "Hormones, Vertebrate" in the Index volume.

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HORMUZ (ORMUZ; Persian JAZIREH-YE HORMOZ), an island of Iran on the strait of Hormuz, between the Persian gulf and the Gulf of Oman, is situated 5 mi. from the coast and 12 mi. S.E. of Bandar Abbas. It extends 3½ mi. from north to south, 4½ mi. from east to west and is crowded with jagged hills. The island is an eroded dome with outcrops of rock salt, red ochre, a greenish clay, marls and sandstones. Its barrenness is relieved only by a few *konar* (*Zizyphus spina-christi*) trees and patches of barley and melons near the village of Hormuz, the only permanent settlement, comprising about 300 mat huts. The population, which is mainly Iranian with a few Balochi and Arabs, may rise to 1,000 males when the salt and oxide mines are being worked, but falls to less than half in the summer when large numbers migrate to the mainland, especially to Minab, for the date harvest or to escape the excessive heat. The water supply is from rainfall, collected in pools or cisterns. The resources of the island are red ochre for export (12,000 tons annually) and salt for local use. Copper and iron ore, though present, are not worked.

Of the old and famous city which stood on the promontory on the northern shore, close to the present village, scarcely anything of definite shape now remains, except part of the old Portuguese fort; but there are traces of buildings of massive foundations and a great number of ruined water cisterns. The name Hormuz originally referred to a town on the mainland, situated probably on Khor Minab, near the present Minab, about four miles from the sea. The earliest mention of the name occurs, it seems, in the voyage of Nearchus (325 B.C.) when that admiral anchored Alexander the Great's fleet on the shore of Hormozia at the mouth of the Anamis (Minab) river. The foundation of a town at this place is ascribed to the first Sassanid ruler, Ardashir I, but it was only after the Arab conquest that it attained prominence. The geographers Idrisi, Istakhri and Al Maqdisi describe the place as the chief market of Kirman (Kerman). Palm groves were numerous and durra, indigo, cumin and sugar cane were cultivated. Yaqut, the Arab geographer (1179–1229), states that this Hormuz had attracted all the trade of India as well as China. Marco Polo twice visited the place, which was then under the rule of the Ilkhan of Persia. At the beginning of the 14th century the Arab ruler of Hormuz, because of the constant incursions of robber tribes from Baluchistan, abandoned the old town and founded New Hormuz on the island then known as Jirun. Strengthened by repeated population transfers from the war-stricken mainland, *e.g.*, Timur's expedition against the Kerman coast, New Hormuz gradually superseded Qais (*q.v.*) as the most important emporium of the Persian gulf. The Franciscan traveler Friar Odoric (*c.* 1286–1331) makes the earliest mention of this city, which he describes as strongly fortified and abounding in costly wares. It again became the market of the wares of India. The princes of Hormuz appear to have held sway over other islands of the gulf and even over the shores of Oman at times.

In 1507 Hormuz was attacked, and in 1514 taken, by the Portuguese under Affonso de Albuquerque who built the fort. For more than a century Hormuz remained (under its hereditary rulers) a possession of Portugal; but the rise of the English trade and factories in the Indian seas, and the establishment of trade relations with Persia by the East India company, led to constant friction with the Portuguese. Moreover Shah Abbas I resented the Portuguese occupation of such a position as Hormuz within his dominion, and sought the aid of English ships in attacking it. In 1622 the combined forces of Shah Abbas and the company captured Hormuz after a gallant defense. Its activities were transferred to Gombroon, the former landing place on the mainland, where Shah Abbas founded a port under the name of Bandar Abbas (*q.v.*). In a few years Hormuz city was little more than a ruin.

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HORN, ARVID BERNHARD, COUNT (1664–1742), Swedish statesman, first minister from 1720 to 1738, was born in Finland on April 6, 1664, of a well-connected but impoverished military family. He entered the army in 1682 and fought in Hungary and the Low Countries before returning to Sweden to make a marriage which brought wealth and connections with the influential Gyldenstolpes and Pipers. His qualities as an officer attracted the attention of Charles XI and he assisted in the military training of the future Charles XII. Horn played a prominent part in the early campaigns of the Great Northern War, but during the years of fighting in Poland was employed increasingly on diplomatic missions. He was ambitious and cautious; Ulrika Eleanora, Charles XII's sister, said that his weakness was his desire "to be liked by everyone." This made him a disappointment to Charles XII who in 1705 created him count and councilor and sent him to Stockholm to bring new life into the government. In the event, Horn did not, in the years of adversity after 1709, support the royal military and financial plans, while his diplomacy as head of chancery (from 1710) was often counter to the king's. Consequently, Charles came not to trust Horn, although he was sufficiently sure of his patriotism to leave him in office.

Horn's caution prevented his committing himself on the succession question during Charles's lifetime. He espoused neither the cause of the duke of Holstein-Gottorp (Charles's nephew, to whom Horn was governor) nor that of Ulrika Eleanora, but he was in contact with the antiabsolutist opposition and when this group emerged victorious in the struggle which followed Charles's death and Ulrika Eleanora's accession in 1718, Horn was thrust into prominence. In 1720 he became *lantmarskalk* and assumed the task of presiding over the *riksdag*.

Playing upon the queen's desire to have her husband, Frederick of Hesse, declared co-regent, Horn persuaded Ulrika Eleanora to resign the crown in Frederick's favour. Once the latter, with no hereditary claim to the throne, had been elected king, his position vis-à-vis the antiabsolutist council proved, as Horn had foreseen, untenable.

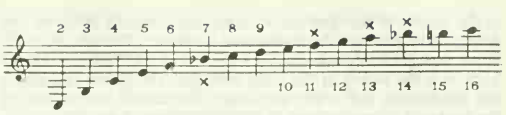
In this way the solid foundation for the 18th-century parliamentary form of government in Sweden was laid. Horn himself was the unwilling instrument of transference of real power from the council, where he as a conservative noble wanted it to remain, to the *riksdag:* the split in the council on important issues was deep enough to force him to transfer decisions to the diet where he could hope to influence greater numbers. This development led to Horn's own downfall in 1738, when a new generation found him out of tune with the wishes of the majority of the estates; but from 1720 to 1738, and particularly between 1727 and 1734, Horn exercised considerable influence, though he was never so powerful as foreign observers believed. At home he stood for retrenchment and a cautious mercantilism. Abroad he stood for peace. He was not interested, as were most other political leaders of his time, in the prospect of regaining any of the provinces lost by the peacemaking of 1719–21. He wanted a balancing policy between the European coalitions and alliance groupings without real commitment.

Horn resigned in Dec. 1738 and died on April 17, 1742.

(R. M. HA.)

HORN, a class of wind instruments sounded by vibration of the player's tensed lips applied to a mouthpiece; these instruments are primarily derived from animal horns blown at the truncated narrow end or, as among many tropical peoples, at a hole in the side. Metal construction, at first imitating natural shapes, dates as far back as the Danish Bronze Age luren, cast in the shape of mammoth tusks. From the oxhorns of medieval huntsmen and watchmen, sounding but one or two notes of the natural harmonic series, later and modern metal horns have been developed by (1) refining the bore profile (which remains mainly conical save at points where this is impracticable, as through valve mechanism) and bell form and (2) such prolongation of the bore as may be desired to lower the fundamental pitch and so bring higher notes of the tube's natural series within the upper frequency limit of a player's lip vibration, thereby extending the instrument's melodic possibilities. Horns conserving the curved shape, but with lengthened tube, include the 18th-century bugle horn (*see* BUGLE). An English straight-built group, derived from early 19th-century hunting horns, includes the brass post horn (sounding harmonics no. 2 to 5, written C G C E but sounding in the key of A♭) and copper coach horn, both of which are lengthened versions, and the 20th-century English hunting horn, a reduced version with one note only.

Accommodation of increased length by making one or more coils in the tube was well known in the 16th century: small once-coiled horns that have led to various continental European small hunting and post horns (whence the cornet, *q.v.*), and close-coiled helical horns with five or more feet of tubing, though not then employed in music. The large circular French hunting horn, *trompe* (or *cor*) *de chasse*, from which the orchestral horn is derived, appeared about 1650. It has varied in diameter and number of coils; as played in modern France and Belgium by huntsmen, horn-playing clubs and brass bands, it is usually 15 in. across, thrice-coiled with 15 ft. of tubing. It is held on the arm with one hand alone; the harmonics most used are from no. 4 to 12 (written as shown below but sounding in D, a seventh lower), though no. 2 and 3 are used for bass notes when the horns are played in harmony:



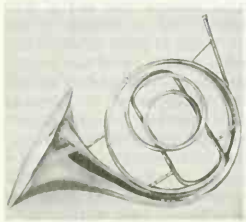
Natural harmonics (open notes) of French horn (also *trompe de chasse*) at their written pitch. Those marked with a cross are not in tune with the musical scale and are used only exceptionally on the valved horn; no. 7 and 14, both too flat, are regularly used only on the hand horn; no. 11 (very sharp) and 13 (too flat) are used also on the *trompe*. No. 2 is often notated in bass clef as the C below the stave. Very high harmonics, in the range 17 to 24, were used by horn virtuosos of the 18th and early 19th centuries, though not extensively.

The orchestral horn or French horn, used also in military bands, exists in two principal forms, French and German, both provided with valves. The French type, the form usually used in England until about 1933, is built with about seven feet of integral tubing to which is added a separate coiled crook inserted at the narrow end. The crook normally used adds about five feet, putting the horn in the key of F, the basic tonality of the modern horn and the reason for its notes being normally written a fifth above their sound. The mouthpiece is funnel shaped. The right hand is placed in the bell mouth and the left actuates the three piston valves, these following the customary arrangement for brass instruments (*see* WIND INSTRUMENTS), save in France where the third valve is typically an ascending valve, raising the instrument by a whole tone when depressed. The German type, in general use outside France, has an enlarged bore and bell, dispenses with the separate crook and has rotary valves instead of pistons. It is built in F, or a fourth higher in B♭, or, more commonly, as a double horn (introduced shortly before 1900 by F. Kruspe), which provides for the instantaneous choice, by means of a thumb valve, of two tonalities, usually either F and B♭, or B♭ and A, thereby bringing various technical benefits such as greater certainty on the higher notes. The German bore and choked mouthpiece also facilitate complex passage work and can deliver a more massive tone when this is called for.

MODERN DOUBLE HORN

Muting is effected by two methods: either by insertion of a separate mute of closed conical form or by fully stopping the bell throat with the right hand. By the latter method (often indicated in music by a cross) the pitch is raised roughly a semitone, for which the player compensates either by fingering a semitone lower or, in some German models, by depressing a special muting valve that lowers the instrument by the requisite amount.

A symphony orchestra normally includes four horn players. Orchestral use of the horn, as opposed to its mere appearance in operatic hunting scenes (as employed by J. B. Lully), commenced in Germany, *c.* 1700, after Count Franz von Spörck had introduced the French *trompe* into neighbouring Bohemia. In England the *trompe* was imported after the Restoration for hunting but was not used orchestrally before Handel. Through most of the 18th century orchestral horns were still held up in the open-air manner, the notes being limited to those of the natural series; crooks were used in various forms and combinations to alter the instrument's tonality as required by the music. Meanwhile, *c.* 1750, A. J. Hampel, a well-known Dresden player, rationalized a hand horn chromatic technique of placing the right hand in the bell for the partial stopping needed to flatten a harmonic by a semitone or more and also for whole stopping to raise it a semitone. Works written for this technique, which depended for its good effect upon skilful matching, as far as was possible,



EIGHTEENTH-CENTURY HAND HORN

of the quality of the open and stopped notes, include Mozart's and Beethoven's solo and chamber works for horn. Though this technique was gradually superseded from about 1825 by the valved horn, it is the legacy of the hand horn that the player still places one hand in the bell, where its musical function is now to control the tone and intonation and to mute as already described.

The tenor cor or mellophone, also circular, is an easily learned and outmoded substitute for the French horn in military bands, having but half the tube length of the latter and a wider mouthpiece. For other band instruments termed horn *see* SAXHORN.

BIBLIOGRAPHY.—A. Carse, *Musical Wind Instruments* (1939); P. Farkas, *Art of French Horn Playing* (1956); R. Gregory, *The Horn* (1961); R. Morley-Pegge, *The French Horn* (1960). (A. C. BA.)

HORN, a hard bony process that grows in pairs from the upper part of the head of certain hoofed mammals and is used by man for making a variety of items. The portion of the horn of greatest utility to man is the keratin sheathing that covers the horns of cattle and other ruminants. (For details about the nature and classification of animal horns *see* RUMINANT: *Horns;* SKIN.)

From ancient times, man has used horn to make such personal and household items as combs, small boxes, drinking cups, goblets, spoons and buttons. These objects often were beautifully engraved and carved and not infrequently were trimmed with silver. Horn was used to fashion one of the oldest of musical instruments and its name still applies to a wide range of wind instruments. The original bugle horn was made from the horn of the aurochs, or European wild ox, now extinct. A particularly interesting use of horn was as a transparent shield to prevent air currents from causing fluctuations in the burning of the time candle, an invention dating from the time of Alfred the Great. Later, transparent horn was used to glaze lanterns. The fighting man used horn as body armour and as a sword hilt. The hornbook (*q.v.*), a child's primer, consisted of a paddle-shaped piece of wood to which a piece of paper or vellum, bearing the alphabet or other lesson to be learned, was attached and covered with a sheet of transparent horn.

Horn becomes plastic in the presence of heat and moisture and can be molded successfully. It may also be cut, shaped and finished with conventional woodworking tools. Man-made plastics have very largely replaced horn as a manufacturing material, but the beauty, usefulness and durability of horn still invite the attention of the craftsman. *See* also references under "Horn" in the Index volume. (E. L. Y.)

HORN, CAPE, a steep rocky headland on Horn Island, at the southernmost extremity of South America, lies 55° 59′ S., 67° 12′ W. in Tierra del Fuego (*q.v.*) archipelago, Magallanes province, Chile. It was named Hoorn by the Dutch navigator Willem Cornelius Schouten, who rounded it in 1616 and who was born at Hoorn, Netherlands. False Cape Horn, the southernmost point of Hoste Island, 35 mi. N.W., is sometimes mistaken for Cape Horn. Navigating the rough waters around the Cape is hazardous. *See* TIERRA DEL FUEGO: *History and Exploration.*

See Felix Riesenberg, *Cape Horn* (1941).

HORNBEAM, any tree of the genus *Carpinus* of the birch family (Betulaceae); more than 25 species are recognized. The American hornbeam, blue- or waterbeech (*Carpinus caroliniana*), is a medium-sized tree, ranging from Nova Scotia to Florida and westward to Minnesota and Texas. Its extremely tough hard wood is used for the making of charcoal.

The European common hornbeam, or yoke elm (*C. betulus*), is indigenous to the temperate parts of western Asia and of Asia Minor and in Europe, where it ranges as high as latitude 55° and 56° N. It is common in woods and hedges in parts of Wales and of the south of England. The trunk is usually fluted and twisted as though composed of several united stems. The bark is smooth and light gray. The leaves are short-stalked, in two rows, two to three inches long, elliptic-ovate, doubly toothed, pointed, numerously ribbed, hairy below and opaque, not glossy as in the beech. The stipules, which act as protecting scale leaves for the winter buds, fall when the buds open in spring. The flowers appear with the leaves in April and May. The male catkins are about one and one-half inches long, and have pale yellow anthers, bearing tufts of hairs at the apex; the female catkins attain a length in the fruiting stage of two to four inches, with bracts one to one and one-half inches long. The fruit is a small, green, angular nut, about one-fourth inch in length, borne at the base of a three-lobed leafy bract.

ERIC HOSKING

EUROPEAN COMMON HORNBEAM (CARPINUS BETULUS)

The hornbeam thrives well on stiff, moist clay soils, into which the roots penetrate deeply; it does not flourish on chalk or gravel. It is occasionally grown as a timber tree, its chief employment being for hedges. The wood of the hornbeam is white, close-grained, of considerable tenacity and little flexibility and is extremely tough and hard to work. Because of its toughness, it was once used to make cogwheels and spindles. As a fuel it is excellent and in France the leaves serve as fodder. The tree is a favourite with hares and rabbits, and the seedlings are liable to be destroyed by mice.

The common hop hornbeam, a native of the south of Europe, is *Ostrya vulgaris;* the allied American species, *O. virginiana,* is also known as ironwood from its hard, tight, close-grained wood. The genus *Ostrya* likewise belongs to the Betulaceae, distinguished from *Carpinus* by papery saclike fruits. (E. S. HR.; N. TR.)

HORNBILL, any bird of the family Bucerotidae classed with the hoopoes, rollers, kingfishers and motmots (*qq.v.*) in the order Coraciiformes. They are usually two to four feet long from tip to tail and are remarkable for the enormous bill, often surmounted by a colourful hornlike casque, solid in the helmeted hornbill (*Rhinoplax vigil*) of the East Indies, honeycombed with air spaces in the others. They are grotesque birds with loud croaking voices and noisy flapping flight. Although these tree-dwellers are omnivorous feeders, most of them search out fruits.

The ground hornbills (*Bucorvus*) are more terrestrial. The larger species will devour snakes, the smaller also eat insects. The plumage is usually black or brown and white, the bill and casque yellowish, with black and orange or red, or largely red. The homrai or great Indian two-horned hornbill (*Buceros bicornis*), the largest, is nearly five feet long, ranging from Bombay to Sumatra.

The female—as in a wedge-tailed hornbill (*Tockus alboterminatus*), of eastern and south Africa, the Papuan hornbill (*Aceros plicatus*) and perhaps most other species—is walled into a hollow tree by the male, imprisoned while she incubates two to four white eggs and cares for the naked helpless young until they can fly; the male regurgitates food in a gizzard lining and feeds the female through a small slit in the mud wall. Most remarkable is the huge rhinoceros hornbill (*Buceros rhinoceros*), nearly four feet long, black and white, with the huge casque turned up in front like another bill turned upside down; it inhabits forests of the Malay peninsula, Sumatra, Java and Borneo. One of the noisiest forest creatures is the rufous hornbill (*B. hydrocorax*) of the Philippines, known for its hissing, whistling flight and its raucous cry.

R. VAN NOSTRAND FROM THE NATIONAL AUDUBON SOCIETY

RUFOUS HORNBILL OR CALAO (BUCEROS HYDROCORAX), A HABITANT OF PHILIPPINE FORESTS

A dozen smaller species of *Tockus*—including the common gray (*T. nasutus*), red-beaked

(*T. erythrorhynchus*) and yellow-beaked (*T. flavirostris*) hornbills —range over Africa, with a few species in India. They are scarcely two feet long. Other genera occur in central African forests, and in southeastern Asia. (G. F. Ss.; X.)

HORNBLENDE: *see* AMPHIBOLE.

HORNBOOK, a name originally applied to a sheet containing the letters of the alphabet, which formed a primer for the use of children. It was mounted on wood and protected with thin transparent plates of horn. The wooden frame had a handle, and it was usually hung at the child's girdle.

BETTMANN ARCHIVE

A LEATHER-BOUND HORNBOOK USED IN COLONIAL AMERICA. INSCRIBED: "THE A.B.C. SET FORTHE BY THE KYNGES MAJESTIE AND HIS CLERGYE, AND COMMAUNDED TO BE TAUGHT THROUGHOUT ALL HIS REALME. ALL OTHER UTTERLY SET APART, AS THE TEACHERS THEREOF TENDER HIS GRACES FAVOUR"

The sheet, which in ancient times was of vellum and later of paper, contained first a large cross —the crisscross—from which the hornbook was called the Christ Cross row, or crisscross row. The alphabet in large and small letters followed. The vowels then formed a line, and their combinations with the consonants were given in a tabular form. The usual exorcism—"in the name of the Father and of the Sonne and of the Holy Ghost. Amen"—followed, then the Lord's Prayer, the whole concluding with the Roman numerals.

See also TEXTBOOKS.

HORNCASTLE, a market town and urban district in the Horncastle parliamentary division of the Parts of Lindsey, Lincolnshire, Eng., at the foot of the western slopes of the Lincolnshire wolds, at the confluence of the Bain and Waring streams, 21 mi. E. of Lincoln by road. Pop. (1961) 3,771.

The name, Hornecastre in Domesday Book, signified the *horna* or tongue of land by a Roman camp. There was a small Roman administrative centre, part of the walls of which remain. This was probably the Banovallum mentioned in the *Ravenna Itinerary*. The manor of Horncastle belonged to Queen Edith in Saxon times and was royal demesne in 1086. Under Stephen it belonged to Alice de Cundi, a partisan of the empress Maud, and passing to the crown on her death it was granted by Henry III to Gerbald de Escald, from whom it descended to Ralph de Rhodes, who sold it to the bishop of Carlisle in 1230. Horncastle was never a municipal or parliamentary borough, but during the middle ages it was frequently the residence of the bishops of Carlisle. The see of Carlisle retained it until the reign of Edward VI when it was granted to Edward, Lord Clinton, but was recovered in the following reign. Horncastle was a centre of the Lincolnshire rebellion of 1536. Royalist troops occupied the town in 1643 and were pursued through its streets after the battle fought at Winceby, 4 mi. E.S.E. of the town. Its prosperity once depended largely on its fairs, the great horse fair described by George Borrow in *The Romany Rye* (1857) being granted to the bishop in 1230 for the octave of St. Lawrence, together with the fair on the feast of St. Barnabas. The church of St. Mary is mainly Decorated and Perpendicular, with some Early English remains and an embattled western tower. Queen Elizabeth's grammar school was founded in 1562. The prosperity of the town is chiefly dependent on agriculture, with malting, tanning, canning and a large plant nursery. There is also a clothing factory. Alfred, Lord Tennyson, was born in the old rectory at Somersby, 7 mi. E.N.E. The red brick castle of Tattershall, 9 mi. S.S.W., dates from 1440.

HORNCHURCH, an urban district of Essex, Eng., which under the London Government Act 1963 was to be amalgamated on April 1, 1965, with Romford to form the new London borough of Havering (*see* LONDON). The urban district is 14 mi. E.N.E. of Charing Cross where the Ingrebourne joins the Thames which gives Hornchurch more than 3 mi. of Thames frontage. Pop. (1961) 128,127. A residential area with a civic theatre (1953), it has some industry including timber importing, engineering and the manufacture of office equipment, plastics, chemicals and clothing. Henry II founded there a hospice for the St. Bernard monks of Savoy, granting them the church and some land. A stone, copper-horned bull's head over the east window of the parish church is probably the origin of the name Hornedecherche in 1311; the bull's head is also on the seal of the French monastery. The Royal Air Force station at Hornchurch was an important fighter base during World Wars I and II. Rainham, Upminster, Cranham, Wennington and North Ockenden, all in the district, have historic churches.

HORN DANCE, a dance performed at Abbots Bromley, Staffordshire, on Wakes Monday in September. Four men impersonate a fool, Maid Marian, a hobby horse and a boy with bow and arrows. Six more bear sets of antlers on their shoulders. A single file procession is followed by a mock battle between the three with black antlers and three with white. Accordion and triangle provide accompaniment. The dance shows some similarities to a local custom observed prior to the English Civil War and may derive from a primitive fertility ritual.

See R. Crompton Rhodes, "The Truth About the Abbots Bromley Horn Dance," *Dancing Times*, N.S. no. 288 (Sept. 1934); Cecil J. Sharp, *The Sword Dances of Northern England Together With the Horn Dance of Abbots Bromley*, 2nd ed., rev. by Maud Karpeles (1951). (S. J. Cs.)

HORNE, HENRY SINCLAIR HORNE, 1ST BARON (1861–1929), British general, a prominent commander during World War I, was born at Stirkoke, near Wick, on Feb. 19, 1861, and joined the Royal Artillery in 1880. He served in the South African War (1899–1902) and became inspector of horse and field artillery as a brigadier general in 1912. Always a calm, efficient and conscientious soldier, he increased his reputation as commander of I corps, Royal Artillery, in 1914 and was commanding the 2nd division by 1915. After a brief period in Egypt where he organized the Suez canal defenses, Horne returned to France in 1916 to take command of the new XV corps and played a big part in the battle of the Somme (July–November). Under his command the creeping artillery barrage and the tank were first tested. In Aug. 1916 he was selected by Sir Douglas (afterward Earl) Haig for the command of 1st army. In the final battles of World War I this army had to overcome the strongest part of the Hindenburg line. He was created Baron Horne of Stirkoke in 1919. Horne was commander in chief, eastern command, 1919–23, and master gunner, 1926–29.

He died at Stirkoke on Aug. 14, 1929. (R. G. Th.)

HORNE, ROBERT STEVENSON HORNE, 1ST VISCOUNT (1871–1940), British lawyer, statesman and businessman, achieved success in whatever he attempted by steady ambition, a talent for organization and genial good humour. Born at Slamannan, Stirlingshire, he studied philosophy at Glasgow university, became interested in student politics and decided to read law, meanwhile taking a post as lecturer in philosophy at the University College of North Wales, Bangor. Called to the Scottish bar in 1896, he took silk in 1910, and in the same year tried at both general elections to enter parliament as a Unionist. During World War I he worked first with Eric (later Sir Eric) Geddes in organizing railway transport at the front and then went to the admiralty, becoming director of materials and priority in 1917, and director of labour and third civil lord in 1918. Elected to parliament in 1918, he became minister of labour, dealing successfully with trouble on Clydeside, in the coalfields and on the railways. In 1920 he was made president of the board of trade and in 1921 chancellor of the exchequer, but after the dissolution of the coalition in 1922, loyalty to Lloyd George led him to refuse office under Bonar Law. He turned his energies to the management of such large undertakings as the Suez Canal company, Lloyds bank, and the Burma corporation. In 1934 he became chairman of the Great Western Railway company. He was created a viscount in 1937 and died on Sept. 3, 1940, at Farnham, Surrey.

HORNED OWL, an owl with hornlike tufts of feathers, especially the large eagle owl (*Bubo bubo*) of Europe, Asia and north Africa; and the great horned owl (*B. virginianus*) of America. The latter, ranging from arctic tree limits to the Straits of Magellan, is a powerful mottled brown predator often reaching two feet in length. Although its usual fare is small rodents and birds, it has been known to carry off larger game, hens, turkeys, etc. Being adapted to desert and forest, the great horned owl migrates only during time of food shortage.

Related species of *Bubo* occur over Africa, India and Burma to the Malay archipelago.

See also EAGLE OWL.

(G. F. Ss.; X.)

JOHN H. GERARD

GREAT HORNED OWL (BUBO VIRGINIANUS)

HORNED TOAD, the common name of grotesque-appearing North American lizards of the genus *Phrynosoma*, which occur in the arid regions of the western United States and Mexico. *See* IGUANA; LIZARD.

HORNEMANN, FREDERICK (1772–1801), German traveler in Africa and the first European in modern times to traverse the Sahara, was born at Hildesheim in Lower Saxony in Sept. 1772. Early in 1796 he offered his services as an explorer to the African association in London. In Sept. 1797 he arrived in Egypt and, after receiving assistance from Napoleon, on Sept. 5, 1798, joined a caravan returning from Mecca to the Maghreb. He was attached to a group of Fezzan merchants traveling with the pilgrims and assumed the character of a mameluke trading with the Fezzan. He was accompanied by Joseph Freudenburg, a German convert to Islam who had made the pilgrimage to Mecca three times, who acted as his servant and interpreter. They traveled by way of the oases of Siwah and Aujila and reached Murzuk on Nov. 17, 1798. Hornemann remained there until June 1799 and then made a journey to Tripoli, dispatching his journals to London in August. He returned to Murzuk intending then to travel southward to Hausa country, and was the first European to establish its definite location. Nothing more was heard of him until a report reached Murzuk in 1819 that he had reached "Noofy" (Nupe) and died there in Feb. 1801.

Hornemann's journal was printed at Weimar in 1802; an English translation, *Frederick Horneman's Travels From Cairo to Mourzouck* with maps and commentary by Maj. James Rennell, was published in 1802.

See Heinrich Schiffers-Davringhausen, *The Quest for Africa*, pp. 285–86 (1957). (R. M. P.)

HORNET, a name given to several species of large wasps, especially the European *Vespula* (*Vespa*) *crabro* and North American *V. maculata*. *See* SOCIAL INSECTS; WASP.

HORNEY, KAREN (née DANIELSEN) (1885–1952), U.S. psychoanalyst, author and teacher, whose importance stems from her dissatisfaction with the traditional Freudian approach to psychoanalysis, was born at Hamburg, Ger., on Sept. 16, 1885, the daughter of a Norwegian father and a Dutch mother. After study at the medical school at Berlin, she began the practice of medicine in 1913, studying meanwhile with Karl Abraham.

She became prominent in the psychotherapeutic field about 1930, moving to Chicago in 1932 to be assistant director of the Institute for Psychoanalysis there, and in 1934 to New York, where she lectured at the New School for Social Research and New York Medical college, trained other psychoanalysts and worked as a practising analyst. She was one of the co-founders of the American Institute for Psychoanalysis. Her death occurred in New York on Dec. 4, 1952.

Dr. Horney stressed the significance of social and environmental factors in determining the personality pattern of the individual and his conflicts. Her best-known books are *The Neurotic Personality of Our Time* (1937), *Our Inner Conflicts* (1945) and *Neurosis and Human Growth* (1950). Emphasis was placed on childhood training in such aspects of behaviour as weaning, cleanliness, sex taboos and aggression.

In later life, she maintained, experiences that are perplexing and threatening may contribute to behaviour anomalies. Dr. Horney, among others, questioned the "death instinct" theory advanced by Freud for explaining aggressive behaviour. (R. M. D.)

HORNFELS, in petrology, a series of rocks that have been partially or wholly recrystallized by the heat of intrusive igneous masses. Most rocks of this series are fine textured and massive, recrystallization having effaced the structures and textures of the original rocks and replaced original minerals by new assemblages. They are the characteristic rocks forming the inner zone of the thermal aureole of alteration surrounding bosses or laccoliths of plutonic rocks. The commonest types are derived from shales, impure limestones and basic igneous rocks. Shales give rise to brown or black types rich in biotite mica, andalusite and cordierite; while impure limestones give "calc-silicate hornfels" rich in pyroxene, garnet, idocrase or wollastonite. The hornfels derived from basic igneous rocks are dark-green types rich in feldspar and pyroxene or monoclinic amphibole. These are the basalt or diabase (dolerite) hornfels. *See* also METAMORPHISM: *Types of Metamorphism.*

(C. E. T.)

HORNIMAN, ANNIE ELIZABETH FREDERICKA (1860–1937), English theatrical manager, who was a pioneer in the repertory theatre movement, was born at Forest Hill, London, on Oct. 3, 1860. Educated privately, she studied art for a period at the Slade school, University college, London, under Alphonse Legros. Later she was secretary to W. B. Yeats.

Miss Horniman's first theatrical enterprise, at the Avenue theatre, London, in 1894, was a failure. In 1904 she became associated with the Abbey theatre, Dublin, and subsidized the Irish National Theatre society, which presented a series of plays by Irish dramatists dealing with various phases of Irish life. She is chiefly remembered, however, for her institution in 1907 of the repertory theatre movement in Manchester. She opened at the Gaiety theatre, Manchester, in 1908, and converted it into a repertory house, the first in Great Britain, in which some of the best-known plays of modern times were originally produced. In 1917 she was forced to disband her company, but retained control of the theatre until 1920. She died at Shere, Surrey, on Aug. 6, 1937.

See R. Pogson, *Miss Horniman and the Gaiety Theatre, Manchester* (1952).

HORNPIPE, a term denoting (1) a musical instrument; (2) a dance; and (3) an item in the musical suite in 3/2 time.

The dance was supposedly performed to the instrument, and at times is synonymous with the jig, country dance (*qq.v.*) and reel. Commonly, "hornpipe" signifies a "round" or country dance (15th–16th centuries), a "longways" country dance in 3/2 time (17th–18th centuries) and particularly a solo dance (usually male) in 2/4 or 4/4 time. Known in all parts of Great Britain, it is characterized by intricate steps and sometimes by mimetic action (as in the "sailor's hornpipe," originally a stage dance in the 18th century). Particularly in northern counties, itinerant dancing masters taught new steps which were jealously regarded as personal to each individual and were performed solo to the fiddle at country balls.

See *Die Musik in Geschichte und Gegenwart*, ed. by F. Blume (1949). (M. J. D.-S.)

HORNSEY, a municipal borough (1903) of Middlesex, Eng., which under the London Government Act 1963 was to be amalgamated on April 1, 1965, with Tottenham and Wood Green to form the new London borough of Haringey (*see* LONDON). It is a parliamentary constituency. The municipal borough of Hornsey is 6 mi. N. of Charing Cross on the "Northern heights." Pop. (1961) 97,885. Area 4.5 sq.mi. The manor, called in the 13th century Haringeie, early belonged to the see of London, the bishops having a seat there. Of the many open spaces in this residential area the chief are Finsbury park (115 ac.), Highgate wood (*see* HIGH-

GATE), Priory park, Queen's wood, Crouch End fields and part of Alexandra park near Muswell Hill. The New river flows through the east of Hornsey.

HORNWORT, a common name for rootless, submerged aquatic plants of the genus *Ceratophyllum* of the family Ceratophyllaceae, a monogeneric family containing three species of cosmopolitan distribution. All possess whorled, finely dissected leaves. Two species (*C. demersum* and *C. echinatum*) are widely distributed in quiet water in temperate North America and are frequently used in the unheated aquarium. *C. demersum* and *C. submersum* are scattered in ponds and ditches throughout temperate Eurasia. (J. M. BL.)

HOROLOGY, the science of measuring intervals of time; also, the principles and techniques of constructing instruments used for indicating time. It is treated in the following articles: CHRONOGRAPH; CHRONOMETER; CLEPSYDRA; CLOCK; HOURGLASS; SUNDIAL; TIME MEASUREMENT; WATCH. The measurement and designation of long periods of time falls under the domain of chronology, and is dealt with in CALENDAR; CHRONOLOGY; DAY; MONTH; TIME; TIME, STANDARD.

HOROSCOPE: *see* ASTROLOGY.

HOROWITZ, ISAIAH (*c.* 1555–*c.* 1630), Jewish rabbi and mystic, was born at Prague, and died at Safad (now in Israel). He held various rabbinates, notably at Frankfurt am Main (*c.* 1606) and at Prague (1614). From 1621 onward he lived in Palestine. In 1625 he was imprisoned by the pasha but, on being ransomed, settled in Safad, at that time the home of Jewish Cabala (*see* CABALA: *16th-Century Cabalists of Safad*). Horowitz' largest work, *Shelah* (abbreviated from the initials of the full title *Shene luhoth ha-berit*, "Two Tables of the Covenant"), is a compilation of ritual, ethics and mysticism. It has been often reprinted, especially in abbreviated form. His prayer book is also marked by cabalistic doctrines.

HORROCKS, JEREMIAH (*c.* 1617–1641), English astronomer and clergyman whose successful observations of the transit of Venus of 1639 are the first recorded of that phenomenon, was born at Toxteth Park, near Liverpool. He was a student at Emmanuel college, Cambridge, from 1632 to 1635; then he became a tutor at Toxteth and studied astronomy in his spare time. He was ordained to the curacy of Hoole, Cheshire, in 1639. He calculated that a transit of Venus, overlooked in Kepler's Rudolphine tables, would occur on Sunday, Nov. 24 (O.S.), 1639; when the transit took place, he fitted his observations in between church services. Horrocks was a brilliant young man, and before his death at Toxteth on Jan. 3, 1641, he had considerably advanced the lunar theory, reduced the solar parallax to 14", suggested perturbations of the moon's orbit as due to the disturbing action of the sun, made observations of the tides, and investigated the irregularities of motion of Jupiter and Saturn.

HORS D'OEUVRE: *see* FOOD PREPARATION.

HORSE (*Equus caballus*). The horse is an important and valuable member of the Mammalia. For its zoological history the article EQUIDAE should be consulted; that on HORSE RACING AND BREEDING describes its speed development, this gift being the horse's age-old special attribute (*see* also HORSEMANSHIP AND RIDING). The present study is historical in the broad sense.

Origin and History.—The prehistory of the horse is largely speculative, the few clues being chiefly of a geological, archaeological or zoological nature. The horse preceded man on earth by many ages but little is known of its history previous to about 2000 to 3000 B.C. The zoological reconstruction of the horse from stage to stage has been made possible by the series of fossil skeletons unearthed in the trans-Mississippi region of the U.S., these antedating all others discovered by the second half of the 20th century; but the original habitat of the species remains controversial. One school of speculation contends for Central Asia, whence migrants to North America crossed (hypothetically) to Alaska and thence made their way south and eastward, where for ages they increased and multiplied, changed vastly in form and then disappeared in some mysterious manner. Their presence there remained unknown until discovery of the remains of the dawn horse and his successors. Be this as it may, it appears that the modern species descended from an Asiatic rather than an American ancestor, the preferred theory pointing to the north central portion of Asia as the region where its rise took place, followed by its distribution throughout the world.

This great equine migration divided into three main streams. One, moving eastward, resulted in the Chinese and other Mongoloid types. Another, moving westward, crossed into Europe and there originated the vast hordes of primeval animals that eventually roamed almost the entire continent. The third and all-important one flowed to the southwest and found its way into Asia Minor and the neighbouring lands of Iran (Persia), India and Arabia. Ultimately it crossed into Egypt, then spread from that country along all of north Africa. At the same time it crossed from Asia Minor into Greece and spread along the northern shores of the Mediterranean. It was from the horses of this final migratory stream that the ancestors of almost all modern improved breeds came. The Chinese and other Mongoloid horses remained too remote to be of any influence outside their own habitats; the same was true of the north European hordes. The destinies of the genus were bound up with that of the Mediterranean civilization, of which the modern horse is the descendant.

John Trotwood Moore, in a tribute to the horse, wrote: "Wherever man has left his footprint in the long ascent from barbarism to civilization we will find the hoofprint of the horse beside it." According to western European mythology and folklore, all the great early civilizations arose among horse-owning, horse-breeding and horse-using nations; those in which the horse was either unknown or in the feral, or untamed, state were backward and no great forward movement of mankind was made without the assistance of the horse. So consistently was this the case that the glorified figure of "the man on horseback" became the symbol of power. The image of the horse was stamped upon man's coinage, sculptured on his temples and even elevated to his pantheon and worshiped as divine.

There were two channels through which the oriental horse, the Arabian and the Barb (Barbary), were distributed in northern Europe. The first led them northward through Greece, Macedonia and the Gothic countries into the land of the Vandals. At the same time they were finding their way eastward to the region of the Huns and Scythians of Asia. The second channel was through the conquest of the Romans across the Alps into the countries now known as France and the Low Countries near the North sea corresponding to the present nations of the Netherlands, Belgium, and parts of Germany. Previously, shaggy descendants of the horse of Central Asia had constituted the equine population of this region. When the barbarians invaded the Roman empire, the vast number of horses which they possessed helped them to overthrow the Romans. The ages that followed witnessed the diffusion of oriental horses throughout the countries of northern Europe and the breeding of improved types. The most important of these was the "great horse," which originated in the Low Countries; its size and strength were required to carry the heavy load of the medieval knight in heavy armour. These horses, the ancestors of modern draft breeds, were bred from the largest and most powerful of the northern European horses, but there was apparently an admixture of the oriental blood which the Romans had brought in.

The crusades of the 12th and 13th centuries took the kings and nobility of northern Europe into the native land of the oriental horse. The speed and agility of these light horses so impressed the crusaders that large numbers were imported into England and France. The Moors took Arabian and Barb horses into Spain over a long period of time. They were crossed with the native stock and produced the superior horses of Spain that were sought after by other nations. The Spanish horses were taken to the Americas by the Spanish conquerors and settlers. Of oriental antecedents, they were the principal ancestors of the western equine population of both North and South America. They thrived in their new homes and multiplied into the numerous herds of the prairies and pampas.

The new world, unlike the old, was never populated by hordes of wholly wild modern horses. The wild bands, known as mus-

tangs, cayuses or broncos, that became numerous on the American prairies were the descendants of the domestic horses imported from Spain. So they were never of the same primitive character as the truly wild horse of Europe and Asia. Not only did the conquistadors take horses from Spain, the English colonists also imported and bred good horses. The only truly wild horse remaining in the 20th century was Prjevalsky's (or Przhevalski's) horse, discovered in western Mongolia in the late 1870s—a small (12 hands or 48 in.), rough, dun-coloured pony that was of wholly feral ancestry and habits. Specimens were acquired for many zoos. They are now apparently extinct in the wild.

The modern horse spread throughout the habitable world because of its capacity to withstand the extremes of climatic conditions and its adaptability to the uses of man. In these respects the horse has no equal.

Classification.—No attempt has ever been made to classify all the breeds and types of horses of the world. There are several ways by which horses can be classified—by size, type, place of origin and use. The most common classification is division into draft horses, light horses and ponies. Light horses may be further divided into riding and driving types. However, there is a great overlapping of use as all light horses can be ridden, driven and used as light work horses. The coach horse is a blend between the two types with emphasis on style and height of action.

Riding horses may be classified by type and training regardless of their breeding. So any of the light breeds may qualify as riding horses. Hunters are trained to jump under field conditions. While usually predominantly of Thoroughbred breeding, they may be American Saddle horses, Standardbreds, part Arabian and even of unknown breeding.

Polo ponies are usually grade Thoroughbreds, that is, have one Thoroughbred parent. It is the nature of training that determines their classification (*see* also POLO). Stock horses are horses of suitable type and training to be efficient in working livestock under range conditions. Cutting horses are similar to stock horses but are more specifically trained to separate cattle. Roping horses are likewise stock horses but are trained for roping in rodeos, where winning is based upon catching and tying a calf or steer in the shortest possible time. In South America the Criollo (native Spanish type) and grade Thoroughbreds with a Criollo foundation are used as stock horses. Most countries of the Commonwealth of Nations use grade or pure Thoroughbred horses for both polo and stock horses. Canada uses some grade Thoroughbreds, but the Appaloosa and Quarter horse and Arabians have gained recognition as stock horses.

The early horses were probably around 12 hands (48 inches) at the withers, and 14 hands was exceptional. Some modern horses reach 17 hands and occasionally 20 hands (80 inches). The Low Countries specialized in breeding for size, first for armoured knights and later for draft horses. The Belgian is the main survival. Other draft breeds of France and England were likewise bred up from the old "great horse." Large-scale use of heavy horses for farm and draft labour was specifically a United States development, although in England the draft breeds were extensively used on the farm and for dray horses in large cities.

The primitive horse was of a prevailing dun-coloured coat. Bay is the standard horse colour among the older registered breeds with brown, black, chestnut, gray and roan completing the list. Extensive efforts have been made to associate coat colour with useful qualities such as speed, gameness and endurance, but the age-old folk proverb that "a good horse is always of a good colour" retains its validity.

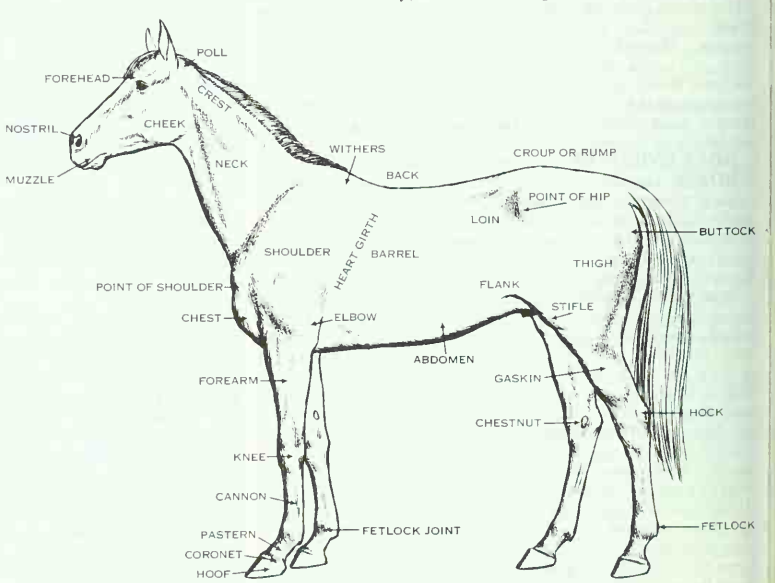
All light breeds of horses are related to the Arabian, mostly through the Thoroughbred. The Arabian is regarded as the oldest breed. The Barb horse, of north Africa, is similar to the Arabian in many characteristics and is probably related to the latter. The Barb, along with other oriental horses, contributed to the origin of the Thoroughbred when they were crossed in various ways among themselves and with the light horses that were native to England.

The Thoroughbreds in turn were used to improve the Hackney, Cleveland Bay and Yorkshire Coach horses of England. Arabians contributed to the quality and the beauty of the head of the Welsh pony. All Standardbred horses trace back to a gray Thoroughbred stallion, Messenger, imported to the United States in 1788.

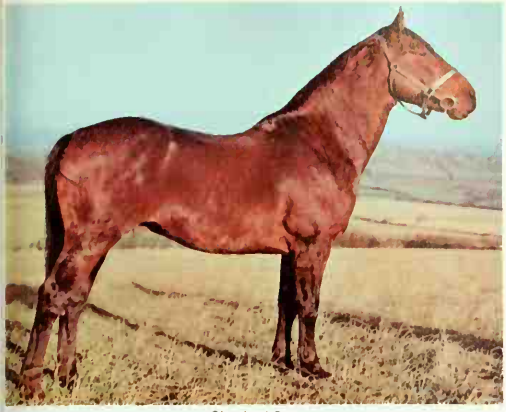
The Thoroughbred sire, Denmark, is recorded as the foundation stallion of the American Saddle horse, though most of the horses trace to him through his outstanding son, Gaines' Denmark, the son of a pacing mare. The Arabian, and the Barb to a lesser extent, contributed more directly to the American breeds. The American Quarter horse and the Tennessee Walking horse have some Thoroughbred breeding.

Horse Terms.—The term horse is used to designate a male, either stallion or gelding, as well as the whole species. A normally sexed male horse is a stallion, and an unsexed male a gelding. A female is a mare and her young is a foal. A male foal is a colt; a female foal is a filly. They are often called colt or filly until mature. A stud is a place where horses are kept for breeding purposes. A stallion kept for breeding purposes is called a stud-horse. A small horse under 14.2 hands is a pony. A mule is a cross between an ass (*q.v.*) and a horse (*see* MULE).

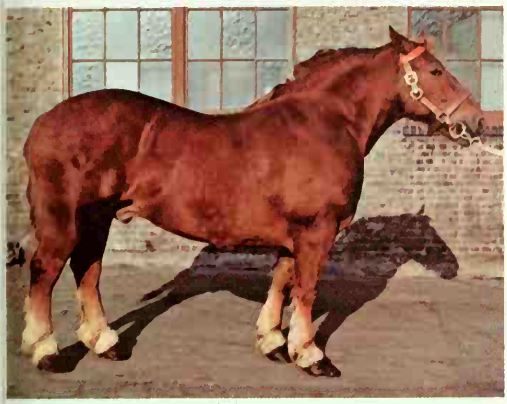
Character of the Horse.—The intelligence of the horse has been appraised in widely different terms. Ordinarily it is ranked fourth among the "lower animals," following the elephant, the ape and the dog, but it is sometimes dropped to tenth or even lower in the scale. Its psychology is difficult to construe with any pretense of exactitude. It is at once timid and courageous, affectionate and unfriendly, docile and ungovernable, hotheaded and



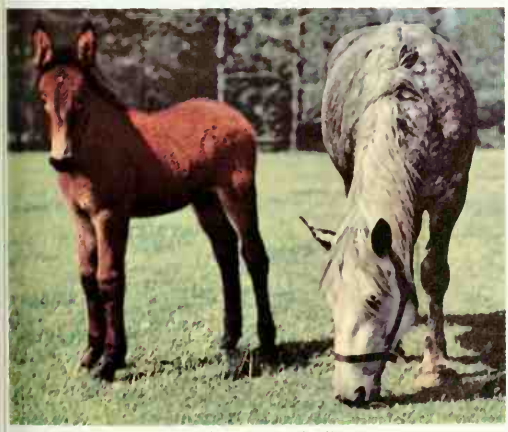
PARTS OF THE HORSE



Cleveland Bay



Suffolk Punch



Percheron mare and colt

Shire

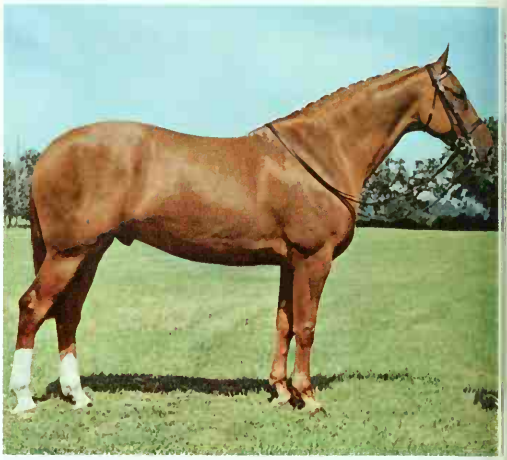
Belgian

BREEDS OF COACH AND HEAVY HORSES

BY COURTESY OF (TOP LEFT) CLEVELAND BAY HORSE SOCIETY, (TOP RIGHT) AMERICAN SHIRE HORSE ASSOCIATION, (CENTRE LEFT) TRUMAN, HANBURY, BUXTON & CO. LTD., (BOTTOM RIGHT) BELGIAN DRAFT HORSE CORPORATION OF AMERICA, PHOTOGRAPHS, (CENTRE LEFT) W. W. ROUCH, LTD., (BOTTOM LEFT) H. ARMSTRONG ROBERTS

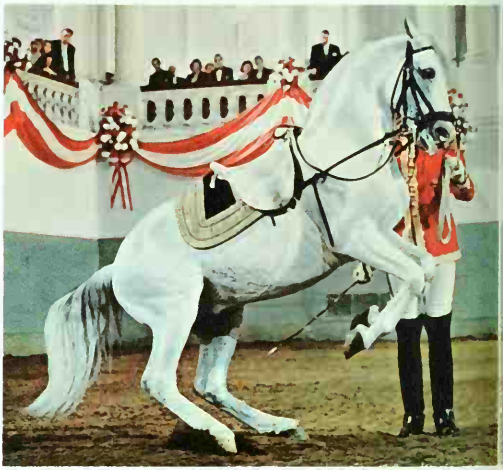
HORSE

Tennessee Walking horse



Grade Thoroughbred hunter

Palomino



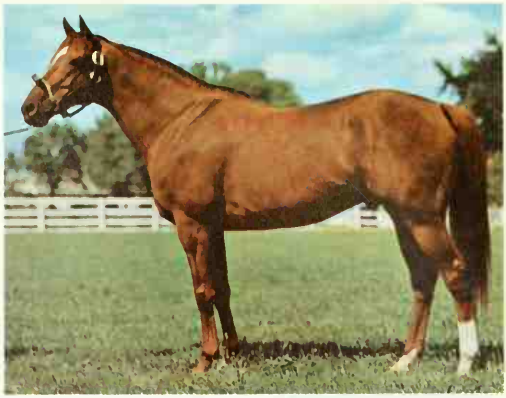
Lipizzaner

Standardbred

SADDLE AND HARNESS HORSES

[illegible] (BOTTOM LEFT) UNITED STATES TROTTING ASSOCIATION, (BOTTOM RIGHT) WALT DISNEY PRODUCTIONS, PHOTOGRAPHS, (TOP LEFT) LES NELSON, (TOP RIGHT) W. W. ROUCH, LTD [illegible] HAROLD M. LAMBERT STUDIOS

Morgan



Thoroughbred

Arabian

Quarter horse

Appaloosa

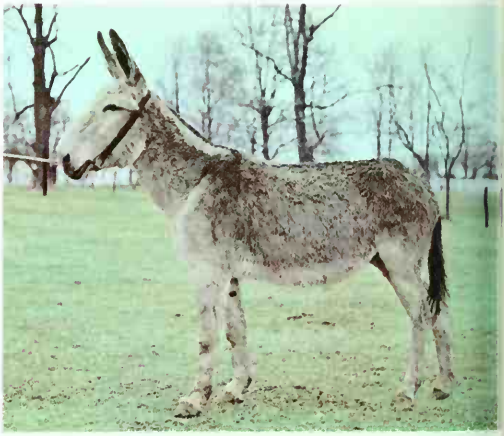
SADDLE HORSES

BY COURTESY OF (BOTTOM LEFT) E. O. SHEA, JR.; (TOP LEFT) ROGER E. ELA; PHOTOGRAPHS, (TOP RIGHT) ARLINGTON PARK COLOR PHOTO; (CENTRE RIGHT) DAROL DICKINSON; (BOTTOM RIGHT) J. C. ALLEN AND SON

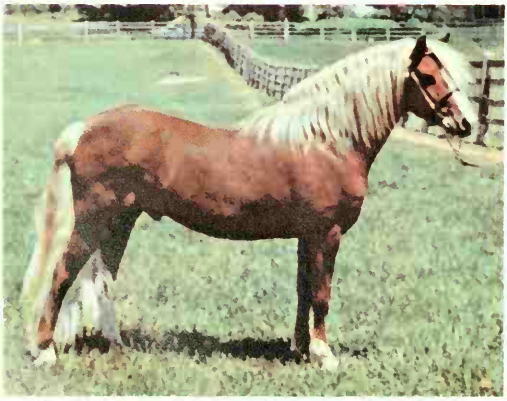
HORSE

Jack

Shetland pony



Jenny



Welsh pony

DONKEYS AND PONIES

BY COURTESY OF (BOTTOM LEFT) WELSH PONY SOCIETY OF AMERICA, INC., PHOTOGRAPHS (TOP RIGHT, BOTTOM RIGHT) PHIL POYNTER, (TOP LEFT) JOHN MARKHAM

phlegmatic, teachable and obtuse. As among human beings, brothers and sisters may be poles apart in temperament, though in certain families and tribes some traits are distinctly hereditary. The horse's sensitiveness is extreme, its memory is long; it has a tendency to form habits difficult to eradicate. Authorities testify that few horses are naturally vicious, and that those which become so have been, with few exceptions, the victims of bad handling, especially as colts. Certain of their instincts are highly developed, such as their ability to find their way home when their masters cannot; to become aware of unknown and unseen dangers; to detect the presence of water in deserts and barren wastes; to discriminate between enemies and friends at long range or close quarters. From time immemorial they have been exploited by man for his own benefit and often with wanton abuse; the Society for the Prevention of Cruelty to Animals was first inspired by their gross ill treatment. Being herbivores, they seldom attack either man or animal. An exception is the stallion protecting mares and foals from the Carnivora. The maternal instinct in the genus is likewise strong, and mares will fight desperately to defend their nursing foals.

Horses are customarily broken, either to saddle or to harness, when two years old—race horses usually as yearlings, the heavy breeds sometimes not until three. When males are gelded it is usually at an early age. Until the five-year-old season, the sexes classify as colts and fillies, subsequently as stallions and mares. Full maturity is attained with the sixth year. It has become the custom to date the ages of all horses from Jan. 1 of the year in which foaling takes place. While cases have been known in which yearling colts have begotten offspring, and yearling fillies been gotten with foal, successful breeders never use animals of either sex until they are at least two or preferably three. The period of gestation for mares is 11 months. While a single foal is the usual result of a mating, mares frequently produce twins and, rarely, triplets; in such cases only one is likely to survive. When both live they are usually weaklings. Normally mares continue fertile until past the age of 20, but instances of maternity beyond 30 are of record. When used solely for breeding, 20 or more foals each have been produced by many brood mares. It is a popular belief that a horse at 20 years is physiologically equivalent in age to a man at 70, though there are authenticated cases of horses living to the age of 50.

The fertility of stallions corresponds with that of mares, but they may retain their potency a few years longer. Some of the highly refined and closely inbred strains, notably the Arabian and the Thoroughbred, are often scanty foal getters. Breeders of race horses ordinarily restrict a sire to from 25 to 40 mares per season, believing that this improves the quality of the offspring, but a normally vigorous sire in his prime may be allowed from 50 to 60, and part-bred and common stock horses often cover 100 or more. Hambletonian, the patriarch of the breed of standard trotters, was badly overbred; at 15 years he covered 217 mares and got 148 foals. From 13 to 17, inclusive, he covered 823 mares and got 524 foals, an average of 105 per season through five consecutive years. The drain on his vitality, however, was so great that he had to be retired from service one season and thereafter to be limited to not more than 30 mares. Some famous progenitors have been remarkable controllers of both colour and form; others have had progeny of all hues and shades, without family resemblances.

When allowed to run wild and breed as nature prompts, horses will degenerate in size and type. Extremes of climate have similar effects. To an extent, stunting produced by environment becomes an attribute of heredity, like the size of the larger breeds. However, after the size and type are established, they must be kept in check by selection, especially when the animals are moved to a more favourable environment, including sufficient feed. There is a tendency for Shetlands to grow larger and they possibly would if it were not for rules limiting the size for registration.

Under ordinary conditions the horse remains healthy, hardy and sound until old age. It is susceptible to many diseases, however, especially those of the respiratory, circulatory and digestive systems. Unless starved, it is particular about food and often dainty; it is strongly affected by quality and sudden changes in food or water. The more highly bred, the more easily its physical organization becomes affected, but this is offset by the manner in which a hot-blooded horse will fight for its life and survive, when a cold-blooded horse, that is, one predominantly of draft-horse breeding, will succumb. Rangemen of the far western U.S. and Canada report that, in hard winters during which range horses obtain all their feed from natural sources, losses of the pure and part-bred light strains are much lower than those of heavy (cold) blood.

By-Products of the Horse.—The use of horseflesh for human food (hippophagy) was common among early mankind and still prevails in various countries, especially in time of scarcity or famine. From horsehide, tanned and untanned, a wide diversity of articles are fabricated. In cruder civilizations these include tents, coverings for all sorts of receptacles, articles of clothing, harnesses, etc. In the middle ages shields and bucklers, the leather coats worn under chain armour, and other portions of the knight's equipment were fashioned from it. Among numerous fine leathers derived from it was the elegant cordovan. In Greece and Rome the mane was used to ornament the helmets of warriors. In medieval and modern times the tail served as a battle standard among the Turks. Horsehair has been woven into fabrics for innumerable uses, among them the shirts worn by religious penitents. The strings of fine violin bows are made of white horsehair of the highest grade. Glue is made from the tissues, bones and blood of the horse, and serum is obtained as a by-product. Gelatins used in photography and in foods are other derivatives. Mares' milk is drunk by various primitive peoples and serves as the basis of kumiss, a fermented beverage of Mongolia.

FEEDING AND CARING FOR HORSES

The natural feed of horses is grass. Idle horses that graze nutritious grasses in large pastures have fewer respiratory and digestive disturbances than more closely confined animals. However, some grain is essential to produce firm muscles and enduring qualities. Grain supplements the grass or hay and provides a more complete diet for working horses.

Hay usually provides sufficient calcium but may lack phosphorus. Calcium and phosphorus are essential for bone growth, protein for muscle growth. By-products of milling such as wheat bran, linseed meal, and soybean meal provide an abundance of phosphorus. Therefore a little of these feeds will offset the lack of phosphorus and protein that may occur in winter range feeds.

Horses are fed for long-time efficiency. For safety some bulk and a variety of feeds and, to insure sufficient consumption, palatable feeds should be provided. Horses do best when fed small amounts frequently according to age, type and amount of work. For efficiency grain is fed punctually three times a day. The bulk of the hay may be fed at night.

Oats, the most satisfactory grain feed, are palatable, bulky and nutritious. Barley, widely used, should be ground or preferably rolled. Corn (maize) is extensively fed but lacks protein and minerals. Grain sorghums may be used, but it is better to feed legume hay, to balance corn and grain sorghums.

Hays may be legume (alfalfa, clover, soybean) or grass. Timothy, the standard grass hay, is palatable and safe but may lack protein and calcium. Legume hay has more protein, vitamin A, and calcium. It usually is included in the ration of young horses. Hay cut early has more protein, minerals and vitamins than late cut hay. Hay and grain should be free from mold and dust. Moldy feeds cause digestive trouble; musty, dusty hay is associated with heaves. Horses will eat too much palatable hay; hence it may be necessary to limit hay for economy and health reasons.

Horses doing heavy work should receive from 1.25 to 1.4 lb. of concentrates and 1.0 lb. of hay per 100 lb. of weight. As the work lessens, the grain is decreased and the hay increased. Idle horses or horses doing light work may be fed only hay.

Salt needs vary, but if salt is available, horses will adjust their requirements. Horses receiving a variety of good feed will seldom need a complicated and expensive mineral mixture. (*See* also FEEDS, ANIMAL.)

Grooming helps the appearance of a horse. Use of comb and

brush eliminates the dead hair and dust and distributes the natural oil, resulting in a sleek appearance. The mane is brushed and trained to fall to the right side for most show horses, the left for stock horses. Some horses are shown with a roached (cropped) mane. The customs of the breed or show classes vary in this respect.

The most vulnerable portion of the equine anatomy is the underpinning. For more than 6,000 years, until the advent of the railroad, the horse was the sole agency of rapid transit on land, yet its legs and feet remain its weakest parts. A broken leg, unless the fracture is slight and not above the ankle, usually necessitates destruction; if saved, the animal is thereafter a cripple. The use of the horseshoe to protect the hoof from breaking, splitting and shelling away dates back to antiquity, and its importance is attested by its having become a symbol of good luck; the axiom "no foot, no horse" is world-wide. The texture of the hoof is strongly affected by climatic conditions and the nature of the habitat. The Arabian, reared in the desert where the ground is rough and stony and the climate dry, has a remarkably tough and sound hoof, while breeds common to moist latitudes are much more susceptible to foot ailments. Under natural conditions, horses keep their feet worn down, and trimming is unnecessary. Confined horses should have their feet trimmed level so the frog makes contact with the ground and the hoof and pastern are on the same straight axis. When horses are used, shoeing is necessary to protect their feet. Trimming may correct a faulty foot, especially of a young horse. After maturity, shoeing may alter the way of traveling but seldom corrects a natural fault. *See* also FARRIERY. (J. A. GN.)

Diseases of the Horse.—*Skeletal and Muscular Defects.*—To allow proper utilization of the horse, it is essential that it remain sound of foot and limb. In part, this is dependent upon inherited characteristics, hence the emphasis placed upon conformation—the proper placement and development of the legs and body anatomical structures. Hard usage, especially when the horse is young, mineral imbalances in the feed, injuries and infection may also be responsible for defects. Some changes in the bones and tendon sheaths may be obvious without exciting lameness; others are definitely associated with lameness; sometimes it is difficult to detect the cause.

Parasites, External.—In certain areas, horses may be bothered by ticks. Depending upon the species of tick, stages in the life cycle may be completed on rodents or other animals with the horse as host for the adult. In others, as the spinose ear tick, only the horse is necessary as a host. Infection is picked up from vegetation carrying the proper stage of tick.

Mange in horses is caused by semimicroscopic mites. Infection may be spread by direct contact with infected animals and indirectly by blankets, harness, etc. Aside from the irritation and local changes in the skin, advanced cases may develop generalized symptoms of weakness. With neglect or where large numbers of horses are held together this may develop into a serious scourge.

Lice on horses may be sucking or biting lice, the former being more injurious. Favourite locations are the mane and tailhead. Resultant irritation leads to rubbing, loss of hair and inflammation of the skin.

Adult botflies (*Gastrophilus* spp.) are of considerable importance due to the annoyance they cause horses. These flies deposit their eggs primarily on the hairs about the head, forelegs and chest wall, certain species having a predilection for a definite area. After a variable period, depending upon conditions, larvae develop. These are passively taken into the digestive tract by the horse's lips coming in contact with the hairs on which the eggs have been laid, or, with some species, this is an active process on the part of the larvae. On reaching the stomach the larvae attach to the wall and undergo developmental stages. After some ten months they pass out with the feces, although some species may for a time attach themselves to the wall of the rectum with resultant irritation leading to tail rubbing. After evacuation from the body the larvae enter a pupal stage in the ground and reappear as adult flies within a few weeks. Considerable numbers of larvae may be maintained on the stomach wall in apparently normal individuals, but their presence is not harmless.

Parasites, Internal.—Ascarids or roundworms may become a serious problem in young horses; occasionally older horses also are seriously affected. Eggs from adult worms in the intestine are passed out with the feces. After a relatively short period of time they develop to the point where they are infectious. Ingestion of contaminated feed or water introduces the parasite; in its further development migration through the lungs occurs before the adult form appears in the intestine. Damage results from migration in the developmental stage as well as from the adult forms. They are easily recognized by their large size, 6 to 12 in. in length.

Practically all horses harbour numerous small worms that conveniently may be grouped together as strongyles, a suborder of "thread worms," or Nematoda. (*See* ROUNDWORM.) Their cycle is similar to that of the ascarids except that from the intestine the ingested larvae enter the circulation. Numbers are deposited in the mesenteric artery in the abdomen and its branches with resultant damage, but many finally reach the intestinal wall which they penetrate to emerge as mature parasites. This migrant journey may produce verminous colic, or, if the arteries of the hind legs are involved, transient weakness or paralysis of these parts. In addition, because of their large numbers and blood-sucking habits a constant drain is placed upon the host. Poor condition, weakness and death may result from heavy infestations.

The oxyurids or pinworms are also common in the colon and rectum of horses. These moderate-sized worms, up to several inches in length, may be seen passed in the feces or attached to the wall of the rectum. They are relatively harmless except for the irritation produced which frequently results in tail rubbing.

Parasites, Blood.—Several blood parasites known as trypanosomes appear in horses. Transfer is primarily by blood-sucking insects; in some this is merely a mechanical transfer but in others biological development in the vector occurs. Nagana affects mammals, especially horses, in Africa producing fever, subcutaneous edema, anemia and emaciation. It is spread through the tsetse fly, *Glossina* spp.

Surra, another of the trypanosomiases, occurs in southeast Asia and is transmitted by flies. *Mal de caderas* is caused by *Trypanosoma equinum* and occurs in South America. Dourine, caused by *T. equiperdum*, is the exception to insect transmission as this disease is transmitted by coitus. Dourine is characterized by local inflammation of the external genital organs, urtical eruptions of the skin and symptoms of paralysis. This disease has, at various times, become widespread.

Infectious Diseases.—The respiratory group includes strangles, influenza and pleuropneumonia. Strangles is an acute, contagious disease marked by pronounced nasal discharge, frequently followed by swelling of the lymph nodes of the throat and to some extent other parts of the body, and in some instances by pneumonia. *Streptococcus equi* is usually considered to be the cause. The organism is resistant to drying and other agents so that a stable infected with pus containing the organism may remain infective for several months. Apparently healthy horses may harbour the organism, and young animals, by close contact with such individuals, may develop the disease. The active case of strangles especially serves as a source of infection by direct contact and dissemination of the causative organism by contamination of water pails, etc. Recovery from an attack usually confers a lifetime immunity against strangles. Young animals in the six months to three years age group, being especially susceptible, should be protected against exposure if at all possible. Inclement weather, shipment and improper feeding and watering lower the animal's resistance.

Equine influenza or shipping fever is an extremely contagious disease marked by high fever and depression. Inflammation of the eyes is usually associated with the disease so that sometimes it is referred to as pink eye. Nasal catarrh and swollen lymph nodes may simulate the appearance of strangles. Edema of the pendant parts of the body may develop. Occasionally panzootics comparable with pandemics of human influenza occur, but usually the infection is not widespread and is apt to be maintained in barns or other centres where there is a continual turnover in the susceptible horse population. Spread is probably air borne in most cases but

the viral agent is also present in the saliva, urine, and semen. Transfer by coitus has been reported.

Equine contagious pleuropneumonia is typically an acute, febrile disease marked by pneumonia and pleurisy. Many cases do not progress to this point but resemble influenza. However, the disease does not appear to be as infectious as influenza and also has a longer incubation period. It is frequently complicated by *Streptococcus equi* infection, although probably viral in nature. Transmission is by droplet infection. Recovery confers immunity of an unknown duration.

Equine infectious anemia is an infectious disease of chronic nature, sometimes termed swamp fever because of its association with low-lying lands. Acute attacks characterized by fever, weakness, anemia and edema of the chest and belly are apt to occur during the summer months. Many such cases appear to recover only to relapse again at some later time. The causative agent is a virus which experimentally has been found in the blood for long periods; it is also present in the body discharges. Spread appears to be chiefly by blood-sucking insects going from an infected to a noninfected animal. The symptoms, while suggestive, cannot always be relied upon for diagnosis, so that for an absolute diagnosis blood from a suspected case must be injected into a normal animal to reproduce the disease.

Infectious equine encephalomyelitis as the name indicates is an inflammation of the brain and spinal cord. Because of the disturbance in mental equilibrium it is popularly known as sleeping sickness. Early in the course of the disease the horse is inclined to walk aimlessly and to push against obstacles. Depression follows and, with paralysis of muscles, the animal may go down and be unable to rise. Animals that recover may retain permanent damage to the brain and fail to have complete control over muscular co-ordination. The cause is a virus. In the U.S., the eastern type of virus appears east of the Appalachian mountains; west of the chain, the western type appears. In South America, the Venezuelan virus is present. A similar disease, Borna disease, is seen in Germany. The American viruses are known also to affect humans. (*See* also ENCEPHALITIS.) Originally importance was attached to the horse as a reservoir for human infection. Work with the eastern and western strains indicates mosquitoes to be the prime vectors. Viremia is present for a short period only in the horse, and it is only during this time that the horse is capable of infecting mosquitoes. However, a number of birds, both wild and domestic, have been found to be inapparent carriers of the disease. Ordinarily the disease, transmitted by mosquitoes, smolders in these reservoirs and flares up in extensive epizootics in the horse only when conditions are suitable. *See* also VETERINARY SCIENCE.

(J. F. RF.)

BREEDS OF HORSES

The following breeds are grouped by types.

Light Breeds.—*Arabian.*—The Arabian is a beautiful horse easily distinguished by his type and style. The head is broad and tapers to a fine muzzle capable of great dilation. The jaws are wide, eyes prominent and expressive. The neck is of moderate length and gracefully arched. The tail is light and gaily carried. The Arabian is small, seldom exceeding 15 hands and 1,050 lb. in weight. The colours are chestnut, gray and bay, a few being brown but rarely black. They are never spotted or pure white. The gray fades to white in old age, but the skin remains dark throughout life. Their best gait is the gallop, which has been perfected by long use at the gallop in their native land. The Arabians are recorded in the stud books of different nations. Horses imported from Arabia are usually accepted for registration and are designated by the suffix D.B., an abbreviation for desert bred.

Thoroughbred.—The Thoroughbred, oldest of the improved breeds, is the running race horse of England. The term is often applied to any purebred horse. Such usage is incorrect. The other breeds may be called purebred or registered, but not Thoroughbred. The Thoroughbred represents the speed types. They are tall, narrow and light of leg and are characterized by refinement, long muscle, long, slender necks, short backs, prominent withers and long legs. The height averages 16 hands but varies from 15 to 17 hands. In breeding condition the animals vary from 1,000 to over 1,400 lb. The prevailing colour is bay with a few chestnuts, browns, blacks and grays. The Thoroughbred has a long, low, straight stride. The trot lacks the height and flexibility of the other light breeds. Their most perfect gait is the gallop. As the Thoroughbred was used in establishing other breeds, so they are still used in improving grade horses throughout the world. The Thoroughbred is an international horse, found wherever racing is a sport. For a more detailed history of the Thoroughbred, *see* HORSE RACING AND BREEDING.

Standardbred.—The Standardbred is a harness race horse that originated in the eastern part of the United States. The Thoroughbred was fused with other breeds and types to produce a light breed with remarkable speed at the trot or pace. They are called Standardbreds because, when the breed was developing, they were required to trot or pace a mile in a standard of time. The Standardbred resembles the Thoroughbred in that it is light and narrow. However, they are usually longer in body, flatter of rib, lower to the ground and heavier of bone. Their weight and height varies a great deal, but they usually weigh 1,000 to 1,200 lb. and vary from 15 to 16½ hands. Bay is the dominant colour with brown, chestnut, black and gray. In earlier races, heat racing prevailed, a heat being a dash or part of a race. It took three and sometimes five heats to determine the winner. The type of racing and training developed stamina and enduring qualities. So they are a useful all-purpose horse.

American Saddle Horse.—This is a breed of riding horse possessing several easy riding gaits, great vigour and style. They are the prevailing riding horse of horse shows in the United States. The Thoroughbred, Morgan, Standardbred, Arabian, pacers and easy riding horses of a mixed background contributed various qualities to this American breed. Selection for an easy riding gait, style and beauty, accompanied by line breeding (*see* ANIMAL BREEDING), helped shape them into a breed. This breed has a short, strong back and the barrel is more rounding than in most light breeds. The neck is long, slender and well arched; it blends smoothly into a well-shaped shoulder. The croup is long and almost level. They have most of the solid colours with limited white markings. They are shown under flat saddles as either three- or five-gaited horses. The three gaits are the walk, trot and canter. The five-gaited horse has these same three gaits plus the rack and one slow gait. The slow gait is usually the stepping pace but may be the running walk or foxtrot. The gaits are characterized by extreme animation and collection. Three-gaited horses are shown with a roached (clipped, standing) mane and a clipped tail. Five-gaited horses are shown with a full mane and tail. They may be used as pleasure horses, driving horses and quite often as hunters and jumpers.

Morgan.—Once the most famous and widely disseminated breed in the United States, the Morgan receded into the background and for a while their breeding was supervised by the government. The breed was founded by a horse known as Justin Morgan, after his owner. He was born about 1789 and died in 1821. He was one of those equine progenitors of such rare prepotency that his individual stamp still persists. He stood about 14 hands high and was a compact, active, virile and stylish little horse whose pedigree was probably a blend of Thoroughbred and Arabian with some other elements. The modern Morgan averages about 15 hands in height and from 1,000 to 1,200 lb. in weight. They are a stylish attractive horse with smooth lines, small ears, expressive eyes and a nicely crested neck. They are an all-purpose horse though they lean toward the riding-horse type more than formerly. The number of registered horses is increasing.

Tennessee Walking Horse.—This breed derives its name from the state of Tennessee and from its distinctive gait—the running walk. It is an older type, organized and recognized as a breed in 1935. In a broad sense, it originated from all the ancestors that could do a running walk. Allan F-1 (b. 1886), a Standardbred stallion with several crosses of Morgan breeding, had the greatest influence on the breed. The Walking horse is heavier and stouter, and lacks the refinement and style of the American saddle horse. The head is usually carried low. Some are more sloping in the croup and more curved in the hocks than other riding horses. They

average 15.2 hands in height and weigh from 1,000 to 1,400 lb. Some ponies derived from crossing with other breeds also will perform a running-walk gait. The Walking horse has a quiet, even temperament, and perhaps because of this they are a long-lived breed. In colour they are flashy. The colours are black, chestnut, bay, brown, roan, gray, yellow and pure white. They are satisfactory as a general-purpose horse. The running walk is a natural gait that may be improved but not acquired by a horse without the natural ability. The gait is faster than a flat-footed walk, with a speed of six to eight miles an hour. The front foot strikes the ground an instant before the diagonal hind foot. The horse has a low, gliding, reaching action, the hind foot overstepping the print of the fore foot by several inches. The foot movement is accompanied by a nodding head. The gait is pleasant to ride and easy on both the horse and the rider. The horse should also do a good walk and a slow, easy canter.

American Quarter Horse.—Although the breed association was organized in 1940, the breed itself represents an old type. The name was derived from its speed in quarter-mile races. The British North American colonies had short-distance running horses called quarter horses. The most prominent sire was Janus, an English stallion imported in 1756. With the advent of longer-distance racing, the type retreated into the background and finally found a home in the southwestern U.S. There it was kept alive by frontiersmen and cowboys in a desultory way until it became the subject of organized promotion and publicity. It is commonly used by cowboys for cutting cattle from herds. Its ancestral elements are chiefly Thoroughbred with an admixture of the Spanish horse and other breeds of the range states. In type, the Quarter horse is a thick, short-muscled horse, varying in height from 14.1 to 15.2 hands and in weight from 900 to 1,250 lb. In addition to the usual colours, buckskin, Palomino and grullo (smoky) colours exist, reflecting the Spanish ancestry. Holders of most short-distance records are Thoroughbreds or Quarter horses with considerable Thoroughbred breeding. However, the fastest horses are not always the best for use under range conditions.

Colour Breeds.—Following the organization of the Palomino Horse association in 1935, other groups began registering horses by colour, additional associations being formed to record the following breeds: Albino, Pinto and Appaloosa.

Palomino.—The Palomino is some shade of yellow or gold with a white or silver mane and tail. The colour does not breed true. Horses of proper colour, saddle-horse type and from at least one registered parent of several light breeds can be registered. Two associations register Palominos; their requirements are slightly different. This colour is popular for pleasure and parade classes. Their type and use depends upon their breeding and training. They may conform to the breed types of several light breeds.

Albino.—Foals are born pure white with a pink skin and remain white throughout life. They conform to riding-horse type.

Pinto.—This is Spanish for painted. Horses are registered on the basis of their colour pattern and light-horse conformation.

Appaloosa.—The most popular of the colour breeds, with several colour patterns. The name derives from the Palouse river of Idaho and Washington state. Some have a solid colour except for a white patch over the hips, interspersed with small, round spots of the same colour as the body. Others may have a basic solid colour with white dots over the entire body, or may be white with coloured dots. They sprang from Spanish stock. The Nez Percé Indians of Idaho selected them for colour and using ability. After the breed association was formed, the quality was improved by crossing with other breeds, especially the Arabian. They are of stock-horse conformation and useful for many purposes. The breeders take great pride in the useful and enduring qualities of these horses.

Ponies.—*Shetland.*—The smallest, most numerous, and most popular of the pony breeds. Shetlands originated in the Shetland islands, 100 miles north of Scotland, where the feed is scanty and the climate severe. They are adapted to this environment. In the Shetland islands, they average about 10 hands and resemble miniature draft horses; in America lighter, more refined types are desired. They are of many colours, solid colours being preferred for show ponies, but spotted ponies being often preferred by children. Shetlands are lively, courageous, hardy and long-lived. They can be quite stubborn, but this may be avoided by proper training.

Welsh.—The Welsh descended from the native ponies of Wales, being improved by a dash of Arabian and Thoroughbred breeding. About 12 hands tall, they may be used by man or child. They possess considerable spirit and ability for their size. Gray and dark colours are preferred in Wales; cream and buckskin colours are popular in the United States.

Others.—Other ponies of England are the New Forest, Dartmoor and Exmoor. These breeds were improved by use of a few Arabian and Thoroughbred sires. They lack the quality of the Welsh but are larger and taller. The United States has no true breed of ponies, but small nondescript range horses are of pony size.

Coach Breeds.—These three breeds originated in England.

The Cleveland Bay is a breed which is always bay in colour. Only minute white markings are permitted for registration.

The Yorkshire Coach is related to the Cleveland Bay with more Thoroughbred breeding which is reflected in more quality and style. They are usually bay or brown in colour. Both the Cleveland Bay and Yorkshire Coach stand over 16 hands tall. They are of limited importance outside of their native regions.

The Hackney is the most popular coach horse because of its style and high action. Their height is from 14½ to 15½ hands tall. Their appearance is one of compactness and strength. The back is strong, the croup level with a high carriage of tail. The colours are usually dark, but roan may be found. They are shown in most of the larger shows of the United States.

Lipizzan Horse (Lipizzaner).—This breed derived its name from the Austrian imperial stud at Lipizza, near Trieste, formerly a part of the Austro-Hungarian empire. The foundation dates to 1580; detailed breeding records are available since 1700. The ancestry was Spanish, Arabian and Berber. The six strains (Pluto, Conversano, Neapolitano, Favory, Maestoso and Siglavy) are named from their foundation sires. They are of comparatively small stature with a long back, a short, thick neck and powerful conformation. The head with a Roman nose, in contrast to the concave profile of the Arabian, and an attractive, expressive eye lacks the refinement of most light breeds. The colour is largely gray, bay and brown being but rarely found. The powerful, flexible and high action qualifies them for the intricate and difficult movements of *haute école* (high school) horses, the purpose for which they have been bred. They are found to a limited extent in countries that were originally a part of the Austro-Hungarian empire. A few have been exported to the United States.

Heavy Breeds.—*Belgian.*—As the name suggests, this type was produced in Belgium and is the modern direct descendant of the "great horse" of the middle ages developed in the Low Countries. Average height is 16 to 17 hands; weight 1,800 to 2,200 lb. Several colours exist, but in the U.S. light chestnuts or sorrels (with flaxen manes and tails) and roans are preferred to other colours. It is a breed of remarkable uniformity of build, style and other traits. Extremely docile, patient and willing, the Belgian excels in straight draft and farm work.

Clydesdale.—A breed native to Lanarkshire, Scotland, a county watered by the river Clyde. The founder was a Dutch stallion brought in from England about 1715. It is slightly smaller than the Belgian or Percheron, though there are occasional immense specimens. Average size is 16 to 16½ hands; weight 1,700 lb. The usual colour is very dark brown or bay, frequently black, which was that of the founder. There are prominent white markings.

The Clydesdale is noted for its long and heavy fetlocks and its high action, both walking and trotting. It is esteemed for farm work.

Percheron.—Most famous of all modern draft breeds, also is known as Percheron-Norman or Norman Percheron, from having originated in the district of La Perche, Normandy. In blood it is a composite of the medieval "great horse," the later French diligence or coach horse, and other strains with a leaven of oriental ancestry which is indicated by the head, often of small size, and Arabian contours. Average size is 16 to 17 hands; weight 1,900 to 2,100 lb. Despite its bulk, it is very active and nimble. The Percheron excels for draft and agricultural purposes.

Shire.—This breed is native to the middle section of England. It is equal to the Belgian in weight but taller. In colour they resemble the Clydesdale but are less extensively marked with white. They are characterized by a greater abundance of hair, called feather, around the pastern than the Clydesdale. They are heavier, coarser, steeper of pastern and lack the quality of the Clydesdale. They are farm and dray horses in England. This breed is not as popular in the United States as those breeds with less feather.

Suffolk or Suffolk Punch.—The typically English heavy breed, originating in Suffolk and existing as far back as 1586. Another descendant of the medieval "great horse," its vast bulk combined with singularly compact form led to the surname. Average height is 16 to 16½ hands, but there is a range of from 15½ upward; weight from 1,600 to 2,000 lb. Colour is uniformly a dusty chestnut with flaxen mane and tail; few white markings. Like the Percheron, it often has a small, handsome head, testifying to oriental ancestry. It is a farm and not a dray type. The Suffolk, Clydesdale and Shire are used almost exclusively in Great Britain in preference to the Percheron and Belgian.

Wild Horses.—The European tarpan was the true wild species of horses found over much of Europe. In the middle ages they existed in the wilder and more inaccessible regions of Europe. A few survived until after 1900; they became extinct but a similar type has been produced by selective breeding. The "wild" horses of North and South America are feral horses or descendants of domestic horses that reverted to the wild state.

Prjevalsky's horse, which once roamed in great numbers in central Asia, is perhaps extinct in the wild. Zoo specimens are yellowish or light red in colour with a whitish muzzle. They usually have a dorsal stripe. The short, erect mane is without a foretop. The mane and tail are dark or black in colour. They are from 12 to 14 hands tall and resemble a large-headed, coarse, domestic pony. The low withers blend into a narrow back almost level with the withers. The croup is short and steep.

Breed Associations.—Breed associations register horses that meet all the qualifications for registration and promote the respective breeds. A new association may admit horses that meet certain qualifications without the parents being registered. These qualifications may be type, colour, or speed. Standardbred horses, for example, were admitted to the registry if they could trot a mile in 2:30 or pace a mile in 2:25. The new associations may be known as open associations. The older associations require that each horse have a registered sire and dam to qualify for registration. These are known as closed associations.

Perhaps the oldest association for registering horses is the *General Stud Book* of England. An *Introduction to a General Stud Book* was published in 1791, and volume i in 1793. The publishers used various records that had been accumulated in connection with horse racing in England in establishing the registry. The *General Stud Book* is recognized as the official registry for the English Thoroughbred. Other leading nations have their own stud books for registering Thoroughbred horses.

Registration certificates of Thoroughbred horses in one nation are usually recognized by all the other Thoroughbred registering organizations.

Other associations have been organized as new breeds developed. The names and addresses of some important ones are:

General Stud Book (Thoroughbred), London; Shire Horse Society, Middlesex; Clydesdale Horse Society of Great Britain and Ireland, Glasgow.

Australian Jockey Club, Sydney, Australia.

Société Hippique Percheronne, Nogent-le-Rotron, France. Chevaux de Pur Sang, Paris.

L'Association des Eleveurs Italiens, Rome.

Gesellschaft für Züchtungskunde, Bonn, Germany.

Sociedad Rural Argentina, Buenos Aires.

Canadian Thoroughbred Horse Society, Canadian Pony Society, Toronto, Ont.; Clydesdale Horse Association of Canada, Winnipeg.

The Jockey Club (Thoroughbreds), New York; American Quarter Horse Association, Amarillo, Texas; the United States Trotting Association, Columbus, Ohio; American Shetland Pony Club, Lafayette, Indiana; Arabian Horse Club Registry of America, Chicago, Illinois; Palomino Horse Breeders of America, Mineral Wells, Texas; Appaloosa Horse Club, Moscow, Idaho.

HORSE POPULATION

The number of horses of the world has been decreasing as a result of the competition of mechanized equipment. In much of Europe and Asia, the horse has given way to food-producing animals. In the eastern half of the world, it is difficult to obtain accurate estimates of the horse population, but it is believed that the numbers remain about the same. The United States showed a pronounced decline from over 25,000,000 horses and mules in 1920 to fewer than 3,000,000 by 1960. Other American countries have shown less decline.

Some of the leading horse-producing countries are France, 2,000,000; Mexico, 1,500,000; and Brazil, 8,000,000.

New Zealand reached a peak of 400,000 horses in 1911 and declined to about 100,000 by the 1960s. Great Britain had about 200,000 horses and ponies, with the numbers still falling, and horse numbers in Australia and Canada have likewise declined.

Horse numbers appear to be increasing in Turkey, Yugoslavia and Brazil. The U.S.S.R. and Poland have had a great interest in horse breeding and, since 1917, the Soviet Union has developed a few new breeds.

Draft horses have declined more than light horses which are used for pleasure and sports. *See* EQUIDAE.

See also references under "Horse" in the Index volume.

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(J. F. RE.; J. L. HE.; J. A. GN.)

HORSE CHESTNUT, the name of a tree, *Aesculus hippocastanum* (family Sapindaceae; listed by some authors as Hippocastanaceae), thought to be indigenous to Greece but now scattered throughout the temperate regions of the world. There are about 25 named species and varieties of the genus. *A. hippocastanum* in particular is called the common horse chestnut, but all are popularly known as buckeye or horse chestnut. Several species are shrubby, as *A. parviflora*, *A. discolor*, *A. neglecta* and *A. splendens*, but the majority are rapid-growing, pyramidal trees attaining a height of 60 ft. or more. They thrive well in moist sandy loam. The buds, conspicuous for their size, are in some species protected by a coat of viscous substance impervious to water. The buckeyes are deciduous with large palmately compound leaves, and white, red or yellow flowers in terminal panicles. They blossom in May or June, and the fruit, superficially resembling the sweet chestnut, ripens in mid-October.

JOHN H. GERARD

FRUIT OF HORSE CHESTNUT (AESCULUS HIPPOCASTANUM)

There is some disagreement as to uses to which the fruit can be put, some authorities even maintaining that it is poisonous. *A. glabra*, the American buckeye, in particular, is thought to have poisonous seeds and leaves. Most of the species have bitter flavoured seeds and bark, the bark being used for tanning. *A. californica*, *A. turbinata* and *A. octandra* are known to bear edible seeds, which are used as sweet chestnuts. The wood of the horse

chestnut is not particularly useful, but as ornamentals both trees and shrubs are very valuable. (P. W. Z.; E. S. Hr.)

HORSEFLY, the common name of the members of the family Tabanidae of the order Diptera, but more specifically any member of the genus *Tabanus*. The female flies suck blood and their bite is most painful. Some other members of the family are called gadfly, cleg and breezes. *See* Fly. (C. H. Cn.; X.)

HORSE GUARDS, ROYAL: *see* Guards and Household Troops.

HORSE MACKEREL, a name loosely applied to any of several large fishes of the family Scrombidae (bluefin tuna, some bonitos) but more restricted to a large mackerellike fish of the family Carangidae (jacks, scads and pompanos), *Trachurus trachurus*, the Atlantic horse mackerel or saurel, more common on the European coast than on the American. Related forms, the jack mackerel (*T. symmetricus*) and the rough scad (*T. lathami*), are found along the American Pacific coast. All carangids are swift swimmers and most are excellent food fish. *See* also Fish: *Survey of the Bony Fishes: Mackerels, Tunas, Billfishes, etc.*

HORSEMANSHIP AND RIDING, the art of training, riding and handling horses. Throughout history the man on horseback has been awarded respect and clothed in an aura of glamour and adventure—from king to cowboy, from cavalryman to jockey, from polo player to trail rider. Horsemanship and riding are not always synonymous. A good rider may be a poor horseman—too rough, too impatient and lacking in understanding of and sympathy for the horse. A good horseman—knowledgeable, patient, understanding—may lack boldness and decision and not ride as well as he might. For description and characteristics of various riding horses *see* Horse. *See* also Horse Racing and Breeding; Hunting; Polo.

FUNDAMENTALS

Good horsemanship requires that the rider control and guide his horse with the greatest effectiveness and least effort and with maximum co-operation of the horse.

The Seat.—A good seat is a position on the horse that will facilitate the rider's control and guidance of the horse, accomplishment of the task to be performed and security on the horse, while permitting it to move naturally and freely. A good seat is characterized by suppleness, ease, comfort and relaxation on the part of both horse and rider. The rider maintains his seat primarily by balance; he increases his grip only to restore his balance. Details of the seat are adjusted to the particular task at hand (racing, working stock, showing, polo, fox hunting, hacking, trail riding, riding in a parade, etc.), and to the conformation of the horse and of the rider.

Posting.—At the trot the rider may either "sit" or "post." When he sits—and this is practised only at a slow or collected trot—he remains in the saddle and is bounced slightly as the horse springs from one diagonal pair of legs to the other. When he posts, he leans a little forward and rises out of the saddle with more of his weight on the stirrup irons as one or the other diagonal pair leaves the ground. (Actually he allows himself to be impelled upward by the thrust of the horse's hind leg.) Posting, also referred to as "rising to the trot," reduces the impact of the trot on both horse and rider.

THE HORSE'S MOVEMENTS (GAITS)

Generally all riding horses, whatever their intended use, will be trained to walk, trot, canter and gallop on both leads (that is, so that the feet on either the right or left side strike the ground in front of those on the other side) and to change from any one of these primary and natural gaits to another: to turn to the left and right and about at each of these gaits; to halt from any of the primary gaits and to take-off again at any gait; to rein back; and to stand quietly while the rider mounts and dismounts.

The walk is a four-beat gait. The feet are raised and planted successively in the order in which they are raised—right hind, right fore, left hind, left fore. Alternately two or three feet are on the ground at the same time.

The trot is a two-beat gait. The feet are lifted and strike the ground in diagonal pairs—the right hind and left fore almost simultaneously; then the left hind and right fore. As the horse springs from one diagonal pair of legs to the other, all of its feet are off the ground.

The canter is a three-beat gait, followed by a period of suspension when all feet are off the ground. The order is: right hind, left hind and right fore almost simultaneously, then the left fore, followed by the period of suspension. In this instance, the horse would be on the left lead. If the right forefoot is the last to leave the ground, the horse is on the right lead.

The gallop is an accelerated canter; the movement is the same as a canter.

Acquired or inbred gaits include the pace, a two-beat gait in which the legs on either side move together. The foxtrot, running walk, single foot and amble are smooth, easy, four-beat gaits, all combining, with variations, some of the movements of a fast walk and a slow trot. The rack is a fast four-beat gait in which the lateral legs move almost simultaneously, the hind foot on either side striking the ground slightly before the forefoot. The slow gait (or stepping pace) is a slow, collected rack characterized by a slight swaying from side to side and animation of the forehand.

After a horse is accomplished in the primary requirements, it may move on to advanced and specialized training to include collection and extension at all gaits; turns on the forehand (that part of the horse which is in front of the rider) and hindquarters; working in small circles, serpentines and figure eights; departing from a halt at a canter on the desired lead; change of lead without coming to a halt (flying change of lead); advanced schooling movements (see *Dressage*, below); neck reining (for polo and stock work); jumping obstacles of various heights and widths; running at the greatest speed; crossing streams; galloping cross-country; and the special requirements for special work or sport.

Training a horse, generally referred to as "schooling," requires considerable patience, tact, knowledge, experience, consistency and understanding of the horse's mentality and temperament.

The chief characteristics of the horse's mentality and temperament are a keen and long memory, timidity and fear of the unknown and unfamiliar. Horsemen understand that a horse performs, obeys and is willing because it has developed confidence and knows what is expected of it; and, conversely, it panics, resists and behaves badly, with few exceptions, only when it is confused as to what is required of it or when it is afraid. Because of the horse's strong association between cause and effect, training is based on a system of prompt rewards and punishments.

CONTROL AND GUIDANCE

Good horsemanship is displayed largely through the use of suitable bits and the effective application of the correct aids.

Bits.—There are two basic types of bits. The snaffle (also bridoon or bradoon), which may be jointed, twisted or straight and made of rubber, metal or wire, is a single bit with pressure applied and released through one pair of reins; there is no shank. The curb (or "bit") is set horizontally between two pieces of vertical metal to form an elongated H, with a curb chain or strap attached. This provides shanks which may be made to apply pressure on the lower outside of the horse's mouth, through the action of the chain or strap. Frequently the two—curb and snaffle (or bit and bridoon)—are combined into a single bit, the Pelham. The latter has rings for the reins at its ends and at the bottom of the shank; it is a sort of combination in one piece of the curb and snaffle.

Bits are sometimes made more severe by a hump, called a port, in the middle. The action of the bit may be intensified by the use of relatively long shanks, a tight curb rein, a high port and draw reins. The bridle holds the bit (or bits) in the horse's mouth and provides means for adjusting the position of the bit. The reins, essentially a part of the bridle, are attached to rings at the ends of the bit. There are many types of bridles, but variations among them do not, in general, affect the control and guidance of the horse. (*See* also Harness and Saddlery.)

Aids.—There are four generally recognized aids for controlling and guiding a horse and transmitting the rider's will to it, to put

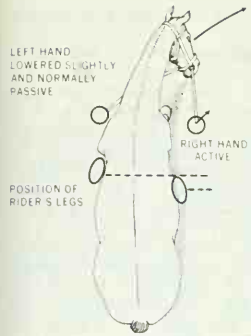


FIG. 1-S FROM "THE CAVALRY MANUAL OF HORSEMANSHIP AND HORSEMASTERSHIP" EDITED BY GORDON WRIGHT, AND ILLUSTRATIONS BY SAM SAVITT © 1962 BY GORDON WRIGHT ILLUSTRATIONS © 1962 BY SAM SAVITT. RE PRINTED BY PERMISSION OF DOUBLEDAY & COMPANY, INC.

FIG. 1.—RIGHT LEADING (OPENING) REIN

it in motion and to direct, regulate and restrain its motion. These are: (1) the rider's hands, which control the bit(s) and reins; (2) the rider's legs; (3) the rider's use of his weight; and (4) the rider's voice. These are the natural aids. Artificial aids include spurs, whips or crops, special nosebands and reins, and martingales (to keep a horse from tossing its head).

Reins.—The rider's hands restrain and guide the horse through the application and relaxation of pressure and tension on the bit in the horse's mouth by means of the reins. The controlling principle in the use of the reins is to push the horse onto the bit with the legs and not to pull the horse back with the bit. The reins are used in five basic actions or effects:

Leading (or opening) rein.—The rein is carried to the side and slightly to the front with no tension to the rear; used to turn the horse to the right or left on a large circle.

Direct rein of opposition.—The rein is held slightly to the side and drawn to the rear; used to turn the horse to the right or left on a small and sharp circle.

Bearing (or neck) rein.—The rein is raised and carried forward against the neck toward the opposite side; used to change direction when the reins are held in one hand and the change is made at speed. (In the early stages of training this is usually combined with a leading rein on the opposite side.)

Indirect rein of opposition—in front of the withers.—One hand is raised slightly to carry the rein across the horse's neck toward the opposite side—in front of the withers—with pressure to that side and to the rear. The other hand is passive.

If the left indirect rein is used, the horse's muzzle is turned slightly to the left and rear (while the left hand is carried to the right across the horse's neck, with tension to the right rear, causing the horse to turn to the right). This rein is used when the horse, moving, is to turn sharply—the degree of sharpness of the turn depending on the amount of pressure on the rein.

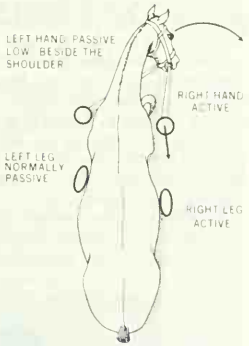


FIG. 2.—RIGHT DIRECT REIN OF OPPOSITION

Indirect rein of opposition—in rear of the withers.—One hand applies pressure toward the rear in the direction of the horse's opposite hip, but does not cross the neck. The other hand is passive. The horse's head is turned to the desired side and rear, its neck and spine curved to that side, forcing the mass of the horse against the opposite hip and hind leg, and increasing the weight borne by the opposite shoulder. This rein effect is used to move the horse in the opposite direction while advancing. For example, if the right indirect rein is applied in rear of the withers, the horse would move to the left front at an angle of about 45°.

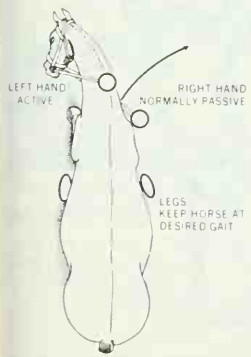


FIG. 3.—LEFT BEARING (NECK) REIN

Use of Legs.—The rider's legs are used equally to induce forward movement, an accelerated gait and increased impulsion. One leg is used with greater force than the other to displace the haunches in the opposite direction. In general the rider's legs control the horse's haunches.

Use of Weight.—The rider's use of his weight in controlling and guiding the horse is primarily a function of the seat or style of riding employed and the saddle designed for that seat (*see* below). The rider endeavours at all times to keep his weight in balance with the horse—his centre of gravity over that of the horse. This is done by increasing the forward inclination of the body from the hips as the gait and pace increase.

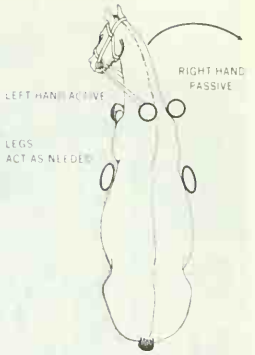


FIG. 4.—LEFT INDIRECT REIN OF OPPOSITION, IN FRONT OF WITHERS

SEATS

There are many styles of riding, generally referred to as seats. Variations in the seat depend basically on the purpose for which the horse is ridden—the seat employed by a jockey on a Thoroughbred race horse is very different from that characteristic of a cowhand working on the cattle range—and both differ from that favoured by most fox hunters. On endurance and long-distance trail rides, hacking cross-country and on trails, the seat and tack to which the horse and rider are accustomed are used.

Forward.—The forward seat, with minor modifications, also is called the balanced, military, hunting or modern hunting, and jumping seat; the terms are used somewhat interchangeably. This is probably the most popular seat with riders on flat or English-type saddles. It is used by fox hunters, cross-country riders, riders showing over jumps, the horse cavalry of most nations, and, of course, in hunting seat equitation classes at horse shows. This seat is forward as compared with the seat characteristic of fox hunters in England and the United States up to about the 1920s, and not nearly so forward as that used by jockeys racing Thoroughbreds.

Using this seat, the rider sits forward in the saddle, resting on the pelvic bones rather than on the fleshy part of the buttocks; there is a good bend of the knees, the legs are slightly back, calves in contact with the horse, knee covering the toe, the stirrups comparatively short and hanging straight; the ankles are flexed inward with heels well down, toes outward to press the calves, knees and thighs against the saddle; balls of the feet on the treads of, and against, the insides of the stirrup irons. The body is inclined more and more forward as the gaits and pace increase and as the height and spread of obstacles jumped are extended. Normal contact is maintained with the crotch, lower thighs and upper legs, but at speed and in jumping, the rider is out of the saddle, his weight largely supported by the stirrups. The upper arms are by the sides, forearms extended naturally so that there is a declining straight line from the elbows through the wrists, hands and reins to the bit. The hands are in front of the withers, separated about eight inches, thumbs on top. Light contact is maintained with the horse's mouth at all times and the hands "follow" the horse's extension of its head. Eyes are up, chest lifted and shoulders back. The rider is forward, balanced, supple, secured, at ease and alert. The rider rises (posts) at the ordinary and extended trot, but sits at the slow or collected trot.

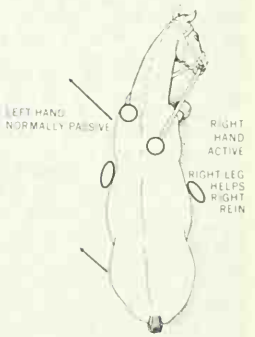
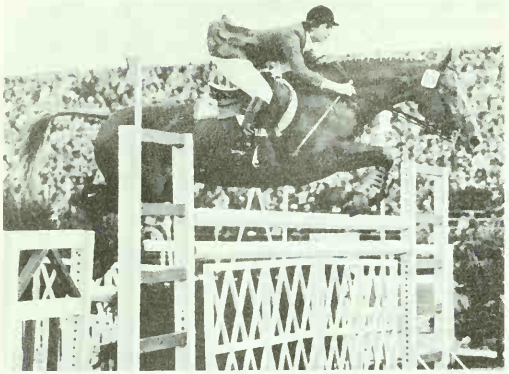


FIG. 5.—RIGHT INDIRECT REIN OF OPPOSITION, IN REAR OF WITHERS

Classical or Academic.—The classical or academic seat, used



BY COURTESY OF AMERICAN HORSE SHOWS ASSOCIATION

THE FORWARD OR "JUMPING" SEAT

in elementary dressage and *haute école*, requires the rider to sit deep in the middle of the saddle, his body erect and supple; the knees are bent slightly, insides of the thighs against the saddle, the legs below the knees hanging naturally and in light contact with the horse, the stirrup leathers vertical and long (the stirrup treads just below the anklebones); the forward part of the balls of the feet rest on the stirrup with toes straight and heels only slightly depressed; the upper arms are close to the body, the forearms straight and nearly level from the elbows to the bit; the hands are held over or a little behind the withers (about four inches from the rider's body) and near together, quiet, and in light and constant contact with the horse's mouth; the head is erect. This seat emphasizes facility in the maximum, yet quiet and inconspicuous, use of the aids.

Stock Saddle.—The stock saddle seat (in the United States, also western) is used by ranchers, rodeo performers and show, pleasure and trail riders using a stock saddle and associated equipment. The stock saddle was designed for the special requirements of working cattle. Its features are the pommel horn, to which a rope can be made fast; the high cantle to lean against during a hard day's work; the deep seat for comfort and additional security on horses not too well broken; the tree, or frame, designed to accommodate a blanket or pad to ease the weight on the horse's back; the long, straight-hung stirrups to facilitate roping (and along with the high cantle to compensate for the inability to lean forward because of the pommel horn).

The seat, in turn, conforms to the saddle and to the work for which it was designed. The rider's legs hang straight and slightly forward or are bent slightly at the knees, with the weight of the body directly over the balls of the feet; the heels are slightly lower than the toes, the balls of the feet on the treads of the stirrups; the body is erect but comfortable, relaxed and flexible; the arms are next to the body, bent at the elbows. The reins are held in one hand, which is fully around them, and above and as close to the pommel as is practicable; the free arm is straight down. The rider does not post at the trot (jog).

Saddle Horse or Show Ring.—This seat is used when riding for pleasure and showing the American Saddle horse, the Tennessee Walking horse and, generally, the Morgan horse and, in the United States, when riding Arabian horses English style (as opposed to western). The saddle seat is recognized by the relatively long stirrups with a slight bend of the knees; the balls of the feet resting on the stirrup irons; an erect body, square shoulders, eyes that look straight forward; the hands held relatively high above the horse's withers (the height depending on where and how the horse carries its head) in an easy position between the perpendicular and horizontal (to the saddle); a barely perceptible rise (post) at the trot; a close seat, going with the horse at the canter, steady in the saddle and legs straight down; at the slow gait, smooth in the saddle, legs down and slightly back; hands a little lower, at the rack. The rider is in the centre of the saddle, but, in comparison with the hunting seat, appears to sit further to the rear.

Flat Racing.—This seat is exaggerated forward with an extremely short stirrup; the jockey's head is practically on the horse's neck, his hands alongside it. When it was first introduced, about the turn of the century, by the famous and popular U.S. jockey Tod Sloan, the seat was described as "a monkey on a stick." This seat is used by jockeys on racing Thoroughbreds on the flat throughout the world. It tends to be more extreme in the United States than in other countries. Some jockeys ride with the inside stirrups a little longer than the outside (this is called acey-deucy) to equalize their weight on the turns.

Steeplechase.—The steeplechase seat varies from the flat racing seat chiefly in that the stirrup leathers are considerably longer and from the forward seat in that, when negotiating the obstacles on the course, the rider's legs are well forward, braced against the stirrup irons ("feet on the dashboard") while their bodies are erect or leaning slightly back. Considering the speed at which high obstacles are taken, the hazard of a fall and the necessity of negotiating obstacles with a sizable drop on the far side (notably in the Grand National, at Aintree, Eng.), the adoption of this seat is understandable.

Substantially this same seat is used by some riders who have participated in fox hunting for a number of years.

Sidesaddle.—The sidesaddle and the sidesaddle seat are classic. The sidesaddle has been referred to as the saddle of queens. For centuries it was the only way a woman would ride. Modern women, with a few exceptions in the hunting field, show ring and park, ride astride; but they have only been doing so (in public, at any rate) for perhaps 50 years.

Using a sidesaddle, the rider rests the right leg firmly against the pommel above the knee; the lower part of the left leg falls in a straight line, also firmly against the saddle, and rests in the single stirrup, heel down. The spine is directly over the horse's backbone, shoulders level and square, hips square. At the trot the rider rises on the right leg with no sidewise motion. The hands are held as they would be if riding astride, with due allowance for the height of the pommel.

Bareback.—The bareback seat is natural. The legs and feet hang freely, the toes pointing slightly downward. Contact is maintained throughout the thighs, knees and calves. The body is erect

BY COURTESY OF CALIFORNIA STATE POLYTECHNIC COLLEGE

CORRECT SEAT FOR THE STOCK (OR WESTERN) SADDLE

BY COURTESY OF CALIFORNIA STATE POLYTECHNIC COLLEGE

CORRECT SEAT FOR THE ENGLISH SADDLE

at the halt, walk and trot, inclined slightly forward at the canter and gallop.

INFLUENCES ON STYLES

Factors influencing the style of riding and the standard of horsemanship have been, over the years, varied and numerous. One of the chief of these has been the use of the horse, which has changed greatly within the 20th century. As the use to be made of the horse determines the breed selected and the nature of its training, so does it largely influence the style of riding and the standard of horsemanship, whether in sport, in war or for utilitarian purposes. The occupation, wealth and interests of the horseman also determine, to some extent, the use of the horse: on the one hand for utility, or simple pleasure and exercise (the one-horse backyard stable or patron of riding academies), and on the other for sport, for show or other competition, or for profit (racing and breeding).

Among other factors the various "schools" of riding have had, of course, a considerable influence on the style and quality of riding, advancing the seat of their preference or conviction. The mounted services, the cavalry, of each nation and of all, collectively, also have had a strong influence on riding, both because of the substantial numbers of men subjected to this training and through nonmilitary riders observing the cavalrymen at horse shows, exhibitions, maneuvers and parades. In addition, most of the mounted services published widely read manuals, and individual cavalrymen disseminated their views in books and published articles. Several "junior cavalry" organizations and some military schools with cavalry units continue to carry on the doctrine and practices of the cavalry.

Riding academies and public stables must be included among the factors influencing riding and horsemanship since so many men, women and children have learned to ride at these establishments. The style and standard of riding taught by them, and the calibre of instruction, vary enormously. Pony clubs and similar organizations in the British Commonwealth, the United States and other countries have been influential in encouraging children to value good riding, high principles of sportsmanship and the proper care and love of the horse.

Competitive activities from jousting and tilting—through racing on the flat, over timber, brush and hurdles, and in sulkies—to horse shows, polo, cross-country riding and Olympic games and other international competitions have contributed much to the evolution of horsemanship and riding.

DRESSAGE

Dressage (French "training") covers a wide range of training from fundamental basic schooling and programmed rides to classic *haute école* or high school. Basically it is systematic, progressive training to achieve balance, suppleness and obedience with the purpose of improving and facilitating the horse's performance of normal tasks. When the advanced training stage is reached, dressage may become an objective in itself, "grand dressage."

Grand dressage is a system of training movements in which the horse's gaits are shortened and raised by bringing the balance rearward to lighten the forehand, thus giving special agility in a limited space. This is done without sacrificing extension and free movement. The desired result is that the horse will be keen but submissive and balance itself with the weight of the rider without undue strain on any set of joints or muscles. The over-all objective is to enable the horse to comply easily and willingly with the demands of the rider and at the same time to improve the horse's pace and bearing.

Grand dressage is generally divided into elementary training (*campagne*) and *haute école*, the art of riding in its highest form and in accordance with classic principles.

Elementary training consists of teaching the horse, usually and preferably a young one, obedience to the aids, balance and relaxation. Starting with the horse on a longe line, or training rope, and then under the saddle, the horse is taught basic and natural movements, especially on a straight line, with some collection and extension of gaits, half and full halts, backing, turns, movements on two tracks (moving diagonally to the side and forward), basic figures, the counter canter (also termed false lead) and flying changes of lead.

In *haute école*, the horse's natural movements are developed to the greatest perfection. It moves in almost perfect balance and precision; walks, trots and canters in highest collection and extension; obedience to its rider's wishes is prompt and flawless. Typical *haute école* movements include a collected flying change of leads; the pirouette, a turn on the haunches in four or five strides at a collected canter; the piaffe, a trot in place; the passage, a very collected, cadenced, high-stepping trot, with the impulsion more upward than forward; the levade, in which the horse raises and draws in its forelegs, standing balanced on its bent hind legs; the courbette (curvet), a jump forward at the levade; the capriole, in which the horse jumps straight upward, with its forelegs drawn in, kicking back with its hind legs horizontal, and lands again in the same spot from which it took off.

JUMPING

Schooling Over Jumps.—The horse is a natural free jumper; but if ridden, schooling becomes necessary. Training is started in an enclosed level area by walking the horse, preferably in a snaffle, over a number of wooden bars or poles laid flat on the ground. When the horse has become accustomed to this, its speed is increased. As it progresses, a small jump (usually not more than two feet) is placed at the end of the row of poles. The horse is then schooled, first at a trot and then at a canter, over a series of obstacles systematically raised and spaced irregularly. The object is to teach the horse: (1) to keep its head down; (2) to approach an obstacle at a quiet and collected yet energetic pace; (3) to decide how and where to take-off; and (4) after landing to proceed quietly to the next obstacle. The horse should be thoroughly confident over every jump before it is raised and should be familiarized with a variety of obstacles.

The most sensitive parts of the horse when ridden are the mouth and the loins, particularly in jumping. The rider's hands control the forehand while his legs act on the hindquarters. As speed is increased the seat is raised slightly from the saddle, with the back straight and the trunk and hands forward, the lower thighs and the knees taking the weight of the body and gripping the saddle, leaving the legs from the knees down free for impulsion. Contact with the mouth is maintained evenly and continually, the rider conforming with every movement of his mount as the horse's head goes forward after take-off, to "drink" out of the obstacle, and as it is retracted on landing, the hands always moving in line with

the horse's shoulder. In order to give complete freedom to the hindquarters and to the hocks, the rider does not sit back in the saddle until at least two strides after landing. Sometimes a neck strap is used to hold onto so that the reins can be dropped if the horse hesitates or if the rider feels he may be left behind; this enables the rider to go with the horse, still leaving the loins clear while not disturbing the mouth.

Show Jumping.—Only thoroughly trained riders and horses compete. Very strenuous effort is required of the horse, as well as of the rider, who does not by any of his actions give his mount the impression that something out of the ordinary is impending. If possible the horse is warmed up by at least a half-hour's walking and trotting before entering the ring. The horse is guided toward the exact centre of every obstacle, the rider looking straight ahead and not looking round after take-off for any reason, as that might unbalance the horse. The broader the obstacle the greater the speed of approach. Although a few experienced riders can adjust the horse's stride for a correct take-off, this should not be necessary with a well-schooled horse. The rider is always ready to conform with every action of the horse, the only assistance necessary being that of direction and increasing or decreasing speed according to the obstacle. (*See* also *Seats*, above.)

HISTORY

Through the ages horses have been ridden, of necessity, as a means of transport, for hunting and to carry warriors into combat—and by the leisure classes as a form of diversion, for exercise, sport and pleasure. The owners of riding horses have been, in large part, relatively wealthy members of the upper classes, and the ownership of riding horses denoted and provided status. To some extent this is still so.

Horsemanship and riding have a long history—sculpture, drawings, tapestries and paintings of men (and women) on horseback and comments on the art of horsemanship go back to well before the Christian era.

The oldest known records are the chiseled stone tablets of the Hittites, dating from about 1400 B.C. The Egyptians, Assyrians and Greeks also provided proof of their excellence in horsemanship hundreds of years before Christ, as did the Mongols, the Chinese and the Persians. The classic work on horsemanship of the pre-Christian era was Xenophon's clear and detailed treatise *Hippike*, written about 400 B.C. Many of his thoughts on training the horse are still valid. The ancients, like the American Indians, rode bareback, and in many instances without a bridle, so that both hands might be engaged in the use of a bow and arrow. (The horse was controlled with knee pressure and the distribution of the rider's weight.)

The use of the saddle and stirrups was introduced in the 4th century A.D., along with a seat characterized by long stirrup leathers, straight legs, the rider in the middle of the saddle "seated" on his crotch, gripping with his thighs and knees. This seat was well suited to knights in armour and was used in Europe throughout the middle ages. The Arabs, the Mongols and the Persians (not so much encumbered by armour) rode with a somewhat shorter stirrup and relied more on balance than on grip.

During the middle ages there was little study of or advance in the art of horsemanship. Knights in heavy armour jousted, tilted and crusaded, heralding and perpetuating the age of chivalry (derived from the French, *chevalier*, "horseman"); Genghis Khan's cavalry was respected as much as it was feared; in Tibet, Persia and India the forerunner of modern polo was a popular game at court; and the Arab invasion of Spain began to influence a change in the style of riding (the seat) in that country. The Arab Ibn Hudayl recorded his principles of horsemanship in a book in the 15th century.

In the 16th century attention to the art of riding was revived in Italy and France. The study and practice of advanced horsemanship is generally credited to C. B. Pignatelli at his academy of horsemanship in Naples. His instruction was so highly regarded that for many years the royalty and nobility of Europe employed Italian riding masters. One of Pignatelli's pupils, Antoine Pluvenil, with the encouragement and support of Louis XIII, was largely responsible for the revival of advanced horsemanship in France. Germany's attention to advanced riding was well covered in a book by G. E. Lohneysen (1588). During the 17th century riding academies, patterned after Pignatelli's school, were established in France, Austria, Germany and England, bringing the art of horsemanship to a high level of perfection and respect. One of Pignatelli's adherents, William, duke of Newcastle (about 1658), developed interest in the practice of advanced horsemanship. The duke recorded his experiences in an excellent book on the art of riding and schooling horses.

In 1733 F. R. de la Guérinière published a book on horsemanship suggesting patience and reward rather than punishment as a basis of training and some new riding techniques based on scientific study. Meanwhile the Spanish Riding school in Vienna (originated in 1572) had grown, prospered and become, during the 18th and 19th centuries, perhaps the greatest influence on the art of riding in Europe, where its classical or academic seat was generally adopted. The French Cavalry school at Saumur, teaching the same seat and techniques, also exerted considerable influence on the horsemanship of Europe during this period, and most of the other European nations established centralized schools for the basic and advanced training of their cavalry officers. So, too, did the United States and several of the Central and South American nations.

During this period exception to the classical seat was taken by the fox hunters of England and Ireland and the United States, who preferred to gallop and jump fences with their feet well forward, their weight well back on the buttocks (and their horses' loins), their reins long and their hands close together.

At about the turn of the 20th century the Italian Frederico Caprilli, after a long study of horses at liberty, concluded that a horse would run and jump at its best if permitted to extend its neck and if it carried its rider's weight just behind the withers. Based on this, Caprilli introduced the concept and practice of his revolutionary "forward seat," popularized by his countryman Piero Santini. The forward seat, with minor modifications, became the standard for riding over obstacles—fox hunting, show jumping, cross-country riding—and the seat most used by military and police organizations and by polo players. As indicated previously, the U.S. jockey Tod Sloan, about 1900, introduced the extreme forward seat used in Thoroughbred racing.

Olympic Games.—The Olympic games, initiated about 776 B.C., included a number of equestrian events and featured chariot racing. So popular were these events that a separate arena, the hippodrome, was built especially for them.

The modern Olympic games have included equestrian events since 1912. (During the four preceding Olympiads—since their revival in 1896—equestrian events were included only in 1900.) The team and individual events included in the Olympic games are:

1. Three-Day event (all-around competition) in three phases.
   a. A test of training (dressage).
   b. An endurance test—consisting of a road test and cross-country and steeplechase performance.
   c. Stadium-jumping.
2. Grand Prix de Dressage—individual dressage competition.
3. Prix des Nations—stadium-jumping competition.

In addition, the modern pentathlon (*q.v.*) includes riding cross-country on unfamiliar horses as one of the requirements. The others are swimming, running, fencing and pistol shooting. (*See* also OLYMPIC GAMES.) (HA. D.)

Horse Shows.—Horse shows are a popular periodic institution evolved from the horse sections of agricultural fairs. Originally their object was to attract buyers and encourage the improvement of every type of horse. Now they are highly organized, conducted by committees of experts and by associations, which enforce uniform rules, appoint judges, settle disputes, maintain records and disseminate information. Riding contests which are included in the program have become increasingly important, enabling riders to display their prowess and win prizes for champion horses and attracting much larger gatherings.

Under the auspices of the Royal Dublin society an international horse show was first held at Dublin in 1864. It takes place at

Ballsbridge in August of every year and is a general exhibition of hunters, yearlings, brood mares and foals, stallions, hacks, riding cobs and ponies. International riding and jumping contests, events for children and auction sales are held during this five-day show.

The National Horse show at New York, started in 1883, was a great annual event in which such classes as buggies, street-car horses, delivery wagons, Shetland ponies, policemen's mounts, three-gaited and five-gaited horses, and draft horses, as well as Thoroughbreds and trotters, were included. Held at Madison Square Garden, it lasts eight days and there are about 120 different events, among the most important being the international military jumping. In the northeastern United States, the smaller shows usually include classes for hunters, jumpers, pleasure hacks, riding ponies and equitation; in the south, classes for saddle horses and Walking (Tennessee) horses are popular; in the west, Quarter horses, Palomino, Appaloosa, Arabian and parade horses dominate. In the larger shows, regardless of section, nearly all divisions are represented, including fine harness (driving).

Horse and pony shows are held regularly in the U.K., the greatest being the Richmond Horse show and the "International" in London. The latter was first held in 1907 under the chairmanship of the earl of Lonsdale, half the capital being subscribed by U.S. directors, among whom was Alfred G. Vanderbilt, the great patron of coaching. Every activity of the horse found a place in it, and the event has grown and flourished under royal patronage, the very considerable number of exhibits being a sign of the support it receives. In includes international jumping, special items, such as the visit of the Spanish Riding school with its Lippizaners from Vienna in 1953, and the Supreme Riding Horse class.

Opened in 1922 and known in Canada as the "Royal," the Royal Agricultural Winter fair at Toronto is a major event in which thousands of horses are entered and in which international jumping figures prominently. In Australia the Royal Agricultural society organizes horse shows annually in every state. Further examples are the Verona agricultural show, originally a *fiera dei cavalli*, and the horse show at the Piazza di Siena in Rome; horse shows are held frequently in Belgium, France, Germany and the Netherlands; notable occasions are the winter show in July in Buenos Aires, and the Exhibition of Economic Achievement in Moscow, where the Horse pavilion serves for show purposes.

Horse shows have become chiefly a round of riding events in which highly trained riders compete on horses specially bred for the particular task. The more elaborate shows in some countries are occasions for a parade of fashionable clothes and an informal social function. (C. E. CA.)

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HORSE NETTLE (*Solanum carolinense*), a North American prickly and poisonous plant of the nightshade family (Solanaceae; *q.v.*), called also sand brier, native to dry fields and waste places in the southern and southwestern United States and introduced northward to New England and southern Canada. It is an erect perennial, one to four feet high, bearing large, more or less deeply lobed leaves, light blue or white flowers strongly resembling those of the potato, and orange-yellow berries, about three-quarter inch in diameter. In sandy or gravelly soils the horse nettle is a troublesome and very persistent weed. In the garden it can be eradicated by uprooting the seedling weeds through cultivation, but control over large areas involves spraying with 2-, 4-D or chlordane. *See* also NIGHTSHADE. (N. TR.; X.)

WALTER SINGER

HORSE NETTLE (SOLANUM CAROLINENSE)

HORSENS, a seaport in Skanderborg *amt* (county), Den., is situated at the head of Horsensfjord, on the east side of Jutland, 42 km. (26 mi.) S.W. of Aarhus by road. Pop. (1960) 37,261. The monastery and church were built in 1270 and there is a museum with a notable collection of Stone Age material. The chief manufactures are textiles, tobacco products, soap, machinery, electrical apparatus, silverware and dairy produce; organs are also made. There is much pleasure boating on the fjord. Horsens stands at the junction of railways from Frederikshavn, Silkeborg and Germany, and has a good harbour. (RO. H. T.)

HORSEPOWER is the common unit of power measurement, the rate at which work is done by an engine, turbine or motor, or absorbed by a driven machine. In the English system one horsepower equals 33,000 ft.-lb. of work per minute. This value was adopted by James Watt after experiments with strong dray horses and is about 50% more than the rate which an average horse can sustain for a working day. The electrical equivalent of 1 h.p. is 746 w., and the heat equivalent is 2,545 B.T.U. (British thermal units) per hour. In the metric system one metric horsepower (*cheval-vapeur* in France) equals 4,500 kg.-m. per minute (32,549 ft.-lb. per minute) or 0.9863 h.p.

Horsepower at the output shaft of an engine, turbine or motor is termed brake horsepower or shaft horsepower depending on whether it is usually measured with an absorption dynamometer such as a brake, or by a transmission dynamometer such as a shaft torsion meter (*see* DYNAMOMETER). Horsepower of reciprocating engines, especially in the larger sizes, is often expressed as indicated horsepower, which is determined from the pressure in the cylinders (*see* INTERNAL-COMBUSTION ENGINE; STEAM: *Steam Engine*). Brake or shaft horsepower is less than indicated horsepower by the friction horsepower of the engine itself, which may amount to 10% or more of the indicated horsepower. Electric motor horsepower can be determined from the electrical input in watts, allowing for heat and friction losses in the motor itself. Thrust horsepower of aircraft jet engines and rocket motors is equal to the thrust (pounds) times the speed of the aircraft (miles per hour) divided by 375 (which is one horsepower measured in mile-pounds per hour). (*See* AIRCRAFT PROPULSION; ROCKETS AND GUIDED MISSILES.)

Taxable or nominal horsepower of steam and internal-combustion engines is an arbitrary figure calculated from certain physical dimensions of the engine and bearing no exact relationship to actual power capacity. For motor vehicles in Great Britain and in some of the U.S. states the usual formula for taxable horsepower is $d^2n/2.5$, where d is cylinder bore of the engine (inches) and n is the number of cylinders. Maximum horsepower of modern automobile engines may be many times the taxable horsepower.

Rated horsepower or horsepower capacity of any machine is the potential output and will be actually developed only when both speed and load circumstances permit. For instance, maximum

horsepower rating of an automobile engine in a passenger car can be developed only if the speed is high enough (on the order of 75 to 100 m.p.h. in driving gear) and the car accelerating or climbing so as to load the engine fully. Gear transmissions and torque converters permit engines to run fast enough to develop their maximum power at lower car speeds. They do not increase the horsepower but make the power available at lower car speeds, thus increasing the propelling force at the wheels.

Rated horsepower of electric motors usually represents the shaft horsepower which can be sustained continuously without overheating to the point of causing damage to the internal insulation of the motor. Such motors usually are capable of momentary overloads well in excess of rated horsepower. (*See* MOTOR, ELECTRIC.)

(Co. C.)

HORSE RACING AND BREEDING. This article is divided into seven main sections dealing with the principal aspects of horse racing and breeding. For collateral information *see* also ANIMAL BREEDING; HORSE; HORSEMANSHIP AND RIDING.

Following are the main divisions of this article:

I. Early History
II. Great Britain
  1. Genealogy of the Thoroughbred
  2. The Classics
  3. The Jockey Club
  4. Matches and Handicaps
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I. EARLY HISTORY

Contests of speed between horses are among the oldest diversions of man, having arisen, in all probability, soon after the domestication of the horse. The earliest dates for such contests have not even been approximated, but archaeologists have turned up at ancient Hattusas, about a hundred miles east of Ankara in Asia Minor, a lengthy treatise on the breeding and training of horses, written about 1500 B.C. (the dating of such texts is still far from exact) by "Kikkuli of the land of Mitanni," an expert apparently in the employ of a Hittite king. The Hittites became a powerful nation through their use of the light, spoke-wheeled war chariot; but their knowledge of horsemanship apparently came to them from older cultures which had already developed the equestrian arts as well as clumsy carts with four wheels of solid wood. The earliest full-length account of a chariot race appears in book xxiii of the *Iliad*. Though it is of uncertain date, it attests a long antecedent history of conventions which had attached themselves to the sport. First prize was "a woman skilled in women's work, and a tripod of two-and-twenty measures with handles to it." Post positions were determined by lot, a patrol judge was sent out, and Antilochus received instructions from Nestor before the race and subsequently was disqualified from second place because of having followed them too well.

The first historical record of races for mounted horses is given in connection with the XXXIII Olympiad, about 624 B.C., but the horse had been used for riding more than a thousand years earlier. The Greeks made less use of horses, and were perhaps less skilled in handling them, than the earlier peoples of Asia or the later Romans. In Rome each of the various racing factions had its own colours and spent enormous sums in anticipation of competitive honours. Successful drivers were as popular and as well known as leading athletes of modern times.

Whether it was entirely fortuitous or largely the result of prehistoric selective breeding, the horses in the Mediterranean areas (whose river deltas became the centres of the first Western civilizations) were the ones best fitted to become ancestors of a breed specialized for speed, the modern thoroughbred. Wherever the Romans went in conquest, they took with them the fleet runners derived from the stock of Arabia, Asia Minor and North Africa; and wherever the Roman civilization persisted, the hippodrome was established. When Caesar invaded Britain in 55 B.C., he was opposed by skilled charioteers, and it was in the British Isles that modern organized racing had its beginning, together with the sovereign breed that came to be known as the thoroughbred.

II. GREAT BRITAIN

The aristocratic status of racing, established centuries earlier, was maintained in England, where it crystallized eventually into the familiar designation of "the sport of kings." The earliest English racing of which a description has been left took place about A.D. 1174, in the reign of Henry II, outside the gates of London at Smithfield, where horse fairs, usually attended by "earls, barons and knights," were held every Friday, the lords coming to inspect and buy "well-bred horses," while "multitudes of citizens" flocked thither to look on. The contenders were ridden by professional jockeys, who urged them forward by their cries and the use of whip and spur. The course was over the open field, cleared for the purpose.

The first mention of a formal event for a money prize, contested by a field of horses, occurred in the reign of Richard I (1189–99) when "at Whitsuntide" a purse of £40 in "ready gold" was run for by divers knights over a 3-mi. course. John, who followed Richard upon the throne (1199–1216), had "running horses" in his stables, this being the first mention of royalty in connection with them. The earliest mention of an established annual race meeting is of that held at Chester; in describing the race (there was only one) for the year 1512 (early in the reign of Henry VIII), the chronicler stated that this event had been given "time out of mind." It is possible, therefore, to date its origin as previous to the year 1500. It was contested over the Roodee, just outside the city, the site of the later Chester course. This has been the scene of racing for five centuries.

The rise of the turf in England must, however, be dated from the advent of the Stuart dynasty, beginning with James I (1603–25). This monarch had previously patronized the sport in Scotland. Subsequently he sponsored meetings at Croydon and Enfield, in the suburbs of London, and associated himself with the infancy of racing at both Epsom and Newmarket. While Henry VIII had acquired numerous "coursers" from Italy and Spain as early as 1520 and had established studs at Hampton Court, at Malmesbury in Wiltshire, at Tutbury in Staffordshire, at Ripon in Yorkshire and elsewhere, it was not until the accession of James that their importance became notable. For this, the influence of his favourite, George Villiers, duke of Buckingham, was largely responsible, he being passionately addicted to racing and breeding and the importer of numerous oriental animals. As master of the horse (according to tradition the king first encountered him in a stable), he had charge of all the royal horses until his death in 1628, after the accession of Charles I (1625–49). Charles himself had little interest in the turf, but concentrated his breeding stock at Tutbury where, according to the inventory taken after his deposition and death in 1649, there was a stud of 139 horses, with 37 brood mares. They were dispersed in a series of sales, but six of them were taken over by Oliver Cromwell, who was obliged to suppress his sporting instincts in deference to his Roundheads, but privately indulged them.

1. Genealogy of the Thoroughbred.—When Charles II inaugurated the Restoration in 1660, he speedily demonstrated the propensities which won for him the title of "father of the British turf." It was his patronage which raised Newmarket to the position it thereafter occupied, as the headquarters of both racing and breeding in the kingdom. There, on various occasions, he rode and

won both match and plate races; *i.e.*, races for money and races for trophies. The statement that he also bred on a large scale and "sent abroad the master of the horse, to procure a number of foreign horses and mares for breeding, and the mares brought over by him (as also many of their produce) have since been called royal mares," which first appeared in volume i of the *General Stud Book* in 1791, is incorrect. The English state papers disclose that throughout his reign Charles II formally contracted with various breeders to supply him with a stated number of animals annually, and upon his death but a single brood mare was found among his horses. The so-called royal mares are of historic importance, as they appear at the foundations of practically all the pedigrees in the *Stud Book*, either as "taproots" (earliest known mares in direct female lines) or collaterally. Analysis of these pedigrees has shown that the entire body of English thoroughbred horses, from the earliest times to the present day, descend in their female lineage from fewer than 50 "taproots," while the vast majority of them descend from fewer than 20. The former supposition that these foundation mares were of purely oriental blood is not tenable in the light of recent research. Only a few of them were imported, the remainder being native (English) bred and of mixed native and oriental blood. The majority of the foundation sires were oriental or quasi-oriental, but the antecedents of the majority are unknown. Few were ever certified as to blood or place of origin. By the old authorities they were termed "Arabians," "Turks," "Barbs," etc., in a loose and careless way.

But one thing emerges with certainty: the percentage of authentic Arabians was meagre, while that of Barbs was proportionately large. The Barb, indeed, may be designated as the preponderant influence of the foundation period. This arises from the much greater facility with which both stallions and mares of that strain could be imported, either direct from North Africa or from Spain or Italy. A long-sustained argument, pro and con, has raged between thoroughbred genealogists regarding the precise origin of the Arabian and the Barb. The theory that both descend from a remote ancestry which flourished in prehistoric Asia Minor, and that the Barb is an offshoot of the Arabian, was generally held by mid-20th century.

The most interesting fact, genealogically, regarding the modern thoroughbred is this: Of the vast number distributed over the entire world, all, without exception, can be traced in their male lineage from but three early 18th-century oriental progenitors: the Byerly Turk, the Darley Arabian and the Godolphin Barb or Godolphin Arabian. Furthermore, in turn, the lines of descent from them trace back through but a single descendant of each: Matchem (1748), grandson of the Godolphin; Herod (1758), great-great-grandson of the Byerly; and Eclipse (1764), great-great-grandson of the Darley horse.

The Byerly Turk was the first of these founding fathers to appear. It is known only that he was the charger of the English Captain Byerly at the battle of the Boyne in 1690, that he was suppositiously a Turkish stallion brought in from Europe shortly before, and that he afterward became a service horse at Byerly's seat, Goldsborough hall, in Yorkshire. The Darley Arabian, in every way a most exceptional animal, came direct from Aleppo in 1704, certified as an Arabian of the best Mu'niqua (Maneghi) blood; he was sent from Syria by Thomas to his father, Richard Darley, of Aldby Park, Yorkshire, where he was kept throughout his career. The Godolphin Barb or Arabian was brought into England from France about 1730 by Edward Coke. As the "mysterious Frenchman," he has been the subject of much picturesque romance, myth and fable. Coke died in 1733, bequeathing the horse to his friend Roger Williams, who either gave or sold him to the earl of Godolphin, the horse dying his property in 1753 at his stud in Cambridgeshire.

In tracing lineage through the male, the prepotency of the Darley Arabian through Eclipse far outstripped that of the Byerly and Godolphin horses; but collaterally, the Byerly strain through Herod is present through the greater number of crosses. Other oriental strains may be found, some of them in great frequency, in pedigrees at the developmental stage of the breed; these are not necessarily less important, but are less well known than the three ancestors which for many generations have monopolized the male lines.

2. The Classics.—It was the patronage of Charles II which brought Newmarket to the front as the English racing capital. That of Queen Anne (1702–14) gave Ascot its high distinction. Still earlier, Epsom Downs had found favour with James I, as noted, but it was not until late in the 18th century, with the foundation of the Derby (1780) and Oaks (1779), that its fame began. The St. Leger at Doncaster, in Yorkshire, founded in 1776, was the first-established of what are now known as the classics, which are five in number, the other two being the much younger 2,000 Guineas (1809) and 1,000 Guineas (1814), both run at Newmarket. These great stakes (races in which the money prizes are mainly the total of fees paid by owners of the horses) have been contested annually since their foundation, except the St. Leger which had to be abandoned because of war in 1939; all are exclusively for three-year-olds; and the Oaks and 1,000 Guineas are for fillies only. The premier all-ages English fixed event is the Ascot Gold Cup race, established in 1807. For military reasons the Derby, Oaks and St. Leger were transferred to Newmarket during World Wars I and II; the Gold Cup, not run in 1915–16 or in 1940, otherwise was shifted to Newmarket. These races vary in distance from 1 mi. (the Guineas), to $1\frac{1}{2}$ mi. (Derby and Oaks), $1\frac{3}{4}$ mi. (St. Leger) and $2\frac{1}{2}$ mi. (Gold Cup). All but the St. Leger are May and June events, it being run in September. Through long and eventful histories, crowded with picturesque and sensational incidents, they became the backbone of the British turf and acquired world-wide celebrity and imitation. The Derby is universally regarded as the greatest horse race of all. The winner of any classic or of the Gold Cup immediately assumes a place apart and an exalted value.

It may be said that the history of the turf, as an authentic chronicle, begins with that of the classics. However, the steady growth of racing and breeding from the time of Charles II had made an annual record of races run the previous year a necessity as early as 1727, when volume i was published of the work still extant as official, the *Racing Calendar*. Its founder, John Cheny, was succeeded by other publishers, most notably James Weatherby in 1772–73, whose descendants continued its issue until 1902 when it was purchased by the Jockey club, though Weatherby's have continued to produce it. James Weatherby is also notable as the originator of the *General Stud Book*, of which he issued a preliminary volume in 1791; not until 1808, after several revisions, did the edition which has become standard appear. This, the basic collection of pedigrees of race horses upon which all subsequent compilations of the kind ultimately rest, has been followed by many volumes. It is still compiled and published by Weatherby's, but it is the Jockey club which, in effect, lays down the rules that govern admission. Until 1913, thoroughbreds of other countries, duly registered in their stud books, had been accepted. Then, by the passage of the so-called Jersey act (sponsored by the earl of Jersey, one of the stewards of the Jockey club), it was declared that only horses whose ancestors, in all removes, were registered in previous volumes would thereafter be admitted. This disqualified a vast number of animals bred outside England and Ireland, including most of the race horses in the United States and stock in other countries derived from North American strains. Since the modern American thoroughbred was descended from numerous ancestors imported before there was a stud book, it was impossible to document connections with a non-existent registry. Thirty-five years of research, remonstrance, ridicule and logic failed to remove the exclusion clause. But immediately after World War II French owners achieved a spectacular series of victories in England, many of them with horses descended from "American" strains imported before France set up its own exclusion policy in 1913. In 1948 the stud book authority in France removed its ban on American horses, and shortly thereafter the British authority followed suit. The thoroughbred in North America now qualifies as a thoroughbred in any other country.

3. The Jockey Club.—The Jockey club, exercising control over racing and breeding in England, and indirectly in many other

countries, was formed about 1750; precise records are lacking. In the beginning it comprised a small group of leading turfmen, mainly noblemen, who banded themselves together for the purpose of promoting the sport. Powerful from the first, it grew more and more so until it became not only a court of last resort but an autocratic one whose decrees are final. During a lengthy period it was the custom to delegate its authority to some steward who commanded general deference and who was popularly known as the "dictator of the turf." The first of them, Sir Charles Bunbury (1740–1821), was succeeded upon his death by Lord George Bentinck (1802–48), and he in turn by Adm. John Henry Rous (1795–1877), the last and most famous one, who had no successor. A board of three stewards administers Jockey club policy. The most important function of the Jockey club in regard to racing itself, is its law- and rule-making powers. Originally confined to Newmarket only, its authority later became supreme. Its code took the place of the many and diverse local ones promiscuously in vogue formerly, a centralization of authority sometimes irksome but on the whole beneficent.. Thereafter, by acquiring first the *Racing Calendar* and then control of the *Stud Book*, it became arbiter of both the turf and the breeding industry, amenable only to the law of the land in its supervision of them. Its immense prestige is attested by world-wide imitation.

4. Matches and Handicaps.—The mechanism of organized racing as it now exists began to evolve in the 16th century. While, as has been seen, contests by fields of horses for money and other prizes are very ancient, when the sport began to assume definite status it tended most often to be a matter of matches, usually between two, but often three or more, owners. The early racing calendars were indeed officially known as "Match Books," and swarm with summaries of these events, often for large amounts, with tremendous sums wagered in side bets. The condition "owners to ride" was common, though professional jockeys were an institution dating far back into Roman days. Feeling ran high, and rough and foul riding were frequent until the strong hand of the Jockey club curbed it by drastic legislation. "Man-to-man" betting was the rule for centuries, either by direct personal wager or by means of go-betweens, and it is impossible to date the advent of the professional better who evolved into the bookmaker, along with "the ring," the milieu in which he operated. As in all things else, Newmarket was betting headquarters, under the aegis of the Jockey club at its famous rooms. In 1752 that body took a long lease of what were then known as the "coffee rooms," later acquired title to the property, converted it into a sort of combination clubhouse and gaming place and still occupies the premises, which have several times been rebuilt.

Meanwhile, off-course betting grew gigantic, with professional layers of odds established in London and elsewhere, patronized alike by the leviathans of the ring and the general public. "Betting on the races" developed into one of Britain's great national preoccupations, permanently to remain so. This situation naturally attracted the attention of the lawmakers and the censors of morals, and finally in 1926 was changed into a revenue-producing medium by the imposition of a tax of 2% on all wagers made at, and 3½% on those made off, the course. This proving unsatisfactory, in 1928 a new Betting act was passed which legalized the use of the totalizator (pari-mutuel), a machine of French origination familiarly known as the tote (see *Totalizator*, below). The bookmaker was not, however, abolished and still handles a major portion of the betting. The tax (or take) deducted from the daily turnover of the tote varies from 10% to 15%, a meagre portion of which is allocated to a maintenance fund and grants of various kinds for the promotion of racing and breeding.

As the 18th century progressed, matchmaking steadily declined and racing programs were devoted chiefly to stakes, plates and the like for fields of horses ridden by professional jockeys, though the "gentleman jock" continued prominent well into the 19th century. These events usually closed their entries months, sometimes a year or more, in advance of decision, and were eventually to include what are termed produce stakes, to which mares with foal are nominated, their produce racing as two-year-olds. The rise of races for two-year-olds—which were for long unknown, while events for three-year-olds were vastly in the minority, most performers being four-year-olds or older—dates from about 1779, when the first calendared event of that kind occurred, but it required several decades for them to become staple. The oldest fixture for that age still in existence, the Woodcote Plate (or Stakes), was founded in 1807, the Champagne in 1823 and the Criterion in 1829; but the Middle Park, familiarly "the two-year-old Derby," was first run only in 1866.

The original absence of all two- and most three-year-olds from the course inhered in the severity of the contests. Four-mile heats were the standard with weights seldom less than 10 stone (140 lb.) and frequently as high as 12 stone (168 lb.)—Eclipse carried 12 stone repeatedly—while in many match races, owners to ride, they were higher still, in some cases more than 200 lb. Immature animals could not meet such tests, and change inevitably took its course, introducing shorter distances and lighter weights, together with the elimination of heats and substitution of dashes exclusively. For a long time, weights were assigned according to the heights of the horses, a system that was bound to be abused and unsatisfactory and that gave way to systematic apportionments based upon three different factors: age, distance and season of the year.

The Jockey club provides a basic set of weight allowances whose theoretical purpose is to equalize the opportunities of horses of different ages. In practice it is used more as a point of departure, in races with penalties and allowances based on previous performances, than as a rigid standard.

To further complicate the already complex weight problem, the handicap injected into it still another ambiguous element. This concerns a type of race which came into vogue with the founding in 1839 of the two most famous ones, the Cambridgeshire and the Cesarewitch. Open to horses of all ages and sexes (including geldings, which are barred from the classics), but with occasional races for two- or three-year-olds exclusively, a handicap field is assigned weights upon the hypothesis of "bringing together" the best and the worst horses that start, and giving each an equal chance to win. The uncertainties of handicaps have proved so great that the principal ones are among the biggest betting races of the season.

The difficulty of winning a great handicap in England became so formidable that it became the established custom never to expose classic winners to the ordeal, though they are proclaimed to possess a class far loftier than any handicap horse may aspire to. This "confession and avoidance" is in contrast with former practice, when classic winners proved themselves in handicaps as well as against each other, thereby establishing an incontestable certificate of merit. It is a significant fact that the three dominant male lines in England (and also in most other parts of the world), namely, those of Bend Or, Isonomy and Hampton, were founded by horses that ran and won great handicaps, while, of the trio, Bend Or alone was a classic winner.

For some years after handicaps were first introduced, the weights were assigned by the various club managements. Later on there came a demand for centralization because of the widely different and often very eccentric assignments by the many local officials that apportioned them. It was felt that this should be remedied and that something more thoroughly rationalized should take its place. The difficulty lay in finding a man whose judgment of "public form" was so widely accepted that there would be general confidence in his work; his position and character should place him above suspicion.

Admiral Rous, last of the three "dictators of the turf" previously referred to, was chosen. His administration of his duties, which, roughly speaking, covered the last 25 years of his life (which closed in 1877), marked a new era in racing. While the imposts he meted out often aroused severe criticism, his work on the whole was such as to vindicate the trust reposed in him. Eventually, as the Jockey club became more and more absolute in the control of the sport, the post of official handicapper was formally created and is now occupied by a man of its selection. The system has proved satisfactory, but has never been adopted in the U.S.

5. Race Courses.—Racing in England is exclusively over turf, the courses varying widely in shape and gradients. Ascot is roughly

triangular, Doncaster kite-shaped, Epsom a tremendous U. Newmarket's great main course is shaped something like a boomerang, about 2¼ mi. in length, the last half quite straight. In the majority of the longer races the start is effected so far from the finish, where the grandstands are located, as to be out of sight of them; in many instances little can be seen of the contest until it is nearly over. A marked exception is the ancient Chester course, which is an oval of almost precisely one mile, lying on level ground, the horses being in plain view at all times.

The great differences in the various courses, differences in themselves as well as between each other, make it extremely difficult to establish any parity of judgment between performances over them. They have ascents and descents, waves and dips, sharp corners and difficult turns, and inequalities of turf and the earth beneath it, all impossible to co-ordinate; this has given rise to the saying "horses for courses," individual animals showing distinct preferences for certain ones and dislikes for others, the skill of jockeys being similarly affected. Because of these things, the time test was discredited by English turfmen until the 1940s, when Phil Bull, using sound statistical procedure, began to appraise the speed of individual runners in relation to fixed standards which made allowance for permanent and temporary differences in courses.

Race courses in England may otherwise be subdivided into two classes, namely, enclosed and unenclosed. Up to about 1875 all fell in the latter category. The general public were at liberty to make themselves at home anywhere about the course except in the small enclosure surrounding the stands at the finish line, to which admission was free for club members and their guests, a fee being charged to all others.

This practice continued at the old established meetings, but more recent parks are, almost without exception, fenced or walled throughout their entire extent, with a gate fee invariably charged. There was at first a loud outcry against enclosed courses, but they are now popular and, on "big" days, are crowded to capacity, having increased rather than diminished the hold of racing on the public. This hold is immense. Naturally no enclosed course can house the vast throngs that attend such meetings as Epsom, Newmarket, Doncaster, Liverpool, etc., which are genuine "outpourings of the masses." Derby day at Epsom, as a national holiday, has long been the theme of the artist, the minstrel and the novelist. It is estimated that as many as 250,000 people often assemble there to witness the decision of that event—the fact that many of them never catch sight of the horses in no way dampens their enjoyment. Grand National day at Liverpool is only second in its drawing power.

Proprietorship of courses varies. Newmarket is owned and administered by the Jockey club. Ascot is a crown demesne, and the Goodwood meetings are sponsored by the duke of Richmond. At Doncaster and other places the town corporation controls. There are clubs and holding companies which own the courses they operate or have long-term leases of the grounds. The Jockey club is, in the last analysis, always the ruling power. No regular meeting can be held unless licensed by it, on dates which it specifies. The powers with which it is clothed are such that it prohibits associations with enclosed courses from declaring dividends of more than 10%, prescribes the patterns of courses that must be constructed, etc.

6. The Rise of Commercialism.—By mid-20th century, horse racing itself offered little resemblance to that which launched the turf upon the tide of prosperity. Despite its aristocratic ensemble, with the royal family foremost in its support, it had become commercialized in many respects; and the epigram coined at the turn of the century, that "In England racing is a sport, in France it is an entertainment and in America it is a business," lost much of its pertinence insofar as England was concerned. Commercialism retrenched distance racing to the danger point, substituting "quick action for your money." It placed precocious speed and two-year-old success at a premium, consequently inflated yearling values, and made the market breeder, as distinguished from the sporting breeder, the producer of a large percentage of the animals that perform. The animals themselves were modified to meet conditions very different from those that formerly existed. The modern race horse may be said to have been remolded to fit the system into which he is dovetailed rather than, as was the case with his ancestors, having that system shaped to fit his own highest capacities. While speed is always the hallmark of the thoroughbred, his gameness, soundness and campaigning ability were, until the end of the 19th century, among the attributes for which he was most highly valued. In the 20th century this no longer ruled. He became much of a hothouse product and could with justice often be compared to the beautiful but short-lived triumphs of the florist, which fade untimely under stress of the stimulation that forced them to such premature efflorescence.

The decline of the British horse was attested by the unprecedented success of raiding French stables in the years following the close of World War II; the French turf, which breeds about one-half as many foals as are produced in England and Ireland, accounted for winners of the Derby, Oaks, St. Leger and Ascot Gold Cup. Most of the important weight-for-age races at the longer distances went to invaders from Europe. In 1956, for example, the richest of them, the 1½-mi. King George VI and Queen Elizabeth stakes, fell to an Italian champion, Ribot, unbeaten in a career of 16 races and generally acknowledged the best horse in Europe (*see* also *Continental Europe*, below). English breeders were aware of the declining stamina of their horses and of the reasons for it, but they could find no remedy. Caught between the millstones of high taxes and low purses, the more important private studs were dispersed or decimated; and the principal goal of breeders became sales to the "dollar areas," where demand for speed and precocity had weakened the native product to a still greater extent. It was because of economic pressure that exportation of top-class horses became the rule, rather than the exception, as it had been.

Before World War II prices at private treaty ranged as high as £60,000 (about $298,000), the sum paid in 1938 by M. H. Benson of London for the unbeaten Italian horse Nearco (1935), whose ancestry combined English, French, American and Italian strains. In 1942 Nearco was syndicated at a valuation of £62,000. In 1953 the Aga Khan sold Tulyar, unbeaten as a three-year-old the previous season, to the Irish National stud for £250,000 ($700,000), the highest price in thoroughbred history until the American colt Nashua was sold for $1,251,200 late in 1955. Tulyar changed hands again in 1955, going to an American syndicate for £240,000 ($672,000). In sales by auction the record price of 47,000 guineas (about $240,000) was paid by an English syndicate in 1932 for the ten-year-old stallion Solario.

The highest price for a yearling was the 28,000 guineas (about $141,000) paid in 1945 by the Gaekwar of Baroda for Sayajirao, which two years later won the St. Leger. Several records were established when the late John A. Dewar's stock was offered at the Newmarket December sales in 1954. The 1,000 Guineas winner Festoon brought 36,000 guineas ($105,840), the highest-price that had been paid for a filly just out of training; Festoon's half-sister Refreshed made 30,000 guineas ($87,200), surpassing the previous record of 18,000 guineas ($52,920) for a brood mare; Festoon's weanling full brother made 19,000 guineas ($55,860), the record for a foal; and a yearling filly by Chanteur II—Minaret—reached 17,500 guineas ($51,450). These exceptional prices are far removed from the economic norms of thoroughbred breeding, which by and large is an extremely hazardous enterprise.

Great Britain and the Republic of Ireland, though politically separate, still use the same stud book. About 40% of the brood mares registered for the two countries are in Ireland, the shift of breeding away from England constituting another example of the result of economic pressure. Anglo-Irish breeding, bolstered by importation of staying stock from the continent, remained the principal source from which other countries made replenishment, but competition was rising.

Queen Elizabeth II, continuing a long tradition of the royal family, had a strong personal interest in racing, and her own stable was at the head of the list of winning owners in 1954. Among the first honours bestowed after her coronation was a knighthood for Gordon Richards, the first professional jockey to be accorded such a distinction. A few days after he had received

the accolade, Sir Gordon rode his first Derby winner, Sir Victor Sassoon's Pinza, with the Queen's colt Aureole in second place. When Sir Gordon retired from the saddle he had ridden a total of 4,870 winners, a record surpassed in 1956 by the English-born U.S. rider Johnny Longden. Eddie Arcaro (U.S.) in 1958 became the third man in the world to attain 4,000 or more victories.

III. NORTH AMERICA

In 1664 when the English invaded New Amsterdam and renamed it New York, the commander of the English forces was Col. Richard Nicolls, who was to establish organized racing in the colonies. The next spring he laid out a 2-mi. course on what then was called Salisbury Plain, Long Island, and announced that he would offer a silver cup each spring and fall, to be contested for over the course, which he called Newmarket. Racing persisted there for more than a century, during which time the racer was attaining the status of a breed. The first "bred" horse in the colonies was a son of the Darley Arabian called Bulle Rock, imported to Virginia in 1730; and in the next 45 years the planters of New York, Maryland, Virginia, the Carolinas and other colonies imported from England 113 stallions and 73 mares which became the foundation of U.S. thoroughbred breeding.

The American Revolution damaged, but did not destroy, the foundation, upon which soon rose an imposing edifice. Among the more than 100 stallions imported between 1783 and 1800 were four winners of the Epsom Derby, including the first one, Diomed, whose influence was a dominant force for many years. Except for the setbacks occasioned by the War of 1812 and the Civil War, racing and breeding continued to expand until the late 1890s, the beginning of a period of repression. Though New York was to remain the principal and most enlightened centre of racing, the breeding of race horses was centred early in Virginia and finally in Kentucky, whose inner bluegrass area for years has been more densely populated with light horse breeding stock—mainly thoroughbred and standardbred (*see* HORSE: *Classification*)—than any other region in the world. After the middle 1930s, however, Kentucky accounted for only about one-fourth of North American breeding; there were important studs in numerous other states. Swaps, winner of the 1955 Kentucky Derby, was bred in California, and Needles, the winner in 1956, in Florida; Tomy Lee, winner in 1959, was bred in England; other winners have come from Tennessee, Texas, Montana, Missouri, Ohio, New Jersey, Virginia and Kansas.

1. U.S. Racing Policy.—Before the Civil War the hallmark of excellence for an American thoroughbred was the ability to outdo the best competition in races of 4-mi. heats. (On one occasion, Oct. 13, 1832, at the Union course on Long Island, a field of America's best race mares ran a total of 20 mi. in one afternoon before the winner was determined.) It was during the Reconstruction period after the Civil War that American racing made its nearest approach to the English model, establishing the $1\frac{1}{2}$-mi. classic as the highest test of merit and setting up other fixtures, many of them still renewed annually, at distances between 1 mi. and 2 mi. The trend of the 20th century, steadily reinforced by considerations of a commercial nature and by competitive expediency on the part of the growing number of race tracks, was toward races which made no pretense of testing stamina. The most common distance for American races was three-quarters of a mile, and contests of $1\frac{1}{4}$ mi. or more became infrequent, even for horses of the highest class.

A corollary development which sets American racing apart from that of other countries is an inordinate emphasis on precocity. Two-year-olds begin running two- and three-furlong dashes in January, and the best of those which survive the excessive strain on immature bodies may compete in October for "the richest race in the world," the $1\frac{1}{16}$-mi. Garden State stakes at Garden State park in New Jersey. The winner of this race, which was inaugurated in 1953, earns more than $150,000. American racing tests its cheaper horses, which constitute the great majority of runners, almost exclusively in claiming races (where each starter is eligible to be claimed from its owner at a given price). The best older horses are raced almost exclusively in handicaps, many of which have added-money values of $50,000 to $100,000. Contrary to the European custom of assigning such high weights to top-class horses that chances of victory are more or less equalized, the American handicapper, except in New York, seldom gives a champion more than 130 lb. to carry. Partly as a result of the arbitrary policy of limiting the range of weights, many moderately good horses have earned more than $100,000, and a number of the best have had total earnings ranging from $400,000 to more than a million. U.S. racing policies result in genetic debility which is remedied only by constant importations from countries with more respect for stamina.

The whole problem ties into that of the modern system of end-to-end (full-speed) race riding, just as in England. In order to facilitate this, the machine age has been invoked; and whereas in England the old-fashioned starting barrier is still used, in the United States it has been replaced by the starting gate, a mechanical device mounted on wheels and movable to any base. Into this the starters are locked, each in a separate stall, the front doors being electrically released by the starter when ready. The entire field then plunges headlong from the gate, reaching top speed in a few strides; they also get off on even terms. The starting gate is very old in principle, going back to the Roman Coliseum and Hippodrome, where its use seems to have originated. It expedites the starts, but many horses are injured in their effort to leap at once into full speed.

U.S. racing shows other wide departures from English racing in the plan and conduct of the meetings, and most especially in their length. The average English meeting lasts but three or four days, even in the case of the most important ones at Epsom, Ascot and Newmarket; in the U.S. they endure in numerous instances for 50, 60 and up to nearly 100 consecutive days, Sundays excepted. There is no centralized governing body like the English Jockey club; racing is controlled as a separate entity in each of the states where it is conducted under laws giving legal status to pari-mutuel betting.

Off-course betting is illegal in the United States, and the considerable amount of such illegal gambling has been a law enforcement problem of considerable difficulty. The controlling body, responsible to the state, is an appointed racing commission—usually consisting of three to five men—which operates independently of other commissions but recognizes and aids in the enforcement of their disciplinary actions. For purposes of parley and exchange of information the groups are organized as the National Association of State Racing Commissioners, with headquarters in Lexington, Ky. The existence of commissions as a means of control is largely a consequence of the pari mutuel, a system of betting originated in France. The money wagered goes into three pools, straight (winner), place (first or second) and show (first, second or third), and is distributed after the race among the holders of the winning tickets. There is also, at most tracks, a "daily double" in which the pool is divided among those who have placed their wagers on the winners of two designated successive races. Before the pools are distributed to the winning players they are reduced by a take-off which ranges up to 15% and slightly higher in some states. A part of this take is retained by the track for the payment of purses and other expenses and for the promotion of the breed; and the remainder, a fixed percentage of the gross total wagered, is paid to the state as a tax. The total of such taxes in the states where racing is organized under the supervision of racing commissions has reached annual figures in excess of $150,000,000, more than twice the amount paid out in stakes and purses. In terms of monetary gain the state governments received the principal benefit from the sport.

Racing is also conducted, on a smaller scale, in eastern and western Canada and in Mexico and Cuba, and for practical purposes the annual statistics usually include these in North American, rather than national, totals. The oldest fixed event run annually in North America is the Queen's Plate at Toronto, Ont., originally endowed in 1836 by King William IV and ever since by the British sovereigns.

All American tracks are prepared dirt ovals, usually of 1 mi., the largest being that at Belmont park, of $1\frac{1}{2}$ mi.; they are scien-

Thoroughbred mare and foal on bluegrass pasture at a breeding farm near Lexington, Ky., a major centre of horse breeding. Other important horse breeding areas in the U.S. are in Florida, California and Maryland

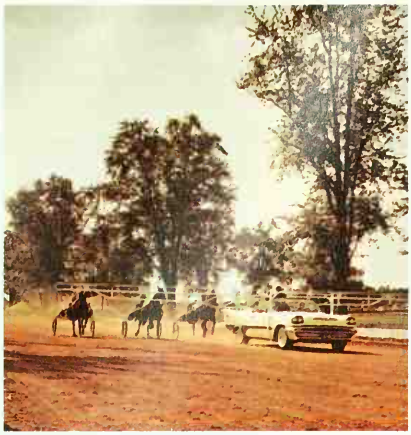
Bugler calling jockeys and horses to the post in the traditional fashion at Keeneland race track, Lexington, Ky. Keeneland is favoured as a testing ground by many breeders and is the site of an important annual auction of Thoroughbred colts

A field of horses breaking from the electrically operated starting gate at Aqueduct, Long Island, N.Y. Races at Aqueduct, as at most other U.S. tracks, are usually run on a dirt track

Horses entering the straightaway on the track at Chantilly, France. Like Chantilly, most European tracks are turf

PHOTOGRAPHS (TOP LEFT) BRADLEY SMITH—PHOTO RESEARCHERS, INC. (TOP RIGHT, BOTTOM) JERRY BOWE (CENTRE) GERRY CRANHAM—RAPHO GUILLUMETTE

HORSE RACING AND BREEDING



Trotters moving into starting pace and position behind a mobile starting gate at a county fair harness race, Connersville, Ind. Traditionally, harness racing in the U.S. has centred on country fairs, though the trend has been toward nighttime racing at more elaborate tracks

Horses at a brush jump and water hazard in the American Grand National steeplechase at Aqueduct track, Long Island, N.Y. Steeplechase hedges are permanently positioned while hedges in hurdling, a related form of racing, are movable.

The parade to the post for the classic Gold Cup race, Ascot heath race course, Berkshire, Eng.

Hurdle racing, Fontwell park, London. The less challenging hazards in hurdling permit racers to maintain a faster pace than in steeplechasing

Thoroughbreds in the stretch contending for the Melbourne Cup, Flemington race track, near Melbourne, Austr.

PHOTOGRAPHS, (TOP LEFT) DAN BUCHER—PHOTO RESEARCHERS, INC., (TOP RIGHT) RAY WOOLFE, JR., FROM KEYSTONE, (CENTRE LEFT) KEYSTONE PRESS AGENCY LTD., (CENTRE RIGHT) MARK KAUFFMAN, (BOTTOM) DOUGLAS DAGLIN

tifically constructed and almost precisely dead level. Most of them have chutes from which starts are made. There is only one straight course, the Widener at Belmont park, which is slightly more than six furlongs. Because of this quasi-uniformity, time is considered most important and enters into betting and handicapping calculations. California tracks are elevated in relation to the viewing area; this is thought to aid drainage and thus permit faster times.

As to the handicapping, this is usually done by the secretary of each club, an exception being that the Jockey club's official handicapper assigns all weights for the New York tracks. The weight scale of the Jockey club, formed in 1873 in New York state on the pattern of the English Jockey club, is basic throughout the country, but not mandatory. The scale was revised in 1953.

Betting on horse races increased after World War II, providing the tracks with such revenues that purses became larger than ever before. By the 1950s, more than 20 races with $100,000 purses were run annually in the United States, and minimum purses at some tracks rose almost to the levels at which important stakes races were being run before 1940. Total North American racing attendance rose to more than 30,000,000 annually, of which all but about 3,000,000 was accounted for in the U.S.; total wagering, to more than $2,000,000,000, of which about $35,000,000 was outside the U.S. (Most of the more than $2,000,000,000 total was comprised of the same money played and replayed numerous times.) Such totals were far higher than those of the years prior to World War II, but the increase was largely due to increase in number of tracks in operation and number of races offered annually.

The Thoroughbred Racing Associations of the United States, Inc., or T.R.A., is perhaps the most important of a considerable number of organizations concerned with the maintenance and improvement of high standards, ethical and otherwise, in racing. Its membership consists of many of the leading tracks whose pooled contributions support the Thoroughbred Racing Protective bureau, an investigative body which constitutes in racing an analogue of the Federal Bureau of Investigation in the affairs of the federal government and is in fact staffed by experienced investigators trained in FBI methods. This self-policing tended to minimize infractions of rules and to raise public confidence in the sport.

Racing is the most nearly universal of the great spectator sports. The most important racing countries place strong emphasis upon, and provide high values for, their leading international races, such as the Prix de l'Arc de Triomphe in France, the King George VI and Queen Elizabeth stakes in England, the Grande Premios Brasil and São Paulo in Brazil and others of like nature, usually testing mature horses over a distance of 1½ mi. or more. Because of its great distance from other major racing countries, and also because of its grassless tracks, the United States found it difficult to offer such international races. The situation was changed by the development of air transport and the construction of numerous turf courses inside the standard dirt tracks. Laurel Race course at Laurel, Md., inaugurated an international whose first running, in 1952, was won by an English runner, Wilwyn, and the second by a French horse, Worden. Santa Anita park, Arcadia, Calif., constructed an unusual turf course which begins outside the main track, covering sloping terrain like that of European courses, and finishes inside the dirt track.

2. Genealogy.—Racing is essentially international insofar as breeding is concerned. The modern American thoroughbred became thoroughly internationalized in blood. There are three long-established male lines, peculiar to America alone and popularly known as the Domino, Fair Play and Ben Brush families, but the breeding fabric represents a particoloured pattern, with these strains and the most fashionable English, French, South American, Australian and other foreign ones complexly interwoven. Kentucky retains its supremacy as the great breeding ground, with Virginia, Maryland, New Jersey and California also prominent. Annual production of foals is almost 10,000, or about double that of England and Ireland. The *American Stud Book* is published by the Jockey club, and all thoroughbred foals must be registered. No horse not so registered can start at any recognized meeting.

The inheritance of racing class has fascinated students of the thoroughbred horse for generations, but the emphasis has been on genealogy rather than on genetics, with the result that racehorse breeding has a somewhat less scientific background than the breeding of other livestock. Because certain families (female lines) were more numerous and hence tended to produce more horses of exceptional class, various qualities were ascribed to different families—as, for instance, the postulate made by the Australian Bruce Lowe in the 1890s that families no. 3, 5, 8, 11 and 14 were the ones responsible for successful sires. The frequent recurrence in the pedigrees of noted runners of such names as St. Simon, Isonomy, Hermit, Hampton and Bend Or led Lieut. Col. J. Vuillier in France to construct a "theory of dosages" based upon a supposed optimum in the proportions in which these strains should be combined—a system which had some acceptance in continental Europe and in South America. Many breeders place their hopes upon the repetition or approximation of a "nick," or combination of bloodlines which already has produced one or more good horses. Such practice gradually gave way in the face of a growing comprehension of the elementary principles of genetics. Only one thoroughly scientific attempt to estimate the complicated probabilities in race-horse breeding was made in the first half of the 20th century —at the Eugenics Records offices of the Carnegie institution at Cold Spring Harbor, Long Island, N.Y., in the 1920s under the direction of Dr. H. H. Laughlin. Most breeders remained unaware of the conclusions reached, and would find it difficult to apply them if they were understood. The American Thoroughbred Breeders association at its offices in Lexington, Ky., where the breeding industry centres, established a small research program to determine some of the more important probabilities involved, using simple standards of measurement. Previous studies, excepting the work at Cold Spring Harbor, had yielded erroneous conclusions, partly because they were based on examination of the ancestry of the best horses only, without recourse to the fundamental statistical procedure of using control groups, and partly because there was available no constant arithmetic measure for appraising individual runners and groups of runners in different generations and in different countries. Laughlin's arithmetic measure was a "yardstick" based on speed, with corrections for weight carried and variations in tracks. The "biological handicap," or genetic prediction index, he used was obtained by compounding the measurements of the individual runner, his parents and his sibs and half-sibs. Laughlin's complex prediction index was never put to practical use, except for a brief and inconclusive trial in the early 1930s at the Mereworth farm of Walter J. Salmon, who had financed the investigation.

3. The Progeny Index.—The index developed in the offices of the American Thoroughbred Breeders association was simpler, less expensive and more effective in predicting genetic probability. It was based on the assumption that relative earning power provided an approximate measure of a horse's class, constitution and soundness, the principal factors to be accounted for in quantitative measurement of the inheritance of racing ability. The basis for all calculations was the average monetary distribution per runner in a given year; and the performance of any runner in that year was expressed as a ratio to this "average expectancy." In 1933 the North American average per starter was $928 (9,176 runners, $8,516,325 total monetary distribution) and in 1955 the average was $2,941 (26,056 runners, $76,643,696). Thus a horse which earned $928 in 1933 had an index of 1.00 for that year, and a horse which earned $928 in 1955 had an index of .32. The yearly indexes, representing division of actual earnings by a corrective constant, are additive without the distortion entailed by summing the inconstant monetary units. The annual differences in opportunity are largest, of course, in countries with the most pronounced inflation; in France the average distribution per runner in 1925 was 9,773 francs, and 30 years later in 1955 it was 371,188 francs.

Studies making use of the average-earnings index have demonstrated that the earning power of the parent is directly proportional to the probable earning power of the offspring, within the limits circumscribed by chance assortment of genes and by environmental factors. (John Pirri, Jr., and Dr. Dewey G. Steele, professor of genetics at the University of Kentucky, using earnings

as a measurement of relative success, were able to make a tentative estimate that heredity accounts for about 50% of the differences in racing class in the thoroughbred.) The most successful sires, with only occasional exceptions, are animals which, as race horses, ranked in the top 1% of their male contemporaries. The highest known full-lifetime progeny index for a thoroughbred sire is 4.75, indicating earning power at a rate 4.75 times the average expectancy; this index was computed for the unbeaten St. Simon, whose offspring raced in Great Britain from 1889 to 1912. Blandford, foaled in 1919, had a lifetime progeny index of 4.29 in Great Britain and Ireland. The sons and daughters of Bull Lea, outstanding American sire of the century, had a group index of 5.01 at the end of 1955; this stallion's 816 year-starters had earned a total of $10,758,394, an average of $13,184 per runner per year. The offspring of Nasrullah, a highly temperamental horse imported to Kentucky in 1950, had a joint British-Irish-American index of 5.05 at the end of 1956. In general, a sire with a progeny index of 1.80 or higher is recognized as successful, and in North America about 7.5% of stallions reach this level, though only about 1% maintain indexes of more than 3.00.

As with stallions, the probable genetic merit of females is best estimated by reference to their racing ability. Of course, a much larger proportion of females have relatively high chances of becoming good producers. About 5.7% of brood mares have racing indexes of 2.00 and upward; the top 10% begins at 1.20, the top 20% at 0.65. More than one-fourth of the thoroughbred brood mare population in North America is comprised of females never tested in competition on the race course.

It is common practice in all racing countries for breeders to select prospective brood mares largely, if not primarily, on the basis of ancestry; particularly they prefer the daughters of a sire already distinguished as a sire of brood mares or the daughters of mares already distinguished by their own racing or that of their offspring. This method frequently yields satisfactory results, but selection based on ancestry compares unfavourably with selection based on individual racing capacity. The highest known index for a group chosen on the basis of ancestry is that of 2.40 (at the end of 1954) for the progeny of daughters of the excellent stallion Blue Larkspur. This figure would be lowered considerably if the best race mares among Blue Larkspur's daughters were subtracted from the totals. On the other hand, the progeny index for the best American race mares as a group was 3.66; for winners of the English 1,000 Guineas (one mile), 3.61; for winners of the English Oaks ($1\frac{1}{2}$ mi.), 3.81. A study completed in 1952, based on actual results in North America, showed that high-class race mares produced 3 times as many horses with over-all racing indexes of 2.00 or higher as equal numbers of mares representing the average of the breed; 6 times as many with indexes of 4.00 and upward; 12 times as many with indexes of 10.00 and up; and 24 times as many top-class runners, as indicated by indexes above 20.00.

4. Breeding Race Horses.—Few games of chance are as hazardous and expensive as that of breeding race horses. An average-of-the-breed study completed in 1956 and based on North American results showed the following expectancies from 1,000 mares covered in 1945: 520 registered foals of 1946, 387 starters, 270 winners, 45 runners with racing indexes of 2.00 and upwards, 15 at 4.00 and upwards. Since a horse must earn about twice the average to pay his expenses in training, and about four times the average to account for production costs plus expenses in training, it is clear that the gold in the hills of race horse breeding is rather low-grade ore, except for the few studs whose refining methods have led them, by accident or design, to choose the best breeding stock. The rewards of breeding and owning race horses are primarily the intangible satisfactions of a sport. But such is the fascination of pursuing these satisfactions that prices of racing and breeding stock have reached figures which have only the most tenuous connection with fiscal probabilities.

In 1955 executors of the estate of William Woodward, Jr., dispersed the 62 horses of his Belair stud and stable for $2,476,600 in an auction by sealed bids. One of the horses in the racing stable was the three-year-old Nashua, who had won 16 of his 20 races and earned a total of $945,415. There were five bids of more than a million dollars. Nashua went to a syndicate that had offered $1,251,200, and that later reported that it had been offered a still higher price for the colt. When he was retired to the stud at the end of the 1956 season, Nashua had earned a total of $1,288,565, surpassing Citation's record of $1,085,760. Round Table in 1958 became the third winner of more than $1,000,000, topping Nashua with $1,336,364 and a life-time total of $1,749,869. This was surpassed by Kelso, five-time U.S. "Horse of the Year," with $1,893,362 in 1964. Nashua was an exceptional runner, and exceptionally sound, though not necessarily superior to champions that had earned smaller amounts in periods of less extravagant purses, or even to his contemporary the California-bred Swaps, who defeated him in the Kentucky Derby and lost to him in a special race later and whose total winnings were $848,900. Man o'War, who ran in 1919–20, earned only $249,465 in winning 20 of his 21 races.

The other Belair horses brought large profits, totaling $610,000, when they were resold by auction early in 1956. One of these was Nashua's dam, Segula, who went to the Greek shipping magnate Stavros Niarchos for $126,000, the highest price ever paid for a brood mare in the U.S. (The top-class fillies Busher and Honeymoon were still in training when they brought $135,000 each at the Louis B. Mayer dispersal in 1947.) The Woodward estate's five shares in the syndicated stallion Nasrullah, sire of Nashua and other good horses, were sold for $251,000, a figure which indicated an approximate total valuation of $1,700,000 for the 16-year-old stallion. In the yearling auctions at Keeneland race course, Lexington, Ky., colts by Nasrullah brought $80,000, $86,000 and $80,000 in three successive years, 1954, 1955 and 1956. The $86,000 record was broken in 1956 at Saratoga Springs, N.Y., headquarters for the principal yearling sales in the east, when Rise 'n Shine, an English-bred son of Hyperion, was sold for $87,000. The highest priced yearling filly, sold at Keeneland, Ky., in 1956 for $63,000, was Idun, who went unbeaten in 1957, earning $220,955, the largest sum ever accumulated by a two-year-old filly.

IV. OTHER COUNTRIES

1. Continental Europe.—While Great Britain and Ireland are still the principal exporters of bloodstock, the studs of these countries have found it necessary to draw recruits from abroad in such numbers that the British-Irish thoroughbred has become a product of international ancestry. The changing situation is largely due to the strength of competition from continental Europe; this, in turn, probably stems from the fact that racing in Europe adheres more strictly to what may be called the classic pattern than it does in Great Britain, from which the pattern was taken. (*See* also *Great Britain: The Rise of Commercialism*, above.)

Racing has long been established in most of the major countries of Europe and attained new heights of popularity after World War II. The British model for three-year-old classics is followed rather closely, each country having its equivalent of the 2,000 Guineas and the 1,000 Guineas races at a mile (1,600 m.), the Derby and Oaks at $1\frac{1}{2}$ mi. and the St. Leger at about $1\frac{3}{4}$ mi. There is, however, a major difference in that the courses in continental Europe have fewer races for two-year-olds and fewer races at the very short and very long distances. The cumulative effect of generations of selection for the classic distances, with only minor accents on precocity and speed on the one hand and extreme distance on the other, has been to render the British and Irish studs largely dependent upon bloodlines developed from the less diverse standards of continental racing.

France, which has attained a position of eminence in racing and breeding, has a limited program of two-year-old races, climaxed by the 1,600-m. Grand Criterium in October. The Derby and Oaks equivalents were founded in 1836 and 1843 respectively, the Poules d'Essai (Guineas) in 1841 and the Prix Royal Oak (St. Leger) in 1872. Older and richer than any of these is an additional classic, the 3,000-m. Grand Prix de Paris, dating from 1834; it is run at Longchamp at the end of June. Most important of the races for three-year-olds and upward is the 2,400-m. Prix de l'Arc de Triomphe at Longchamp in October, an international test with a larger value than any other race in Europe. French breeding is

under government supervision, and the Société d'Encouragement, roughly equivalent to England's Jockey club, administers the conduct of horse racing.

In Germany and Italy and elsewhere in Europe, racing tends to follow the French pattern, rather than the British. Stallions from France and Italy have exercised such persistent influence that it is the exception to find a British classic winner, especially beyond the one-mile distance of the Guineas, without parents or near ancestors from Europe. Italy has produced so many horses of exceptional merit, such as the unbeaten Nearco, his half brother Niccolo dell'Arca, Donatello II, Tenerani and the unbeaten Ribot, best runner in Europe in 1955–56, that its influence on breeding in Great Britain and elsewhere is far out of proportion to its relatively small annual production. Among the most successful sires in the U.S. after World War II were Nasrullah, a son of the Italian Nearco (himself descended from English, French and American stock); Bull Lea, a son of the French-bred Bull Dog; and Princequillo, by Prince Rose, one of the best horses bred in Belgium.

European racing is under the direction of organizations whose authority is delegated by the government, usually through the ministry of agriculture. The fortunes of the sport have varied with military and economic conditions, but there has been no suppression like that in the U.S. In areas under Soviet domination, the horses, as well as the race courses, are owned by the state, and successful trainers and jockeys are rewarded less liberally than in countries where private enterprise persists. Hungary, one of the nations where Communism has created the anomaly of competition between horses under state ownership, was the birthplace of the phenomenal mare Kincsem, unbeaten in 54 races, and of Kisber, winner of the 1876 English Derby.

2. British Commonwealth.—In countries of the British Commonwealth racing has been sedulously cultivated, rising to the greatest success and importance in Australia, New Zealand, Malaya, India, Canada and South Africa. Canadian turf affairs are so closely connected with those of the U.S. that they are generally considered together. Climatic conditions make Canadian breeding of local importance only; thoroughbreds produced north of the Great Lakes are, however, improving as a result of recent improvements in racing itself. Many of the fixed events of the Canadian meetings are restricted to Canadian breds. Conversely, countries which have long seasons of intense tropical heat, such as India, have found it difficult to maintain thoroughbred production at a high level without making frequent importations of racing and breeding stock from areas of more favourable climate. Meetings were held in India as early as 1795, but it was not until 1857 that the Viceroy's cup was first given, which eventually became the most important fixed event of the Indian racing calendar. (After India attained independence the name was changed to that of the reigning British monarch.) The valuable Eclipse stakes is raced at Bombay.

Among the commonwealth countries, Australia and New Zealand easily stand first, both in the character of their racing and the class of horses they have produced. It is recognized that the breeders of "down under" have turned out animals comparing with the greatest ones of England, France and the U.S., and that to win their classics, cups and handicaps affixes a stamp of international significance. The Melbourne Cup race, run annually at the Flemington course, near that city, distance 2 mi., is among the most famous handicap races in the world; it was established in 1861 and the roll of winners includes the names of many grand performers, headed by that of Carbine, whose feat of carrying 145 lb. to easy victory in 1890 in what was then record time, 3:28¼, stands unequaled in modern turf history as a weight-carrying feat. His intrinsic greatness he further demonstrated by his stud career in both Australia and England. Today his blood appears in the pedigrees of many of the best horses of all racing countries. Carbine was bred in New Zealand, which produced also the great gelding Phar Lap (1926) and numerous other runners which have dominated the turf in Australia. The two great racing centres of Australia are the Flemington course at Melbourne and the Randwick course at Sydney, but there are many other meetings, and Australia ranks second only to the U.S. in the number of races run annually. New Zealand's principal courses are at Auckland in the North Island and Christchurch in the South Island. The New Zealand Derby at Christchurch was established in 1860.

3. South America.—Racing is firmly established in the majority of the greater South American countries, with Argentina the leader and Brazil, Uruguay, Paraguay, Chile, Peru, Ecuador, Colombia and Venezuela all active. The courses at Buenos Aires, Santiago, Rio de Janeiro and São Paulo are among the most luxuriously appointed in the world.

In the matter of breeding Argentina ranks first and Chile second, though many successful studs are maintained in other countries. The "Purple Land" of Argentina is perhaps unexcelled for purposes of race-horse production, and its great stud farms, lavishly equipped, produced many runners which presumably could be ranked with the world's best. Both Argentina and Chile have a considerable export trade in thoroughbreds, of which many good ones have gained distinction in the United States. There is very little exportation of breeding stock from either North or South America to Europe.

In general, racing in South America is under the direction of Jockey clubs, which may have hundreds or even thousands of members but exercise their control through small boards of governors. These bodies have a lesser degree of autonomy than the Jockey club in England; usually they operate within the limits prescribed by, and under the immediate direction of, the national government. Venezuelan racing is administered directly by the government.

V. STEEPLECHASING AND HURDLE RACING

These forms of racing trace their ancestry directly back to the chase and the field of war, where the necessity of clearing the most formidable obstacles was paramount, and horses of great size, strength and agility, as well as speed, were required. In fact, if the history of the steeplechase (of which the hurdle race is a miniature form) is investigated, it will be found almost invariably to have been sponsored in the beginning by cavalry officers and sportsmen avid for the excitement and danger of the hunt. It is therefore natural that in its organized form it still attracts many gentlemen riders, the weights being such as to allow their constant participation; and its administration is usually left to the National Hunt committee in England and to the National Steeplechase and Hunt association in the U.S. Many of the most important fixed events, with valuable and coveted trophies, are run at the various hunt club meetings over cross-country courses of great difficulty.

Steeplechasing reaches its annual apogee in the Grand National, which was first run in 1839 over the Aintree course at Liverpool, and attracts world-wide interest and enthusiasm, in which regard only the Derby at Epsom may be said to exceed it. The honour of winning it has been sought by sportsmen of many different nationalities, not only because of the lasting prestige that goes with a victory, but for the material reward; in value to the winner it has ranged as high as $64,625 (1929), though originally it was almost negligible. The course is of great danger and difficulty, being an irregular triangle in shape, which must be covered twice, making a total run of 4 mi. 856 yd. and calling for 30 jumps. A number of these jumps, such as Becher's and Valentine's Brooks, the water jump, etc., are of tremendous hazard, causing many starters to come to grief during the course of the race. All told, during the 100 years and more of Grand National history, the number of contending horses that have either met their deaths or been permanently crippled is large; the human toll taken from the riders has also been considerable. This, however, seems merely to add to the fascination of the event, both to the participants and the public. Thirty or more horses often go to the post, of which sometimes but a scattering few ever finish, while on one occasion only a single horse completed both rounds without falling.

The Grand National is a handicap, with very high imposts. On three occasions 12 stone 7 lb. (175 lb.) has been carried to victory. While the general belief prevails that only a horse of prodigious strength and stamina and great size can win it, as a matter of

fact it has been won by animals of many different shapes, sizes and types. Its nearest analogue in the U.S. is the American Grand National, run at Belmont park. The only horse that has ever won both events, Mrs. Marion du Pont Scott's Battleship, was a little horse standing but 15.1¾ hands (5 ft. 1¾ in.) and weighing less than 1,000 lb. in racing trim. Nevertheless, he carried 11 stone 6 lb. (160 lb.) at Aintree and defeated a field of 35 in 1938. He was then 11 years old and had won the American event four years before when 7 years old, under 147 lb. Battleship was bred in the United States, a son of Man o' War. Many of the renewals at Aintree have been won by Irish horses, and the belief prevails that the Irish hunting type is the most approved one for cross-country racing. It remains also to be said that many of the most famous Grand National winners have been half-bred, not purely thoroughbred. (J. L. He.; J. A. Es.)

VI. HARNESS RACING

The trend in harness racing in the United States and Canada after World War II was away from the old country fairs, still the more numerous in number, to the arc-light mutuel circuit headlined by the two largest circuits, Yonkers raceway in Yonkers, N.Y., and Roosevelt raceway in Westbury, N.Y., both in the metropolitan New York area.

When the Old Country Trotting association pioneered nighttime light harness racing over a half-mile oval in the fall of 1940 at Westbury, there were but 126,000 fans for the season, who wagered only $1,704,000. The climb in interest and activity was steady after the end of World War II. Early in the second half of the 20th century the national annual attendance at harness races had grown to more than 10,000,000. The mutuel handle was more than $600,000,000.

Annual sales of horses were more than $5,000,000, and the leading sale at Harrisburg, Pa., was more than $2,000,000. L. B. Sheppard's Hanover Shoe farm of Hanover, Pa., paid $500,000 for the 15-year-old bay stallion Adios in 1955 to Delvin Miller of Meadow Lands, Pa.

Not only did attendance and mutuel figures skyrocket on a national basis, but purses tripled in a decade from $7,338,876 immediately after World War II to $21,862,611. The famed three-year-old trot, the Hambletonian, was worth $117,117.98 in 1953.

While Roosevelt raceway and Yonkers raceway combined produced more than 50% of the national attendance and mutuel figures, there was a constant growth in the Maryland and Delaware areas, Detroit, Cleveland, Chicago and the west coast. Even the fairs through the middle west started to swing to night racing.

The Illinois State fair, in Springfield, held a one-week meeting worth almost $500,000 annually. On the night circuit the Messenger stake, William H. Cane stake, the American Classics and the Trans-America series were among the major events. The pacing side of the sport started to outstrip its trotting rivals.

1. The Standardbred Horse.—The American standardbred trotter is descended chiefly from thoroughbred ancestry and, as a breed, closely resembles the thoroughbred in many respects, the differences between the two being, at best, chiefly those of detail. As a recognized breed, while the beginnings date back to post-Revolutionary times, it was with the creation of the *American Trotting Register* in 1871, followed by the erection of the standard government admission thereto in 1879, that its history officially began. (*See* also Horse.) The breed has been disseminated over almost the entire globe, and thousands of its select members have been exported for racing, breeding and other purposes to most European countries, to the antipodes and elsewhere. In England it received little recognition and never gained a foothold, being unable to make headway there against the thoroughbred. However, in such countries as France, Germany, Italy, Belgium, Denmark, Sweden, Austria, Hungary, the U.S.S.R., Australia and New Zealand, the influence of American blood and American training and racing methods became dominant, though marked by diverse national differences.

To Messenger, an English thoroughbred stallion of fame upon the British turf, is given the credit of being the "great father" of the standardbred. He was foaled in 1780, imported in 1788 and died in 1808, leaving a large progeny. While his success as a thoroughbred progenitor was great, it was the remarkable trotting capacity of his descendants that rendered him a monumental figure. This came to a climax in his great-grandson Rysdyk's Hambletonian (1849), a stallion who was thrice inbred to him and who became the patriarch of the modern standard breed, which, indeed, might with equal propriety be termed a Hambletonian breed, so all-pervasive is his blood throughout its entire structure.

2. Records.—The standardbred, in the beginning built up from heterogeneous elements, has evolved into a breed which, like the thoroughbred, is established upon a basis of blood alone, whereas in the beginning it was founded principally upon that of performance. Selective breeding, long continued, has not only purified its blood and refined its physical structure, but has improved its speed until it has attained a rate once considered impossible.

The trotting records marking this progress were as follows (for one mile):

First 2:30 trotter—Lady Suffolk, 2:29½ (1845)
First 2:20 trotter—Flora Temple, 2:19¾ (1859)
First 2:15 trotter—Goldsmith Maid, 2:14 (1874)
First 2:10 trotter—Jay-Eye-See, 2:10 (1884)
First 2:05 trotter—Nancy Hanks, 2:04 (1892)
First 2:00 trotter—Lou Dillon, 1:58½ (1903)

The mile record for trotters, 1:55¼, was made in 1938 by E. J. Baker's Greyhound.

Harness race horses are divided into two classes, trotters and pacers, which ways of going are variants of one original gait; but whether trot or pace was first common to the prehistoric Equidae it is impossible to say. Within the present standardbred there is little difference in ancestry between performers at the two gaits; many animals have made fast records at both, the most notable instance being that of Calumet Evelyn (1:59½ trotting, 1:59¼ pacing), winner of many rich events in each division. The mile record for pacers at mid-20th century stood at 1:55 flat, by Billy Direct in 1938. As will be seen, the extreme rate of speed attained by trotters and pacers is practically the same.

All racing is over prepared dirt and clay tracks, which, to facilitate extreme speed, have a harder surface than those used by running horses. Many tracks are ovals of one mile but the great majority of those in use are a half mile and five-eighths of a mile in length. There is one notable three-quarter mile track at Vernon, N.Y.

The principal mile tracks belong to the Grand Circuit, an organization which was formed in 1873. Half-mile tracks also form part of the Grand Circuit schedule now. All racing is to sulky, a two-wheeled vehicle of the lightest possible construction, weighing about 25 lb., with pneumatic tires. The average driver weighs about 170 lb., though some famous reinsmen have scaled more; thus the gross weight pulled on most occasions is approximately 200 lb. In the early days of trotting in the U.S., racing under saddle was popular, but this has long since been discontinued. However, the champion Greyhound was sent for a saddle record in 1940 and was ridden a mile in 2:01⅜ by Mrs. J. B. Johnson (later Mrs. Fred Van Lennep of Castleton farm), a lady who never before had attempted such a feat. With his professional trainer, the late S. F. Palin, up, Greyhound in 1937 set the record for 1½ miles at 3:02½ and in 1939 that for two miles at 4:06.

Racing to four-wheeled wagon is another form of the sport now discontinued. The record at this hitch was 2:00 minutes flat, first set in 1903 by Lou Dillon and equaled in 1911 by Uhlan. Both were owned and driven by C. K. G. Billings, an amateur, who weighed about 175 lb. and whose wagon weighed 49 lb., making the total weight pulled about 225 lb.

Harness racing in the U.S. and Canadian fair circuit is usually at one-mile heats, best two in three, or with three heats the limit, the horses being placed as they stand at the conclusion of the third. In case of ties the heat winners race off. The mutuel tracks dominantly hold all races as one-mile, single dash events. The administration of the sport is vested in the United States Trotting association, a central governing body, which also owns the *Trotting Register* and publishes it and the annual *Year Book* in which official summaries of all meetings appear. State racing

commissions and the Harness Tracks of America, Inc., embracing the larger mutuel tracks, appeared with the growth of the mutuels and became increasingly active.

3. Futurities.—There are numerous fixtures for two- and three-year-olds of high value, many of them classified as futurities. Older fixtures include the Hambletonian, Little Brown Jug, Kentucky futurity, Fox stake and the Horseman stake. With the evolution of the breed, the production of early and extreme speed became the great goal, and the two-year-old record of 1:58 was set by the pacer Torpid in 1956. The two-year-old trotting mark of 2:00 was made by Titan Hanover in a time trial in 1944 and was equaled in a race by Scott Frost in 1954. Titan Hanover also held the trot mark as a three-year-old, 1:58. The three-year-old pacing mark is held jointly by Tar Heel and Solicitor at 1:57⅗ for one mile, made in 1951; three-year-old Matastar did $1\frac{1}{16}$ mi. on a half-mile track in 2:10½ in 1961. One of the leading breeding grounds is Kentucky; there Greyhound, a gelding, was bred by H. H. Knight, as was the champion mare Rosalind (1:56¾) by B. F. White, her trainer and driver. Billy Direct (1:55), the champion pacer, was a stallion and was bred in Tennessee by H. H. Ridge of Massachusetts. Adios Harry (1:55), who tied Billy Direct's mark in a race at Vernon, N.Y., in 1955, was bred by L. T. Hempt of Harrisburg, Pa. Adios Butler, Del Miller driver, trainer and breeder from Meadowlands farm in Pennsylvania, set the world record at 1:54⅘ in 1960. The champion pacing mare, Her Ladyship (1:56¾), was bred in Indiana by Clair Wolverton, a professional reinsman, as was the world's champion trotting stallion, Star's Pride (1:57⅘), bred by Henry J. Warwick of Westfield.

In extreme speed over fractional distances the harness race horse has attained rates which compare favourably with those of running horses. Billings in 1911 drove Uhlan to a four-wheeled wagon over a half-mile distance in 56¾ sec., and in 1913 his trainer, Charles Tanner, drove him one-quarter mile in 27 seconds flat. Joe O'Brien approached such clockings with Scott Frost in 1955 and again in 1956. Directum I. the pacing stallion, set a half-mile record of 55¾ sec. in 1916 with trainer Thomas W. Murphy.

The blood of Hambletonian has submerged all others in production of the standard type. On the trotting side it is now confined almost exclusively to two direct male lines known as those of Axworthy and Peter the Great. Axworthy traces to Hambletonian's son George Wilkes, and Peter the Great to his son Happy Medium. In the pacing genealogy, the principal male lines are those founded by Abbedale, descended from Hambletonian's son Electioneer, and by Direct, descended from his son Dictator. Individually there is no difference in type between trotters and pacers, as might be expected when their blood is in such large measure identical. The average standardbred stands about 15 to 15¾ hands (5 ft. to 5 ft. 3 in.) tall and weighs in racing trim between 850 and 1,000 lb., being smaller in pattern than the thoroughbred but upon sturdier lines.

Canada has produced few thoroughbreds capable of holding their own with those below the border, but many standardbred stars on both gaits, the trot and the pace, including a two-minute trotter in Lee Hanover and several pacers led by Winnipeg (1:57½), holder of the world record for geldings at that gait. None will forget Dr. Stanton, a two-minute trotter of more recent vintage. (J. L. He.; J. C. Hn.; E. C. Bg.)

VII. TOTALIZATOR

The totalizator, a complex mechanism employing both electrical and mechanical devices, is used on race courses for wagering under the pari-mutuel system. Its major functions are to print and issue tickets acknowledging wagers on various contestants; to summarize the sale of such tickets; and to display to public view the progress of wagering. Its popularity and the popularity of racing itself derive largely from the totalizator's speed and efficiency and from its numerous safeguards against unethical practice.

1. The Pari Mutuel.—The pari-mutuel method of wagering was developed in France by Joseph Oller. The descriptive French term (from *pari*, "bet," and *mutuel*, "mutual") is still in use, though the half-anglicized term mutuel betting is commonly heard in the United States. Oller's first *voitures des Poules* made their appearance at the Hippodrome de La Marche on March 5, 1865. The wagons carried equipment and personnel for selling numbered tickets, assigning the horses by lot and paying, after the race, the players who held the winning number. The pools, equivalent to American "jackpots," were simple lotteries, and later were suppressed by the courts for this reason. Oller at first provided only a larger facility for the popular practice of drawing the names of contestants from a hat and awarding the pool (in the U.S., the "pot") to the person who had drawn the winning horse.

In 1869 Oller instituted the pari-mutuel method, in which the player chose the horse he wished to back, and the payoff to the winners was made from the pool (the sum of wagers on the various runners) after deduction of a commission. The innovation gained quick popularity, since it allowed the player not only to make his own selection but to choose, by rough estimate at least, between long and short odds. The system was declared illegal in 1874, the courts holding that it violated the antilottery act of 1836, but in 1887 it was reinstated in favour. Except for the lottery operated under government direction, it remained as the only legal form of wagering on horse races in France, where—as in New Zealand—it included numerous off-course urban centres for accepting wagers which became a part of the pools at the course.

The pari mutuel was introduced into the United States in the 1870s, but proved less popular than bookmaking, a method imported from England about 1871. Churchill Downs, which also had auction pools and bookmakers, maintained a few machines for mutuel betting from the spring of 1875 until 1889, and revived it in 1908, when it was established by court decision as a legal method of betting on races in Kentucky. Thereafter mutuel betting became the predominant form of wagering on horse races in the United States, though it did not supersede the bookmaker in New York until 1940.

Mutuel betting does not thrive in competition with bookmakers, as was demonstrated by its early history and by the situation in England into the second half of the 20th century, where the books continued to be more popular. (*See* also *Great Britain: Matches and Handicaps*, above.) It had, before the totalizator was developed, two great deficiencies. Tickets were sold by hand, and each sale was recorded on a hand-operated tally machine; since the totals shown on the various "clickers" were not summed up until after the race, the player had no accurate estimate of the odds. Further, the integrity of the system depended upon the integrity of management and of many employees; and however honest the workers in the mutuel department may have been, the public was always free to speculate upon the degree of dishonesty among them. The tote corrected both of these deficiencies, leaving the bookmaker with one major advantage, that he could offer the player a fixed price at any stage in the progress of wagering. In the United States and in most other countries the tote came into favour because of its safeguards against sharp practice and the fact that, with bookmakers excluded, it submitted all wagers to the easy collection of commissions and taxes.

The pari-mutuel system is adapted to many types of wagering, including doubles and triples (combinations of horses in different races) and the involved cumulative bets which have their greatest popularity in South and Central America (*see* also *Double and Quinella Pools*, below); but its most common use is for straight (win), place and (in the United States) show pools. Except in North America, the general practice is to operate straight and place pools. Money in the win pool, after deduction of the stakeholder's fee, is divided among those who backed the winner. In the place pool, after commission has been deducted, the remainder is divided into three equal parts, and each third is divided among backers of the horses which placed (in the United States, showed); that is, which finished first, second or third. This method of calculation makes possible a return less than the amount wagered.

The North American methods are different; there are three pools instead of two, and the calculation is made in such a way that the return on a winning ticket must be greater than the sum wagered, even if the stakeholder must forfeit a part or all of its commission, and possibly more, to pay the winners a stipulated minimum of five or ten cents on the dollar as profit. The straight

pool is for the winner only; the place pool is for the horses which finish first and second; the show pool, corresponding to the place pool of other countries, pays off on the horses which finish third or better. In calculating the place payoff the commission is taken off first; the money bet on the first two horses is subtracted from the pool; the remainder is divided into two equal parts; and each part is distributed among the backers of the first and second horses, plus their original stake. The show pool is calculated in the same manner, except that three horses, instead of two, must be accounted for.

The Two Methods of Calculating Pari-Mutuel Returns

	In U.S. ("Show" pool)	Elsewhere ("Place" pool)
Example		
Total pool	100,000 units	100,000 units
Amount bet on winner	50,000 units	50,000 units
Amount bet on second horse	10,000 units	10,000 units
Amount bet on third horse	5,000 units	5,000 units
Method of calculation		
Total pool	100,000 units	100,000 units
Stakeholder's fee (10%)	10,000 units	10,000 units
Amount returned to public	90,000 units	90,000 units
Amount bet on first three horses	65,000 units	(not considered)
Profit or actual winnings	25,000 units	(not considered)
Amount (of profit) shared by each group	8,333 units	30,000 units
Amount returned per unit wagered on winner	$\frac{8,333}{50,000} + 1 = 1.15$*	$\frac{30,000}{50,000} = .60$†
Amount returned per unit wagered on second horse	$\frac{8,333}{10,000} + 1 = 1.80$*	$\frac{30,000}{10,000} = 3.00$
Amount returned per unit wagered on third horse	$\frac{8,333}{5,000} + 1 = 2.65$*	$\frac{30,000}{5,000} = 6.00$

*Odd pennies above the nearest five cents are called breakage and are retained by the stakeholder. A two-dollar bet would return twice the amount shown.
†This is a loss of .40 units.

2. Totalizators.—A totalizator developed by George Julius was first used at the Ellerslie race course, Auckland, N.Z., in 1913. The electromechanical device was first called the Julius tote, later the Premier tote and, more recently, the Automatic tote. A company organized by Julius provided totalizators for several countries, including the United States, where the so-called American tote superseded it in popularity. The American Totalisator company was organized by Henry L. Straus of Baltimore, Md., with primary assistance from the brothers Charles A. and Gurnee Munn of Palm Beach, Fla. The first engineering development was directed by A. J. Johnston of the General Electric company, who was later assisted by O. C. Levy and H. C. Robinson of the Automatic Electric company. The first American totalizator, built in 1927–28 by Johnston, was taken in 1929 to England, where it was adopted, with modifications, by the Race Course Betting Control board, and was used first at Newmarket in 1930 and later at many other courses. This tote, based on automatic telephone equipment, had a minimum of mechanical parts.

The ticket-vending machines most widely used in the U.S. and Great Britain were developed in England by the Bell Punch and Printing company of Uxbridge. The simplest of various types of such machines is a hand-operated box which ejects preprinted tickets by means of a lever or slide. Most modern totes use a complicated device which prints and issues a ticket in the same operation. When the better has given the program number of the entry he wishes to back, the vendor presses the corresponding key. Electrical impulses record the wager in the appropriate adding machine for the contestant and in the grand-total machine for the pool. The machines record the wager simultaneously and return an acknowledging impulse which sets the rotary press in motion. The press prints the mutuel ticket from a roll of specially designed laminated paper, cuts the ticket from the roll, ejects it from the machine and returns to a neutral position. The machines are capable of issuing from 40 to 55 tickets per minute.

The American tote uses a mechanical counter from which each vending machine produces a printed record of its sales. This device provides the only method for a complete audit of the tote operation and for checking against the possibility of error in the various money totals. Another type of vending machine is capable of issuing tickets in more than one pool and in more than one denomination from the same unit. In some situations they are more convenient than the one-pool, one-denomination machines, but they are slower in operation and have no mechanical counters to provide data for a complete audit. They were not generally adopted in the United States.

All vending machines are electrically locked by a designated official to render impossible any sale of tickets after a race has begun. They remain locked until precautions have been taken to ensure that they can issue tickets only for the next race. So many protective devices are in use that counterfeiting of winning tickets has been rendered virtually impossible.

The adding machines in general use fall into two categories: (1) the electromechanical and (2) the electrical. The first makes use of a motor-driven collecting or accumulating device which actuates an electrically operated escapement mechanism, usually driven through slipping belts. As wagers are received, the locking gears are disengaged, and the driven shaft is permitted to turn a distance calibrated to correspond to the value of the wager (for example, 2° for a $2.00 bet and 10° for a $10.00 bet). The turning shaft either actuates a self-synchronous motor which keeps a similar motor operating the indicator board in step or actuates indicator drums by direct gearing or by means of chains and sprockets.

This is the method used by the machines operating in most countries. In the U.S. and, to a large extent, in England, the electrical totalizator is used.

The electrical totalizator operates on an entirely different principle. Wagers are collected by means of either a multiple bank rotary switch or by a relay chain. As bets are collected, betting relays are actuated which correspond to the value of the wagers. These relays step appropriate rotary switches, in the units, tens, hundreds and thousands positions, etc. Each position of these switches energizes a combination of indicator relays which cause illuminated numerals to appear on the display boards.

In both systems, the problem is complicated by the necessity of maintaining not only great speed and accuracy, but of obtaining instantaneous alarms if a bet fails to get through. This alarm system must indicate both the source and the cause of trouble.

3. Tote Boards.—Totalizator indicator boards display either the number of units or the amount of money wagered on each contestant in each pool and the total for each pool.

In some cases the approximate odds are given for the win pool, instead of the amount wagered on each entry, but more usually both the amounts and the approximate odds are shown. The American tote uses an electric analogue computer for automatic calculation of the odds. In the place pool (place and show pools in the U.S.) only the amounts are shown; it is impossible to estimate the odds, since the payoff on any one horse will vary in accordance with the amount wagered on the other horse or horses whose backers are to share in a division of the pool. The tote boards display results of races, payoff prices, running time of the race, time of day, post time for the next race, a signal to indicate an inquiry by the stewards, and other information.

Early types of indicator boards were built on the cyclometer principle, using large drums driven by gears or by chains and sprockets. The mechanism was cumbersome, and the drums were so heavy that they were difficult to start and difficult to stop at the proper point. A more ingenious device was of the "flapper" type, with the top half of the numerals painted on a nest of flat plates and the bottom half on a similar nest of plates which flipped into position in sequence as the actuating shafts rotated. A third method used a vertical ribbon against a calibrated background on which the odds could be read as on a thermometer.

None of these devices approached, in speed or readability, the modern indicators consisting of nests of incandescent lamps, 24 lamps to the unit, combinations of which may display any numeral from 0 to 9. In the section showing approximate odds two nests of lights are placed opposite each betting entry, so that odds up to 99 to 1 may be indicated, but not 100 to 1. The only moving units are small telephone-type relays. Changes in indication are made automatically at extremely high speed, since there is no inertia and no necessity for running through a sequence before

coming upon the correct digit. Indicator boards with such equipment may be placed anywhere, without reference to the distance from other units of the tote.

4. Double and Quinella Pools.—The totalizator operation includes wagering in the double and quinella, or quiniela, pools. In the daily double, as it is called in the U.S., the better attempts to select the winners of two races. In the quinella the payoff is made on tickets picking the horses which finish first and second in a given race, without reference to the order of their finish. These wagers require special vending machines, and the pools, of course, are separate from those of other types of betting. The vending machines most commonly used in North America for the double and the quinella have mechanical counters which register separate totals for each combination. Each machine, at the close of betting, produces a printed record of the wagering, and from the total and subtotals thus made available, the payoff price for the winning combination is computed. In another type of vending machine the wagers on each combination are summed automatically in the same manner as in straight, place and show betting.

See also GAMBLING. (J. A. Es.)

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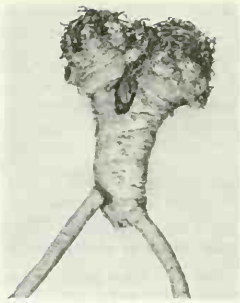
HORSE-RADISH (*Armoracia rusticana*, *A. lapathifolia* or *Radicula* [*Rorippa*] *armoracia*), a hardy perennial plant of the mustard family (Cruciferae), grown for its fleshy pungent root, which is used mainly as a condiment or table relish to promote appetite but earlier occasionally was used in medicine. Horse-radish, native to Mediterranean lands, is grown generally over the temperate zones, and in many cool, moist areas it has become a troublesome weed. Large, coarse, glossy green basal leaves arise from the crown atop the large white root; petioles are long; blades are up to 1 ft. long and 4 to 6 in. wide, generally with wavy or crenate margins; leaves of the flower stalk are smaller, not petioled, and oblong or lance-shaped. Small white flowers are borne in terminal or axillary racemes; pods are small, oblong and tipped by a short, persistent style; seeds are rarely borne under field conditions.



WALTER SINGER

HORSE-RADISH ROOT

Processors of horse-radish desire roots that are large, free of crown or root branches and free of woodiness due to age. For producing such roots, deep rich moist soil free of stones and trash is essential. Horse-radish is usually propagated in the spring by planting pieces of pencil-sized roots about 2 ft. apart in rows about 2½ ft. apart. They are planted at a slight angle with the upper ends covered about one-half inch deep. All but the terminal shoot should be removed to prevent later formation of multiple crowns; the side roots are also rubbed off to minimize formation of crooked and branched roots. This is done by hand, removing the soil from the upper part of the root piece, rubbing off excess shoots and roots, then replacing the soil. The procedure is repeated after 6 weeks.

Roots should be harvested after only one growing season. They are plowed from the soil and washed and trimmed for sale. The root tissue is grated and packed in white or distilled vinegar in glass containers; cider vinegar causes undesirable darkening of the product. (V. R. B.)

WALTER SINGER

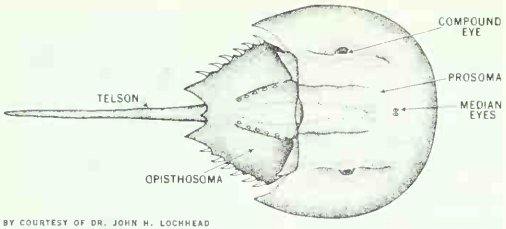
HORSE-RADISH (ARMORACIA RUSTICANA)

HORSESHOE CRAB, a name applied to large, marine arthropods of the order Xiphosura in the class Merostomata, found today only on the east coasts of Asia and North America. Other names less commonly used are king crab (*q.v.*) and swordtail crab. Despite these names the animals are not crabs at all but have their closest living relatives among the scorpions, spiders and other members of the class Arachnida. Females grow to a size about 25% larger than males. *Limulus,* which occurs from Maine to Yucatán, reaches its largest size near the centre of this range, where females may attain a length of more than two feet. The animals are most abundant in estuarine waters, in winter at depths up to more than 65 ft., in summer often on intertidal mudflats.

Importance.—Xiphosurans are of peculiar interest to zoologists in a number of ways. (1) They are of extremely ancient origin, and so are often spoken of as "living fossils." (2) Many strange features are found in their anatomy. (3) A quite remarkable tenacity of life is possessed by the eggs, larvae, adults and individual organs. This last characteristic has endeared these animals to physiologists, whose work on xiphosurans, particularly on the eyes and heart, has yielded results of classical importance. Commercially, xiphosurans have served as food to some peoples, are converted into fertilizer in New Jersey and are sometimes among the most serious enemies of the soft-shelled clam.

Geological History.—Fossil representatives of the Xiphosura are recognized from as far back as the Silurian period (beginning about 350,000,000 years ago). Forms closely like those of today date back to the Jurassic, long before the origin of mammals. Present genera include two in Asia and one in America. Best known is the single American species, *Limulus* (formerly *Xiphosura*) *polyphemus;* the Asian species resemble it closely in both structure and habits.

Structure and Function.—The body of a xiphosuran is di-



BY COURTESY OF DR. JOHN H. LOCHHEAD

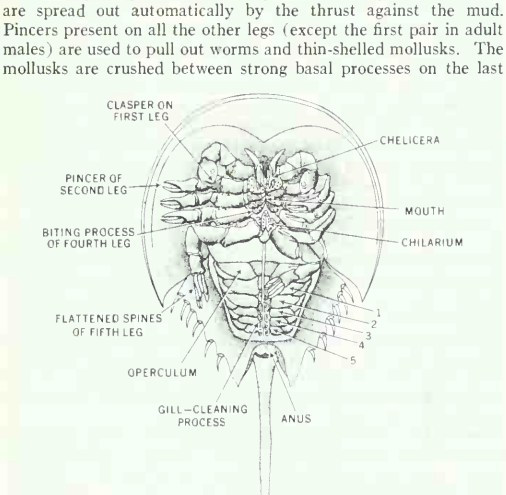
FIG. 1.—HORSESHOE CRAB (LIMULUS), DORSAL VIEW. POSITION OF THE HEART SHOWN BY DOTTED LINES

vided into three parts: a broad, low prosoma, a much smaller opisthosoma and a long, sharp tail-spine or telson; these parts are hinged together. On the smoothly arched upper surface of the prosoma are a pair of compound eyes and a much smaller median pair of eyes.

The under surface of the prosoma is concave, thus the five pairs of legs are completely hidden from above. Of these legs the first pair corresponds to the pedipalps of scorpions. A pair of small chelicerae, also like those of scorpions, is present just in front of the legs. Behind the bases of the last legs is a pair of reduced appendages called chilaria. From the opisthosoma hang six flaplike structures, which probably are modified appendages. The first flap serves as an operculum, covering the other five. On the posterior surface of each of these latter is a pair of gills, each gill consisting of a stack of thin plates, like the leaves of a book. The gills are ventilated by rhythmic beating of the flaps. The mouth lies in the centre of the area surrounded by the legs. The anus is at the base of the telson.

All surfaces of the animal are covered by a leathery brown cuticle, composed of about 25% chitin and about 75% of a protein resembling the keratin of mammalian claws and hair. Internally are a number of skeletal structures, some with a structure and chemistry much like vertebrate cartilage.

Sometimes xiphosurans swim, back down, by vigorous rhythmic beating of the opisthosomal flaps. But usually they plow through the mud, arching the body, and then pushing with the telson and the last legs. Special flattened spines at the tips of these legs are spread out automatically by the thrust against the mud. Pincers present on all the other legs (except the first pair in adult males) are used to pull out worms and thin-shelled mollusks. The mollusks are crushed between strong basal processes on the last pair of legs. On the bases of the other legs are spiny biting processes that separate the food fragments and roll them into the mouth. Internally, further grinding occurs in a gizzard. An extensive hepatopancreas secretes digestive enzymes into a long stomach-intestine. Absorption of digested food occurs probably here and especially in the hepatopancreas.



FROM THE "JOURNAL OF MORPHOLOGY"

FIG. 2.—ADULT MALE LIMULUS, VENTRAL VIEW. 1–5, GILL-BEARING OPISTHOSOMAL FLAPS

Blood is circulated to all parts of the body in a highly developed vascular system. A long dorsal heart pumps the blood into arteries, from which it passes through open tissue spaces (sinuses) into a system of veins. Before returning to the heart the blood passes through the gills. A bluish respiratory pigment called hemocyanin occurs in the blood, but is of questionable importance. The principal organs for excretion seem to be a pair of long coxal glands in the prosoma, opening just behind the bases of the fourth legs.

In the nervous system the chief ganglia are fused into a ring around the esophagus, and a surprising feature is the enclosure of this ring and of all the larger nerves within arteries.

The gonads of both sexes branch profusely through much of the body, between lobes of the hepatopancreas. The paired reproductive ducts open on the posterior surface of the operculum.

Reproduction and Life Cycle.—Spawning takes place on sandy beaches in spring and summer, usually after sunset and perhaps most often during high spring tides. Each female is accompanied by one or more males, at least the first one holding firmly by his claspers to the posterior edges of her prosoma. The females scoop out a series of hollows in the sand, and lay 200–300 eggs in each, while the males cover these eggs with sperm. Usually the nests are just below high water mark, but north of Cape Cod they tend to be placed lower on the beach, perhaps because the tides there are more extensive.

After several weeks so-called trilobite larvae hatch from the eggs. These larvae, about five millimetres long, have no tail-spine and live off a store of yolk. They are succeeded by the second stage larvae, which have a short tail-spine and which feed on small organisms in the mudflats, where they may overwinter. Third stage animals have longer tail-spines and look like miniature adults. At each molt, escape from the old cuticle is through a slit round the margin of the prosoma. Growth in length immediately after each molt averages about 25%. It is thought that sexual maturity is reached after about 16 molts, at an age of 9–12 years. The mature adults often become covered with a variety of encrusting organisms.

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HORSESHOE PITCHING. The origin of horseshoe pitching, as well as that of quoits from which it probably derived, is uncertain in place and date. Legend ascribes the origin of both games to the early centuries of the Christian era when the games were played by soldiers in their camps. Both games involve the attempt to throw an object, usually iron or steel, so as to encircle a stake, or hob (as it is called in quoits), or to get the object as close to the stake as possible. The throwing object in quoits is a ring, usually metal, though in deck quoits played on shipboard the quoit is made of rope; in the 20th century rubber quoits sometimes replaced metal ones as a safety measure, the striking of the metal quoit on the metal hob occasionally striking off shards dangerous to the eyes. A miniature quoit game was once a favourite in English public houses. In Canada and Scotland quoits is often the summer game of curling clubs.

Horseshoe pitching is usually played by two or four players. When two play, they pitch from one pitching box, 6 ft. square, in the centre of which is an iron or steel stake 1 in. in diameter extending 14 in. from the surface and inclined 3 in. toward the opposite stake 40 ft. away (30 ft. for women and juniors). After both players have pitched two shoes each (an inning), they walk

to the opposite box and pitch from it. When four play, each pair of partners pitches from opposite boxes. Singles are played to a winning score of 50, doubles to 21. After all shoes have been pitched in an inning, scoring is as follows: one point for each shoe closer than an opponent's if the shoe is six inches or closer to the stake; three points for each ringer (shoe enclosing the stake); four points for ringer and closest shoe. If shoes are equally distant or if opponents have the same number of ringers, these are considered ties and no points are scored. A leaning shoe has no value over one touching the stake. Horseshoes designed for pitching weigh $2\frac{1}{2}$ lb., are $7\frac{5}{8}$ in. long, 7 in. wide at the greatest width, with a $3\frac{1}{2}$ in. space between the calks, as the small toes at each open end are called.

The National Horseshoe Pitchers association was incorporated and became the governing body of the sport in the United States in 1921. World championship tournaments are held annually, 36 contestants engaging in round-robin play so that each plays all the others. Outstanding pitchers have been Ted Allen and Fernando Isais; the former holds the record (72) for consecutive ringers in tournament play. (E. O. Br.)

The game of *jukskei*, indigenous to South Africa, resembles horseshoes. The object of the game is for players to gain points by knocking over the pin (3 points) or by tossing their *skeis* closer to the pin than those of their opponents (1 point each); to win, a team must score exactly 23 points (if a team scores more than 23 it forfeits its points and begins at zero again). The Kroonstad *jukskei* field is the site of the annual All South Africa *jukskei* championship tournaments.

HORSETAIL, common name for plants of the genus *Equisetum*, the only living genus of a unique subdivision of vascular plants, the Sphenopsida, which flourished in former geologic times.

ROCHE

CONE-SHAPED REPRODUCTIVE AND BRANCHED VEGETATIVE SHOOTS OF EQUISETUM ARVENSE, A HORSETAIL COMMON IN NORTH AMERICA

Members of this subdivision, fossil and living, characteristically have whorled leaves and, in some species, branches. When branches do occur, they develop in alternating radii with the leaves. This arrangement is known in no other group of living plants for elsewhere buds tend to occur in the axils of leaves.

The jointed, slender, herbaceous stems of *Equisetum* have hollow internodes. Superficially, the internodes are ridged and grooved. In living species (*E. arvense, E. telmateia,* etc.) the whorled leaves are arranged in a toothed sheath but are without chlorophyll; photosynthesis is accomplished in the green stems. The fossil forebears of the horsetails (*Calamites,* etc.) apparently were sizable trees with larger leaves, probably photosynthetic, which, at least in some forms, were separate from one another and not arranged in a sheath.

In reproduction, some horsetails have terminal, conelike strobili on aerial branches which later become vegetative. Other species, however, have separate, upright, aerial branches for vegetative and for reproductive shoots. In the latter, the strobilaceous branches appear first and, after the spores are shed, the green, vegetative shoots develop. Fertile appendages are whorled; each consists of a stalk bearing a flattened disk at its apex on the inner side of which is found a cycle of sporangia, each opening and shedding spores by a longitudinal slit on its inner side. The carboniferous, treelike horsetails and their sphenopsid allies are believed to have possessed the most elaborate reproductive strobili known among the vascular plants.

The spores, under low light intensity, grow to green, branched, small bisexual prothallia. The outer spore wall regularly breaks into four bands, which are hygroscopic and so coil and uncoil with moisture changes. Entangled by bands the spores, and the prothallia they grow into, are frequently shed in clusters.

This genus is comprised of about 27 living species, found on all continents. In the United States 13 species are described; of these 8 species are known in the eastern states and eastern Canada and 11 species in the west coast states and in adjacent Canada. Nine species are known in Great Britain. Generally horsetails are 30 in. or less in height. In the tropics, however, taller species are known. Accounts are given of specimens of *Equisetum giganteum* of the American tropics which attain heights of 10 to 12 yd. but which have a diameter of less than an inch. By contrast, a Mexican species two yards in height may have a diameter of up to four inches.

The horsetails have had little economic importance. At times, they have been used for scouring dishes and utensils of diverse kinds; their cleaning value is attributed to the silica in the walls of the epidermal cells. Undoubtedly the scouring rushes, as certain species were known, were beneficial in removing tarnish and dust from metallic surfaces, but the silica must have been equally hard on the metal itself. *See* also Fern; Paleobotany; Plants and Plant Science. (R. H. We.)

HORSHAM, a market town and urban district of West Sussex, Eng., lies 38 mi. S.W. of London by road. Pop. (1961) 21,155. The earliest authentic references to the town occur in the early 13th century. From 1295 to 1832 Horsham returned two members to parliament as a parliamentary borough but there is no record of any charter of incorporation. The parish church of St. Mary is mainly Early English and Perpendicular with remains of Norman work and a lofty spire. There are houses dating from the 15th century and there is a local museum. The grammar school for boys founded in 1532 was rebuilt in 1893. Christ's Hospital school for boys (the Blue Coat school), founded in 1556 in the City of London, was moved from its original home in Newgate street to Horsham in 1902; the boys (approximately 800) still wear the traditional costume of long blue coat, breeches and yellow stockings. Horsham provides the main shopping centre for a radius of about 15 mi. but otherwise the principal industries are those connected with agriculture. Prior to the Industrial Revolution it was a centre for iron smelting. There are a number of brickfields in the vicinity. (S. A. St.)

HORSLEY, JOHN (*c.* 1685–1732), British antiquary, who devoted his life to the study of Roman Britain. He was born either in Northumberland or Midlothian in 1684 or 1685 and was educated at Newcastle upon Tyne grammar school; he earned his M.A. at Edinburgh university in 1701. By 1709 he was Presbyterian minister at Morpeth, Northumberland, where he opened a school.

An amateur scientist, Horsley lectured on mechanics and hydrostatics. It was, however, probably as an archaeologist that he was elected a fellow of the Royal society, April 23, 1730. Horsley's celebrated and valuable book, *Britannia Romana: or the Roman Antiquities of Britain,* published posthumously in 1732, set a standard in scholarship and field work long unsurpassed. A copy in the British museum is annotated by John Ward (*c.* 1679–1758). Horsley died at Morpeth on Jan. 12, 1732. (J. M. Wi.)

HORSLEY, SAMUEL (1733–1806), English theologian, mathematician and bishop, famous for a celebrated controversy with Joseph Priestley (1783) in which he defended the doctrine of the Trinity and of the divinity of Christ. Horsley was born in London, Sept. 15, 1733. Entering Trinity hall, Cambridge, he became bachelor of laws in 1758 and in 1759 succeeded his father as rector of Newington Butts, Surrey. He was elected a member of the Royal society in 1767 and secretary in 1773. He also edited Newton's works (1779–85). Horsley became bishop of St. David's in 1788, was translated to Rochester in 1793 and to St. Asaph in 1802. He died on Oct. 4, 1806. He was energetic both in his diocese and in parliament, using his influence for tolerance toward all religious dissent. In 1793 he preached before the house of lords on the dangers of the revolutionary spirit and in 1801 was one of the few to oppose the peace of Amiens.

See H. Horsley Jebb, *A Great Bishop of One Hundred Years Ago* (1909). (G. Hu.)

HORSLEY, SIR VICTOR ALEXANDER HADEN (1857–1916), English surgeon and physiologist, who conducted important early work in neurological and experimental surgery, was born at Kensington, London, on April 14, 1857. He studied medicine at University college, London, and qualified in 1880. In 1884 he was appointed superintendent of the Brown institution, London university, and in the following year assistant surgeon at University College hospital. These posts provided ample scope for his early researches on the role of the thyroid gland in the causation of myxedema and cretinism, on epilepsy, on rabies, on the pituitary body and on the localization of function in the brain. He also carried out self-experiments in connection with various methods of anesthesia. In 1886 he became surgeon to the National hospital, Queen square, London, and was also secretary to the commission appointed to report on Pasteur's preventive treatment against rabies. In the following year he was appointed professor of pathology at University college. His work on cerebral localization had familiarized him with brain surgery, and after his appointment to Queen square he became famous for his pioneer work in neurosurgery. Before the end of 1886 he had done ten brain operations at Queen square, most of them successful. On June 9, 1887, he successfully carried out the first operation ever performed for removal of a tumour of the spinal cord. He was elected a fellow of the Royal Society in 1886 and was knighted in 1902. During World War I he served in France, Egypt and Mesopotamia. He died at Amarah (Iraq), on July 16, 1916.

See Stephen Paget, *Sir Victor Horsley: a Study of His Life and Writings* (1919). (W. J. Bp.)

HORST, the term used in geomorphology for a block of the earth's crust that has remained stationary while the land has sunk on either side of it, for example, the Vosges mountain range in Germany. The word is also applied in a more general sense to those larger areas, such as the Deccan of India, where the continent remains stable, with horizontal beds forming a tableland, in distinction to a folded region such as the Himalaya mountains.

HORT, FENTON JOHN ANTHONY (1828–1892), British biblical scholar, editor, with B. F. Westcott (*q.v.*), of a celebrated critical edition of the Greek New Testament, was born in Dublin, Ire., on April 23, 1828, and was educated at Rugby school and at Trinity college, Cambridge, where he was the contemporary of E. W. Benson, Westcott and J. B. Lightfoot. The four men became lifelong friends and fellow workers. In 1854, in conjunction with J. E. B. Mayor and Lightfoot, Hort established the *Journal of Classical and Sacred Philology* and plunged into theological and patristic study. In 1857 he married and accepted the college living of St. Ippolyts, near Hitchin, Hertfordshire, where he remained for 15 years. In 1870 he was appointed a member of the committee for revising the translation of the New Testament.

In 1872 Hort became fellow and lecturer at Emmanuel college, Cambridge, and in 1887 Lady Margaret reader in divinity. In the meantime (1881) he had published, with Westcott, the reconstructed Greek text of the New Testament. The revision committee had very largely accepted this text, even before its publication, as a basis for its translation of the New Testament. Hort died on Nov. 30, 1892.

Among other important writings are *Judaistic Christianity* (1894) and *The Christian Ecclesia* (1897), both published posthumously.

See his *Life and Letters,* ed. by his son A. F. Hort, 2 vol. (1896); W. Sanday, in *American Journal of Theology,* vol. i, pp. 95–117 (1897).

HORTA, VICTOR, Baron (1861–1947), Belgian architect, was born at Ghent on Jan. 6, 1861, the son of a cobbler. With Henry van de Velde and Paul Hankar, Horta ranks among the pioneers of modern Belgian architecture and is an outstanding architect of the European *art nouveau* style. Trained at the Académie des Beaux-Arts in Brussels, 1876–81, he became a pupil of Alphonse Balat and after the latter's death in 1895 became professor of the academy. Three houses in Ghent (1885), in unornamented, neo-Renaissance style, mark the beginning of his career. His first independent building (1892–93), 6 Rue Paul Émile Janson, Brussels, was a four-storied, narrow-fronted house with a stone and cast-iron façade. It is the first continental example of the *art nouveau,* although incorporating neo-Gothic and neorococo styles. Other buildings in Brussels in his rich, elegant style are 2 Avenue Palmerston and Hotel Winssingers (both 1895–96) and his own house in Rue Américaine (1898). His chief work is the Maison du Peuple, Brussels (1896–99), an important building in the history of modern architecture and the first in Belgium with a largely iron and glass façade. After 1900 Horta simplified his style; in 1913 he became director of the academy and designed the Palais des Beaux-Arts (1913–27), in a simple and severe classical style; his last big undertaking was the central railway station in Brussels, begun just before World War II. He died in Brussels on Sept. 8, 1947.

See A. Courtens, "Victor Horta," *Le Document* (1946–47); S. Tschudi Madsen, "Works and Style of Victor Horta Before 1900," *Architectural Review* (1955); Robert L. Belevoy, "Victor Horta," *Belgische Kunstmonografieën* (1958). (S. T. M.)

HORTENSE (Hortense de Beauharnais) (1783–1837), queen of Holland from 1806 to 1810 and mother of Napoleon III, was born in Paris on April 10, 1783, the daughter of the future empress Josephine and her first husband Alexandre de Beauharnais. Her mother's marriage to Napoleon Bonaparte (1796) brought Hortense under the latter's protection, and in Jan. 1802 he married her to his brother Louis. When Louis was proclaimed king of Holland (June 1806), Hortense went to The Hague with him and their two sons, Napoleon Louis Charles (1802–07) and Louis Napoleon (1804–31). A third son, the future emperor Napoleon III, was born in 1808.

Hortense's marriage was unhappy, and this gave rise to bad feeling between Louis and Napoleon, as Napoleon thought that Louis was chiefly to blame. Yet, though both Hortense and Louis wanted a divorce, Napoleon would not allow it and only allowed them to separate in 1810, when Holland was annexed to the French empire. Returning to France, Hortense in 1811 gave birth to a son by her lover, the comte de Flahaut; this son, who was adopted by a relative, was the future duc de Morny.

At the first Restoration of the Bourbons, her husband's countship of St. Leu was raised to the rank of duchy for Hortense (May 1814), though Louis refused to accept this title. However, her fervent support of Napoleon during the Hundred Days led the government of the second Restoration to banish her (July 1815). She spent several months in Baden and in Rome and in 1817 bought the chateau of Arenenberg in Thurgau, Switz., where she was to spend most of the rest of her life. She died on Oct. 5, 1837.

Hortense wrote several songs, including the famous "Partant pour la Syrie." The editing of her memoirs, begun by Prince Napoleon Victor Jérôme, was completed by J. Hanoteau, *Les Mémoires de la Reine Hortense,* 3 vol. (1927; Eng. trans., 2 vol., 1927).

HORTENSIA, the daughter of the Roman advocate and orator Quintus Hortensius (*q.v.*), known only for the speech she made against the taxation of women without representation, related by Appian (*Civil Wars,* iv, 32–34). In 43 B.C. the triumvirate of Antony, Octavian (later the emperor Augustus) and Lepidus, in great need of funds to carry on the war against Brutus and Cassius, proposed to raise money by taxing the property of 1,400 rich women. The women first applied for help to Octavia, sister of Octavian, and to the mother of Antony and were not repulsed, but Fulvia, Antony's wife, drove them away with insults. Thereupon they proceeded to the forum, and Hortensia spoke for the group before the triumvirs, rebuking them for having deprived the women of fathers, sons, husbands and brothers and for their present proposal to seize their property. She asked why, when the women had no part in the government or in the conduct of the war, they should be taxed for what the men had done, and declared that the women would help resist a foreign enemy but that they would never contribute their wealth for civil wars. The speech angered the triumvirs, but they reduced the number of women liable to the tax from 1,400 to 400 and imposed a similar tax on the men.

HORTENSIUS, QUINTUS, dictator of Rome in 287 B.C. When the plebeians, pressed by their patrician creditors, "seceded" to the Janiculan hill, Hortensius was commissioned to put an end to the strife. He passed a law (*Lex Hortensia*) whereby the resolutions of the plebs (*plebiscita*) were made binding on all the citizens without the approval of the senate being necessary. He is said to have died while still dictator.

HORTENSIUS, QUINTUS (surnamed HORTALUS) (114–50 B.C.), Roman orator, delivered his first forensic speech at the age of 19, and enjoyed a distinguished career as advocate for 45 years. He was leader of the bar until, defending Verres in 70 B.C., he clashed with Cicero, to whom thenceforth he yielded the supremacy. He was a spokesman for the senatorial party. Passing through the *cursus honorum*, he became consul in 69. He and Cicero later collaborated harmoniously in a number of trials.

The speeches of Hortensius were published, but virtually no fragments remain; the subjects of 28 of them are known. His oratory was of the "Asianic" style, florid and exuberant, combining passion and elegance. He possessed an exceptional memory, and a capacity for organization, felicitous composition and rich and graceful diction. He produced the greatest impression through his delivery: his voice was musical, his action studied and theatrical—indeed actors imitated his gestures—and he devoted excessive care even to his dress (Cicero, *Brutus*, 303, 317; Gellius, i, 5, 2; Macrobius, *Saturnalia*, iii, 13, 4; Valerius Maximus, viii, 10, 2). The speeches were more charming to hear than to read (Cicero, *Orator*, xxxviii, 132; Quintilian, *Institutio oratoria*, xi, 3, 8).

Hortensius wrote *Annales*, an epic on the Social War (War with Italian Allies, 90–88 B.C.); a rhetorical treatise dealing with *loci communes;* and erotic verses, deemed ungraceful (Gellius, xix, 9, 7) and wanton (Ovid, *Tristia*, ii, 441). Cicero assigned him a role in the first edition of the *Academica*, and in the lost dialogue *Hortensius*, in which Hortensius attacked philosophy. To him Catullus sent poem lxvi, the rendering of Callimachus' *Lock of Berenice*.

Hortensius was very wealthy and noted for the luxury of his houses and table. (HY. CN.)

HORTHY DE NAGYBÁNYA, MIKLÓS (1868–1957), Austro-Hungarian naval officer and regent of Hungary from 1920 to 1944, was born at Kenderes, eastern Hungary, on June 18, 1868, of a Calvinist family of the middle nobility. He entered the Austro-Hungarian naval academy at the age of 14 and served in various commands at sea, besides holding several shore appointments. From 1909 to 1914 he was naval aide-de-camp to the king-emperor Francis Joseph. In World War I he distinguished himself as an able and daring naval commander; he several times broke through the Allied blockade of the Adriatic. On May 14, 1917, he was severely wounded while commanding a squadron of three cruisers in the Strait of Otranto. He was promoted admiral and, in Jan. 1918, commander in chief of the Austro-Hungarian navy. On him, therefore, devolved the task of handing over the fleet to the Yugoslav National council (Oct. 31, 1918).

Horthy then returned to Kenderes and in May 1919 was requested by the counterrevolutionary Hungarian government at Szeged to organize a national army to fight the Communist regime installed in Budapest. As the French military authorities refused to let his force move from Szeged, Horthy could do little until the Rumanians, who had occupied Budapest when Béla Kun fled, had been induced to retire. Horthy led his troops into the capital on Nov. 16, 1919, after promising to allow the formation of a coalition government, which should then hold free elections. The parliament elected in Jan. 1920 declared on March 1 the monarchy, which had been abolished by Mihály Károlyi (*q.v.*), to be restored and elected Horthy to the ancient Hungarian dignity of regent, pending clarification of the position of the throne.

Horthy's attitude during the preceding months had been criticized: he was accused of tolerating the "white terror," to which he was, however, probably rather blind than privy. Acute controversy soon after centred on his attitude to King Charles's two attempts to recover his throne (in March and in Oct. 1921), when he carried through, with what seemed to be little reluctance, his unescapable task of preventing the king from reassuming his powers. From 1921 to 1931 he intervened little in public affairs, the conduct of which he left to Count István Bethlen, but in the troubled 1930s he found himself driven by the situation increasingly to assume control of affairs. As a considerable extension of his powers voted unanimously by parliament in 1937 showed, this was widely welcomed. By this time conservatism had overlaid in Horthy any earlier tendencies toward extremism and he had become a moderating factor in internal politics, while his conviction of the invincibility of sea power made him reluctant to see Hungary involved in war with the west. It was only over the "crusade against Bolshevism" that he sympathized with Adolf Hitler, whom he disliked and against whom he robustly defended the independence and traditional institutions of Hungary. His attempt to extricate Hungary from the war (*see* HUNGARY: *History*) led to his forced abdication (Oct. 16, 1944) and abduction into Germany. He was released in the Tirol by U.S. troops on May 4, 1945, and later allowed to go to Estoril, Port., where he died on Feb. 9, 1957.

By Magda Purgly, whom he had married on July 22, 1901, Horthy had two sons and two daughters. Both daughters died in early womanhood, and his elder son, István, who shortly before had been elected deputy regent, perished in an aircraft accident on the Soviet front on Aug. 20, 1942. Horthy's *Memoirs* (1956) were written without much documentation.

See O. Rutter, *Regent of Hungary* (1939), an authorized biography; C. A. Macartney, *October 15th: a History of Modern Hungary, 1929–1945* (1957). (C. A. M.)

HORTICULTURE, the division of agriculture which relates to the cultivation of fruits, vegetables and ornamental plants, is both an art and a science. It is an art in that through practice certain skills are developed in necessary operations, such as propagation, pruning and spraying, which are essential to successful culture. It is a science in that underlying these practices is an orderly array of fundamental facts which explain and direct their performance. "Horticulture" originally meant the culture of a garden or enclosure, in contrast with "agriculture," meaning the cultivation of a field.

This article is divided into the following sections:

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I. INTRODUCTION

The association of horticulture with intensive culture of plants in small areas is a popular conception; yet some phases of horticulture have developed into industries which occupy important economic positions in the field of agriculture.

There are no hard and fast rules that determine when a crop or an operation is horticultural. The type of culture, the general custom and the purpose for which a crop is grown are determining factors. Sweet corn, cabbage and potatoes are, for example, generally classed as horticultural crops; yet in some areas where they are grown extensively for processing and market they are classed as field crops. Even the tomato approaches field-crop status in some locations. Nut trees are considered horticultural crops when

grown in orchards for nut production, but they become forest crops when grown for timber. Grasses are treated from the horticultural viewpoint when used for lawns but become agronomic when used for pastures.

Horticultural crops may be divided into four main groups, namely: (1) fruits; (2) vegetables; (3) flowers and ornamentals; and (4) nursery stock and seeds. The culture of fruits is known as pomology or fruit growing; of vegetables, as market vegetable gardening; of flowers, as floriculture; and of ornamental plants other than flowers, as ornamental horticulture. The planning and grouping of plants for the purpose of enhancing the beauty and value of the landscape is called landscape gardening or landscape architecture (*q.v.*).

A fruit, horticulturally, is the edible product of a perennial plant, usually woody; it is closely associated with the development of a flower. Fruits are divided into tree fruits, including deciduous forms such as apple, pear, quince, peach, cherry, plum and apricot; evergreen forms such as orange, grapefruit, lime, lemon, citron, avocado and mango; and soft fruits, such as grape, strawberry, currant, gooseberry, raspberry and blackberry. (*See* FRUIT.)

A vegetable is popularly defined as the product of a herbaceous plant which provides fresh material either for culinary purposes or for salads. Vegetables may be botanically grouped according to the part of the plant which is used, as *tuber*—potato; *root*—beet, carrot, horseradish, parsnip, rutabaga, turnip, salsify, sweet potato; *bulb*—chive, garlic, onion, shallot; *stem*—asparagus; *bud*—cabbage Brussels sprouts; *leaf*—lettuce, spinach, kale, mustard, chard; *leafstalk*—celery, rhubarb; *flower*—cauliflower, broccoli; *seed*—pea, bean; and *fruit*—cucumber, muskmelon, tomato, watermelon, pepper, eggplant. (*See* VEGETABLES.)

Flowers and ornamentals are plants used for their aesthetic or decorative value. They may be grouped for convenience as shown below:

Flowers.—(1) *annuals,* completing the life cycle and dying within a year, requiring reseeding each season (cosmos, petunia, zinnia); (2) *biennials,* requiring approximately two years to complete the life cycle, requiring reseeding every other season (foxglove, Canterbury bell); and (3) *perennials,* living more than two years, not requiring frequent reseeding (chrysanthemum, phlox, peony).

Shrubs and Vines.—(1) *deciduous,* shedding the foliage each year (deutzia, honeysuckle, spiraea); and (2) *evergreen,* retaining the leaves the year round (*narrow-leaved*—mugho pine, Pfitzer juniper, yew; and *broad-leaved*—laurel, rhododendron).

Trees.—(1) *deciduous,* shedding the foliage each year (elm, maple, oak); (2) *evergreen,* retaining the leaves the year round (*narrow-leaved*—fir, spruce, pine; and *broad-leaved*—citrus, holly).

Such arbitrary groupings, however, are not rigid. The petunia, snapdragon, and wax begonia are annuals in northern U.S. and in Great Britain, where they are killed by winter cold, but they remain perennial where mild winter temperatures prevail, in the southern U.S. and in southern Europe. Candytuft, which is commonly called a herbaceous perennial, is shrublike and may properly be called a small shrub. *See* FLOWER; WILD FLOWER; TREE.

II. ORIGIN OF HORTICULTURAL CROPS

The first agriculture was in a sense horticulture. The first cultivated plants were taken from the wild. As cultivation advanced, culture became more intensive and more critical, and improved forms took the places of less desirable ones. The intensive application of the laws of Mendel (*see* MENDEL, GREGOR JOHANN) provided the key which enabled William Bateson (*q.v.*) and others to understand the results of hybridization. Mendel worked with the garden pea and for the beginning used two simple characters, tall or short stature and white or coloured flowers. Later the chromosome theory brought greater understanding and potentialities of heredity. Hybrid vigour has given great advances both in size and stamina of crop and ornamental plants.

One of the best examples is the development of improved forms of maize (corn), which is discussed under PLANT BREEDING; another is the onion. However, practically every important flower, vegetable or commercial crop has been subject in some degree to a program of intensive breeding. Among flowers the daffodil and the chrysanthemum have shown phenomenal advances in the 1960s. Size in daffodils has been greatly increased while the narrow starry perianth segments have been replaced with broad overlapping segments of greater substance. The coronas or trumpets have been varied in colour from a fiery orange-red to a deep shell-pink. In chrysanthemums the early varieties which flower in August and September out-of-doors have been enlarged almost to the size of the later flowering greenhouse varieties and the colours have become progressively brighter and stronger.

The development of the grape in eastern North America prior to 1700 was with native wild grapes, as *Vitis labrusca, V. vulpina* and *V. aestivalis,* raised from seed. About 1800, selections from these wild forms were made and propagated vegetatively by cuttings, as the Alexander or Cape grape. Gradually, other species, including the old-world grape (*Vitis vinifera*), were blended with native species by natural crossing, and such improved varieties were produced as Catawba (1819), Concord (1843) and Delaware (1849). Finally, toward the close of the 19th century, systematic breeding methods began to raise the standards of quality, adaptability and production to the high level seen in such horticultural varieties (cultivars) as Ontario, Fredonia, Niagara, Golden Muscat and several seedless grapes. Flowers, ornamental plants, nuts and vegetables have all shown this same general pattern of development. To protect originators of new plant materials, the U.S. established a plant patent law, July 1, 1931. *See* PLANT PROPAGATION; GRAFTING (IN PLANTS); PLANT BREEDING.

III. HORTICULTURE AND THE HOME

Socially, horticulture has been and continues to be of great significance through its influence upon the settlement, development and refinement of areas and of peoples. It is closely identified with the establishment of the home in which fruits, vegetables and ornamental plants are combined in a plan of unity and utility, and this has become the 20th-century conception of the private home garden. Gardening has passed through a number of widely differing styles and vogues. There have been the eras of very formal gardens with geometrically arranged beds and with trees and hedges trimmed to artificial forms, of gardens on the grand scale which involved removal of walls and boundaries and took gardening into the parks and fields, of wild gardens and of Victorian gardens with flower beds set in lawns. Trees and hedge plants are now commonly permitted to assume natural forms, the lawn is kept open, flower beds have given way to herbaceous borders, the rock garden has assumed a place of importance and sometimes provision is made for semiaquatic plants.

It is most important that there be a plan. The areas in a home plan may be divided into: (1) a public area, which is open to view of the public and which furnishes a setting for the home; (2) a private garden area, which is in a sense an outdoor living room; and (3) a service area, which includes drives, clothesyard, outbuildings and fruit and vegetable gardens. There is a wide range of plant materials from which to choose, and the choice should be made in consultation with local residents, nurserymen or professional horticulturists, or with the advice of nearby schools, colleges and experiment stations.

1. Lawn.—The lawn is one of the first considerations, since it serves as the floor covering of the outdoor living room. Bluegrasses (*Poa* species) make good turf grasses, well suited to the temperate zone and widely used in the U.S. where the soil is neutral and of fair fertility. The Merion strain of Kentucky bluegrass (*Poa pratensis*) develops a thick, dark turf which is well suited to close mowing and which is resistant to leaf spot. Bermuda grass (*Cynodon dactylon*) is used in warmer regions, and bent grasses (*Agrostis* species) do well in moist cool climates, as in northeastern U.S. and along the west coast north from San Francisco. Fescues (*Festuca* species) are useful for shaded northern areas with low rainfall, and Roughstalk bluegrass (*Poa trivialis*) is good in moist, shaded conditions. A mixture of basic grasses is usually preferred: as 60% Kentucky bluegrass, 20% red fescue

(*Festuca rubra*), 15% rye grass (*Lolium* species) and 5% redtop (*Agrostis alba*); or 80% Colonial bent (*Agrostis tenuis*) and 20% redtop. One-half to two ounces of seed are needed for a square yard of soil. Seeding should be done at the time of year when cool temperatures and moderate moisture can be expected. This means late summer, early autumn or early spring in most regions. The introduction of selective herbicides such as 2,4-D (2,4-dichlorophenoxy-acetic acid) revolutionized lawn maintenance by controlling such common broadleaf weeds as dandelion and plantain.

Lawns form a very important part of British gardens and usually receive much care. They can be made either by direct seeding or by turfing. The mixture to be used depends on the soil and the use to which the lawn will be put. The best lawns are made from a mixture of *Agrostis tenuis*, *A. canina* and fescue grasses. Cheaper mixtures for rougher lawns often contain rye grasses such as *Lolium perenne*. (*See* LAWNS, CARE OF.)

2. Trees.—Trees are employed to frame views, to provide points of interest, for shade, as screens, as background and as windbreaks. Some of the more common and dependable kinds, of which there are many, are listed below:

Deciduous.—Maple (*Acer*), hickory (*Carya*), dogwood (*Cornus*), hawthorn (*Crataegus*), beech (*Fagus*), honey locust (*Gleditsia*), walnut (*Juglans*), sweet gum (*Liquidambar*), tulip tree (*Liriodendron*), plane tree (*Platanus*), oak (*Quercus*), linden (*Tilia*), elm (*Ulmus*).

Evergreen.—Fir (*Abies*), cedar (*Cedrus*), cypress (*Cupressus*), spruce (*Picea*), pine (*Pinus*), yew (*Taxus*), arborvitae (*Thuja*) and hemlock (*Tsuga*). (*See* TREE; ARBORICULTURE.)

3. Shrubs.—Shrubs are used for much the same purposes as trees and, in addition, are used to separate areas and as foundation plantings. The shrub border outlines boundaries, and consists of high-growing plants in the background and low-growing plants in the foreground. Foundation plantings serve to visually tie the house to the ground, employing higher specimens at the corners and lower kinds between. A list of some common forms follows:

Deciduous.—*Azalea*, barberry (*Berberis*), butterfly bush (*Buddleia*), sweet shrub (*Calycanthus*), *Ceanothus*, flowering quince (*Chaenomeles*), rockrose (*Cistus*), dogwood (*Cornus*), *Cotoneaster*, *Deutzia*, *Euonymus*, *Forsythia*, witch hazel (*Hamamelis*), *Kerria*, beauty bush (*Kolkwitzia amabilis*), privet (*Ligustrum*), honeysuckle (*Lonicera*), mock orange or syringa (*Philadelphus*), flowering currant (*Ribes*), rose (*Rosa*), flowering raspberry (*Rubus*), *Spiraea*, lilac (*Syringa*), *Viburnum* and *Weigela*.

Evergreen.—*Abelia*, *Azalea*, box (*Buxus*), *Camellia*, *Cotoneaster*, *Daphne*, juniper (*Juniperus*), mountain laurel (*Kalmia latifolia*), *Rhododendron*, fire thorn (*Pyracantha*) and yew (*Taxus*).

4. Herbaceous Annuals and Perennials.—Herbaceous annual and perennial flowering plants are employed in the foreground of the shrubbery border, usually in long narrow beds at the sides of the lawn, or in separate beds in the garden to provide cut flowers. The best effects are produced by group plantings so that as each group blossoms, a mass of colour is produced. Annuals must be reseeded each year, but perennials will grow up again each spring. In the autumn the old leaves and stems should be cleaned out of the bed. When the plants become overcrowded, they should be lifted, divided and replanted. Some common herbaceous flowering plants are listed below:

Annuals.—*Ageratum*, snapdragon (*Antirrhinum*), *Aster*, *Browallia*, *Calendula*, China aster (*Callistephus*), *Centaurea*, *Clarkia*, *Coreopsis*, *Cosmos*, larkspur (*Delphinium*), *Gaillardia*, *Gypsophila*, hound's-tongue (*Cynoglossum*), candytuft (*Iberis*), snapweed (*Impatiens*), sweet alyssum (*Lobularia*), stock (*Mathiola*), *Petunia*, *Portulaca*, *Salpiglossis*, sage (*Salvia*), scabious (*Scabiosa*), marigold (*Tagetes*), nasturtium (*Tropaeolum*), *Verbena* and *Zinnia*.

Biennials and Perennials.—Hollyhock (*Althaea rosea*), columbine (*Aquilegia*), hardy aster or Michaelmas daisy (*Aster*), *Astilbe*, bellflower (*Campanula*), *Chrysanthemum*, *Coreopsis*, *Delphinium*, pink (*Dianthus*), bleeding heart (*Dicentra*), *Gaillardia*, *Gypsophila*, day lily (*Hemerocallis*), *Iberis*, flax (*Linum*), lupine (*Lupinus*), forget-me-not (*Myosotis*), evening primrose (*Oenothera*), poppy (*Papaver*), *Phlox*, hardy primrose (*Primula*), speedwell (*Veronica*) and violet (*Viola*).

Perennials from Bulbs, Roots and Corms.—*Canna*, *Crocus*, *Dahlia*, snowdrop (*Galanthus*), *Gladiolus*, *Iris*, lily (*Lilium*), grape hyacinth (*Muscari*), *Narcissus*, *Oxalis*, peony (*Paeonia*), squill (*Scilla*), *Trillium* and tulip (*Tulipa*).

5. Vines or Climbers.—These forms are used as ground covers and to cover walls, fences, trellises and pergolas. They are much more used in Europe than in the U.S., due in part to a less rigorous climate and to the preponderance of stone structures, to which climbers more readily cling and with less injury to the structure. Some of the more common kinds are Dutchman's-pipe (*Aristolochia*), bittersweet (*Celastrus*), *Clematis*, ivy (*Hedera*), morning-glory (*Ipomoea*), Virginia creeper (*Parthenocissus*) and wisteria (*Wistaria*).

6. Hedges.—Plants that are sufficiently dense in growth habit may be used as hedges, to serve as a mark of the property line, as a barrier, as a protection to privacy, as a means of providing a formal atmosphere and as a screen.

Most hedges should be pruned so that they are wider at the base than at the top, to avoid shading out of the lower branches. However, some narrow-growing materials, such as American arborvitae, and some vigorous-growing kinds, such as privet, may be clipped vertically on the sides without danger of causing the lower branches to die.

Representative plants for several hedge purposes are: Formal ornamental—true dwarf box (*Buxus sempervirens suffruticosa*); informal ornamental—true hedge columnberry (*Berberis thunbergi erecta*); flowering ornamental—Japanese rose (*Rosa multiflora*); evergreen—arborvitae (*Thuja*); coloured fruits—fire thorn (*Pyracantha*); coloured twigs—Tatarian dogwood (*Cornus alba*); protective thorny—English hawthorn (*Crataegus oxyacantha*); protective dense—box (*Buxus*); low, under 2-ft. high—dwarf Japanese yew (*Taxus cuspidata nana*); medium, about 4 ft.—Amur privet (*Ligustrum amurense*); Japanese barberry (*Berberis thunbergi*); high, 6 ft. or taller—Eastern arborvitae (*Thuja occidentalis*); and windbreaks and screens—Norway spruce (*Picea abies*).

7. Rock Garden.—Rock gardens are especially suited to sections where the climate is neither too cold nor too hot, and where sufficient moisture either is available or can be provided. They are especially popular in Great Britain, on the continent of Europe, in Japan and on the north Pacific coast of North America. In Japan a feature of the rock garden is the rocks themselves, many of which are of foreign origin. For the most part, the rock garden is a garden of alpine plants, commonly, plants which grow in mountain habitats.

The garden is constructed so as to provide the conditions required by the different plants which are to be grown, as sheltered crevices, boggy spots, dry banks, peaty soil, leaf mold and limestone rubble. Conditions should be made as nearly natural as possible. A north-and-south direction provides a variety of exposures for different plants. (*See* also LANDSCAPE ARCHITECTURE.)

Plants commonly used in rock gardens may be grouped according to their requirements for culture:

1. Woodland and pasture plants of the mountain regions—aconites, delphiniums, tulips, colchicums, campanulas, helianthemums, anemones, pinks, aquilegias, centaureas, geraniums, thalictrums and gentians (*Gentiana asclepiadea* and *G. cruciata*).
2. Shade-loving plants—ferns, certain lilies and some aconites.
3. Plants favouring moist or marshy places—buttercups, trilliums, cypripediums, bog orchids, parnassias, loosestrifes (*Lysimachias*), mimuluses and saxifrages.
4. Wall plants which love full sunshine—*Corydalis lutea* and *C. ochroleuca*, toadflax (*Linaria*), some campanulas and *Erinus alpinus*.
5. Plants of the peat bog—heath, blueberry, rhododendron.
6. Ordinary rock and alpine plants—golden tuft (*Alyssum saxatile luteum*), alpine rock jasmine (*Androsace alpina*), anemones (*Anemone baldensis* and *A. pulsatilla* [*Pulsatilla vulgaris*]), aubrieta (*Aubrieta deltoidea* Dr. Mules), rose daphne (*Daphne cneorum*), alpine pink (*Dianthus alpinus*), checkerberry wintergreen (*Gaultheria procumbens*), gentians (*Gentiana acaulis*, *G. sino-ornata* and *G. verna*), evergreen candytuft (*Iberis sempervirens*), saxifrages (*Saxifraga cotyledon*, *S.*

umbrosa, S. burseriana), stonecrops (*Sedum acre, S. album*), cobweb houseleek (*Sempervivum arachnoideum*), moss campion (*Silene acaulis*), Sicily thyme (*Thymus nitidus*) and violet (*Viola bertoloni*).

7. Bulbous plants—snowdrops, narcissuses, scillas, fritillaries and crocuses.

8. Pioneer plants—willowweed (*Epilobium dodonaei*), alpine toadflax (*Linaria alpina*), mountain wormwood (*Artemisia spicata*), twinleaf saxifrage (*Saxifraga oppositifolia*).

9. Dwarf trees and shrubs—redleaf Japanese barberry (*Berberis thunbergi atropurpurea*), rock cotoneaster (*Cotoneaster horizontalis*), Lawson false cypress (*Chamaecyparis lawsoniana* Fletcher), broom (*Cytisus kewensis*), winter daphne (*Daphne odora*) and spring heath (*Erica carnea*).

8. Rose Garden.—The rose offers a wide variety which makes it adapted to a great range of climatic conditions and individual tastes. Good effects are secured in a variety of ways, as with ramblers over a lattice, fence or pergola; with polyantha roses in mass plantings and in borders; and with a few plants in a bed for cut flowers. If a portion of the grounds is set aside for a rose garden, a good plan is to use climbers and pillar types as the border or enclosure. The rugosas and shrub roses are then used in a parallel planting inside the border and within this are the beds of hybrid perpetuals with the hybrid teas in the centre.

Roses will grow in most soil types if given plenty of sunshine and an adequate supply of moisture. They do especially well in heavy soils where a uniform climate and an even moisture supply are provided. Protection from insects and diseases is most important and can be secured fairly easily by using a combined fungicide-insecticide dust or spray, obtainable in ready-mixed formulations. Much winter injury is traced to weakening of plants through insect and disease attack. While there are hardy forms for colder sections, most roses need some degree of winter protection.

Roses require careful pruning. In the U.S. the operation is best left until late spring, when danger from severe winter cold is past; in Great Britain, however, it is usually done in early spring. All dead, weak and unripe wood should first be removed and the remaining wood should then be cut back for the results desired. Climbers need vigorous pruning. Wood more than two years old should be removed and the six or eight new shoots which are left should be cut back and tied in place. If exhibition blooms are desired, hybrid perpetuals should be cut back to seven to nine buds per cane and hybrid teas to three or four buds per cane. On the other hand, if a quantity of flowers is desired, the canes should be merely cut back to live wood.

Roses are propagated on many different types of stocks, including the multiflora, the manetti and the rugosa. Of these, manetti is most used for greenhouse roses and multiflora for garden roses.

The wide interest in roses throughout the world stimulates constant improvement and change, so that a list of desirable types and varieties changes in a short time. Of the five following popular types the hybrid tea roses are among the most popular.

Rambler and Pillar Roses.—Blaze (red), City of York (white), Climbing Talisman (yellow and copper), Dr. J. H. Nicolas (pink), Dorothy Perkins (pink), Doubloons (yellow), High Noon (yellow), New Dawn (pink), Silver Moon (white), Spectacular (red), Tausendschon (pink), Torch (orange), Albertine (copperyorange), Paul's Lemon Pillar (pale yellow) and Danse du Feu (red).

Hybrid Perpetuals.—Baroness Rothschild (pale pink), Frau Karl Druschki (white), General Jacqueminot (clear red), American Beauty (red), Georg Arends (light pink), Henry Nevard (pink), Mrs. John Laing (clear pink), Paul Neyron (deep pink) and Ulrich Brunner (cherry red).

Floribundas (Grandifloras).—Gold Coast (deep yellow), Merry Widow (red), Queen Elizabeth (pink), June Bride (white), Firecracker (orange-red), Red Favourite (deep red), Iceberg (White) and Allgold (bright yellow).

Hybrid Teas.—Katherine T. Marshall (pink), Comtesse Vandal (pinkish blend), Crimson Glory (red), Eclipse (yellow), Etoile de Hollande (red), Golden Dawn (yellow), McGredy's Ivory (white), McGredy's Yellow (yellow), McGredy's Sunset (yellow orange), Mme Edouard Herriot (salmon), Margaret McGredy (brick red), Mrs. Pierre S. du Pont (yellow), Nocturne (red), Peace (yellow blend), Radiance (pink), Red Radiance (red), Sutter's Gold (yellow), Talisman (yellow and copper), Super Star (bright orangepink), Monique (deep pink), Perfecta (white and pink), Spek's Yellow (deep golden yellow), Virgo (white) and Prelude (lavender).

Small-flowered Polyanthas.—Chatillon Rose (pink), Miss Edith Cavell (red), Gloire du Midi (salmon), Pinocchio (pink) and Red Pinocchio (red).

Large-flowered Polyanthas, Often Called Floribundas.—Betsy McCall (pink), Betty Prior (pink), Donald Prior (red), Else Poulsen (salmon pink), Fashion (pink), Irene of Denmark (white), Spartan (salmon red), Summer Snow (white), Vogue (pink), World's Fair (Minna Kordes) (red).

For more botanical and horticultural information *see* Rose.

9. House Plants.—Accompanying an increase in city living was a fuller appreciation of plants in the home. Certain plants are useful as flowering pot plants, others as foliage plants and others (principally cacti, succulents and foliage plants) as terrarium and dish garden subjects. Trees dwarfed in the manner of the Japanese art of *bon-sai* (*q.v.*) make very effective arrangements. The following plants are generally successful in ordinary rooms:

Flowering Plants.—*Begonia*, airbrom (*Billbergia*), poinsettia (*Euphorbia pulcherrima*), *Fuchsia, Gardenia, Amaryllis, Narcissus*, florist's geranium (*Pelargonium*), azalea (*Rhododendron*), rose, African violet (*Saintpaulia*), gloxinia (*Sinningia*), Jerusalem cherry (*Solanum pseudocapsicum*) and tulip.

Foliage Plants.—China green (*Aglaonema simplex*), Norfolk Island pine (*Araucaria excelsa*), fern asparagus (*Asparagus plumosus*), cast-iron plant (*Aspidistra elatior* varieties), bird's-nest fern (*Asplenium nidus*), *Caladium*, treebine (*Cissus*), leafcroton (*Codiaeum*), *Coleus*, tuftroot (*Dieffenbachia*), *Dracaena*, rubber plant (*Ficus*), English ivy (*Hedera helix*), baby tears (*Helxine*), sentry palm (*Howea*), Boston fern (*Nephrolepis exaltata bostoniensis*), screw pine (*Pandanus*), *Peperomia, Philodendron*, date palm (*Phoenix*), bowstring hemp (*Sansevieria*), strawberry saxifrage (*Saxifraga sarmentosa*), ivy arum (*Scindiapsus*), *Selaginella*, wandering Jew (*Tradescantia fluminensis*) and periwinkle (*Vinca*).

Cacti and Succulents.—*Agave, Aloe, Cereus, Crassula, Echeveria, Epiphyllum, Gasteria, Haworthia, Kalanchoe, Mammillaria*, fig marigold (*Mesembryanthemum*), prickly pear (*Opuntia*) and houseleek (*Sempervivum*). (*See* House Plants.)

10. Vegetable Garden.—The vegetable garden is primarily to provide food for the family, yet it may reach considerable economic importance in the aggregate.

The size of the garden will be dictated by the size of the family, the interest in gardening, the labour available and the geographical location. Following is a suggested plan for a garden 30 by 60 ft. for temperate zone conditions and arranged in numbered rows according to season of planting: (1) asparagus; (2) lettuce and radishes; (3) spinach, followed by cucumbers and bush squash; (4) onion sets; (5) early turnips, mustard, cress; (6) early beets, followed by late cabbage; (7) onions; (8) parsley, carrots; (9) parsnips; (10) early peas, followed by string beans; (11) cabbage, cauliflower; (12) lettuce, followed by celery; radishes, followed by celery; (13) late peas; (14) string beans; (15) early sweet corn, followed by turnips; (16) late sweet corn; (17) dwarf lima beans, peppers; and (18) tomatoes and eggplant.

The garden soil should be well drained and should be kept both in good fertility for satisfactory crop yields and in good physical condition for ease in handling. Animal manures are no longer easy to procure, but where they are, there is nothing better. In order to destroy weed seeds it is a good plan to compost the manure. Peat moss, grass clippings, leaves and any other available types of organic matter are valuable and may be added to the compost pile. Peat moss is especially useful in the garden. A 2-in. top-dressing will produce most satisfactory results. Certain organic chemicals (synthetic resins) tend to granulate heavy clay soils and improve their structure. Where manures cannot be secured, commercial fertilizers may be used, employing them in the manner and at the rates recommended by the manufacturers. The use of so-called starter solutions, employing commercial fer-

tilizers in water in small amounts, has been found beneficial in transplanting, and the side placement of concentrated fertilizers in bands a few inches from the plant and at a depth of 2 to 6 in. rather than broadcast over an entire area, has not only proved economical but has also resulted in increased yields. *See* also articles on specific vegetables.

11. Fruit Garden.—The fruit planting will be largely of small fruits where the available area is small and may include tree fruits where more room is available. For the temperate zone, the selection may include strawberries, red raspberries, black raspberries, purple cane raspberries, blackberries, currants, gooseberries, grapes, peaches, plums, sweet cherries, sour cherries, apples, pears and nut trees. Subtropical areas and warmer parts of temperate zone areas include citrus fruits, figs, persimmons and vinifera grapes. The choice of varieties is dependent upon local adaptation, so that advice should be sought from local residents, professional horticulturists, or nearby agricultural colleges or experiment stations. The tendency is to overplant the fruit garden. A few good selections well cared for are the most satisfactory.

Planting distances for fruit trees will vary with the variety and geography, but are approximately as follows: Apples, 30 to 40 ft. each way; apples (dwarf), 8 to 10 ft. each way; apples (semidwarf), 20 to 25 ft. each way; pears, 20 to 30 ft. each way; pears (dwarf) 10 to 15 ft. each way; plums, 16 to 25 ft. each way; peaches, 16 to 20 ft. each way; cherries (sour), 16 to 22 ft. each way; cherries (sweet), 20 to 30 ft. each way; apricots, 16 to 20 ft. each way; nectarines, 16 to 20 ft. each way; quinces, 8 to 14 ft. each way; figs, 20 to 25 ft. each way; mulberries, 25 to 30 ft. each way; Japanese persimmons, 20 to 25 ft. each way; loquats, 15 to 25 ft. each way; pecans, 35 to 40 ft. each way; walnuts, 40 to 50 ft. each way; oranges and lemons, 25 to 30 ft. each way; grapes, 8 to 10 ft. each way; currants, 4 by 5 ft.; gooseberries, 4 by 5 ft.; raspberries (black), 3 by 7 ft.; raspberries (red), 3 by 7 ft.; blackberries, 4 to 7 ft. by 6 to 8 ft.; cranberries, 1 or 2 ft. each way; blueberries, 4 by 8 ft.; and strawberries, 1½ by 3½ ft. Important varieties and details of cultivation are given in the article FRUIT FARMING. (H. B. T.; X.)

Dwarf Fruit Trees.—Dwarf fruit trees are especially useful in the garden not only as fruit bearers but also as attractive ornamentals. In horticultural practice the dwarf fruit tree is produced by grafting a variety of apple, peach, pear or plum to a closely related and compatible plant, called the rootstock, which inherently makes small growth and in a corresponding manner restricts the growth of the variety grafted on it. A fruit tree can also be dwarfed by restricting root development; *e.g.*, by growing the tree in a pot.

Rootstocks used to dwarf fruit trees originate from individual seedlings having dwarfing tendencies and are propagated by vegetative means, as by layering or by taking cuttings and rooting them. Each plant propagated from the original is identical with it. In the production of dwarf apple trees standardized East Malling (EM) rootstocks are useful, especially EM IX and EM VII. More disease resistant are the later developed Malling-Merton rootstocks. The former has the greater dwarfing ability and induces the tree to bear fruit at the earliest age. Pear trees are dwarfed by grafting the variety to a quince rootstock. *Prunus besseyi* and a selected plum stock known as St. Julien serve as dwarfing stocks for peach and plum varieties. The Mahaleb cherry (*Prunus mahaleb*) is used for dwarfing the cherry.

Dwarf trees are grown as various forms. The bush tree, having a 30-in.-long trunk with several lateral branches arising from it, is the most popular and easiest to grow. The pyramid type, with a central stem 8 ft. long from which branches arise in successive tiers 20 in. apart, is more difficult to train. The cordon, consisting of a single stem 10 ft. in length on which the fruit spurs are arranged, is grown in a vertical position or can be trained to grow at an angle. The espalier trained on trellises or walls has a central stem from which arise horizontal tiers of branches that carry the fruit spurs. The fan-trained tree has a permanent framework of branches arranged in the shape of a fan when training is completed. The bush tree is adapted to all the different tree fruits, whereas pyramids, cordons and espaliers are best suited for apples and pears. The fan-trained tree is preferred for growing peaches and plums against walls or trellises. (See *Propagation of Plants*, below.) (K. D. B.; X.)

IV. COMMERCIAL HORTICULTURE

Horticultural crops, with the exception of the Irish potato, are more important as a group than as individual crops. They include fruits, vegetables, ornamentals and nursery stock and seeds.

1. Fruits.—Principal fresh fruits of world commerce are the grape, apple, orange, pear, plum and banana; principal nuts are the almond, Brazil nut, chestnut, coconut, filbert, pecan and walnut. Large quantities of fruits are dried, canned, frozen and otherwise processed. The grape, including grapes grown for wine, for drying and for table use, is the leading fruit of the world.

The apple is the most important tree fruit of the temperate zone. The U.S. is the largest producer of apples and oranges, producing more than one-third of the annual world crop of each. The orange is the most important commercial tree fruit of tropical and subtropical regions. The principal orange-producing countries are the U.S., Spain, Brazil, Italy and Mexico. The date is an important crop in the drier areas of the world, especially in Asia Minor, Arabia and the Sahara desert region. There are more species of fruit in the tropics than in any other region, but most of them are only of local importance because of their highly perishable nature. The four of greatest commercial value are the banana, pineapple, coconut and Brazil nut. Others include mango, avocado, papaya, guava, sapodilla, cherimoya and prickly pear. The mango is as important to the people of India as is the apple to the inhabitants of the temperate regions. The banana is the great starch food of the tropics.

There is perhaps no period in the history of commercial horticulture in which so many changes have occurred on such an extensive scale and over so wide an area as during the period since 1920. Substantial increases have occurred in both production and consumption and important shifts have occurred in locations of the industry. Many new types and varieties have been introduced which have markedly altered consumer habits and trade customs. Great strides have been made in production methods and in harvesting and handling. Nut crops are both shaken from the tree and gathered mechanically. Modifications of this method of harvesting are used for blueberries, cherries and apricots for processing. Although not harvested mechanically, other fruits are transported and stored in large bins and boxes which reduces labour and handling costs. The results of this trend will be the growing of more fruit for processing. Higher packing standards have been almost universally adopted, and significant progress has been made in precooling, refrigeration, prepipening and conditioning. The world transportation system has been revolutionized. Fast trucks, freight cars and ships designed and constructed essentially for carrying fruit play an important part, so that highly perishable products are transported over great distances to provide an abundance and a variety formerly considered impossible.

2. Vegetables.—Because of their bulk and their perishable nature, fresh vegetables do not figure prominently in world commerce as do fruits and nuts, yet large quantities are shipped into England from France, Spain and Italy, and the whole region north of the Alps receives early vegetables from the south. As canned, frozen and dried products, vegetables attain considerable importance in world commerce. In domestic commerce, however, vegetables surpass fruits in value. The sweet potato is a universal food crop in the tropics and offers much promise for development. Improvements in mechanical harvesting and handling of vegetables for processing have been rapid. Among crops handled successfully are beets, carrots, potatoes and onions. Modest success has also been realized with tomatoes and pickling cucumbers. Trends in this direction point toward further increases in vegetables grown for processing.

3. Flowers, Nursery Products and Seed.—Flowers and nursery products are relatively less important in world commerce than other horticultural crops. Nevertheless, the production of bulbs for export is of considerable importance in the Netherlands, and prior to the restrictive embargo placed by the U.S. on fruit-

tree and rose rootstocks in 1930, considerable quantities of these materials were imported each year. Vegetable and flower seeds are of relatively greater importance in world trade than ornamental plants and nursery stock. In California are located districts for the production of seed of onion, lettuce, carrot, radish, sweet pea, nasturtium, celery, aster and zinnia. In Washington are areas for spinach, turnip and beet seed; in Montana and Idaho, for garden pea seed; and in Indiana, for tomato seed. Denmark produces cauliflower seed; France and Italy, celery seed; England, seed of cabbage, broccoli and Brussels sprouts; and there is an important general seed-producing region at St. Rémy, France.

In domestic commerce, on the other hand, flowers, ornamentals and nursery stock are of great importance, especially in areas of older world civilization.

4. Propagation of Plants.—Horticultural plants are propagated (*i.e.*, increased in numbers) by two methods, namely, by seedage (sexual propagation) involving the formation and planting of seeds, and by vegetative means (asexual propagation) involving the use of a portion of the plant other than the seed. Propagation by seed is employed for plants which provide an abundance of seed and which can be bred readily to uniform and pure lines, as most annual flowers and many vegetables. Hybrid seed, such as that used for sweet corn, is produced by developing two pure lines and then combining them by cross-fertilization. Such seed may produce superior yields, but seed taken from plants raised from hybrid seed should not be used for reseeding.

Seed of herbaceous plants, such as tomato, onion and zinnia, will germinate as soon as it is mature. On the other hand, seed of many wood plants must be afterripened before it will germinate. Thus, peach seed requires 12 weeks at about 41° F. (5° C.), under moist surroundings, and apple seed requires 8 weeks at approximately the same temperature. In nature, these conditions are provided out-of-doors in winter. Nurserymen and plant breeders either plant such seed in the early autumn, or provide similar conditions by stratification in which seeds are placed in boxes or trays in alternate layers with sand, soil or peat moss and stored at temperatures of about 41° F. (5° C.) for the period of time required for the particular seed under treatment. (*See* SEED; SEED TESTING.)

Plants are propagated vegetatively from portions of leaves, stems or roots. Although in propagation by seed each plant varies somewhat from every other plant in the lot, in vegetative propagation all daughter plants are identical in genetic make-up and are also identical to the parent plant from which they are secured. This is of great importance in horticulture, since it means that a single plant with desirable characteristics can be retained and perpetuated, identical in all respects to the original. None of the common tree fruits, such as the apple, pear, cherry, plum and peach will produce true from seed; distinctive horticultural varieties, such as the Northern Spy and Cox's Orange Pippin apples, the Washington Navel orange and the Williams Bon Chrétien (Bartlett) pear, are propagated by vegetative means.

A combination of both seedage and vegetative propagation is common with many woody plants, such as fruit trees and roses, in which an inexpensive seedling root is raised from seed or cutting and upon which the desired variety is then budded or grafted. The portion of a plant which serves for the root or underportion is called the rootstock or stock, and the portion of a plant which is placed upon the stock is called the scion. The resulting plant is thus composed of a stock root and a known-varietal top and may be termed a stion (combination of stock and scion). In combining a stock and a scion, various techniques are employed, all of which are a form of grafting. A common form is called budding, in which a single bud is grafted onto the stock during the active growing season, as contrasted with grafting with dormant scions in midwinter or early spring. Strains of plants which are propagated by vegetative means are called clones.

The standard rootstock upon which to propagate the apple used to be crabapple seedlings grown from French-produced seed. Seedlings from seed of cultivated varieties of apple, such as Delicious and Rome Beauty, are now generally used. Wide interest has developed in clonal, or vegetatively propagated, rootstocks, which has been intensified by the standardization and introduction of the EM rootstocks, named for the East Malling Horticultural Research station in England where they were standardized. Many of the EM rootstocks are dwarfing in nature, as EM IX (Jaune de Metz), which produces a tree 4 to 6 ft. tall. Others, in approximate ascending order of size tree which they produce, are EM VII, IV, II, I, XIII, XVI and XII, the last named producing a tree of standard size. EM VII and II are especially esteemed for commercial fruit production when a small tree is desired.

For the pear, seedlings of French-grown pears are commonly used, and, since about 1930, seedlings of such cultivated varieties as Bartlett and Winter Nelis have been employed. The oriental rootstocks have not proved generally as compatible with the more commonly cultivated varieties of pears (*Pyrus communis*), although they are superior for such a cultivar as Kieffer, which is a hybrid between the common pear (*P. communis*) and the sand pear (*P. pyrifolia*). For dwarfing, the Angers quince (*Cydonia oblonga* variety) is used, of which the EM A and B represent standardized types and EM C a very dwarfing type.

For the plum, seedlings of the myrobalan plum (*Prunus cerasifera*) are widely used. For the sweet cherry, seedlings of the wild mazzard (*Prunus avium*) are preferred; while for the sour cherry both the Mahaleb cherry (*P. mahaleb*) and the mazzard are used, the former producing a tree slightly smaller, earlier-bearing and shorter-lived than the latter. For the peach, seedlings are from pits collected from wild trees ("naturals"); however, because of the gradual disappearance of wild peach trees, seed of Lovell and Muir canning peaches from California has been widely employed. Apricots are propagated upon seedlings of the Blenheim and Royal varieties; almonds, on seedlings of the bitter almond (*Prunus amygdalus amara*). The most popular rootstock for the pecan is the common pecan (*Carya illinoensis*); for the black walnut, seedlings of the Eastern black walnut (*Juglans nigra*); and for the English walnut, seedlings of the California black walnut (*J. californica*).

Where the grape phylloxera (*Phylloxera vitifoliae*) is a problem, as with vinifera varieties of grapes (*Vitis vinifera*), resistant rootstocks are used, such as riverbank grape (*V. riparia*), sand grape (*V. rupestris*) and various species hybrids such as those between *V. riparia* and *V. rupestris* (no. 3306 and 3309).

The most widely used rootstock for the orange and grapefruit is the sour orange (*Citrus aurantium*), though the rough lemon is used on sandy soils and the grapefruit is used to some extent. The trifoliate orange (*Poncirus trifoliata*), because of its hardiness to winter cold is used along the Gulf coast areas outside the commercial citrus belt. The sweet orange is the standard stock for the lemon in California.

For the avocado, seedlings of the Guatemalan type are preferred; for the loquat, seedlings of the loquat (*Eriobotrya japonica*) or of the Angers quince; for the native persimmon, seedlings of native persimmon (*Diospyros virginiana*); for the Japanese or kaki persimmon, seedlings of the kaki persimmon (*D. kaki*) and the date plum persimmon (*D. lotus*).

Seedlings or cuttings of *Rosa multiflora* are used largely for field roses, *R. noisettiana* Manetti and *R. odorata* for greenhouse roses, and *R. rugosa* for tree roses.

Plants may be propagated vegetatively in many ways, different methods being employed with different plant materials under different conditions and at different seasons. Thus, the quince may be propagated by hardwood stem cuttings in early spring; the strawberry by runners; lily of the valley by underground stems or rhizomes; black raspberry by tip layerage; dwarf apple by mound layerage; lychee or litchi nut by air layerage or Chinese layerage; blackberry by root cuttings; chrysanthemum by softwood stem cuttings during the growing season; sedum by leaf cuttings; and fruit trees and roses by budding and grafting.

Humidity, light, temperature, soil, rooting medium and the nature of the material itself play important parts in the method of propagation selected and the results secured. Continuous artificial mist has aided in the rooting of softwood cuttings; synthetic growth substances, such as indolebutyric acid, have increased the speed and degree of rooting; and synthetic plastic films, such as

polyethylene, having proved of great value in air layerage and in propagation of cuttings. *See* PLANT PROPAGATION and GRAFTING (IN PLANTS) for further details.

5. Pest Control.—Pests of horticultural plants are controlled by both natural and artificial means. The development of varieties which are resistant to certain pests has become one of the important functions of plant breeding. For example, resistance to mosaic virus has been bred into red raspberries, wilt resistance into tomatoes, powdery mildew resistance into canteloupe and nematode resistance into peach understocks. Artificial controls include crop rotation, purification and grading of seeds, soil cultivation, sanitation, soil fumigation, placing of mechanical guards as protection against rodents and spraying, dusting and dipping with various fumigants, fungicides and insecticides.

Common insecticides include arsenate of lead, used as a stomach poison against chewing insects; nicotine, pyrethrum, rotenone, dinitro compounds, oils, organic phosphates (malathion, parathion, etc.) and chlorinated hydrocarbons (DDT, chlordane, etc.), used as contact insecticides; and hydrocyanic acid, carbon disulfide, paradichlorobenzene, ethylene dichloride, used as fumigants. Common fungicides include various sulfur compounds, bordeaux mixture and copper and mercury compounds. Intensive industrial research continues to develop many organic compounds which, in many instances, are replacing some of the old, standard materials enumerated above.

Pest control has become a highly specialized and essential part of the production of many horticultural crops. Mobile spray equipment has been developed which is tractor drawn and which may deliver 30 to 50 gal. a minute at 600-lb. pressure from tanks of 600- to 800-gal. capacity. With air-blast equipment, concentrated spray may be successfully applied with one-half, one-third or even one-tenth the standard amount of water. The airplane and helicopter are effective in the application of dusts and concentrate sprays, especially to row crops of vegetables and small fruits. Control of weeds is dealt with in the article WEED. For more detailed information on plant diseases and garden pests *see* PLANT DISEASES; ENTOMOLOGY.

Foliar nutrients and plant regulators for blossom thinning, prevention of preharvest drop and control of colour and maturity are also applied with spray equipment. (*See* SPRAYS AND DUSTS IN AGRICULTURE.)

6. Harvesting and Storing.—The time of harvest is dependent upon the nature of the crop itself, the use which is to be made of it and the facilities for storage. Beans are harvested in the green, immature stage when used as snap beans, but are left until full maturity when used as hard-shell beans. Daffodils are harvested when half open, roses, peonies and poppies in early bud stages and chrysanthemums, China asters and zinnias when fully open. Apples, pears and peaches for commercial shipment are harvested when the green fruit takes on a slightly yellowish tinge. In commercial fruit operations, careful inspections are made to determine the correct time to harvest; for if the fruit is harvested prematurely it will shrivel in storage, and if it is left too long on the tree it will lack long-storage qualities. Among the indexes of maturity are changes in colour, changes in the pressure required to puncture the flesh as measured by a mechanical pressure tester, and the predetermined time interval between full bloom and the usual harvest season.

Both common storage and artificial cold storage are used for horticultural products. Common storage depends upon natural outdoor temperatures and is provided by basement storage rooms in residences, by boxes or barrels sunk into the ground and by specially designed pits, caves and ventilated buildings. Cold storage is provided by refrigeration in specially constructed and insulated buildings. By the use of sealed chambers in which the concentration of carbon dioxide and other gases in the atmosphere is controlled and regulated, great improvement has been made in the storage life and quality of certain produce. Certain growth regulators, such as maleic hydrazide, applied to onion and potato plants several days prior to harvest, have inhibited sprouting and lengthened the storage life of these vegetables. Large quantities of fruits and vegetables are also stored frozen.

V. SCIENTIFIC HORTICULTURE

Great development has occurred in the application of science to horticulture, particularly since 1900, which is reflected in horticultural organizations. For example, in 1849 in the U.S., the American Pomological society was formed and focused its attention largely upon varieties of fruits, their performance and adaptation. In 1903 the American Society for Horticultural Science was formed and was concerned with the application of science to horticulture. Emphasis was placed first upon fruits; next, beginning about 1920, upon vegetables; and then, beginning about 1930, upon ornamentals and nursery crops.

The commercial application was the force initially responsible for the introduction of modern science to horticulture. Later, however, horticultural research institutions, given good financial backing, began to support much fundamental work in the theoretical plant sciences.

Among some of the applications of science to horticulture may be mentioned: *photoperiodism*—in which chrysanthemums, typically flowering during the short days of autumn, are induced to flower at any month of the year by prolonging day length with artificial lighting and shortening day length with black cloth, as desired (*see* FLOWER: *Commercial Flower Growing*); *photosynthesis*—in which it has been found that lime-sulfur sprays reduce photosynthetic activity in comparison with the milder, wettable sulfur sprays; *carbohydrate-nitrogen relation*—in which the relation of carbohydrates to nitrogenous compounds within the plant is correlated with vegetative growth and with fruiting; *genetics and plant breeding*—in which varieties are produced to meet desired specifications, such as season of fruit ripening and disease resistance. Further applications of scientific findings derive from studies of: *developmental morphology*—explaining the changes which occur in developing fruits and the relation of these changes to commercial fruit culture; *mineral deficiencies*—including the correction of internal corking of apples by the use of boron and the control of rosette of citrus by zinc; *hormones*—including the use of such growth-regulating substances as indoleacetic acid, indolebutyric acid, naphthaleneacetamide and others to promote the setting of fruits without fertilization, to thin blossoms, to hasten the rooting of cuttings, to increase fruit size, to prevent preharvest fruit drop and to prolong dormancy; *physiology of storage*—including storage of fruits and vegetables in atmospheres of relatively high concentrations of carbon dioxide; and *physiology of ripening*—involving the ripening of bananas under controlled temperatures, colouring of oranges with ethylene gas, removal of leaves from rose plants in storage by ethylene gas, ripening of pears at controlled temperatures and use of chemicals to prevent decay and to regulate rate of ripening. (*See* PLANTS AND PLANT SCIENCE; FERTILIZERS AND MANURES; HYDROPONICS.)

1. Research Agencies.—Horticultural research is conducted for the most part by public institutions, though private support is supplied to some degree by organizations dealing in such commercial crops as pineapples, flower seeds and roses, which support their own research workers and laboratories. Further, support is provided to established public institutions through private endowments and grants-in-aid, usually to work upon some special problem which is of importance to the donor. In most countries, horticultural research is a part of a larger research organization, yet the relative emphasis placed upon horticultural crops by some has made them outstanding in the field.

In the U.S., horticultural work is conducted at the various state experiment stations and land-grant colleges throughout the country, supported in part by state funds and in part by federal funds. Among these, the following stations may be specially mentioned for their interest in horticultural work: Massachusetts (pomology); New Jersey (pomology, peach breeding, floriculture); New York, at Ithaca (pomology, vegetable crops, floriculture, ornamental horticulture), at Geneva (systematic pomology, truck crops, fruit breeding, rootstocks); Ohio (pomology, vegetable crops, floriculture, ornamental horticulture); Michigan (pomology, fruit breeding, floriculture, ornamental horticulture, vegetable crops); Indiana (pomology, vegetable crops); Minnesota (fruit breeding); Iowa and South Dakota (breeding of hardy

fruits); Oregon (pomology); Washington (pomology); California, at Davis (pomology, vegetable crops), at Riverside (citrus); Hawaii (tropical fruits, pineapple); Pennsylvania (pomology, floriculture, vegetable crops); Illinois (fruit breeding, floriculture, vegetable crops); Louisiana (vegetable crops); Texas (citrus); and Puerto Rico (vegetable crops). The U.S. department of agriculture expanded its work in horticulture markedly after 1930. Its research centre at Beltsville, Md., is linked with branch stations and works in co-operation with state institutions in all parts of the country.

In England, important contributions have been made on storage and transportation of horticultural crops at the Low Temperature Research station at Cambridge university. The Cheshunt Experimental and Research station has carried on experimental work with greenhouse crops such as tomatoes, cucumbers and chrysanthemums. The East Malling Horticultural Research station has made important contributions in general pomology, pathology, pest control and hop culture, and is internationally recognized for the standardization and propagation of rootstocks for fruit trees. The John Innes institute has concerned itself largely with genetics and plant breeding. The Long Ashton Agricultural and Horticultural Research station, University of Bristol, which began as the National Fruit and Cider institute, has expanded its endeavours to include general fruit culture, and has made notable contributions on cider making, fruit nutrition and pathology. At the trial grounds and in the laboratory of the Royal Horticultural society at Wisley valuable work has been done on general horticultural problems.

Research stations doing horticultural work are also maintained in China, Japan, India, the U.S.S.R., Israel, Egypt, Argentina, New Zealand, Australia, South Africa and Canada. The Canadian experimental work is centred at the Dominion Experimental farms at Ottawa, Ont., and is linked with branch farms and stations located in the various provinces, as Kentville, N.S.; Vineland, Ont.; and Summerland, B.C.

2. Horticultural Education and Organization.—Horticulture is a recognized subject for a degree at many colleges and universities. In the U.S. and Canada, the development of horticultural courses and institutions has been very rapid. High schools employ teachers of vocational agriculture who give courses in horticulture. In addition, there are state and county schools of agriculture in some states (New York, California, Wisconsin) where horticulture is taught.

The land-grant colleges and state universities have developed special departments of horticulture and often special departments of pomology, vegetable crops, floriculture and ornamental horticulture. They maintain extensive orchards, greenhouses and laboratory facilities and affiliated substations in the more intensive commercial horticultural areas where students may work, study and supplement academic training with practical experience. The B.S. degree is given upon completion of the course and some institutions offer the M.S. degree and the Ph.D. degree.

Among institutions which have well-developed specialized courses in horticulture offering advanced degrees are: the University of Massachusetts, Amherst; Cornell university, Ithaca, N.Y.; Ohio State university, Columbus; University of Maryland, College Park, Md.; Michigan State university, East Lansing; Rutgers university, New Brunswick, N.J.; University of Illinois, Urbana; Iowa State University of Science and Technology, Ames; Purdue university, Lafayette, Ind.; University of Missouri, Columbia; University of Wisconsin, Madison; University of Minnesota, Minneapolis; University of California, Davis; Washington State university, Pullman; Oregon State college, Corvallis; Ontario Agricultural college, Guelph; University of British Columbia, Vancouver; and MacDonald college of McGill university, Ste. Anne de Bellevue, Que. In addition, the basic sciences, such as botany, chemistry, geology and zoology, in many leading universities have been oriented so as to attract students seeking a basic scientific training which may be applied in the horticultural field. Among such institutions are Harvard university, Columbia university, The University of Chicago, University of Toronto, and McGill university, Montreal, Que.

In Great Britain, horticultural courses for degrees are given at the universities of Leeds, London (Wye college), Cambridge and Reading. Horticultural work toward advanced degrees is offered by the Long Ashton Agricultural and Horticultural Research station, the East Malling Horticultural Research station, and by other similar centres in affiliation with accredited colleges and universities. Horticultural courses are given at the Midland Agricultural college, East Anglian institute, Chelmsford and at the farm schools of many county councils. The Royal Horticultural society has a school at the horticultural gardens at Wisley. Each British county council employs one or more skilled horticulturists to teach in the village. The Royal Botanical gardens, Kew, Surrey, and the Royal Botanical garden, Edinburgh, are internationally reputed for the training of gardeners.

In France, Belgium, the Netherlands and Europe generally, the land and agricultural schools give special courses in horticulture, and a well-developed trade school and apprentice system has been established, as at the École Nationale d'Horticulture de Versailles in France.

Public Parks and Arboretums.—Public parks and arboretums are no longer merely recreational areas and botanical collections. The trend has been toward horticultural treatment. Low spots may be accentuated by groupings of low plants, and high spots by arrangements which accentuate height. Certain formal areas may be devoted to lilac plantings or to rose gardens, a rocky wall may become walled with rhododendrons, slopes may be covered with shrubs, one area may be devoted to flowering magnolias, and another area may be devoted to conifers. Trials are held of flowering plants such as roses, irises, gladioluses, dahlias, peonies, tulips and narcissuses.

Most large cities and many of the smaller ones have attractive parks which show this horticultural influence, including Boston, New York, Washington, D.C., Philadelphia, Rochester, N.Y., Chicago, San Francisco, Edinburgh, London, Paris, Vienna, Berlin, Ottawa, Montreal, Sydney and Melbourne.

The Arnold arboretum at Jamaica Plain, Mass., is world renowned. Highland and Durand-Eastman Park arboretum at Rochester, N.Y., is recognized for its displays of lilacs, rhododendrons and azaleas. Golden Gate park in San Francisco presents a wide display of excellent horticultural plant material. Other outstanding parks and arboretums showing the horticultural touch are Morris arboretum, Philadelphia, Pa.; Morton arboretum, Lisle, Ill.; the Brooklyn Botanic garden, Brooklyn, N.Y.; the New York Botanical garden, New York city; Longwood gardens, Kennett Square, Pa.; and Kingwood Center, Mansfield, O. As populations increase, the trend is for individuals to develop small private gardens, which are supplemented by an increasing number of large public gardens and arboretums. (*See* ARBORETUM; BOTANICAL GARDENS.)

Horticultural Organizations.—Horticultural organizations, through meetings, publications and trial grounds, are of great importance in horticultural education. These are of three main types, namely, general, official and trade. The general organization takes the form of national horticultural societies with numerous smaller, local affiliated societies. One of the largest and most important horticultural organizations is the Royal Horticultural society, London, founded in 1804. Similar national bodies exist in most European countries. In the U.S. there is no general organization of this kind; instead, there are more than 1,500 local societies based upon geography and upon particular crops, as the Vegetable Growers Association of America, the Massachusetts Fruit Growers' association and the American Rose society.

International horticultural congresses have been held from time to time under arrangements made by international committees consisting of members nominated by various governments, as follows: Paris, 1889; Chicago, 1893; Paris, 1900; Paris, 1905; Brussels, 1910; Ghent, 1913; Amsterdam, 1923; Vienna, 1927; London, 1930; Paris, 1932; Rome, 1935; Berlin, 1938; London, 1952; The Hague-Scheveningen, 1955; and Nice, 1958. An International Society for Horticultural Science was formed in 1958 with permanent headquarters at The Hague.

Trade associations are numerous and are concerned with pro-

tecting and informing their memberships as the International Apple association, American Association of Nurserymen and the Society of American Florists and Ornamental Horticulturists. (*See* HORTICULTURE AND BOTANY, SOCIETIES OF.)

Publications.—Journals and periodicals of special horticultural interest are: *American Fruit Grower; American Nurseryman; American Vegetable Gardener; Blue Anchor* (California); *Florist's Exchange and Horticultural Trade World* (U.S.); *Fruit World* (Australasia); *Gardeners' Chronicle* (England); *Gartenbauwissenschaft* (Germany); *Horticulture* (U.S.); *Journal of Horticultural Sciences* (England); *Journal of the Royal Horticultural Society* (England); *Proceedings of the American Society for Horticultural Science; Revue Horticole* (France); reports and bulletins of research institutions, government agencies, colleges and experiment stations; transactions and proceedings of special subject societies and local horticultural societies as the American Rose society, Northern Nut Growers association, New York State Horticultural society, Pennsylvania Horticultural society, Massachusetts Horticultural society and Minnesota Horticultural society.

See also references under "Horticulture" in the Index volume.

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HORTICULTURE AND BOTANY, SOCIETIES OF.

Only strictly botanical and horticultural societies and their dates of founding, together with their publications, are listed below. Museums, botanical gardens and educational institutions publishing botanical or horticultural journals are not included. Academies of science within the various countries are not usually included.

Many of the following societies do not have permanent addresses; they are centred where their editors and officers are located. For up-to-date locations see the latest editions of *The World of Learning* and (especially for the U.S. and Canada) *Union Lists of Serials.*

BULGARIA: Botanicheskiya Institut, Bulgarska Akademiya na Naukite (1947), *Izvestiya na Botanicheskiya Institut* (Botanical institute, Bulgarian Academy of Sciences, *Bulletin of the Botanical Institute*); *Bulletin de l'Institut.*

CANADA: Canadian Phytopathological society (1929), *Proceedings;* Quebec Society for the Protection of Plants (1908), *Reports;* Canadian Forestry association (1900, inc. 1936), *Forest and Outdoors;* Canadian Institute of Forestry (1908, inc. 1950), *Forestry Chronicle.*

CHINA: Botanical Society of China (1933), *Acta Botanica Sinica;* Chinese Society of Forestry (1951), *Forestry.*

EGYPT: Botanical Society of Egypt, *Egyptian Journal of Botany.*

FINLAND: Suomen Metsatieteellinen Seura (Society of Forestry in Finland) (1909), *Acta Forestalia Fennica, Silva Fennica;* Societas pro Fauna et Flora Fennica (1821), *Acta Botanica Fennica.*

FRANCE: Société Botanique de France (1854), *Bulletin, Mémoires;* Société Mycologique de France (1884), *Bulletin Trimestriel;* Société Nationale d'Acclimatation de France (1854), *Bulletin, Archives d'Histoire Naturelle;* Société Nationale d'Horticulture de France (SNHF) (1827), *Jardins de France, Annales de la SNHF.*

GERMANY: Deutsche Botanische Gesellschaft (1882), *Berichte;* Vereinigung für Angewandte Botanik (1902), *Angewandte Botanik;* Wissenschaftliche Gesellschaft für Land- und Fortswirtschaft (1947), *Archiv;* Deutsche Botanische Gesellschaft (1909), *Zeitschrift für Botanik.*

GREAT BRITAIN: Royal Horticultural society (1804, inc. 1809), *R.H.S. Journal, Curtis's Botanical Magazine;* British Mycological society (1896), *Transactions;* British Bryological society (1896), *B.B.S. Reports, B.B.S. Transactions;* British Ecological society (1913), *Journal of Ecology;* Empire Forestry association (1921), *Empire Forestry Review;* Botanical Society of the British Isles (1836), *Watsonia, Proceedings;* Linnean Society of London (1788), *Journal, Proceedings;* Royal Forestry Society of England and Wales (1882), *Quarterly Journal of Forestry;* Society of Foresters of Great Britain (1925); *Forestry;* Society for Experimental Biology, *Journal of Experimental Botany.*

INDIA: Indian Botanical society, *Journal;* Indian Ecological society, *Indian Ecologist;* Indian Phytopathological society, *Indian Phytopathology;* International Society of Plant Morphologists; *Phytomorphology;* Royal Agri-Horticultural society (1820), *Monthly Garden News Sheet;* Botanical Society of Bengal (1947), *Bulletin.*

ITALY: Societa Botanica Italiana (1880), *Nuovo Giornale Botanico Italiano.*

JAPAN: Phytoecological Society of Japan, *Annals of Phytoecology;* Phytopathological Society of Japan, *Annals;* Ecological Society of Japan (Nippon Seitai Gakkai) (1954), *Japanese Journal of Ecology;* Genetics Society of Japan (Nippon Iden Gakkai) *Japanese Journal of Genetics.*

MEXICO: Sociedad Botánica de México (1941), *Boletín.*

NETHERLANDS: Royal Netherlands Botanical society (Koninklijke Nederlandsche Botanische Vereeniging) (1845), *Acta Botanica Neerlandica* (1952).

POLAND: Polskie Towarzystwo Botaniczne (Polish Botanical society) (1922), *Acta Agrobotanica, Acta Societatis Botanicorum Poloniae, Fragmenta Floristica et Geobotanica.*

SWEDEN: Svenska Botaniska Föreningen (1907), *Svensk botanisk Tidskrift.*

SWITZERLAND: Schweizerische Botanische Gesellschaft (1890), *Berichte der Schweizerischen Botanischen Gesellschaft;* Société Botanique de Genève (1909), *Travaux.*

UNION OF SOUTH AFRICA: Botanical Society of South Africa (1913), *Journal.*

U.S.S.R.: Vsesoyuznoe Botanicheskoe Obshchestvo, *Botanicheski Zhurnal* (All-Union Botanical society, *Botanical Journal*); Akademiya Nauk SSSR, *Doklady Akademii Nauk SSSR* (Academy of Sciences of the U.S.S.R., *Proceedings of the Academy* [Botanical Sciences section]).

UNITED STATES: American Bryological society (1898), *Bryologist;* American Fern society (1893, inc. 1936), *American Fern Journal;* American Forestry association (1875), *American Forests;*

American Horticultural Society, Inc. (1922; combined with the National Horticultural society, 1926; and with the American Horticultural council, 1959), *National Horticulture Magazine;* American Phytopathological society (1908, inc. 1915), *Phytopathology;* American Pomological society (1848), *Fruit Varieties and Horticultural Digest;* American Rose society (1899, inc. 1921), *American Rose Annual, American Rose Magazine;* American Society for Horticultural Science (1903), *Proceedings;* American Society of Plant Physiologists (1924), *Plant Physiology;* Botanical Society of America, Inc. (1893, reorg. 1906, inc. 1939), *American Journal of Botany;* Ecological Society of America (1915), *Ecology, Ecological Monographs;* Massachusetts Horticultural society (1829), *Horticulture;* Mycological Society of America (1931), *Mycologia;* National Shade Tree conference (1923), *Proceedings, Arborist News;* Society of American Foresters (1900), *Journal of Forestry;* Torrey Botanical club (1867, inc. 1872), *Bulletin.* (F. S. Ht.)

HORUS (Egyptian Hor), an Egyptian sky-god in the form of a falcon whose eyes were the sun and the moon. The falcon therefore was sacred to him, and Horus' name was usually written with the figure of this bird . Originating probably in the delta of the Nile, the cult of Horus spread in prehistoric times over the whole of Egypt. Thus there arose several distinct falcon gods, particularly at Nekhen (Gr. Hierakonpolis, "falcon-town"), which was the capital of the upper Egyptian kingdom before the country was unified and the site of which is opposite the modern Al Kab; and at Edfu (Egyptian Behdet), where Horus, called there "the Behdetite," assumed the form of a winged sun disk. At Nekhen the conception arose that the reigning king was an incarnation of Horus and, after Egypt had been united by the kings from Nekhen, this conception became a generally accepted dogma. The first of the Egyptian king's five names was the Horus name; *i.e.,* the name which identified him with Horus.

With the god Setekh of Ombos in upper Egypt Horus lived in peace during the first dynasties as a partner in a joint incarnation of the king; Setekh remained the representative of upper Egypt, while Horus represented lower Egypt. Not later than the end of the 5th dynasty, however (*c.* 2425 B.C.), the cult of Osiris (*q.v.*) spread over Egypt, and Horus was introduced into the Osiris cycle. The deceased king having been by then identified with the god Osiris and the living and reigning king being an incarnation of Horus, Horus became the son of Osiris and of the goddess Isis, Osiris' sister-wife. As such he now became an opponent of Setekh, the murderer of Osiris and the contestant of Horus' heritage, the royal throne of Egypt. According to the myth Horus defeats Setekh, thus avenging his father and assuming the rule. In the fight his left eye (*i.e.,* the moon) was damaged—this being the mythological explanation of the moon's phases—and was healed by the god Thoth. The figure of the restored eye (*udjat*-eye) became a powerful amulet. After the battle, Horus mourned Osiris and conducted his funeral rites.

RICHARD HARRINGTON

HORUS, FROM THE HORUS TEMPLE AT EDFU, UPPER EGYPT

In later times Horus appeared as a local god in many places and under different names and epithets: as Harmachis (Har-em-akhet, "Horus in the horizon"); as Harpocrates (Har-pe-khrad, "Horus the child"); as Harsiesis (Har-si-Ese, "Horus, son of Isis"); at Kom Ombo as Haroëris (Har-wer, "the elder Horus" as distinct from "Horus the child"); at Dendera as Harsomtus (Har-sem-tow, "Horus, the unifier of the Two Lands"); and as Harendotes (Harend-yotef, "Horus, protector of his father"). Horus was identified by the Greeks with Apollo, and Edfu was called Apollinopolis ("Apollo's town") in the Greco-Roman period. Horus harpooning his enemy Setekh in the form of a crocodile was a potent magical figure and seems to have served as the model for St. George killing the dragon.

See S. A. B. Mercer, *Horus, Royal God of Egypt* (1942). (J. Čý.)

HOSANNA, in modern speech and liturgical usage, is a cry of praise to God. It has acquired this meaning through the assumption, perhaps correct, that it was so meant by the multitude that hailed Jesus on Palm Sunday (Mark xi, 9 ff.). If it was, it must already have become a (Jewish) liturgical cry rather far removed from its original meaning—the word is a Greek transliteration of Hebrew *hôshî'āh-nnā'*, "Save, (we) beseech Thee!" It meant, thus, entreaty, not praise (*cf.* Ps. cxviii, 25). If the crowd still knew its original meaning, they must have been addressing it to Jesus, the new David, as a plea for political salvation. (Ke. G.)

HOSE, a general term applied to flexible piping to convey liquids or gases. The word is derived from the old English word *hosa,* "a stocking."

The earliest flexible hose was made from the intestines of animals and is a classic example of a seamless unsupported hose. The biblical water skins made from animal stomachs retained portions of the esophagus and small intestine tubing for pouring purposes; these portions of tubing represent early examples of hose. Stiff leather strips wound in a spiral and bound with leather thonging may have been used in the elaborate plumbing systems in use in the Minoan civilization as early as 5000 B.C.

The growth of the rubber industry in the latter half of the 19th century saw great developments in the hose. The first step was to build layers of rubber around a pole or mandrel and, after vulcanizing the rubber, to remove the mandrel and thereby produce a flexible but collapsible tube. From that beginning it was a short step to introduce layers of rubberized canvas to the basic rubber tube which gave additional strength and therefore increased the burst pressure of the hose.

To prevent collapse of the hose, wire was then introduced in the form of a supporting helix and this process produced endless variations, dictated largely by the type of duty the hose had to perform. For example, an internal wire helix could be used for support together with an external armouring wire to give added protection and strength; a spiral wire could be embedded in the body of the hose; the hose itself could be corrugated by the use of wires to give added flexibility. With the introduction of extruded rubber tubing it was possible to produce any length of hose, the mandrel tubing being restricted of course to the length of mandrel. Again the problem of reinforcement was overcome in the case of extruded tubing by cotton braiding, wire braiding, the helical wrapping of wire and wrapping with rubberized canvas.

Various methods of curing extruded hose in long lengths were used but where considerable pressure during vulcanization was required, as in the case of an extruded hose containing braiding or rubberized canvas or both, in order to ensure a good bond between the constituent layers of the hose, the lead-curing process was a major advance. Briefly this consists of coating the complete but unvulcanized hose with a seamless layer of lead. This is done by passing the complete hose through an extruder which coats it with a layer of lead. The ends of the hose are sealed after it has been pressurized to a small degree and it is then vulcanized in an autoclave. During vulcanization the internal pressure within the hose increases owing to the expansion of the fluid because of the heat, and compresses the hose wall against the lead cover. After vulcanization the lead sheath is stripped from the hose.

Up to 1939 the techniques of hose manufacture were, broadly speaking, in advance of the materials available. Natural rubber was usually the basic material for the body or filler of the hose and the major manufacturers of hose were naturally the rubber companies who had pioneered the hose industry. There was a little synthetic rubber used, but taken as a percentage of the total usage this was negligible. The paucity of available materials severely restricted the usage to which the hoses could be put. For example, various acids, the aromatic hydrocarbons and numerous other chemicals had a harmful effect on rubber and limited the use of otherwise well-designed hose.

World War II stimulated the development of numerous synthetic rubbers, each with their physical and chemical characteristics which, in particular applications, gave added chemical resistance. Of the synthetic rubbers, neoprene shows a marked resistance to deterioration usually associated with exposure to ultraviolet rays and to ozone; nitrile rubber demonstrates great resistance to attack by the aromatic hydrocarbons; butyl rubber has excellent resistance to higher temperatures and also to certain inorganic acids; the Hypalon rubbers demonstrate great resistance to acids; silicone rubbers have excellent heat-resisting and dielectric properties.

The discovery of polyethylene prior to World War II and its commercial production opened a new field in plastics, and the rise to prominence after the war of polyvinyl chloride, or PVC, revealed a new range of materials available to the hosemaker. The discovery of polytetrafluoroethylene, or PTFE, produced a new plastic whose resistance to the majority of chemicals is outstanding and placed in the hands of the hosemaker a material which is more difficult to fabricate than other more commonly used substances but one which offers endless possibilities for the production of hoses resistant to most known liquids.

Metals have also been used with great success in the manufacture of flexible hose. These fall into two main types: the first is the winding of metal strip formed so that the edges of the strip interlock during the process of winding to form a continuous hose; the other main type is the seamless corrugated metallic hose where a rigid thin-walled tube of metal is corrugated either with parallel or helical convolutions which cause the metal tube to become flexible to a remarkable degree. It is customary to cover the outside of a convoluted metallic hose with wire braid, which is anchored to the end fittings. The purpose of the braid is to strengthen the hose and also to prevent it from expanding longitudinally under pressure. Metallic hoses are largely of use where high pressures and temperatures are in operation.

With the growth of the hose industry and the use of plastics and metals for hosemaking, new companies were formed whose business is exclusively hosemaking and to whom rubber is merely another material rather than the main constituent. A result of this adaptable outlook is a hose made from stainless steel wire and Dacron (Terylene) (polyethylene terephthalate). Dacron has the unusual quality of retaining its flexibility at ultralow temperatures. It is known to be still flexible at −196° C., which is the temperature of liquid nitrogen. By the use of Dacron it is possible to make a hose that can convey liquid oxygen, liquid nitrogen and numerous other liquids requiring ultralow temperatures and yet still remain flexible in the process. (P. W. O'B.)

HOSEA, BOOK OF, one of the Old Testament books of the Latter Prophets and the first of the Book of the Twelve or Minor Prophets (Hosea [Osee in the Douai version], Joel, Amos, Obadiah, Jonah, Micah, Nahum, Habakkuk, Zephaniah, Haggai, Zechariah and Malachi). Ch. i is the account of Hosea's marriage to Gomer and the birth of his three children. Ch. iii is generally taken as the story of the prophet's remarriage to Gomer after he had divorced her, symbolizing the reconciliation of Israel after the judgment. The rest of the book consists of oracles of judgment on Israel, primarily for its religious apostasy, with occasional predictions of redemption and restoration and pleas to repent.

Times and Life of the Prophet.—Hosea began to prophesy during the prosperous reign of Jeroboam II of Israel (*c.* 786–746 B.C.), when Israel's borders extended from Lebo-hamath (Revised Standard Version: "the entrance to Hamath") in Syria to the Sea of the Arabah (the Dead sea; *see* II Kings xiv, 23–27). Ch. i–ii (iii) come from this period. Ch. iv ff. come from the period of confusion and regicides that followed (*cf.* iv, 1–3; vii, 7). Jeroboam's son, Zechariah, reigned only six months, and his murderer, Shallum, only one month. Hosea may have continued to prophesy through the reigns of Menahem and Pekahiah into the reign of Pekah, whose alliance with Rezin of Damascus brought Tiglath-pileser III of Assyria against Israel, *c.* 734–732 B.C. (*see* v, 8–11, 13; compare II Kings xv, 29; xvi, 5–9). Hosea was thus a contemporary of Amos and Isaiah.

In contrast with the meaning of his own name, Hosea ("Deliver" or "Save") began with a message of judgment, evidenced in the names he gave his children—Jezreel, Not pitied and Not my people. He was a native of the kingdom of Israel and perhaps did most of his prophesying at the Bethel sanctuary, as did the Judaean prophet Amos. Much obscurity surrounds his marriage. To dramatize Israel's apostasy (harlotry), Hosea married Gomer, "a woman of harlotry" (a cult prostitute?), and gave symbolic names to the children. Variant answers are given to the following questions raised by ch. i–iii: (1) Was Gomer a harlot before her marriage? (2) Was Gomer faithless to Hosea after her marriage? (3) Was Hosea the father of the children? (4) Does the Lord's divorce of his faithless wife Israel in ii, 2 imply that Hosea had divorced Gomer? (5) Is Gomer the adultress bought by the prophet for a price in ch. iii? (6) Is ch. iii a sequel to ch. i, or is it the prophet's own account of his marriage, in contrast with the biographer's account in ch. i? (7) Does ch. iii refer to Gomer's life of shame before her marriage? (8) Does ch. iii recount a second marriage of Hosea? (9) Is ch. i or ch. iii an allegory, not an actual incident? (10) Is ch. iii a postexilic allegory, the editor using autobiographic style (*cf.* Jer. xvii, 1 ff., also editorial)? (11) Should iii, 1 be translated, "And the Lord said to me again, 'Go, love a woman . . .' "? Most scholars assume that in divorce and remarriage Hosea learned or expressed the love of God for wayward Israel. The data remain inconclusive.

Themes of the Book of Hosea.—*Judgment From a God of Love.*—The historic love of God for Israel is a central premise of the prophet. When Israel was a child, the Lord loved him, carrying him in his arms, leading him with cords of compassion, with bands of love (xi, 1–4). The names of Hosea's children, Not pitied and Not my people, imply an earlier time when the Lord was compassionate and regarded Israel as his people. Israel, as the Lord's wife, had been showered lavishly with the good things of the earth (ii, 8). Israel was to him like the cherished first fruits of the fig tree, like grapes in the desert (ix, 10). Only reluctantly the Lord brings judgment; he is pained that Israel forced him to bring retribution, for he would prefer to be Israel's healer (vi, 4, 11b; vii, 1, 13). The God of love is naturally prominent in the oracles of hope: the Lord loves the people of Israel despite their sins and will take Israel to himself (iii, 1–3), speaking tenderly to her and betrothing her to himself forever (ii, 14, 19–20); his compassion grows warm and tender, and his sons will return to their homes, and he will love them forever (xi, 8–11; xiv, 4).

But judgment must come on faithless Israel. The Lord had warned Israel but received only bitter provocation (xii, 10–14). He cannot ransom or redeem them from their deserved fate, and compassion is now hidden from his eyes (xiii, 14). He will no longer have pity and will love them no more (i, 8; ix, 15). Repentance comes too late (v, 6; vi, 1–4). The Lord will be as a moth or dry rot to Israel (v, 12), as a lion rending its prey (v, 14), as a lion or leopard lurking by the road, as a bear robbed of its cubs (xiii, 8). He will catch them like birds in his net (vii, 12). He will drive them from his house (ix, 15). The land will be devastated of its produce (ii, 9, 12; viii, 7; ix, 2, 6, 16). The trumpet of war will sound against Israel and the sword rage against its cities (v, 8; xiii, 16). Israel's kings will be killed and the kingdom come to an end (i, 4; vii, 7; x, 15). Israel will return to slavery in Egypt and eat unclean food in Assyria (vii, 16; viii, 13; ix, 3, 6; xi, 5; xii, 9). Israel is destined for prey, bereavement and exile (ix, 12–16). The sanctuaries will be devastated and abandoned (x, 2, 8; xii, 11), and the calf image at Bethel will be carried into exile (viii, 5; x, 5, 6).

Apostasy of Israel.—Whereas Amos (*q.v.*) was concerned primarily with Israel's disobedience of the ethical requirements of the covenant, the injustice and oppression in the social order, Hosea's chief care was Israel's worship of pagan gods and the licentious fertility cult practices. In Hosea the term harlotry designates both the apostasy of Israel, the wife of the Lord, and participation in the cult prostitution rites. The worship of Baal, the Canaanite god of rain (ii, 8; vii, 16; ix, 10; xiii, 1), and the Baals, the various Canaanite deities (ii, 13, 16; xi, 2), is harlotry. The calf image at Bethel, although part of the cult of the Lord, is condemned as idolatry (viii, 5–6; x, 5–8). Israel

(Ephraim) was joined to idols (iv, 17). Wine flowed too freely at the sanctuaries (iv, 11, 18). The shrines flourished, but the Lord took no pleasure in the sacrifices (vi, 6; viii, 11–13; ix, 4; x, 1–2). Guilty priests misled the people (iv, 4–10; v, 1; vi, 9), and the prophets were corrupted (ix, 7–8). Israel had transgressed the law and broken the covenant (viii, 1). There was no true knowledge of the Lord (iv, 1, 6; v, 4; vi, 6; viii, 2; xi, 3). Ethical evils also are condemned, including lying, killing, stealing, adultery, empty oaths, false balances and land grabbing by the princes (iv, 2, 13; v, 10; vi, 9; vii, 1, 4; xii, 7). The wicked kings are called to account (v, 1; vii, 3–7; viii, 4; x, 7; xiii, 10, 11). Like the later prophets, Hosea decried dependence on foreign alliances for the salvation of Israel (v, 13; vii, 8–12; viii, 9–10).

Forgiveness and Restoration.—The message of the Book of Hosea culminates in its picture of reconciliation and restoration of Israel. Israel will return to her husband (ii, 14–23; iii, 1–5; *cf.* Isa. l, 1–2). The exiles will come back from the lands of the Dispersion (xi, 10–11). As in Deutero-Isaiah the return from Exile is pictured as a second Exodus (ii, 14–15; *cf.* Isa. xliii, 16 ff.; xlviii, 20–21; li, 9 ff.). A covenant will be made with wild animals, birds and creeping things (ii, 18). War will be abolished (ii, 18; *cf.* Isa. ii, 4), and the land will be fruitful (ii, 21–23; xiv, 4–7). The government will be in the hands of the Davidic Messiah (i, 11; iii, 5). There will be no more reliance on foreign help or idols (xiv, 3, 8). In the style of wisdom literature, a separate editorial addition at the end of the book admonishes him who is wise to understand these things, for the ways of the Lord are right.

Literary History.—By the time the Book of the Twelve took its final form in the late postexilic period, the prophetic writings had undergone expansions, additions and changes. The literary form of the book of Hosea suggests it is a compilation; ch. i is biographical, ch. ii, iv–xiv a collection of poetic oracles and ch. iii autobiographical. The superscription (i, 1), giving data about the prophet, is editorial. Other editorial activity was in part an adaptation of the prophet's message to the needs and ideals of the postexilic community. It is found largely in the oracles of hope and restoration, some of which seem out of context and reflect more obviously than others the background and diction of the later period. A few scholars consider most or all of such passages to be late. Editorial activity may also be seen in the references to Judah, extending Hosea's message to include Judah or excluding Judah from some of Hosea's bitterest condemnations; in v, 12–14; vi, 4; viii, 14 Judah has been substituted for an original Israel or Ephraim. The Hebrew text is often corrupt, but the Greek and Syriac versions particularly give some help in its reconstruction. *See* also BIBLE.

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HOSHANGABAD, a town, *tehsil* and district in the Bhopal division of Madhya Pradesh, India. The town lies on the southern bank of the Narmada river 40 mi. (64 km.) S.S.E. of Bhopal. Pop. (1961) 19,284. Hoshang Shah Ghori, sultan of Malwa, founded it in the 15th century. In 1802 it was occupied by Wazir Mohammed, a minister of Bhopal, and in 1809 by the Marathas. In 1860 it became British territory. The town has a college and a school of oriental learning and theology, and it is a trade and agricultural centre served by the Central railway.

HOSHANGABAD DISTRICT (area 3,867 sq.mi. [10,016 sq.km.]; pop. [1961] 618,293) extends along the southern bank of the Narmada for about 120 mi. (193 km.), while its width is 22–40 mi. Adjoining the Narmada is a black-soil plain south of which the Satpura runs in successive ranges parallel to the valley, and to the northwest are the outliers of the Vindhya range. Forests cover 36.8% of the district. The principal crops are wheat, cotton and oilseeds. Brasswork, weaving and dyeing are the chief local industries. The towns are Hoshangabad (the administrative headquarters), Sohagpur, Seoni-Malwa, Harda, Pachmarhi, Itarsi and Piparia; the first four are *tehsil* headquarters, and Pachmarhi (4,000 ft. [1,219 m.] above sea level) is a hill station. At Itarsi junction railways radiate to Calcutta, Bombay, Delhi and Madras. (S. M. A.)

HOSHEA (in the Douai version of the Bible OSEE; Heb. "deliverance"), the last king of Israel, who ruled *c.* 732–723 B.C. (II Kings xv, 30; xvii, 1–6). The attempt of his predecessor, Pekah, to take Jerusalem with the help of Rezin of Damascus was frustrated by the intervention of the Assyrian king Tiglath-pileser III (*see* AHAZ), who attacked Gilead, Galilee and the northern frontier and carried off some of the population. Pekah's resistance to Assyria led to a conspiracy in which he lost his life, and Hoshea the son of Elah became king. Tiglath-pileser claims to have set him on the throne and extracted from him a yearly tribute. After the death of that monarch, Israel took steps to recover its independence. Its policy, however, vacillated "like a dove, silly and without sense" (Hos. vii, 11), and negotiations were opened with the Egyptian So, often identified with Pharaoh Shabaka or perhaps Shabataka of the 25th (Ethiopian) dynasty but more likely a certain Sib'e, the turtan (commander in chief) of Egypt who was later defeated by Sargon. When Israel's annual payment of tribute ceased, Shalmaneser V invaded Israel, imprisoned Hoshea and laid siege to Samaria, which fell at the end of three years to his successor, Sargon. The land was again partly depopulated and an Assyrian governor appointed. *See* also HOSEA, BOOK OF; ISAIAH, BOOK OF. (J. P. HY.)

HOSHIARPUR, a town and district in the Jullundur division of the Punjab, India. The town is situated 5 mi. (8 km.) S. of the Siwalik range and 25 mi. (40 km.) N.E. of Jullundur. Pop. (1961) 50,739. There are three arts and science colleges affiliated to the Punjab university. The town is an agricultural centre, and also specializes in the manufacture of inlaid woodwork and furniture and in the production of rosin and turpentine. It is well served by roads and is connected with Jullundur by rail. Hoshiarpur was founded, according to tradition, in the early 14th century. In 1809 it was occupied by Ranjit Singh (*q.v.*).

HOSHIARPUR DISTRICT stretches between the Sutlej and Beas rivers along the Siwalik range. Pop. (1961) 1,233,493; area 2,210 sq.mi. (5,724 sq.km.). The district is divided equally into hilly and plain regions. The hilly region, consisting of vast beds of sand, clay and conglomerates, has Jaswan Dun (valley) in the east. The upper part of the Dun is drained by the Sowan stream, and the lower part by the Sutlej. The plain is of alluvial formation with a general westerly slope. Numerous seasonal torrents that come down the steep slopes of the Siwalik hills have badly eroded the sub-Siwalik region. The average annual rainfall is about 32 in. and more than 30% of the total area is under cultivation, about one-third of which is irrigated. Rice, maize (corn), wheat, sugar cane, gram and cotton are the major crops. Religious fairs, which are held at Anandpur, Mukerian and in the temple of Chintpurni Devi, attract a great concourse of people. Anandpur was founded by Guru Teg Bahadur (the 9th guru of the Sikhs) and contains several Sikh shrines. (O. P. B.)

HOSIERY, coverings for the feet and legs designed to be worn inside shoes and other outer foot coverings. The term is so understood in most countries, particularly the United States, and is so used in this article, although in Great Britain it also includes machine-knitted garments of all types.

History.—The earliest known type of stocking or sock was mentioned by the Greek poet Hesiod in the 8th century B.C. when he referred to *piloi*, probably matted from animal hairs, as a lining for shoes. The Romans used a form of leg covering consisting of long strips of woven cloth or leather wrapped around the foot, ankle or leg, in a manner resembling the puttees of World War I military uniforms. *Udones*, first mentioned in the 2nd century A.D., were probably the forerunners of the modern stockings. They were cut and sewn from woven fabric, felt or skins and were pulled over the foot. Their major disadvantage was the lack of elasticity,

a quality inherent in knitted fabrics and a matter of importance in proper fit, especially at the ankle and knee.

Hand-knitted fabrics were known before the year A.D. 256, and knitted socks discovered in tombs in Egypt have been dated between the 3rd and 6th centuries A.D. A child's knitted sock, or sandal, divided at the great toe and found in a tomb at Antinoe, Egy., can be seen in the Leicester, Eng., museum.

Hand-knitted stockings in their 20th-century form were in being in Europe about 100 years before the mechanization of knitting and were of a better quality than the first machine-knitted stockings. Indeed, Queen Elizabeth I was reputed to have refused the grant of a patent of monopoly to the inventor of the first knitting machine because the stockings produced on it were comparatively coarse, unlike those imported from Spain, which were finer and, incidentally, made of silk.

The first knitting machine, invented in 1589 by the Rev. William Lee of Calverton in Nottinghamshire, Eng., was so perfect in its conception that it continued to be the only mechanical means of knitting for hundreds of years. The inventor, having failed to obtain a patent, crossed to France with his machines, but died there in poverty in 1610. His brother, who had accompanied him, returned to England to bring out improved models, from which time the framework knitting industry really began. The number of frames in Great Britain increased from an estimated total of 650 in 1660 to about 43,000 in 1844. Many were exported in spite of laws prohibiting their removal from the country. Framework knitting started in America in the middle of the 17th century on a smuggled machine.

A charter was obtained by the framework knitters from Oliver Cromwell in 1657, but he died before it could be properly implemented, and the Worshipful Company of Framework Knitters did not really come into being until a charter was granted by Charles II in 1663.

In Great Britain, Luddism, *i.e.,* machine breaking as a means of intimidating employers, one of the protests against the technological displacement created by the Industrial Revolution, probably had its roots in stocking manufacture, for a dispute between frame owners and knitters resulted in frames being thrown through the windows of a framework knitter's shop in Spittlegate, London, as early as 1710. (*See* also LUDDITES.)

The hand stocking machine provided the sole mechanical means of producing stockings and other knitted articles for approximately 250 years, although stockings still had to be fashioned (shaped) by hand manipulation and then hand seamed. The frame was gradually improved, the first modification for which a patent was granted being the introduction of rib knitting by Jedediah Strutt in 1758. However, the general principles of knitting embodied in the frame are incorporated in all modern machines, and the bearded spring needle—a part of Lee's original machine—is used in all machines producing full-fashioned stockings.

In 1900, 88% of all women's stockings were of cotton, 11% of wool and 1% of silk. By 1929, 99% were of silk or of artificial silk (rayon). Nylon, introduced about 1940, almost immediately eliminated the silk trade. It looked better than silk, was tougher and could be manufactured into very sheer stockings. "Nylons" wore well and fitted beautifully; moreover, they were attractive, plentiful and reasonably priced. Subsequently, the history of women's hosiery was concerned mainly with changing fashions rather than with materials or methods of manufacture.

Stocking Manufacture.—Coverings for the feet and legs can be produced on several types of knitting machines (*see* KNITTING). Materials used are nylon, cotton, wool, silk, rayon, etc. In the manufacture of stockings, either plain knitting or the "mesh" or spread-loop structure, which has run-resisting properties, can be used. The weight of the finished product depends upon the size of the yarn and the gauge, or needle spacing, of the machine. Nylon yarn is measured as denier, the smaller numbers designating the finer yarns; thus 15 denier yarn is finer than 30 denier, and yarns as fine as 10 denier can be used. Gauge in full-fashioned hosiery is the number of needles in 1½ in., the higher numbers signifying closer stitches. The sheerness of the stocking depends upon the combination of gauge and denier. Thus 60 gauge, 15 denier nylon hosiery is closer knit than 51/15 and for that reason is somewhat less sheer (although the yarn is the same size) but wears better; 60/30 and 51/30 are considerably heavier and much less sheer.

Full-fashioned hose, knitted flat and then seamed up the back, are made on a straight-bar machine or Cotton's patents, invented in Loughborough, Leicestershire, Eng., by William Cotton in 1864. These machines may have up to 40 knitting heads, each simultaneously knitting one stocking "blank"—the piece before it is seamed. Knitting, which is back and forth across the fabric (weft knitting), begins at the top with the welt, a section of extra thickness to give additional strength for gartering and extra stretch around the thigh. Below the welt is the afterwelt (antiladder band), not as thick as the welt but thicker than the leg of the stocking; its purpose is to stop runs (ladders), and in some stockings it is patterned. The leg or panel part is then knitted, the fabric being shaped by reducing the number of needles that are knitting. At the heel part the fabric is widened again (by increasing the number of needles that are knitting); through the foot part it is narrowed again, until finally at the toe only about eight needles are knitting. The complete knitting operation commonly takes place on one machine; before World War II two machines—one for the leg and one for the foot—were commonly used. After the blanks are knitted they are seamed, boarded (placed on stocking forms and heated, a process that gives nylon a permanent shape), dyed and finished.

Seamless stockings are knitted on circular machines; latch needles, brought into use in the middle of the 19th century, are normally used in this type of machine. Such stockings have been made for many years, but, because stitches cannot be added or dropped in circular knitting, the resulting product was a straight knitted tube that did not fit as well as full-fashioned hose. The thermoplastic properties of nylon yarn, enabling a permanent shape to be formed in the tube, contributed to a marked degree to the move in the 1950s from the full-fashioned to seamless nylon hosiery for women.

In seamless, as with full-fashioned stockings, the welt is made first, followed by an afterwelt. The leg part, or panel, is then knitted with a spliced area preceding the formation of the heel pouch. The foot follows, again with a spliced area in the foot bottom. The toe pouch is made on the same principle as the heel pouch. The toe is closed either by seaming or by linking or looping, that is, joining two rows of loops, done on a machine called a looper. The finishing operations are similar to those for the full-fashioned product. The most popular gauge is 400 needle in a 3¾-in.-diameter machine (approximating 51 gauge in full-fashioned stockings) and deniers are mainly 30 or 15.

Normally, machines for circular-knit stockings have one or two feeders; *i.e.,* they knit one or two rows each time the cylinder makes one revolution, but from the 1950s three-, four-, six- and eight-feeder machines were introduced. Some of these machines were not equipped to make the connectional-type heel or toe and therefore produced what is known as the "tube" stocking. The boarding or setting operation forms the heel shape and plain knitting or a mesh structure can be used.

Warp-knitted stockings have been produced for many years, but the use of nylon yarns on these machines has increased interest in them. The stocking blank shape can now be marked out on the machine.

Half Hose and Sock Manufacture.—Half hose and socks can be made on a plain circular machine with rubber thread in the welt or, more usually, on a double cylinder machine, invented in Leicester, Eng., in 1900, and employing a double-headed latch needle. The double cylinder machine is able to produce half hose and socks in "string" formation (that is, continuously), with a welt, rib top, leg, heel pouch, foot, and toe pouch, in plain, rib or a pattern. After the individual articles have been separated, the toe is closed by linking or looping, and the item is put through its finishing operation. In some instances the toe is seamed, a quicker but less satisfactory operation.

Cotton and wool continue to be favoured materials for socks, although some are made of nylon, which is widely used with other fibres as a reinforcement for the areas of abrasive wear at the toe

and heel. A system of twisting the yarn and making use of its thermoplastic qualities produced a finished sock that would stretch through several sizes and return to its original shape, thus fitting the foot better. (J. C. H. H.)

HOSIUS (commonly accepted orthography now OSSIUS) (*c.* 256–357/8), bishop of Córdoba, ecclesiastical adviser to the emperor Constantine I and chief defender of orthodoxy in the west against early Donatism and Arianism, was born in Spain (probably at Córdoba) and was consecrated bishop of Córdoba about 295. He attended the Council of Elvira (Granada, *c.* 300) and from 312 till 326 acted as ecclesiastical adviser at the court of Constantine, who in 324 sent him as imperial legate to the east to settle the Arian dispute. Hosius convoked a synod at Alexandria of the Egyptian bishops, and another at Antioch of the bishops of the east at which Arius and his followers were condemned. On the suggestion of Hosius, Constantine then summoned the first ecumenical Council of Nicaea in the summer of 325. As president, Hosius was influential in securing the inclusion of the *homoousios* (*see* ARIUS) in the creed issued by the council. In 343 he presided at the Council of Sardica. From 353 till 356 he strongly resisted the efforts of Constantius II to have Athanasius condemned by the western bishops and in a famous letter reproved the emperor for intruding into ecclesiastical matters. Summoned to Sirmium in 356 and detained at court for a year, after threats and physical violence Hosius signed the frankly Arian formula of Sirmium (357) but retracted his signature before his death.

See Athanasius, *Historia Arelanon*, ch. 44, for Hosius' letter. *See* also A. Hamman, *Migne Patrologia Latina, Supplementum*, vol. i, col. 194–196 (1958); V. C. De Clercq, *Ossius of Cordova* (1954).

HOSIUS, STANISLAUS (STANISŁAW HOZJUSZ) (1504–1579), Polish cardinal, described by St. Peter Canisius as the most brilliant writer, the most eminent theologian and the best bishop of his time, was born on May 5, 1504, of a German father, Ulrich Hos, in Cracow. On completion of his studies at Cracow he went to Padua and Bologna to read law and theology. He was made bishop of Chelmno in 1549, and translated to Warmia in 1551. At the synod of Piotrkow (1551) he drew up a profession of faith, later expanded into his *Confessio catholicae fidei Christiana*, which saw 30 editions in his lifetime. He was created cardinal in 1561 and was one of the five papal legates in the last period of the Council of Trent. He died at Capranica, near Rome, Aug. 5, 1579.

See Hosius' works in 2 vol. (1584) and A. Vacant (ed.), *Dictionnaire de théologie catholique*, vol. vii (1922). (ER. G.)

HOSKINS, JOHN (d. 1664/5), English miniaturist, perhaps a pupil of Isaac Oliver, and father of John Hoskins junior. He is believed to have been born in the 1590s; a John Hoskins made a will in 1662 and was buried in St. Paul's, Covent Garden, on Feb. 22, 1664/5, but it is uncertain whether the father or the son made that will and died at that date. Samuel Cooper (d. 1672), the great miniaturist and nephew of Hoskins senior, bequeathed money to his cousin John Hoskins; it is possible that a third John Hoskins, son of John II, is involved. Signed miniatures by the eldest Hoskins date from about 1620; the latest date on a Hoskins miniature, be it by the father, the son or by both in collaboration, is 1664. With Nicholas Hilliard, Isaac Oliver and Samuel Cooper, whom he trained, John Hoskins senior is in the front rank of English miniaturists. His early work is in the Hilliard-Oliver tradition; his later work shows the influence of the oil portraiture of Van Dyck, D. Mytens and Cornelius Johnson. He and his son copied subject pictures by old masters.

See Graham Reynolds, *English Portrait Miniatures* (1952). (C. H. C. B.)

HOSKYNS, SIR EDWYN CLEMENT (1884–1937), 13th BARONET, Anglican theologian who, at Cambridge, strongly influenced biblical study at a turning point in its development, was born Aug. 9, 1884, in London. Educated at Haileybury college and Jesus college, Cambridge, he was ordained in 1908, and after a curacy was warden of Stephenson hall, Sheffield (1912–15), and an army chaplain (1915–19). From 1919 until his death in Cambridge, June 28, 1937, he was dean of chapel, Corpus Christi college, Cambridge.

In *Essays Catholic and Critical*, edited by E. G. Selwyn (1926), Hoskyns exposed the subjectivity of the liberal Protestant reconstruction of the "Jesus of history." In *The Riddle of the New Testament* (1931; with F. N. Davey) he showed that study must concern itself not so much with what has partial analogies outside the New Testament as with what, within it, is strange and unparalleled, however unpalatable to modern humanism, for with this the New Testament writers were preoccupied. In the last resort, not the historian but the theologian must examine what the biblical writers were trying to communicate and what it means. Sensitive to the danger of imposing modern humanistic ideology upon the Bible, Hoskyns found congenial much in Karl Barth's *Epistle to the Romans*, which he translated (1933). But his theology remained radically different from Barth's. His work on St. John's Gospel (his unfinished commentary on which was published in 1940) taught him to hold together the apostolic appeal to history and the apostolic interpretation of history, and gave him the theological eloquence which influenced so profoundly those who heard him lecture or preach. (F. N. D.)

HOSMER, HARRIET GOODHUE (1830–1908), U.S. sculptor, was one of the leading American women sculptors working in Rome and perhaps the only woman sculptor of the Roman group to win complete financial independence by her work as a sculptor. Born at Watertown, Mass., on Oct. 9, 1830, she early showed an aptitude for modeling, and studied anatomy with her father, a physician, and afterward at the St. Louis medical college. She then studied in Boston until 1852, when she went to Rome with her friend the actress Charlotte Cushman. From 1853 to 1860 she was the pupil of the English sculptor John Gibson. She lived in Rome until a few years before her death.

Among her works were "Puck" (1855), which she copied for the prince of Wales, the duke of Hamilton and others; "Oenone" (1855), in the St. Louis (Mo.) Museum of Fine Arts; "Beatrice Cenci" (1857) for the Mercantile library of St. Louis; a bronze statue of Thomas H. Benton (1868) for Lafayette park, St. Louis; bronze gates for the earl of Brownlow's art gallery at Ashridge hall; and a siren fountain for Lady Marian Alford. She died at Watertown, Mass., on Feb. 21, 1908.

See Albert T. E. Gardner, *Yankee Stonecutters* (1945). (A. T. G.)

HOSPITAL, a place equipped and staffed for diagnosis and treatment where sick and injured persons receive medical care of such nature that some patients are required to utilize a bed during part or all of their stay. A hospital may be contrasted with a clinic or dispensary for ambulatory patients who return to their homes after each visit; also, with a "home" for aged, convalescent, infirm or indigent persons requiring mainly custodial care and in which little or no medical service is provided.

The word hospital is derived from the Latin, *hospitium*, a place where guests (*hospes*) were received, and the adjective *hospitalis*. Related forms are hospice, *hôpital*, hotel, spital and hostel. Modern English emphasizes the word hospital, with occasional use of hospice or hostel to signify a home. The word hotel has become synonymous with inn as a place for travelers or guests, but in French the term *hôtel Dieu* indicates a public hospital.

History of Hospitals.—Some evidence exists that places for the congregation of the sick, and the facilities for their care, were set up when man established his first communities. Medical treatment has always been associated with religious service; early priests served as physicians, or medicine men. Pre-Christian religions identified certain of their deities with healing as early as 4000 B.C. Temples were specially dedicated to Saturn, Asclepius or Hygieia, and they served as both medical school for practitioners and resting place for patients under observation or treatment. Historical records indicate the existence of such edifices in Greece, Egypt, Babylonia and India. India seems to have had the first country-wide system of hospitals. In about A.D. 402 the Chinese pilgrim Fa-hsien visited India and mentions that he found hospitals at many points.

The Christian era emphasized the hospital as an asylum for travelers and victims of disaster. By the 4th century A.D., Christian church members in the Roman empire had established hospitals for lepers, cripples, the blind and the sick poor. The Hôtel Dieu of Lyons, France, was founded in A.D. 542, and hospitals of the

Arabian kingdom existed throughout Spain, north Africa and western Asia. Religious communities emphasized care of the sick, and sisterhoods and brotherhoods devoted much of their time to nursing, with hospitals constructed adjacent to the monasteries. The first solely nursing order is considered to be the St. Augustine nuns, organized about 1155.

The work of physicians and surgeons was separate from hospitals during the medieval period. Even by the time St. Bartholomew's hospital was established in London in A.D. 1123 the physicians, apothecaries and blood-letting surgeons practised their professions in home or office, with only hopeless and homeless cases finding their way to hospitals. The Renaissance period emphasized science in the healing arts, and the Reformation saw the beginnings of secular support of hospitals when Henry VIII endowed St. Bartholomew's hospital in London. European explorers of the 16th and 17th centuries helped religious brotherhoods create institutions for the homeless and sick poor of the western world. The Hospital of Jesus of Nazareth, founded by Cortés in Mexico City, 1524, is the oldest institution with continuous service in the Americas. Missionaries, aided by well-to-do citizens in France and Canada, established the Hôtel Dieu, Quebec, in 1639, and the Hôtel Dieu, Montreal, 1644.

During the 18th century, scientific advances in Europe ultimately were reflected in the treatment of hospital patients, with vaccination against smallpox in England, 1796, and the unshackling of mental patients in France, 1793. In the United States the Philadelphia almshouse, which was founded by the Society of Friends (Quakers) in 1713, was used for treating the insane beginning in 1732 and ultimately became the Philadelphia General hospital. The Pennsylvania hospital, Philadelphia, established 1751, was the first hospital constructed solely for sick and injured persons in the United States. Other early institutions were the New York hospital, 1771; the Massachusetts General hospital, 1811; and the New Haven hospital, 1826.

The 19th century witnessed important developments in the United States. State-owned hospitals were constructed for the insane; local government facilities were opened for the aged, infirm, the sick poor and victims of contagious disease. These trends also characterized English and continental European institutions. The church hospitals established in the 19th century were primarily for underprivileged persons. Self-supporting patients were treated in private dwellings or nursing homes conducted by individual medical practitioners.

Military Hospitals.—Military activity has greatly influenced the history of hospitals and medicine. Records mention military surgeons as early as the time of Homer and military hospitals during the reign of Hadrian. Hospitals were established along the routes of the crusades in the medieval period as resting places for the wounded as well as centres of religious influence. The treatment of wounds provided the opportunity and need for new surgical procedures, and conditions of combat stimulated the grouping of patients in hospitals for treatment by military physicians and their assistants. (*See* MEDICAL SERVICES, MILITARY.)

During the Crimean War, 1854, Florence Nightingale, a volunteer nurse with the British army, achieved the first effective coordination of scientific medicine and humanitarian care of patients in hospitals. Her theories and principles were rapidly applied throughout the world, and in the United States her birthday, May 12, has been celebrated as National Hospital day since 1924. Since early after its formation in 1863 the Red Cross has conducted hospital service programs for disasters and emergencies, such as fire, flood, famine or military occupation.

World Wars I and II resulted in further contributions to hospital expansion and management. Among the specific advances were: (1) the discovery that good medical care can be provided in improvised facilities, including such varied structures as tents in the theatre of operations, public buildings, private homes, ships, barges, trains, ambulances, airplanes and even submarines; (2) development of the mobile field hospital, with physicians, nurses and supplies following the movement of troops for emergency treatment; (3) the mass movement of convalescent patients for distances and by means previously considered impossible; (4) the control of contagious diseases by large-scale methods later adapted to civilian practice.

Classification of Hospitals.—The two major bases of classification are by type of ownership and type of service. As to ownership, hospitals are: (1) governmental (national, state, provincial or local); or (2) nongovernmental, including the proprietary conducted for private gain and the voluntary conducted on a nonprofit basis by churches, fraternal orders or independent associations.

Most hospitals throughout the world, except in the United States, are government owned. But every country contains a number of small proprietary institutions, usually with a capacity of fewer than 50 beds, owned by one or two physicians for the care of well-to-do patients. They provide less than 5% of the total bed capacity of the world.

The use of the term voluntary to describe private nonprofit institutions arose in England, where hospitals were administered by religious groups or secular associations and were supported by voluntary contributions from the general public. Patients also made some voluntary financial contributions, and physicians served without monetary reward. Members of the royal family and aristocracy sponsored drives for funds for specific hospitals. The forerunner of what later became the King Edward's Hospital fund, London, was developed in 1897 for contributors who wished to support voluntary hospitals as a group.

In the United States, the term voluntary is applied to any hospital conducted by a church or religious order, a fraternal society or an independent nonprofit association. Such institutions are available for use by the entire population. The affairs of voluntary hospitals are controlled by trustees who serve without pay in these capacities and who are responsible for designating the medical staffs, for employment of the administrator and for the professional and financial policies of the institution. Typically, the medical staff serves free and part-free patients without remuneration but charges fees to private patients under personal care and supervision in the hospitals.

As to type of service, hospitals may be general or special. A general hospital accepts all types of medical or surgical cases, usually concentrating upon acute illnesses requiring short-term care, including maternity service and the care of children. A special hospital is one that limits service primarily to single classes of patients or types of illnesses, particularly mental and tuberculosis cases and those requiring isolation because of contagious conditions. Special hospitals for short-term cases are less common than formerly, with a tendency for hospitals for children, maternity, cancer, crippled, etc., to become affiliated with general hospitals in order to improve quality of service and economy of administration. Special sections for mental and contagious cases have been established in many general hospitals.

British Hospital Service.—In 1948 hospital care in Great Britain became part of the national social security program, which included physicians' services, dentistry, drugs and convalescent care. The various voluntary hospitals were originally directed by boards of governors selected from civic, industrial and professional leaders of their communities. Such boards were continued as hospital management committees and were co-ordinated under the National Health act, which, on July 4, 1948, vested the title of all acceptable voluntary hospitals in the national minister of health. Proprietary hospitals were not involved in the change in title although the act authorized a change of this sort. The local committees are no longer responsible for raising funds to finance the hospitals. Their function primarily is to advise the hospital administrator (house governor or secretary) in budgeting and expenditure of monies received from the national exchequer. Control of all hospitals financed under the act, except those operated in connection with medical schools, is exercised by 14 regional boards. These boards are set up as corporate bodies and their members are appointed by the minister of health. The minister is advised by the Central Health Services council, which he appoints. Members of the council, as well as the regional boards and hospital management committees, serve without pay. Hospitals that provide facilities for undergraduate or postgraduate clinical teaching have their own boards of governors that are re-

sponsible directly to the minister of health.

Patients are accepted for care in British hospitals without direct cost to themselves, after consultations with the medical specialists who serve the hospitals on a full-time or part-time salary basis. There is limited private medical practice in hospitals under the National Health act for patients who choose to pay for the use of private facilities in the hospital. Some well-do-do patients elect to be cared for in nursing homes or clinics that are not included in the national health plan; there they pay fees for hospital care as well as to the attending physician or surgeon. The services provided under the National Health act are financed in part by compulsory contributions from each adult person; the balance of the costs are met from other forms of national taxation.

National Hospital Insurance Plan of Canada.—A joint federal-provincial program of hospital financing was started in Canada on July 1, 1958. This plan provides for the national government to match the provincial governments in the cost of financing the operating expenses of Canadian hospitals. The ownership and management of the hospitals were not disturbed. The cost of physicians' services is not included in the plan. The federal share of the expense is borne from general taxes, while each province may elect to pay its share from general taxes or from personal premiums paid by insured persons and families.

Hospitals in the United States.—The approximate 7,000 U.S. hospitals have about 1,670,000 beds and make about 25,500,000 admissions annually. The corresponding rates are therefore about 9.2 beds and 139 admissions per 1,000 population. On an average day the number of hospital patients in the U.S. is 1,390,000, establishing an occupancy rate of approximately 85%. The average stay in a short-term general hospital is 7.5 days; this type of hospital, of which there are about 5,500, accounts for about 92% of all admissions, although possessing only 39% of the total beds.

About 4,000,000 births annually, or about 94% of all recorded births, occur in U.S. hospitals. Hospital bassinets for the newborn total about 105,000.

Government hospitals comprise about 32% of the institutions and 70% of the beds, but they account for only 24% of the annual admissions. They include nearly all the bed facilities for mental and tuberculosis patients, the former group remaining in the hospital approximately three years on the average, the latter about ten months. In sharp contrast, the nongovernmental hospitals dominate hospital service for general medical and surgical cases, including maternity. The nongovernmental general hospitals contain 28% of all beds but receive 74% of all inpatients annually.

Many government hospitals are very large. The state mental hospitals and the federal hospitals for veterans usually exceed 2,000 beds, as do certain local government institutions for medical and surgical cases, notably Bellevue hospital, New York city; Philadelphia General hospital; Cook County hospital, Chicago; St. Louis City hospital; and Los Angeles County hospital.

More patients are using hospitals than ever before and their length of stay is briefer in all types of institutions. The average length of stay in general hospitals was reduced by about 50% between the mid-1930s and the 1960s. Advances in medical science permit early ambulation of patients with resulting shorter convalescence. Consequently, hospitals are able to serve more patients with the same plant and equipment.

Hospital Finance.—The replacement value of hospitals in the United States is approximately $17,500,000,000. The annual hospital bill for the United States approximates $8,400,000,000, or about $47 per person. There are about 1,700,000 professional and institutional employees with an annual payroll of $5,700,000,000, which constitutes about two-thirds of the hospitals' expenses. Patient revenue makes up about 93% of all monies received by the voluntary short-term hospitals.

The financing of hospital care in the United States was revolutionized through the development of prepayment plans. About 122,000,000 persons in the United States have such protection. More than 109,000,000 of this group are covered for surgical and medical expenses if admitted to a hospital. The pioneer in the prepayment movement was the Blue Cross plans that started in 1929. These plans have contracts with hospitals and provide hospital "service" to their subscribers rather than offering cash indemnity. (*See* also HEALTH INSURANCE.)

Outpatient Service.—In some urban hospitals the number of outpatients greatly exceeds the number of inpatients. About 4,000 U.S. hospitals provide service to about 110,000,000 outpatients a year; such patients do not occupy beds and do not stay overnight. There is a growing trend for physicians to locate their private offices near hospitals so they can refer patients to hospitals as outpatients for use of diagnostic and therapeutic services.

Co-ordinated Hospital Systems.—Many small hospitals correlate their work with the services of medical specialists in large institutions, thereby avoiding the necessity of providing duplicate professional personnel and scientific apparatus and equipment. In 1946 congress encouraged the principle of co-ordinated hospital systems in states and regions through the Hospital Survey and Construction act, which has appropriated an average of $125,000,000 annually for surveys and construction of necessary facilities, particularly in rural areas. The states and local communities are required to provide two-thirds of the total costs of approved projects.

The American Hospital association, organized in 1899, is the national organization of hospitals. It conducts information and co-ordination services for the improvement of hospital administration, including institutes or short courses on such subjects as nursing, accounting, personnel, purchasing, laundry management, public relations, etc. The American College of Hospital Administrators is the professional society for hospital administrators. Organized in 1933, it has a membership of about 3,700 and carries on a program of educational activities aimed at continuing improvement in the professional competence of the hospital administrator. The first college course in hospital administration was offered at The University of Chicago in 1934. Sixteen universities in the U.S. now offer formal training in this field.

Hospitals are the training centres for medical and nursing education throughout the world. In the United States, medical education in hospitals is supervised by the Council on Medical Education and Hospitals of the American Medical association. In the early 1960s, 1 or more hospitals were directly affiliated with each of the recognized medical schools, about 870 were used for the training of interns and about 1,250 offered residency training in the various medical specialties. There were also about 1,000 schools for the training of professional nurses in the hospitals of the United States. These schools had a total enrollment of over 120,000.

The Hospital Council of Philadelphia, established in 1946, exemplifies a trend in large cities toward the co-ordination of hospital service, research in administration, contacts with public bodies, nursing education, central purchasing, uniform accounting and relations with the medical profession. Such groups are financed by membership dues from hospitals and contributions from philanthropic sources.

Hospital Management and Operation.—The modern hospital is a complex institution engaged in a variety of activities. Design and construction have changed to reflect trends in medical science. Important trends include the following: (1) patients' rooms contain fewer beds, mostly one or two beds in new institutions; this permits greater flexibility in use by patients of different age, sex or medical condition; (2) air conditioning has offset the disadvantages of cold or warm climates and has reduced dangers of infection during treatment or convalescence; (3) buildings are higher, to reduce construction costs, utilize land space and conserve time of nursing employees (the first hospitals to exceed 15 stories in the United States were St. Luke's, Chicago, 1925; Jefferson, Philadelphia, 1927; Hahnemann, Philadelphia, 1928; Presbyterian, New York city, 1928; New York hospital, 1931; many other "skyscraper" hospitals have been erected since that period); (4) outpatient facilities are expanding in order to utilize effectively the various types of scientific diagnostic apparatus; (5) group medical practice is developing in hospitals, with many part-time or full-time physician members using offices provided by the institutions; (6) schools of nursing are being provided with special facilities and quarters; (7) departments of social service are supplementing medical science by emphasis on personal and environ-

mental problems; (8) an increasing number of hospitals in large cities are providing home care for discharged hospital patients; (9) an increasing number of volunteers are providing part-time services to hospitals on a voluntary basis. There are now more than 1,500,000 such volunteers; they devote from a few hours to a few days each week to service in the hospitals.

Hospital care involves a high degree of readiness-to-serve costs, inasmuch as certain administrative, professional and household personnel must be employed regardless of the number of inpatients or outpatients served. Accordingly, great emphasis is now placed upon professional or administrative practices that will achieve a high degree of utilization of the beds and scientific apparatus.

The modern hospital differs widely from the place of custody or isolation in early times and from the last refuge for the sick poor. Patients enter a hospital with confidence, knowing that chances of recovery are greater than elsewhere and that every phase of medical knowledge and skill will be devoted to restoring them to health and normal life. The modern hospital has become the logical centre for all preventive and curative health services.

See CLINIC; *see* also references under "Hospital" in the Index volume.

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(C. R. Ro.; R. E. Bn.)

HOSPODAR, a term of Slavonic origin meaning "lord" (Russ. *gospodar*). It is a derivative of *gospod*, "lord," and is akin to *gosudar*, which primarily means "sovereign." In Ukrainian the title *gospodar* (Pol. *gospodarz*) is specially applied to the peasant master of a house or head of a family. The rulers of Walachia and Moldavia were styled hospodars from the 15th century to 1866. At the end of this period, as the title had been held by many vassals of Turkey, its retention was considered inconsistent with the growth of Rumanian independence. It was therefore discarded in favour of *domn*, which continued to be the official princely title up to the proclamation of a Rumanian kingdom in 1881.

HOSTA, a genus of popular garden perennials of the family Liliaceae (*q.v.*), comprising ten species, all from China and Japan, as well as several horticultural varieties grown for ornament under the name of plantain lily or funkia. They have tuberous rhizomes, basal, plantainlike leaves and attractive clusters (racemes) of drooping, funnel-shaped, blue, white or lilac flowers. They are much grown for edging and in borders and are of the easiest culture, most of them doing well in partial shade. Propagation, which is easy as they are prolific growers, is accomplished by division.

HOSTAGE, in war, a person handed over by one of two belligerents to the other, or seized as security for the carrying out of an agreement or for preventing violation of the law of war. The practice of taking hostages is very ancient and has been used in cases of conquest, surrender and armistice. The Romans often took the sons of tributary princes and educated them at Rome, thus holding a security for the continued loyalty of the conquered nation, and also instilling a possible future ruler with ideas of Roman civilization. The British adopted this practice in the early period of the occupation of India, as did the French in their relations with the Arab states of north Africa. Hostages were detained as prisoners of war until the negotiations or treaty obligations were carried out. In ancient times they were punished or put to death in case of treachery or refusal to fulfill promises. The practice of taking hostages as security for the carrying out of a treaty between civilized states became obsolete in the 18th century. The last occasion was at the treaty of Aix-la-Chapelle in 1748, when two British peers were sent to France as hostages for the restitution of Cape Breton to France.

In modern wars, hostages have been taken as a measure of reprisal to assure observance by the enemy of the law of war in respect to such matters as the treatment of prisoners and the sick and wounded. The Geneva convention of 1949 forbade reprisals against prisoners of war, and persons taken as hostages are entitled to the treatment of prisoners of war. Vicarious punishment of enemy individuals for war crimes committed by other enemy persons is not favoured by the modern law of war. Even more doubtful is the practice of taking hostages to assure observance by the civilian population of regulations imposed in occupied territory for the security of the occupant's forces and communications and for the payment of contributions. This practice was extensively resorted to by the Axis powers during World War II, but war crimes tribunals after the war found the execution of hostages taken for these purposes to be a war crime except, in the opinion of one tribunal, under very exceptional circumstances.

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(Q. W.)

HOSTEL, the old name for an inn (*see* HOSPITAL), later used to describe a building providing lodgings for students and other groups, especially workers employed on new industrial projects outside towns or in towns with insufficient accommodation. In the 20th century the word also came to be used to designate the houses which were opened in many countries by youth hostels associations which aimed at providing cheap, simple overnight accommodation in country places for walkers and cyclists. The movement began in Germany, arising out of the romantic bands of *Wandervögel*, groups of young people who in about 1900 worked their way from place to place, sleeping out-of-doors and collecting folklore and folk music. The first hostel was opened in 1910; the idea soon spread to Switzerland and the Netherlands. The Youth Hostels association (of Great Britain) was founded in 1930; later separate Scottish and Irish associations were formed and the title became the Youth Hostels association (England and Wales). The first international conference was held in 1932, and in 1933 an International Youth Hostel federation was formed. In 1934 American Youth Hostels Inc. was founded and by the 1960s there were hostels in more than 20 countries, including Australia, New Zealand and Canada, and some north African countries. Members of national associations were able to use hostels in other countries. After World War II international work camps were organized to help rebuild hostels damaged during the war.

Youth hostels vary greatly in size and in the facilities they offer, but at most hostels in Great Britain supper and breakfast are provided, although there is always a kitchen where members may do their own cooking. Sleeping accommodation is generally in dormitories. As well as paying a small sum for services, members are allotted a duty by the warden, who is responsible for the upkeep and good order of the hostel.

See O. Coburn, *Youth Hostel Story* (1950).

HOSTILIAN (GAIUS VALENS HOSTILIANUS MESSIUS QUINTUS), Roman emperor A.D. 251, younger son of the emperor Decius (*q.v.*) who made him *Caesar* in 250, was adopted by Gallus (*q.v.*) after his father's death and made joint emperor, but died of the plague soon after. (JN. R. M.)

HOTCHPOT or HOTCHPOTCH, in common law the name given to a rule of equity whereby a person, interested along with others in a common fund and having already received something in the same interest, is required to surrender what has been so acquired into the common fund, on pain of being excluded from the distribution.

The same principle is to be found in the *collatio bonorum* of the Roman law: emancipated children, in order to share the inheritance of their father with the children unemancipated, were re-

quired to bring their property into the common fund. It is also found in the law of Scotland.

HÔTEL DE VILLE, the town hall of a French municipality. The most ancient example, which was still preserved perfectly in modern times, was that at St. Antonin (Tarn-et-Garonne) dating from the middle of the 12th century.

Other fine town halls are those of Compiègne, Orléans, Saumur, Beaugency and St. Quentin. The Hôtel de Ville in Paris, built in the 16th century, burned by the Commune in 1871, has since been rebuilt on an extended site, the central portion of the main front being a reproduction of the old design. There is only one town hall in a French town, those erected for the mayors of the different *arrondissements* in Paris being called *mairies*. *See* GOVERNMENTAL ARCHITECTURE.

HÔTEL DIEU, the term applied in France to any hospital in the middle ages, now reserved to those whose history goes back to medieval times. Many examples from the Gothic period still remain, notably that of Angers (1153–84), the so-called *salle des morts* at Ourscamps (early 13th century) and that of Tonnerre (*c.* 1300). In all of these the most important feature is a vast hall in which were placed the beds for the sick. In the two earliest the hall is divided into three aisles by pillars and vaulted so that four rows of beds on either side of the pillars were possible. At Tonnerre the great hall, nearly 60 ft. wide and 300 ft. long, was roofed with wooden trusses and had a wooden barrel vault ceiling. The beds were in little chambers along the sides, open to supervision from a gallery that ran continuously around the side walls immediately below the window sills.

At Beaune the *hôtel Dieu*, founded in 1443, is of quite different character, occupying three sides of a courtyard, in two stories. In addition to the halls for the sick, various other rooms for the use of the nuns were furnished. The whole is a picturesque Gothic timber construction.

HOTELS AND INNS. The word "hotel" is of ancient origin but its use in English for a house offering lodging and food for travelers is recent. The hostelers of London took the name of innholders in 1473, the word "hostler" or "ostler" having come to mean merely an inn servant. As early as 1327 the hostelers of London were mentioned in certain chronicles and in 1446 regulations were made for the proper government of their profession. A charter was granted to the innholders of London in 1514. The word "inn" has been in use since about 1400, and it was not until 1800 that "hotel" (derived from the Old French *ostel*) became fashionable. The word "inn" itself is closely related to the preposition "in" and can be used as a verb meaning "to lodge" or "put up," being so used by Chaucer. The inn was a place of sojourn for travelers, pilgrims and wayfarers. The tavern, from the Latin *taberna*, was a wine shop in Tudor times mainly found in the cities and larger towns for the retail sale of wines, though it might also provide cooked meals. A 17th-century regulation said that "it must not be accounted a small matter to afford house room, lodging, rest and food to the comfort of God's children," and Richard Burn in his *Justice of the Peace and Parish Officer* (1755) stated that "if an alehouse lodges and entertains travelers, it is also an inn." An act of 1604 mentioned that "the ancient, true and proper use of Inns, Alehouses and Victualling Houses was for the Receipt, Relief and Lodging of Wayfaring People traveling from Place to Place . . . and not meant for the entertainment and harbouring of Lewd and Idle People to spend and consume their Money and Time in Lewd and Drunken Manner." The English inn originated in connection with the religious houses of medieval times, but there are many earlier parallels. As a group of lodgings round a court or yard there is some likeness to be traced between the caravansary (*q.v.*) of the ancient east and a later form such as the Inns of Court in London. The Romans must have provided the province of Britain with places of lodging and entertainment, together with the posting houses of the Roman roads and the taverns of the Romano-British cities, though only the sign of the Bacchic wreath or garland of vine leaves survived after the Roman occupation.

EDWIN SMITH

COURTYARD OF THE NEW INN, GLOUCESTER, ENG., 1450

GREAT BRITAIN

There were inns in ancient Britain along the main Roman roads, but the English inn in its modern form cannot be traced any further back than the middle ages, although there is some substance in the claims to antiquity of such inns as the Angel at Grantham, Lincolnshire (1213); the George and Dragon at Speldhurst, Kent (1270); and the King's Head at Aylesbury, Buckinghamshire (shortly after 1386). In Chaucer's *Canterbury Tales* the Tabard at Southwark, London, has all the features of a modern hotel, including a table d'hôte meal and a reckoning.

Hospitality dispensed by monasteries to travelers was at first an informal service but later separate dormitories and refectories were established with certain monks detailed to look after the guests. From the special hospices erected later, adjacent to the monastery or abbey at a key point on the roadside, the inn developed in Christian Europe primarily as a service to the traveler. The Trip to Jerusalem at Nottingham, with its reference to the crusades, claims to be the oldest inn in England, with rough or stained floors, common bedrooms and meals self-provided. Pilgrimages and crusades increased the demand for inns. In medieval times the inn seems to have developed first in the larger towns, and in the earliest inns the wayfarer was expected to supply his own food, fuel and bedding. Elsewhere wayfarers depended largely on the hospitality of manorial lords and of religious houses. In the countryside many inns developed after the dissolution of the monasteries under Henry VIII. Some modern English inns indisputably began as monastic hospitia; *e.g.*, the New Inn in Gloucester and the George at Glastonbury, Somerset. The earliest accounts of the English inn date from this period and the development of the inn in late medieval and early Tudor times must be related to the improvement of the internal security of the country.

Before the middle of the 16th century the plan of the inn had developed the conventional form that it retained until the coming of the railways. The centre of the premises was an enclosed cobbled courtyard, often with an imposing arched entrance from the main street, with the kitchen and public rooms occupying the main structure. Other rooms were in a galleried structure fronting two sides of the courtyard with stables and outbuildings on the fourth side. Sometimes in very large inns the outbuildings surrounded a second courtyard opening from the main one. A few such inns survive in part (*e.g.*, the New Inn, Gloucester, and the Golden Cross, Oxford), though usually the gallery has been built in later. Remaining examples, however, are the Bull at Dartford, Kent; the George at Huntingdon; the Red Lion at Colchester, Essex; the George at Southwark; and the White Hart at Chipping Norton, Oxfordshire.

It is in the 16th century that the first statutory reference to inns is found. Magistrates were ordered to take sureties from innkeepers, as from alehouse keepers, for the maintenance of good order in their houses. The act was repealed in 1828 but its basic principles still form part of English law. The legal definition of an inn is still unsatisfactory. It is said to be a "house where the traveller is furnished with everything he has occasion for while on his way"; or "house the owner of which holds out that he will receive all travellers and sojourners who are willing to pay, and who come in a situation in which they are fit to be received"; or "premises having a full excise licence and containing accommodation for permanent and casual guests." From the 17th century there are many literary references to specific inns in both general literary works and the journals and diaries of travelers in England.

The Coaching Age.—Stagecoaches are first mentioned in 1637, and by the middle 1650s the beginnings of the public stagecoach system had appeared. The system developed throughout the 18th century and lasted until the coming of the railways in the 1840s.

Many coach services were first established by innkeepers who were anxious to attract custom to their houses. Until the end of the coaching era, coach terminals and "stages" were almost invariably at inns. Old inns were rebuilt (or often refronted) and new inns were built, especially on the great trunk roads radiating from London. Thus the Rose and Crown, Saffron Walden, Essex, was refronted in 1748; the White Hart, Salisbury, Wiltshire, an enormous inn covering nearly an acre, with a very fine classical portico, was completely rebuilt in 1800; and the County, Taunton, Somerset, was refronted in 1820. The Blue Boar, Maldon, Essex, was refronted in sombre gray brick *c.* 1800, but a wing containing some untouched 15th-century work remained visible from the yard. Some of the greater coaching inns of this period were designed to serve many of the purposes of a modern railway station, with booking offices, waiting rooms and through bookings along a whole network of routes centring at the inn. A good example of an inn of this kind with a total of 23 passenger services centring there is the Royal, Cheltenham, Gloucestershire. A common feature in an 18th-century town inn is the assembly room—sometimes now partitioned into bedrooms but originally designed as the centre of social activities in the town. The Lion at Shrewsbury, Shropshire, has a very fine Adam assembly room (1777) and the Cups, Colchester, has another that is later but almost equally beautiful. Sometimes, when the assembly room occupies the first-floor front, it has a balcony, which may continue to serve as a rostrum for public speakers; *e.g.,* at the White Hart, Salisbury. One survival of the coaching period is at the George, Stamford, Lincolnshire, where the 18th-century dining-room doors north and south are labeled respectively Edinburgh and London.

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WHITE HART HOTEL, SALISBURY, ENG., REBUILT IN 1800

The Coming of the Railways.—With the development of the railways, coach services virtually disappeared. The railways, however, preserved the sites and sometimes the very signs of the coaching inns and a few remain as railway district goods and parcel offices; in London the railway office in Aldersgate street preserves the memory of the Elizabethan Castle and Falcon; 65 Gresham street is a vestigial survival of the Swan with Two Necks (recorded from 1556); and the office at 138 Borough High street is the successor to the Catherine Wheel (*ante* 1534).

The general effect of the advent of railways upon the older, established English hotels was disastrous, as they naturally reduced the time that travelers had to spend on their journeys. Many hotels went out of business or were substantially reduced in size and many once-famous inns became for the time little more than mere public houses; *e.g.,* the Bell in Holborn, London, the Bull's Head, Meriden, Warwickshire, and the Castle, Marlborough, Wiltshire. While a few hotels were built in holiday and show towns and in health resorts, for instance the Randolph at Oxford (1864–66) and the Wellington at Tunbridge Wells, Kent (?1870), the Victorian era was in general a time of neglect and even of decay for many hotels of the older kind.

The development of the first railway hotels, beginning with the Euston and the Victoria in 1838, both at Euston station in London, was due, of course, to the necessity for accommodation as long-distance travel became more general. Other station hotels soon followed, the Great Western Royal at Paddington (1854), the Charing Cross (1863) and the St. Pancras. In the terminal cities outside London, moreover, there was often more than one railway hotel; *e.g.,* the St. Enoch and the Central in Glasgow and the North Western (Lime street, 1871–1933), the Exchange and the Adelphi in Liverpool.

Modern Times.—At the end of the 19th century, with the invention of the safety bicycle and the rapid development of the automobile, traffic came back to the roads. Many old hotels were reopened and became more imposing and more prosperous than ever. The renaissance of the English roadside hotel dates from the 1890s.

In 1878 was founded the Bicycle Touring club (later the Cyclists' Touring club), which maintained a register of inspected and approved hotels. The Royal Automobile club (1897) similarly registers and indicates hotels. Two other institutions that had an influence on hotelkeeping out of proportion to the number of houses that they controlled were the People's Refreshment House association, founded in 1896 by F. J. Jayne, 33rd lord bishop of Chester, and the various country trust companies, founded from 1904 onward under the inspiration of the 4th Earl Grey and mostly later absorbed into P.R.H.A. or into Trust Houses Ltd. The aim of these associations was the reform of the English public house (the word being used in its widest sense to include hotels, inns, taverns and alehouses) by centralized control with inspection of local managers, fixed and reasonable prices, no tie for alcoholic refreshments (no ties to any brewery company), the encouragement of catering of all kinds and the provision of residential accommodation. Most of the properties sponsored by these organizations are hotels in the ordinary sense of the word; and these include many of the oldest and most interesting ones in England—the Angel and Royal, Grantham; the Dolphin, Southampton, Hampshire; and the King's Head, Aylesbury. Of the remainder a few are "free houses" (no ties), and vary in excellence, the best being very good indeed. Other hotels in Great Britain (apart from a few hundred residential ones in pleasure resorts, spas, seaside towns, etc.) are almost always owned or leased by a brewery company.

Two pioneers of the modern catering trade were Felix Spiers and Chester Pond, Englishmen who had met in Melbourne, Austr., in the 1850s and made a small fortune by supplying gold prospectors with food and drink. They later returned to London where they secured a catering contract from the old Metropolitan railway. The railway companies had not yet realized that supplying food and drink to the traveling public might be a source of profit and could even be part of their business. The Great Western railway had even agreed that no train could ever pass through Swindon station, Wiltshire, without stopping for at least 20 minutes, a condition that the refreshment contractor had insisted upon and one that delayed for some years all attempts at speeding up. Long before the first Pullman dining car had been introduced into England in 1879 between Leeds and London, Spiers and Pond had done what they could to improve the railway catering and had gone further afield.

The 1880s saw the rise of the luxury hotels of London. Richard D'Oyly Carte (1844–1901) opened the Savoy hotel off the Strand in 1889 with what was then the distinction of having 70 bathrooms, 6 elevators and electric lighting throughout; and it was he who brought César Ritz (1850–1918) to London, who with his friend Georges Auguste Escoffier revolutionized London's social life. For the first time, people left their homes to dine out on Sunday, and within ten years the directors of the Savoy had acquired not only Claridge's (reopened 1898) and the Berkeley (originally the Gloucester coffeehouse, terminal of the mail coaches from the west country) in Mayfair, but also the Grand hotel in Rome. Ritz left the Savoy in 1897 to go to the Carlton; his own Ritz hotel was opened in 1906, on the site of the former Walsingham house in Piccadilly. In 1897 the London Hotel Victoria, off Trafalgar square (opened in 1887 at a cost of £5,200), accommodated 500 visitors when fully let in June. Frederick Gordon, who conceived the idea of stately hotels and who also founded

EDWIN SMITH

THE RITZ HOTEL, LONDON, 1906

several restaurants in the City, became chairman of the Gordon hotels group which he promoted in 1889 with Sir J. Blundell-Maple. What Gordon and Blundell-Maple had done for the rich middle classes, D'Oyly Carte and G. Reeve Smith did on a higher level for the benefit of society and the wealthier visitors to London. At the same time the development of the large and more modest hotels near Holborn took place: Harold Walderck first rebuilt the Bedford, where in 1800 there had been a coffeehouse, and in 1907 founded the Imperial in Russell square. By the middle of the 20th century his company, the Imperial London Hotels Ltd., controlled nine hotels, including the Tavistock (1951), the first new hotel opened in London after World War II.

EUROPE

Ancient Rome.—A hotelkeeper in imperial Rome would not receive guests unless they carried a letter of evection from the reigning authority. Without this a tourist would not be lodged in any of the large hostelries, called *mansiones*, situated along the main routes. Everyone realized that the magistrates kept a strict eye on these inns, where army officials would lodge as well as tourists and where the mail carrier would call, but no one felt entirely free or at ease, for the proprietor, it was well known, would listen at the doors. (This was paralleled later in France by Cardinal Richelieu's keeping innkeepers in the pay of his police.)

Any guest not in possession of a letter of evection (a letter of authority for travelers on government business) was obliged to lodge in less elegant surroundings; though they were mean, these inns were numerous enough to give their names to certain regions and often surrounded places of entertainment, such as circuses. The Appian Way, for example, was full of inns where all kinds of orgies, immoralities and thefts took place, encouraged somewhat by the last of the Roman emperors. The law required hoteliers to keep a nightly vigil, except during religious festivals or during public mourning or civil celebrations. He was also required to note down the name, station and nationality of his guests.

Middle Ages.—Until the middle ages conditions were very much the same all over Europe, although road traffic was severely cut as a result of the fall of Rome, affecting the inn a great deal. Later, as in Britain, hospitality was dispensed by the monasteries and other religious institutions. By the 12th century it again became safe to travel and innkeeping quickly developed on the main routes. A law of 1254 forbade French innkeepers to accept any but bona fide travelers; in 1315, as a check on crime, they were made to replace three times the value of any effects belonging to anyone who died on the premises that were not handed over to the authorities. Standards rose steadily and a traveler's guide of 1589 clearly defined the difference between the types of accommodation available to those who traveled on business or pleasure.

Modern Europe.—The Riviera, stretching from Pisa to Marseilles, was popular even in Roman days; the Phoenicians and Greeks made their trading posts there and the Romans built their roads along it. But it was not until the 19th century that its delightful climate was really discovered; rich Englishmen left the winter behind; Polish and Russian noblemen fleeing from the blizzards of the northern winter were the first guests; and the Victoria and Westminster hotels and the Russian churches in the larger towns are reminders of this. For the ever-increasing tourist trade attracted to the south of France, the "season" (which was the winter) is reversed and the summer months, especially July and August, are the most popular.

BY COURTESY OF THE GERMAN TOURIST INFORMATION BUREAU

HOTEL PETERSBURG, KONIGSWINTER, GERMANY, COMPLETED 1914

The growth of tourism from the middle of the 20th century stimulated hotel building in capital cities and historic centres and also at holiday resorts. In Italy a chain of hotels, the Jolly hotels, was founded to serve holiday makers, often at places where such catering had previously been insufficient to meet their needs. In Spain government-owned *paradores*, established in 1929, provide tourists with accommodation for a stay of limited duration at places of special interest. In Scandinavia hotels and pensions exist in reasonably adequate numbers, and in Norway in particular much building took place after World War II. In some parts of Sweden an organization called Svenska Turistföreningen established hotels that are open to travelers who are members of a recognized touring or sporting organization. The Royal Norwegian Automobile club has a few tourist huts and chalets in country districts, and mountain huts and youth hostels are also available. In Denmark mission hotels run by a religious organization provide accommodation at a reasonable price for anyone; though no licence can be obtained for these establishments, they are convenient for the majority of people who travel frequently. The government supervises to a degree the running of most hotels in Denmark; prices are fixed and frequent inspections are carried out, which ensures a high standard of cleanliness. The capital cities of Europe are well provided with luxury hotels on the grand scale.

(D. S. W.)

UNITED STATES

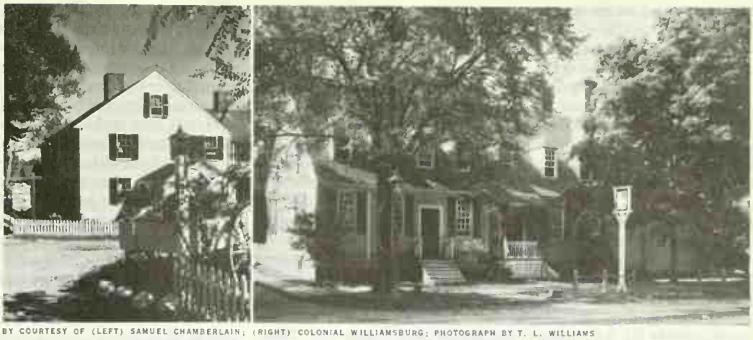
In the United States a hotel is generally thought of as an establishment that provides lodging, or lodging and meals, for the general public. The term includes hotels that are operated by membership organizations such as the Y.M.C.A. and are open to the general public, as well as apartment hotels that provide some accommodations for transient guests. The newest form of lodging establishment is the motel, or motor hotel, which provides services similar to those of a hotel but caters mostly to the motoring public and provides convenient parking facilities. Included in the category of motels are motor lodges, motor courts, motor inns, tourist courts and the like. The term motel has won widespread acceptance as the most suitable word for a motor hotel; tourist court is the nomenclature of a bygone era, even though one still finds it used in some parts of the country.

The magnitude of the hotel industry is indicated by the fact that the annual receipts of all U.S. hotels and motels totaled about $4,000,000,000 in the early 1960s. Hotels have traditionally had the largest percentage of the receipts in the lodging industry, but motels increased their share of the market in the years following World War II. By the early 1960s there were about 50,000 motels in the United States, as compared with 29,000 hotels. Receipts of motels amounted to about 25% of the total income of the lodging industry, hotels receiving 75%. The lodging industry serves three major groups: (1) persons attending conventions; (2) commercial travelers; and (3) vacationers and tourists. In the commercial traveler and tourist markets, hotels and motels compete with one another in most areas of the country; there is a fairly large concentration of motels in the south and west, while hotels dominate in the northeast and north central regions. The convention market is centred mainly on a small number of hotels located in large metropolitan areas, primarily in New York and Chicago. It is this type of concentration that explains why approximately 550 hotels, or about 2% of all establishments, account for 41% of all hotel receipts. In contrast with hotels, motels are generally small and approximately half of them have no paid employees. The motel industry in the United States represents one of the few cases where it is accurate to characterize an industry as consisting mainly of small businesses.

History.—The first American hotels were Atlantic seaport inns and converted farmhouses scattered along the stagecoach routes. When the canals and railroads succeeded the stagecoach as the

principal means of transportation, the wayside inn gave way to larger hostelries built along the canals and near the railroad depots. As cities grew, new hotels arose in the business centres and theatrical districts.

By 1929, when for the first time the federal government included hotels in the census enumeration of business establishments, the lodging industry had come to the end of its first major period of expansion. During the 1920s there was a 35% increase in the number of hotel establishments and a 47% increase in the number of rooms. By 1960, on the other hand, the number of hotels had not risen much above the 1929 total, though there was a small increase in the number of rooms. The forces behind the great surge of hotel construction in the 1920s were the same as those that made America the land of expansion and speculation. It was a period of prosperity, business optimism and rapid industrial development; it was the era when every city, town and village in the United States wanted a hotel "better than the Waldorf."



BY COURTESY OF (LEFT) SAMUEL CHAMBERLAIN; (RIGHT) COLONIAL WILLIAMSBURG; PHOTOGRAPH BY T. L. WILLIAMS

(LEFT) OLD YARMOUTH INN, YARMOUTHPORT, MASS., *c.* 1696; (RIGHT) MARKET SQUARE TAVERN, WILLIAMSBURG, VA., LICENSED AS A TAVERN 1767

When the depression came in the 1930s the overbuilding of hotels had its effects, as four out of every five hotels went bankrupt at least once, while many experienced numerous financial reorganizations. The country's largest hotel, the 3,000-room Stevens in Chicago, was supposedly "depression proof," but its occupancy rates in the 1930s were extremely low. Widespread rate cutting dominated the industry in the '30s. Not until World War II did occupancy rates reach a high enough level to earn a profit on the room capacity added in the preceding decade.

With the end of World War II hotels embarked upon a vast rehabilitation and modernization program at an estimated cost of several billion dollars. Only a handful of new hotels were built in the United States after the 1920s but by the 1960s most establishments were far different from their original structures. Typical examples of the refurbishing and modernization program are the former Lincoln hotel in New York, now the ultramodern Hotel Manhattan, and the former Stevens hotel in Chicago, now owned by the Hilton chain and renamed the Conrad Hilton.

While the hotel division of the lodging industry was going through a stage of refurbishing and modernization, there was a great surge in construction of new motels. The number of motels doubled between 1948 and 1960 while the number of rental units tripled. To an increasing degree commercial travelers and tourists used motels because they were built near main highways. Despite the gains of motels in the commercial market, these establishments continued to be largely dependent upon the tourist trade.

DICK SMITH

WAYSIDE INN, SUDBURY, MASS., 1686

Hotel chains have always played a significant role in the lodging industry, with the Statler and Eppley chains representing some of the most famous hotels of the 1920s. Since the 1940s motel chains have also become important, even though the typical link between establishments is the franchise agreement rather than direct ownership. Under a franchise agreement the individual proprietor retains ownership but uses a widely advertised name, such as Howard Johnson or Holiday Inn. In the early 1960s there were approximately 170 hotel-motel chains in operation in the United States. The Hilton corporation had 47 establishments and 34,000 rooms (including operations abroad); the Sheraton corporation had 59 establishments and 31,000 rooms. In the franchise group, Holiday Inns of America, Inc., had approximately 200 affiliates with a combined total of 20,000 rental units, while the Howard Johnson's Motor Lodges had approximately 100 establishments and 7,000 units.

Types of Hotels and Motels.—The main categories of hotels and motels are transient, resort and residential. Establishments are classed as "mainly transient" when at least 75% of the guests are not permanent residents. Although it is common for a transient hotel to have at least some permanent guests, a residential hotel has practically no transients because the services provided do not usually meet the needs of the traveler. The guest in a typical transient hotel in the United States can expect a room with private bath, telephone, radio and television; in addition, he may expect that there will be available a coffee shop, dining room and cocktail lounge; one- or two-day laundry service, cleaning, pressing and valet services; a barber shop; newsstand and cigar counter. Because of the wide variety of services offered by transient hotels, only about one-half of their income is derived from the room charges; the other half comes from the sale of food and beverages.

Resort hotels are designed to serve guests whose principal requirements are pleasure or relaxation and who visit such hotels to enjoy the recreational facilities or the scenery of the surrounding areas. In the middle years of the 20th century the most popular resort hotels were in the south, particularly in Florida, in contrast with an earlier period when the New England region was an important resort area. The switch from Maine to Florida as a play area for vacationing Americans came largely because of the increased importance of winter vacations. Some resort hotels in the United States operate on the American plan where the cost of the meals is included in the charge for the room. Others operate on the European plan where the rate covers only the room and guests are free to make their own arrangements for meals. All transient hotels in the United States operate on the European plan.

(J. P. He.)

THE FAR EAST

In the *ryokan*, the traditional Japanese inn, the rooms are divided in many cases by sliding doors, while the necessary offices

are centralized in an open courtyard. Doors with locks do not exist. High in the wall of each room is a carved wood grille through which one may determine whether or not a room is occupied. The rooms are simple and have clean floor boards with a few mats scattered about. There is usually either a balcony or a wall that will fold back like a screen to reveal a glorious view over a river or an exquisite garden. There is never a communal restaurant, for food is served and even cooked in the room. A reservation cannot be made at such an inn for in earlier times traveling from one part of the country to another could take any amount of time, especially since most people then traveled on foot. Modern hotels are also to be found, the Imperial hotel in Tokyo being the most prominent.

In China in the 13th century the relay house was established by the Mongols to accommodate travelers and provide a postal service. This type of establishment still exists to a large extent and is controlled by the government. In India and Pakistan few hotels outside the large centres reach European standards. There the dak bungalow (also government-controlled), run by a *khansara* ("keeper"), caters for the traveler, but one can expect to be accommodated for only 24 hours and no reservations can be made. Food is not provided and there is a fixed price for the bed. The luxuries of modern Europe are to be found in the larger cities if desired. (D. S. W.)

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HOTELS AND RESTAURANTS, LAWS CONCERNING. In law, the words "hotel" and "inn" mean the same thing, namely, a public house where all suitable travelers are lodged for a reasonable compensation. A mere eating place not supplying lodging, for example a restaurant, is not an inn. In an early English case (*Thompson* v. *Lacy,* 3 B. & Ald. 283), Justice William Best defined an inn as "a house, the owner of which holds out that he will receive all travellers and sojourners who are willing to pay a price adequate to the sort of accommodation provided, and who come in a situation in which they are fit to be received." To establish the innkeeper-guest relationship which obligated the innkeeper to take extraordinary care of the guest's goods, the common law required that food, lodging and stabling be provided, but the courts no longer insist on all these requirements. The distinctive features of the modern hotel are that it receives transient guests and furnishes them with lodging; the supplying of food is no longer necessary to charge the hotelkeeper with the strict liability of the common law. A mere customer at a bar, restaurant or barbershop operated by a hotel is not a guest, nor is one who simply goes to a hotel to visit a guest or to attend a ball or banquet (even if he buys liquor or food).

The hotelkeeper is required by law to receive as guests all suitable travelers who apply for lodging, and a refusal without just cause makes him liable for damages. Admission may be denied, however, when there are no accommodations, or if the traveler is unwilling or unable to pay the price asked, or where he is drunken, disorderly or has a contagious disease, or desires the room for illegal purposes. The hotelkeeper cannot offer to take in the traveler but not his luggage, unless the traveler comes with "something exceptional which is not luggage—such as a tiger or a package of dynamite" (*Robins & Co.* v. *Gray,* 2 Q.B. 501 [1895]).

The hotel need not receive the traveler until tendered the price of the room, although this is usually waived in practice, and charges for accommodations must be reasonable. It is not necessary physically to register to become a guest, as where the clerk merely hands the traveler the key to a room. The clerk may assign the guest to any proper room and may change the room at will. A guest may be evicted from a hotel if he refuses to pay his bill when so requested, if he gives up his traveler status and becomes a resident, or for drunkenness, disorderly or illegal conduct. One ceases to be a guest when he pays his bill and departs from the hotel, but the innkeeper-guest relationship continues a reasonable time for removal of luggage.

Hotels may make and enforce reasonable rules to prevent immorality and conduct offensive to other guests; the rule that a person without either luggage or proper identification will not be assigned to a room is reasonable. Hotels have special rules governing the care of animals, and one cannot insist upon bringing a dog or cat into a room where other guests are. Local ordinances on safety in public places apply to hotels, and smoking in bed, for example, is generally prohibited. Once assigned to a room, the guest has a right of occupation for all lawful purposes, subject to the hotelkeeper's right of reasonable and proper entrance to see that his rules are being complied with, or upon the happening of an unanticipated emergency. The hotelkeeper is not an insurer of the person of his guest against injury, but is responsible only for the exercise of reasonable care for his safety, comfort and convenience. The guest is entitled to privacy and to freedom from abuse and unjustified interference from hotel employees and other guests. Wrongful interference with a guest by an employee, acting within the scope of his employment, is actionable, as where a house detective falsely accuses a guest of immoral conduct and orders him to leave. Necessary force may be used to remove a guest who conducts himself improperly and refuses to leave when so requested. Guests who intentionally carry away hotel linens commit larceny. Hotels may close during reasonable hours, but a traveler arriving late at night may demand admittance.

The common law gives the innkeeper a specific lien (*q.v.*) on the guest's goods until compensated for his charges. This lien is "doubtless a survival of an ancient power of legally permitted self-help" (J. H. Beale, *Innkeepers,* par. 257). The hotelkeeper's lien is now statutory, and extends to goods brought by the guest into the hotel (*infra hospitium*) even though never actually delivered to the hotelkeeper. After published notice, the hotelkeeper may sell luggage on which there is a lien to recover his charges. One who surreptitiously removes such luggage commits larceny.

At common law, the innkeeper is an insurer for the loss in his inn of the goods of the guest, except where the loss arises from negligence of the guest, an act of God, or the public enemy. This harsh rule has been somewhat modified, and most states no longer hold the innkeeper liable, in the absence of negligence, for losses due to an accidental fire; however, he is still liable for losses by theft or robbery committed by an employee of the inn, by a stranger or by another guest. But theft from a guest by a companion he brings with him to the inn is the guest's own negligence. Again, a guest's failure to lock or bolt his door is evidence of negligence. Statutes on hotelkeepers' liability differ from state to state, but a very common provision limits their liability if they maintain a safe for the deposit of money or valuables and give notice thereof to the guest by signs posted in prominent places, for example, the guest's room. If the guest complies with the notice, the strict liability of the innkeeper at common law is unaffected.

A private lodging or boardinghouse is not an inn, the keeper of such a house being free to choose his guests, while the innkeeper is not; also, the lodger makes an express contract for a certain time and rate (weekly or monthly), while the guest at an inn stays from day to day upon an implied contract. A hotel may have a double character, being a lodginghouse to some and an inn to others. Motels or auto courts appear to be subject to the law of innkeepers.

Restaurants.—An establishment furnishing the public with food and drink, without lodging, is a restaurant, not an inn, and the duties and liabilities of the innkeeper at common law are not applicable to restaurants. However, the proprietor of a restaurant may rent rooms to travelers and thereby make his establishment also an inn. In law, the term restaurant includes cafeterias, tearooms, sandwich shops, etc., but not a place that sells only soda

water and ice cream, or a bar that serves liquor (unless food is also available there). A restaurant must use due care to furnish wholesome food, fit to eat, and failure to do so, resulting in injury to a customer, makes the proprietor liable in a lawsuit. The service of food is usually considered a sale with an implied warranty of fitness for human consumption, but some states also permit a suit in negligence.

The restaurateur is responsible for the negligent or willful torts of his employees, as where a waiter spills food on a customer's suit or uses physical force or threats against the customer, but insulting language which results only in humiliation or embarrassment is not actionable. Reasonable force may be used to eject a customer, even after he has ordered a meal, for intoxication or disorderly conduct. The facilities of restaurants are available to all persons without discrimination as to race or colour, but the right to patronize them normally rests upon local ordinances and state statutes which vary considerably in wording and enforcement.

The restaurateur is a bailee and is liable in the absence of due care for the loss or damage to a customer's property left for safekeeping with an attendant. If a waiter or other person, acting within the scope of his employment, takes a customer's wrap for deposit in a safe place, a bailment (*q.v.*) results; but if the waiter merely hangs the wrap on a wall hook near the customer's seat, or if the customer himself places the wrap on such a hook to which other patrons have equal access, there is no bailment. The bailment of a coat does not entail responsibility for objects left in its pockets, where the objects are unknown to the attendant. The words "Not Responsible for Hats and Coats" printed on a menu will not relieve a restaurant of a bailment liability. Where a parking-lot attendant takes a customer's automobile at the entrance and redelivers it when called for, a bailment is created, and the same is true where the customer is given a claim check and is required to surrender it in order to reclaim the automobile, even though he is not required to leave the keys. Where there is no attendant, and the customer himself parks the automobile and keeps the keys, there is no bailment. A statement limiting liability printed on a parking check or posted on a conspicuous sign does not necessarily prevent a bailment from being created.

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HOTHOUSE: *see* GREENHOUSE.

HOTMAN, FRANÇOIS, SIEUR DE VILLIERS SAINT-PAUL (latinized as FRANCISCUS HOTOMANUS) (1524–1590), French jurist and one of the most learned of humanist scholars who took a leading part in the legal, political and religious controversies of his time, was born on Aug. 23, 1524, in Paris of a family of Silesian origin. He took his doctorate in law at Orléans and practised law in Paris where, in 1546, he became professor of Roman law. In 1547 he was converted to the Reformed Church and went to teach law successively at Lyons, Geneva, Lausanne and Strasbourg where John Calvin went to hear him. In 1563 he returned to France and taught at Valence and, after 1567, at Bourges, then the foremost law school in Europe, where he succeeded Jacques Cujas. In 1572, after the massacre of St. Bartholomew, he fled to Geneva and taught again there and later at Basel, where he died on Feb. 12, 1590.

Hotman made important contributions to the work of the French school of Romanists who, in opposition to the Italian commentators, sought to restore the texts of classical Roman law. In his *Anti-Tribonian* (1567) he combined an attack on the compilators employed by Justinian with a plea for codification of French law on the basis of native custom and experience and without borrowing excessively from Roman law. In *Franco-Gallia* (1573), which became his most influential work, Hotman showed that there was no historical foundation, other than the absolutist tendency of Roman lawyers, for the growth of royal absolutism in France which was used to prevent religious reform. In these and numerous other writings, published collectively by J. Lectius (1599–1601), Hotman sought to advance the cause of humanist learning, of religious freedom and of government by consent.

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HOT SPRINGS NATIONAL PARK, a city, spa and tourist resort of central Arkansas, U.S., and seat of Garland county, is located at the eastern gateway to the scenic Ouachita mountains (*q.v.*), 52 mi. S.W. of Little Rock. The springs, probably visited by Hernando de Soto in 1541, were explored in the 1600s, frequented by Spanish and French health seekers in the 1700s, and analyzed, routed and mapped in 1804 by the William Dunbar-George Hunter expedition under orders of Pres. Thomas Jefferson. Warring Indian braves regarded the valley as neutral ground and bathed there together to strengthen their belief that the waters were a therapeutic boon of the "Great Spirit" to all his children. Permanent settlement dates from 1807; the town was incorporated in 1876, and in 1921 was renamed Hot Springs National Park to correspond with the change in nomenclature when Hot Springs reservation was established as a national park. However, the city operates under its own municipal and state laws and is independent of the federal government.

The roadways, hiking trails, bridle paths and picnic areas of the park are easily accessible from the city's main thoroughfare. The park (about 1,000 ac.), including the 47 thermal springs, denied to private ownership in 1832, was one of the first areas set aside for national conservation. There are 20 hydrotherapeutic institutions (a number on Bathhouse row and the rest in hotels and hospitals) and the Physical Medicine centre, all under federal regulation. Accommodations range from luxury hotels to trailer parks. The climate is mild and nearby lakes with about 1,300 mi. of shore line afford year-round water sports and fishing. The annual schedule of events includes a 31-day horse-race meet. Adjacent Ouachita National forest offers camping, swimming and hunting in season. For comparative population figures *see* table in ARKANSAS: *Population*. (M. D. HU.)

HOTTENTOT, a generic term embracing culturally differentiable divisions of peoples known as the Hottentots, the Korana and the Nama located in South West Africa, living either in European settlements or on official reserves. Most Hottentots (numbering about 24,000 in the latter 1950s) are either Nama or "Orlams," the latter term denoting remnants of the Cape Hottentots together with many of hybrid descent. The main Nama concentrations are the Bondelswarts, Rooinasie, Swartboois and Topnaars; the Orlams groups are the Witbooi, Amraal, Berseba and Bethanie. Physically, true Hottentots closely resemble the Bushmen, the Hottentots' slightly taller stature and decidedly longer and narrower head form being the only marked differences. (*See* BUSHMAN.)

Traditional Hottentot economy and social organization have changed drastically. Formerly, they practised a herding, hunting and gathering economy. While some independent families still lead a nomadic pastoral life, the majority have settled and live by selling their labour, adopting the material equipment, dress, language and general mode of living of their Europeanized rural environment. It is claimed that most Hottentots have become Christian. The former nomadic unit, the patriarchally organized group of related families, now finds expression as the ward of a village. The clan tribes, to which persons were affiliated by descent and within which interclan affairs were administered by a council of clan heads, have given way to reserve groups, which are administered as political units by chiefs and headmen, loyalty to whom defines tribal membership. (V. G. J. S.)

Language.—Hottentot is the European name for the Nama, !Kora and other languages comprising 14 or 15 subdivisions of the main Hottentot speech. Of these, the Nama is the most important and will be used for illustration. (*See* also BUSHMAN LANGUAGES.)

The Hottentot tongue has the five vowels *a, e, i, o, u*. They are long or short and appear also in reduced form. The consonants are *p, t, k, ɔ, s, x, h, r, m, n, t', k'*. Nasalized vowels are marked by ~ written above them. The outstanding characteristics of the Hottentot language are: (1) the presence of clicks (*q.v.*); (2) the partly monosyllabic nature of the vocabulary; and (3) the presence of tones. The clicks are dental, palatal, cerebral and

lateral. These clicks are initial and begin a large percentage of the Hottentot words. The languages are remarkably regular. Word building is simple and regular; gender is marked by suffixes or sex determinatives. Nouns have singular, dual and plural forms; they undergo declension for objective and vocative cases only. Adjectives are not inflected and can be formed from nouns.

Numeration is decimal; the form *disi* for ten is not Indo-European **dék̂m* "ten," except in outward appearance and by mere coincidence.

The languages are rich in pronouns and have suffixed forms in singular, dual and plural, in masculine, feminine and common genders. The verb is simple and has present, past, perfect, pluperfect, future and future perfect tenses; subjunctive and optative moods; emphatic and inverted forms (verb first). Derivation of nouns from verbs, of verbs from nouns and of secondary verbal forms (iterative, causative; passive) is widespread.

Adverbs, prepositions, conjunctives and interjections are not declined. Adverbs of manner are largely derived from adjectives.

See also references under "Hottentot" in the Index volume.

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HOUBRAKEN, JAKOB (1698–1780), Dutch portrait engraver, was born at Dort on Dec. 25, 1698. In 1707 he settled in Amsterdam. He commenced the art of engraving by studying the works of Cornelis Cort, Suyderhoef, Gérard Edelinck and the Visschers. Among his best works are scenes from the comedy of *De Ontdekte Schijndeugd*, executed in his 80th year, after Cornelis Troost, who was called by his countrymen the Dutch Hogarth. He died on Nov. 14, 1780.

HOUDENC (or HOUDAN), **RAOUL DE** (fl. *c.* 1200–1230), French trouvère of the early 13th century, born in Houdenc (Beauvais), Houdenc-en-Vimeux (Artois) or perhaps Houdan (Seine-et-Oise). Little is known of his life. It may be inferred from his reading and from certain passages in his writings that he was a monk, but there is nothing to prove it: in any case he was trained as a "clerk." He seems to have lived as a minstrel in Paris, singing sometimes in the street and sometimes at the courts of the minor nobility.

He wrote two didactic works, the *Songe d'enfer*, which at times displays a violent energy, and the *Romon des Ailes* (both edited by A. Schéler in *Trouvères Belges*, 1876), in which he enumerates the qualities necessary for courtly love; and also an Arthurian romance, *Méraugis de Portlesguez* (edited by H. Michelant, 1869; and M. Friedwagner, 1897), which is outstanding for the ingenuity of its construction, its delicate psychology and the subtlety of its thought and expression. An imitator of Chrétien de Troyes (*q.v.*), he was praised, like his master, in Huon de Méry's *Tournoiement Antéchrist* (*c.* 1234). *La Voie de Paradis*, an allegorical poem, and a romance, the *Vengeance Raguidel* (edited by E. Hippeau, 1862; and Friedwagner, 1909), have been attributed to him but without definite proof.

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HOUDINI, HARRY (1874–1926), U.S. magician who was famous for his sensational escapes, was born in Appleton, Wis., on April 6, 1874. The son of a rabbi who had emigrated from Hungary, Houdini, whose real name was Ehrich Weiss, became a trapeze performer at an early age. In 1894 he was married to Wilhelmina Rahner, who thereafter as Beatrice Houdini served as his stage assistant.

By the early 1900s Houdini earned an international reputation for his theatrical tricks and daring feats of extrication from shackles, ropes and handcuffs and various locked containers.

In his article on conjuring in the 13th edition of *Encyclopædia Britannica* (1926), Houdini attributed his success partly to his "great physical strength and the fact that he is slightly bow-legged."

In a typical act he was shackled with irons and placed in a box which was locked, roped and weighted. The box was submerged from a boat, to which he returned after freeing himself under water. In another outdoor exhibition he allowed himself to be suspended, head down, about 75 ft. above the ground, in which position he freed himself from a strait jacket.

Houdini campaigned against mind readers, mediums and others who claimed supernatural powers. He argued that they were charlatans who produced all of their effects through natural means and various tricks. His *Miracle Mongers and Their Methods* was published in 1920 and *A Magician Among the Spirits* four years later. Houdini and his wife, however, agreed to conduct an experiment in spiritualism: the first to die was to try to communicate with the survivor. Houdini died in Detroit, Mich., on Oct. 31, 1926; his widow declared the experiment a failure before her death in 1943.

Houdini, who named himself after the French magician Robert-Houdin (Jean Eugène Robert, 1805–71), published *The Unmasking of Robert-Houdin* in 1908.

See Harold Kellock, *Houdini: His Life Story* (1928); Beryl Williams and Samuel Epstein, *The Great Houdini* (1950); Walter B. Gibson and Morris N. Young (eds.), *Houdini on Magic* (1953).

HOUDON, JEAN ANTOINE (1741–1828). French sculptor, achieved such pre-eminence in portraiture that the list of his portraits is a roster of great names of the late 18th century. Not the importance of his sitters, however, but the vividness with which he expressed physiognomy and personality has sustained his reputation as one of the great portrait sculptors of all times.

Houdon was born on March 20, 1741, at Versailles where his father was in domestic service. He underwent the long training prescribed by the Académie Royale, and climaxed it by winning the Prix de Rome in 1761. At the French Academy in Rome, from 1764 to 1768, Houdon established his reputation by a large marble statue of St. Bruno (S. Maria degli Angeli, Rome) and an *écorché*, an anatomical study of a standing man, which served later as the basis for replicas widely used for instruction.

In avoiding the extremes of the decorative emphasis of the preceding generation and the new passion for all that ancient Roman sculpture seemed to stand for, Houdon was following his inclination toward first-hand study of nature. In 1770, two years after his return to Paris, he presented a reclining figure, "Morpheus," as his reception piece for membership in the Académie Royale (marble version, 1777, Louvre).

GIRAUDON

VOLTAIRE BY JEAN ANTOINE HOUDON. AT THE COMÉDIE FRANÇAISE, PARIS

Houdon exhibited in almost all the biennial Salons from 1771 to 1814. Among the early portraits shown were: Diderot, 1771; Duke Ernst II von Sachsen-Gotha (whose extensive patronage of Houdon accounts for the important collection of the sculptor's works in the Gotha museum), 1773; Catherine II of Russia (not from life), 1773; the marquis de Miromesnil, the composer Gluck and the singer Mlle. Arnould as Iphigenia, 1775.

Houdon created four different busts of Voltaire besides the renowned seated figure at the Comédie Française, for which he made first studies shortly after the death of the aged philosopher in May 1778. Five weeks later, on hearing of the death of Jean Jacques Rousseau, Houdon hastened to Ermenonville and took a cast of the dead man's face. From this he developed the bronze bust in the Louvre. In 1785, at the instance of Thomas Jefferson and in company with Benjamin

Franklin, Houdon crossed the Atlantic to carry out a commission for a statue of George Washington. Several weeks at Washington's home at Mount Vernon sufficed for his studies, which he took back to France. The marble statue, signed and dated 1788, was set up in the Virginia state capitol at Richmond in 1796.

Houdon modeled his sculpture in clay; subsequent versions might be of marble, bronze, plaster or clay. A skilled technician in all of these mediums, Houdon either took full charge of repetitions or limited himself to finishing touches upon his assistants' work. He avoided a high finish that would conceal toolmarks; the sense of freshness in execution accorded with his concern for a characteristic pose and for the effect of a direct and vivid glance.

The most celebrated of Houdon's mythological works is the "Diana," first shown in 1777, although not at the Salon (possibly to avoid questions of propriety regarding the artist's frank treatment of the life-size undraped figure). The goddess steps forward on her left foot with head erect and turned to her right, a bow in her left hand and an arrow in her right. Versions of this supple, elegant work are in the museums of Tours and Gotha, the Louvre, the Hermitage (Leningrad) and the Huntington Library and Art gallery (San Marino, Calif.).

At the Salon of 1791 Houdon exhibited busts of La Fayette, Franklin, Bailly, Necker and Mirabeau. The turbulence of the Revolution did not prevent him from working, and several charming portraits of his young daughters come from this period. His prestige continued during the Napoleonic era when he portrayed the emperor and received the legion of honour.

He was a professor at the École des Beaux-Arts and a member of the Institute. In 1814 a portrait of Alexander I was his final Salon exhibit. He survived, a figure of the past, until July 15, 1828.

See G. Giacometti, *La vie et l'oeuvre du sculpteur J.-A. Houdon* (1929). (Js. W. F.)

HOUGHTON, ALANSON BIGELOW (1863–1941), U.S. businessman and ambassador to Germany and Great Britain, was born at Cambridge, Mass., on Oct. 10, 1863. His father, Amory Houghton, was the founder of the Corning Glass works, Corning, N.Y. Houghton graduated from Harvard college in 1886 and later studied in France and Germany. He joined his father's firm in 1889, becoming successively vice-president and president and, in 1918, chairman of the board of directors. He was elected a member of congress in 1919 and re-elected in 1921, resigning in 1922 on his appointment by Pres. Warren G. Harding as U.S. ambassador to Germany, a position he held until 1925. From 1925 to 1929 he was ambassador to Great Britain. In 1928 he was nominated Republican candidate for senator from the state of New York, but was not elected. He died at South Dartmouth, Mass., on Sept. 16, 1941.

HOUGHTON, RICHARD MONCKTON MILNES, 1ST BARON (1809–1885), English poet and man of letters who considerably influenced public taste in literature, was born in London on June 19, 1809, the son of R. P. Milnes of Fryston hall, Yorkshire, and the Hon. Henrietta Monckton, daughter of the 4th Lord Galway. He was educated at Trinity college, Cambridge, where he joined the Apostles club, which included Tennyson, Henry Hallam and Herbert Trench. He was elected member of parliament for Pontefract in 1837 and interested himself notably in the question of copyright. He left Peel's party over the corn-law controversy and joined Palmerston, at whose instance he was made a peer in 1863.

His literary influence was considerable. He helped young writers, published the pioneer *Life and Letters of John Keats* (1848), secured a pension for Tennyson, made Emerson known in England and was an early champion of Swinburne. His own poetry (two volumes, 1876) has period charm. He died at Vichy (Allier), Aug. 11, 1885.

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HOUGHTON-LE-SPRING, a market town and urban district in the Houghton-le-Spring parliamentary division of Durham, Eng., 6½ mi. N.N.E. of the city of Durham. Pop. (1961) 30,740. It lies below limestone hills at the head of a tributary of the Wear, and the main road from Durham to Sunderland passes through a cutting in the limestone 80 ft. deep. St. Michael's church is an Early English and Decorated building, with a rectory embattled in the 15th century. Bernard Gilpin (*q.v.*) was rector from 1558 to 1583 and founded the grammar school in 1574; it ceased to be used in 1922. Houghton hall, of the late 16th century, became a social club.

The population is mainly dependent on the neighbouring collieries and on agriculture.

HOUND, a dog; now used only of dogs of the chase, and especially of foxhounds. Other breeds have a defining word prefixed; *e.g.*, coonhound, bloodhound, etc. *See* DOG.

HOUND'S-TONGUE (*Cynoglossum*), a widely distributed genus of hairy herbaceous plants of the family Boraginaceae (*q.v.*), including several species native to North America and Great Britain; most are considered weeds but a few are used in the garden. The common hound's-tongue or gypsy flower (*C. officinale*), a native of Europe and Asia and found in waste grounds in the British Isles, is widely naturalized as a weed in eastern North America. It is an erect biennial, 1½ to 3 ft. high, with large, oblong, pointed grayish leaves, purplish-red flowers, ¼ in. across, and a conspicuous burlike fruit that splits into four prickly nutlets. The wild comfrey (*C. virginianum*), or dog bur, native to woods in the southeastern U.S., is a similar but more slender plant with blue flowers. The western hound's-tongue (*C. grande*), a perennial with blue flowers, grows in woods from California northward to Washington. The latter and *C. amabile*, called Chinese forget-me-not, native to eastern Asia, are good garden subjects.

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HOUND'S-TONGUE (CYNOGLOSSUM OFFICINALE)

HOUNSLOW, a town of Middlesex, Eng., and the name of a new London borough which under the London Government Act 1963 was to be formed on April 1, 1965, by the amalgamation of Brentford and Chiswick, Heston and Isleworth, Feltham (*see* LONDON). It is 11 mi. W.S.W. of Charing Cross, where the Bath road crosses the Great West-Great South West road. Now residential and industrial, it was formerly a busy coaching station with flourishing market gardens, the stable manure being used to improve the soil edging Hounslow heath. The parish church replaced the chapel of a priory founded in 1211. In 1546 the heath covered 6.7 sq.mi., and in the 17th century successive armies encamped there on their way to London. In 1813 it was all enclosed except about 300 ac. left for military training. In 1784 the base line of the first trigonometrical survey in England was laid down there.

HOUR: *see* CALENDAR; TIME MEASUREMENT.

HOUR ANGLE, the angle at the pole between the hour circle through a celestial body and the hour circle through the observer's zenith, his meridian. It serves as a basis for measuring time in astronomy. This angle, expressed in hours and minutes, is the time elapsed since the body's last transit of the observer's meridian. The angle can also be expressed in degrees, 15° of

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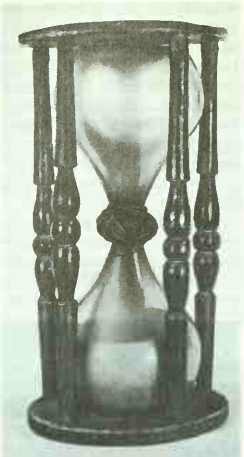
MEASUREMENT OF HOUR ANGLE (*see* TEXT)

arc being equal to one hour. Angles greater than 12 hours (or 180°) west may be subtracted from 24 hours (or 360°) and labeled east. *See* also TIME MEASUREMENT. (D. L. H.)

HOURGLASS, a device for measuring intervals of time, also known as sandglass, and as log glass when used in conjunction with the common log for ascertaining the speed of a ship. It consists of two pear-shaped bulbs of glass, united at their apexes and having a minute passage formed between them. A quantity of sand (or occasionally of mercury) is enclosed in the bulbs, and the size of the passage is so proportioned that this sand will completely run through from one bulb to another in the time it is desired to measure; *e.g.*, an hour or a minute. Instruments of this kind, which have no great pretensions to accuracy, were formerly common in churches.



THE TRUSTEES OF THE NATIONAL MARITIME MUSEUM

SHIP'S HOURGLASS WITH WOODEN STAND; 1650

HOURI, the term for a beautiful maiden who awaits the devout Muslim in paradise. The word is the French representative of the Arabic *hur*, pl. of *hawra*, literally "the white ones," in reference to their eyes, whose very black iris contrasts with the clear white around it.

There are numerous references to the *hur* in the Koran, which describes them as "purified wives" (*e.g.*, ii, 25; iii, 15). On entering paradise the believer is presented with a large number of houris, with each of whom he may cohabit once for each day he has fasted in Ramadan (*q.v.*), and once for each good work he has performed. This idea has been given a metaphorical interpretation by some theologians (*e.g.*, al-Baidawi) to the effect that, although the terminology used to describe aspects of heaven may be the same as that used in describing aspects of the created world, as in the case of the *hur*, this does not imply that the comparison is intended to be literal rather than metaphorical or metaphysical. It has also been suggested that Mohammed misunderstood pictures he saw of the Christian paradise and that the angels are the originals of the houris.

HOURS, CANONICAL (LITURGICAL HOURS or DIVINE OFFICE), in both Eastern and Western churches, though under different names, denote the times of daily prayer and the services appointed to be held or said in private at these times.

In the Roman Catholic Church the prayers for the hours are contained in the breviary (*q.v.*). They are seven in number (the first two being counted as one): matins and lauds, prime, terce, sext, none, vespers and compline. Matins, lauds and vespers are known as the greater hours, the rest as the little (or lesser) hours.

Matins (or mattins), the night office, was originally known as *vigiliae* ("vigils"); it originated in the vigils (held during the night preceding Sundays and the festivals of martyrs) of the early church and was celebrated at midnight or soon afterward. Nowadays in most monastic houses and a few cathedral chapters it is said in the early morning together with lauds or anticipated (without lauds according to the new rubrics that came into force on Jan. 1, 1961) in the evening of the day before. Matins on most days of the year consists of one nocturn of nine psalms and antiphons preceded by introductory versicles, invitatory said with the *Venite* (Ps. xciv in the Vulgate) and hymn and followed by three lessons and responsories, two lessons from Scripture and one of the life of the saint celebrated that day, or on Sundays and certain festivals, an extract from a homily of one of the Fathers of the Church. On about 55 days of the year that are festivals of importance there are three nocturns, each of three psalms, three lessons and responsories. On most days, save those of a penitential nature, the office concludes with the *Te deum* and, if lauds does not follow immediately, the collect of the day.

Lauds and vespers, the oldest of the hours, can be traced back to the synagogue morning and evening prayers of the pre-Christian era. Both consist, after the introductory versicles, of five psalms and antiphons (at lauds the canticle *Benedicite*, Dan. iii. 57–88 in the Vulgate, does duty for the fourth psalm in some offices), a short reading from Scripture (one or two verses), hymn, Gospel canticle (at lauds *Benedictus*, at vespers *Magnificat*) with its antiphon, and conclude with the collect of the day. Lauds is to be said always in the early morning, never anticipated (even if this means that is separated from matins), and vespers in the afternoon or evening.

Prime (morning prayers for the first hour of the day), terce (prayers for the third hour; *i.e.*, 9 A.M.), sext (sixth; *i.e.*, midday) and none (ninth; *i.e.*, 3 P.M.) are the little day hours. Prime is of later, probably monastic origin; the other three go back to the earliest times of the church (*cf.* Acts iii, 1 and x, 9). Each consists of introductory versicles, a hymn appropriate to the time of day (*e.g.*, at prime, "Now that daylight fills the sky") and three psalms with antiphon followed by a short reading as at vespers and lauds with responsory and the collect (of the day at terce, sext and none; an invariable prayer for the beginning of the day at prime). In cathedral chapters and monastic choirs prime is followed by the reading of the martyrology and prayers for the benefactors and for help in the work of the day.

Compline, which is of monastic origin and is said before retiring for the night, begins with a short reading (I Pet. v, 8–9a) and continues with a short private examination of conscience (added in 1960), general confession and then three psalms, a hymn ("Now at the ending of the day"), little chapter, responsory, *Nunc dimittis* (Luke ii, 29–32) and collect, a prayer for the night.

Each of the hours has fixed psalms appointed for each day of the week, save on the greater festivals when special psalms are appointed for matins and the Sunday psalms are said at the little hours. In this way the whole 150 psalms are usually said weekly.

The purpose of reforms of the canonical hours in 1911, 1955 and 1960 was to ensure more regular recitation of the whole psalter weekly by reducing the number of festivals with special psalms; simplifying the daily office; and abbreviating it to a more manageable length. Since it is recited daily by all Roman Catholic priests, monks and friars and certain nuns, some simplification and shortening was necessary to accommodate it to the conditions of 20th-century life.

Because of the great complexity of the canonical hours, simpler forms were evolved for the use of the laity, though these have always remained optional for them since they first came into use in about the 9th century. In the middle ages these additional offices were often said together with the canonical hours by monks and clergy. Belonging to this category is the Little Office of the Blessed Virgin Mary, a much shorter and invariable office, using the shortest psalms and briefest scripture passages. This office was that to be found in the books of hours (*see* ILLUMINATED MANUSCRIPTS), which were richly illuminated for the use of important personages in the middle ages, and in the "prymers," which then often served as a first reader for children. Nowadays nuns of teaching or nursing orders often say the little office instead of the longer canonical hours.

In the east the hours, though they correspond practically speaking in name, content and function, are drawn up on a far more complex pattern. Each hour, for example, has its own fixed psalms for daily recitation, but in addition the whole psalter is divided into 20 sections called *kathismata*, and each *kathisma* into three stasis. Two *kathismata* are said at the morning office and one at night (in Lent the 20 *kathismata* are said twice a week) in addition to the fixed psalms. In this way the weekly recitation of the psalter is ensured. The Scriptures are read as in the west, but the characteristic of the eastern hours is the very large amount of religious poetry that makes up the principal part of each hour (*see* KANON; KONTAKION, THE).

In the Anglican Book of Common Prayer the services of morning prayer (matins) and evening prayer (evensong), which the clergy

are bound to recite daily, are made up of the basic elements (psalms, Scripture readings, canticles and collects) of matins, lauds and prime and of vespers and compline respectively.

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HOURS OF LABOUR. Although precise distinction is not always easy, it is both conventional and convenient to divide a person's day, week or lifetime into so many hours of work or labour and so many of leisure. Statistics referring to the number of hours of work usually refer to the number of hours the person is presumed to spend at his job, irrespective of how much work he actually performs. The remainder of his time is considered leisure, though the time consumed in traveling to and from work might merit some other designation.

The increase in years spent at school, with the attendant postponement of entry into the labour force, involves a reduction in hours worked over a person's lifetime. Reducing the retirement age also lowers the number of hours of labour over the worker's lifetime, and increasing the number of holidays reduces hours worked per year. Because the fraction of life spent outside the labour force—either at school or in retirement—has tended to rise since 1900, the statistics of the decline in average weekly hours worked tend to understate the rise in lifetime hours of leisure relative to lifetime hours spent at work.

Economic Cost of Leisure.—In general, the more work performed by an individual or a community the greater the resulting production and real income. Therefore, reducing the daily or weekly hours of labour involves risk of sacrificing real income produced per worker. However, economic progress tends to raise the hourly productivity of workers, creating the possibility of getting either more output per worker per day, or the same output with fewer working hours, or some combination of both. In most countries of the western world, the economic progress since the mid-19th century has been used partly to increase real output per worker per year and partly to reduce the average work week. However, the question of how to divide the fruits of progress between work and leisure has been a subject of bitter dispute.

A shorter working day was a major demand of trade-unions in most countries during the latter part of the 19th century and throughout the first half of the 20th. In a number of countries legislation was enacted requiring or at least encouraging the adoption of fewer weekly hours. Despite this pressure the length of the work week declined only slowly prior to 1920, partly because of employer resistance. The economic reason for such resistance is not hard to discover. In the 19th century capital equipment was scarce and expensive relative to labour. Competition was keen and, save for occasional depressions, employers used their equipment as intensively as possible. This practice meant running it to the limit of its physical capacity; that is, running it whenever there was a market for the product and the machines did not require repair. Competitive pressure in product markets kept selling prices and wage rates down and, because hourly wages were low, workers needed to work long hours to make enough for subsistence. Put differently, wages were so low that leisure for any purpose other than sleeping and eating was a luxury workers could not afford.

Conditions in the early 19th-century factories were extremely unhealthful, especially for women and children, and those in mines were even worse. It is doubtful that long hours and bad working conditions were conducive to profits; the larger and more successful employers, of whom Robert Owen was an outstanding example in Great Britain, generally offered better wages and working conditions than the average. (However, the best of conditions in 19th-century factories would be judged intolerable by 20th-century standards.) But many small employers simply could not afford the modest capital outlay necessary to provide tolerable working conditions, and there was a wide though not universal failure to appreciate the adverse effect of long hours and bad conditions upon worker productivity.

Basically, however, working conditions were poorer and hours longer in the 19th century as compared with the 20th, because labour was cheaper relative to capital and was therefore used more carelessly. After the turn of the century, as an hour of labour became increasingly more valuable, pressure was placed on employers to use it more effectively. This pressure was reflected in the trend toward "scientific management," which, although it centred in the United States, affected management practice in all developed economies. One of the early findings of the "scientific managers" was that comfortable surroundings enhance worker productivity and that excessively long hours tend to reduce it. These views secured increasingly wide acceptance in the years after World War I, partly because of empirical findings that hourly productivity was severely reduced by unduly long work periods. For example, one investigator found that reducing a longer working day to ten hours would so increase a worker's hourly production as to lead usually to an increase in his daily output as well. This investigator also found that reducing daily hours from ten to eight sufficiently increased hourly output to leave daily production unaffected.

Later studies emphasized that the relation between worker productivity per hour and the number of hours worked per day or per week is not simple. For example, it is possible to increase sharply the number of weekly hours without adversely affecting hourly productivity, provided that the longer hours are worked for only a few weeks. It is now agreed also that hourly output varies considerably with workers' interest in their jobs, with the pace of work and with the age and health of the workers as well as with daily and weekly hours. However, despite these complications, it is generally accepted that in manual occupations weekly hours in excess of 48 (and in some cases even in excess of 40–42), if long continued, seriously reduce hourly productivity. It also seems clear that there is some work week of probably no more than 60 hours (and possibly less) at which weekly output reaches an upper limit. The spread of beliefs such as these lessened employer resistance to appeals for a shorter work week, and in many cases, especially in the United States, it led employers voluntarily to reduce weekly hours during the 1920s.

Work Week and Unemployment.—The only valid economic reason for opposing a shorter work week was the fear that it would imply a sacrifice of production. Empirical studies have shown that this fear was greatly exaggerated, if not completely groundless, when the work week was over 50 hours. However, the same studies also have shown that when the work week is less than 48 hours reductions tend to lower weekly output even though hourly productivity may rise somewhat. This means that reducing the work week below six eight-hour days is likely to involve a sacrifice of potential output. This has not in any way lessened the demand for reducing the work week to 40 and even fewer hours. The proponents of a shorter work week have never rested their case upon the contention that it would not lower potential output; they have argued that the increases in potential annual output per worker are sufficiently large that part of them should be diverted to provide leisure for workers. This argument has appealed to economists and humanitarian reformers.

It is not, however, the only argument offered by trade-unionists (and their sympathizers) in support of shorter hours. They have argued also that shorter hours would spread available employment opportunities among a larger number of workers and thereby reduce unemployment. This argument, before the 1930s, was rejected by a great majority of economists, who denied the implication that there was usually a shortage of employment opportunities. But the great depression of the 1930s brought an overwhelming demand from almost all quarters that scarce opportunities for gainful employment be shared. As a result, the trade-union view of the relations between working hours and employment opportunities became the view of virtually the whole of society. Further, the developments in economic theory that culminated in the publication in 1936 of Lord Keynes's *General Theory of Employment, Interest and Money* swung a large body of economists to the view that a shorter work week served to convert full-time unemployment for some workers into a combination of jobs and leisure for a larger number.

This attitude was partly responsible for the decline in the work week in the United States during the 1930s. To a considerable extent the decline resulted from the voluntary action of employers, trying to ration and distribute more or less equally a diminished amount of work. But there was also considerable pressure in the same direction from trade-unions, and in some countries, notably the United States and France, there was legislation to limit the weekly hours of labour.

Choice Between Work and Leisure After 1940.—Scarcity of employment opportunities ended with World War II, and in advanced countries employment continued at a fairly high level through the 1950s. This caused no appreciable lengthening of the work week, nor was there any material reduction in the hours worked. In all belligerent countries during the war years the average work week rose appreciably, but the additional hours were usually paid at overtime (premium) wage rates. This continued to be the case after 1945, and in some occupations workers came to count upon overtime pay as part of their regular weekly earnings.

In the mid-1950s the attitude of workers toward shorter hours varied from one country to another. In all countries workers presumably would like shorter hours if obtaining them involved no sacrifice of either actual or potential weekly earnings. However, such a sacrifice is required, and the willingness to bear it differs from one country to another and among different groups of workers within a given country.

In the United States a number of unions in the mid-1950s called for reductions in the length of the scheduled work week from 40 to 35 hours. This was prompted, in good part, by fear that technical progress would soon create a shortage of employment opportunities in the industries affected.

However, the appeal for a shorter work week was opposed by the leaders of a number of other unions who claimed that their members wanted more income rather than less work. It was also pointed out that in most unions workers fight for their share of overtime work rather than avoid such work. Furthermore, some workers (about 5% of the labour force) took advantage of the short work week to take extra jobs. Nevertheless, the pressure for a shorter work week was generally increasing in the early 1960s.

In western Europe, including Great Britain, the scheduled work week after 1945 tended to average between 45 and 50 hours, with overtime being fairly common. The labour movements of a number of countries urged the desirability of a shorter work week, but the need for income seemed to outweigh the desire for added leisure.

The average work week of a country tends to vary roughly with its level of development or its per capita income. Poorer countries tend to have relatively long work weeks, and economically more advanced countries to have shorter ones. The table shows

Average Weekly Working Hours in the United States, 1850–1960

Year	Weighted average	Nonagriculture	Agriculture
1850	69.8	65.7	72.0
1860	68.0	63.3	71.0
1870	65.4	60.0	70.0
1880	64.0	58.8	69.0
1890	61.9	57.1	68.0
1900	60.2	55.9	67.0
1910	55.1	50.3	65.0
1920	49.7	45.5	60.0
1930	45.9	43.2	55.0
1940	44.0	41.1	54.6
1945	46.4	44.6	54.4
1950	40.0	38.8	47.2
1960	40.8	40.1	48.0

Source: J. Frederic Dewhurst and associates, *America's Needs and Resources: a New Survey*, Appendix 20–4, p. 1073 (1955), 1850–1950; Peter Henle, "Recent Growth of Paid Leisure for U.S. Workers," *Monthly Labor Review*, vol. 85, no. 3, p. 250 (March 1962) (1960 data not strictly comparable with earlier figures).

that in the United States the average work week declined from approximately 70 hours in 1850 to 40 hours in 1950. It remained relatively constant during the 1950s. A similar trend occurred in other advanced countries, and meanwhile, per capita income rose. There are, however, important qualifications to these statements. In the mid-20th century underdeveloped countries aimed to achieve the working hours and conditions of more advanced countries as quickly as possible. Consequently they did not tolerate the very long work weeks characteristic of 19th-century Europe and America, and the intercountry differences in work weeks were proportionately less than the differences in per capita income.

Economic progress has tended to narrow the differences in income, and especially in hours, among occupations. Thus in the early 1960s in advanced countries there was little difference between the work weeks of white-collar workers and factory workers. Such differences are much more likely to exist in backward areas, where skilled workers of all kinds are scarce and enjoy relatively greater advantages in working conditions (as well as greater wage premiums) than are usually found in more advanced countries. The differences in hours and working conditions among occupations tend to be especially great when occupational boundaries coincide with racial or caste distinctions.

The differences between socialist and capitalist economies have not affected the work week so much as might be thought. In the Soviet Union, in 1934–35, the average work week in manufacturing and mining was 35.7 hours, less than in other European countries. In the following years, however, the work week was lengthened substantially, and by 1940 it was 48 hours in Soviet manufacturing. This was still the standard week in 1950, though overtime work was less common than it had been during the war.

Meaning of Work and Leisure.—Some workers clearly want overtime work; others would rather have leisure. There are individual and occupational differences, but in general it is the workers over 50 years of age who prefer leisure and younger men with family responsibilities who prefer extra income and work.

In interpreting workers' attitudes toward reduced hours of labour it is important to bear in mind that in economically advanced countries the normal working day no longer is so long as to be physically burdensome to a man in the prime of life and in good health. An additional daily hour of leisure is of questionable utility to him, and he might well prefer extra holidays with pay or longer paid vacations or sick leave to a further shortening of the working day. After World War II there was a trend toward more generous provisions for paid holidays and vacations, observed in a number of countries but especially marked in the United States. As a result, annual hours worked tended to decline more than weekly hours.

The United States worker has a shorter work week than any of his European counterparts, but it is widely believed that Americans work harder than Europeans. Whether this opinion is valid is not important here; it serves to indicate that there is more than one dimension—number of hours—to the quantity of work performed.

Economic progress has brought a reduction in weekly, annual and lifetime hours of work; it has also involved a reduction in the amount of muscle power that the typical worker must exert to perform his task. But these blessings may have been offset, in part, by an increase in the intensity with which the worker must tend his increasingly expensive and complicated machine. If this is true, then it may be that the shorter hours of U.S. workers are partly an offset to the faster pace at which they work. Though this subject has been much speculated about, there is little reliable information upon it.

The idea that leisure may be had at the place of work as well as elsewhere should be borne in mind in interpreting statistics on the hours worked by farmers as compared with those in industry. Agricultural hours are always longer, a fact that sometimes causes farmers (and others) to comment adversely upon the easy life of the factory worker. In agriculture, however, the worker has far more opportunity to set his own pace and take a rest when he is tired.

Defining the length of the work week involves difficult problems of separating gainful employment from leisure. For example, there is the time necessary for donning uniforms, for cleaning up and for traveling to and from work. In one sense, classifying the time spent on such activities as work or leisure is merely a verbal matter. However, in collective bargaining negotiations, unions sometimes give up wage increases or other benefits in order to get employers to include, in working time paid for, time spent on such activities. This has the effect of disguising actual declines

in the work week; because of this, the work week in the United States probably declined more after 1945 than the figures show. By the 1960s it was estimated that, in U.S. manufacturing, about 6% of the hours for which employers paid were not worked.

Higher Wages and Shorter Hours.—*Labour's Share.*—Advocates of shorter hours have usually had mixed motives. Shorter hours have been desired not only as a means to leisure but also as a method of raising wages. As a 19th-century American rhyme put it,

> Whether you work by the piece
> Or work by the day,
> Decreasing the hours
> Increases the pay.

If other things are equal, reducing daily hours per worker reduces total labour supply and therefore tends to raise hourly wage rates. There might well be a reduction in weekly wages, however, despite the rise in hourly pay, for once daily or weekly hours fall below certain maximums further reductions cause output to fall below what otherwise would be obtainable. This has the effect of reducing the community's income of which wages is one share, and thus militates against any increase in labour income. It is sometimes argued that, despite the decrease in total income, reducing the hours of labour will so increase the share of wages in the total as to raise the weekly income of the workers involved. The significance of this argument lies in its implication that reducing hours of work increases the weekly (or yearly) wage incomes of the workers concerned. Where this applies, the fruits of "labour monopoly" are a combination of greater leisure and higher incomes for those benefiting.

The validity of this contention, however, depends upon the group of workers and the time period considered. If the workers whose weekly hours have been reduced can be replaced only with great difficulty; if their wages are only a small part of the total cost of production; and if the demand for the product is very inelastic, then the decline in output resulting from a reduction in hours will lead to a marked rise in product price and a consequent rise in wage rates sufficient to increase weekly earnings despite fewer hours. However, these conditions are far from being satisfied everywhere. In general, they are more likely to be satisfied for short periods than for longer intervals in which employers can find ways of replacing high-priced workers.

For the economy as a whole, it is very difficult to judge whether reducing weekly hours will increase labour's share of the national income. Most economists would deny that there is sufficient knowledge upon which to make a sound judgment.

Significance of Overtime Payment.—In most countries provision is made for permitting work in excess of the prescribed number of hours. Such overtime work must usually be compensated at premium hourly rates, or overtime rates. The significance of requiring premium rates for overtime varies with the state of the labour market. When there is a great deal of unemployment, premium rates penalize employers for employing any one worker more than the standard week and thereby encourage sharing of available work. But when labour becomes scarce and overtime hours must be hired, the effect of premium rates is to provide an automatic device for raising weekly earnings.

The different effects of overtime pay in periods of unemployment and of labour scarcity caused the United States Fair Labor Standards act of 1938 to have quite unanticipated consequences. This law provided that 1½ times the standard rate of hourly wages should be paid for all weekly hours in excess of 40. This was frankly intended to discourage the employment of any one person for more than 40 hours per week, in order to create additional jobs. Soon after the law took effect, however, the labour shortage of World War II replaced the unemployment of the 1930s. As a result, the overtime provisions brought substantial increases in weekly wages to workers during the war years, and to a lesser—though still appreciable—extent after 1945. This outcome had not been envisaged by either the advocates or the opponents of the law.

Union Control of Hours.—Through their unions, workers in economically advanced countries have gained substantial control over the length of their work week. It is not that employers are powerless to resist but that to a considerable extent they are indifferent as to how long workers choose to work, provided they do not work so long as to undermine their efficiency. This partial indifference to the length of the working day results from the fact that the employer if he wishes usually can compensate for an inconveniently short day by having his employees work overtime, use extra shifts or both. Of course, overtime work and multiple shifts involve extra costs, and employers take them fully into account in bargaining with unions. A union that genuinely wants a reduction in the standard work week, however, usually can obtain it by sacrificing potential wage increases or other benefits.

This is not to suggest that employers can alter technological processes to suit workers' leisure preferences. Often, these processes require continuous work. The number of shifts used to operate a process, however, usually can be varied within very wide limits, though at some cost.

In the 19th century employers were generally far less pliable about the length of the working day than they became in the middle years of the 20th. There are a number of possible explanations for this change in attitude, but the most important is the fact that in the 19th century long hours were a method of cutting hourly wages, when daily wages were close to a subsistence minimum and could scarcely be reduced further. That is, the employers' resistance to shorter hours was primarily resistance to the accompanying demand for no reduction in daily pay.

HISTORY OF THE SHORTER HOURS MOVEMENT

Before 1860.—The "shorter hours" movement began almost with the formation of unions. In the United States in 1791 the carpenters of Philadelphia resolved that a day's work should not exceed 12 hours. In the decade 1825–35, especially in 1835, there were numerous ten-hour-day strikes in the seaboard cities, some of which succeeded. These strikes involved primarily building tradesmen, though others were also involved. Despite some temporary success, this embryonic trade-union movement was destroyed in the depression of 1837. Its only permanent legacy was the ten-hour day in federal government work, which was achieved in 1840 after prolonged agitation.

These early unions were organizations of artisans. Effective unionism in the factories of New England did not arise until much later. By the 1840s hours and working conditions in the New England textile mills had become so bad as to cause a demand that hours be regulated by law, and in the decade following 1847 eight states enacted maximum hour legislation for women. These laws, however, were mere declarations of public policy, unenforceable and unenforced.

During the first half of the 19th century the movement for shorter hours in Great Britain was concerned primarily with factory employment, especially in textile mills. The development of the factory system in the first quarter of the century had led to the employment of women and children for more than 12 hours per day, under unhealthful conditions. As a response to this, a series of Factory acts was passed regulating various hours and working conditions of women and children. The first of these acts, passed in 1802, merely limited the hours of apprentices to 12 per day. Subsequent acts imposed increasingly severe restraints upon the hours of women and children. Legislation had to be enacted over a determined laissez-faire opposition, however, and it was not until 1847 that an effective limit of ten hours per day was placed upon factory employment of women and children. Confining legislation to women and children was a concession to laissez-faire sentiment, which objected to impairing the freedom of contract of adult males. However, it was generally understood that regulating the hours of children would effectively control the hours of the men whom they assisted.

1860–90.—Although legislation aimed at restricting daily hours was enacted in several states prior to the American Civil War, it was not until the 1870s that any such law contained provision for enforcement. Massachusetts' maximum-hour law of 1874 was the first one to be genuinely enforceable, but its example was not rapidly followed. In the 1880s and 1890s a number of states en-

acted maximum-hour statutes but only three of these contained provision for enforcement.

During this period the eight-hour day became a union battle cry. Agitation began in the 1860s, and by the 1880s the eight-hour day had become a characteristic demand of labour unions. In 1884 the Federation of Organized Trades and Labor Unions, forerunner of the American Federation of Labor, made it one of its dominant issues. It was resolved that after May 1, 1886, workers should refuse to work more than eight hours per day. Although the full implications of this were not explained, the resolution suggested to many that a general strike for the eight-hour day was to be called on May 1, 1886. Though a general strike was impractical, about 300,000 men demonstrated and 190,000 actually did strike on that day; of these, perhaps 42,000 obtained shorter hours. Another 150,000 obtained some reduction in the working day without resorting to strike action. Most of these gains were soon lost through employer counterattack or were offset by wage cuts.

The American Federation of Labor did not abandon the drive for the eight-hour day but changed its approach to supporting individual unions in rotation. On May 1, 1890, the Carpenters' union struck for the eight-hour day and over 23,000 carpenters obtained it; 32,000 more gained a nine-hour day.

In the years following, the various unions chosen to head the drive were too weak for the task, though the Typographical union persisted in its campaign and eventually, in 1906, achieved substantial success. Despite the great union agitation, however, there was no substantial reduction of the work week during this period.

In Great Britain, the factory legislation that had been enacted in the first half of the century was extended in the 1860s and 1870s to a wide variety of industries and also to workshops. Furthermore, in 1874, a (maximum) nine-hour-day law was enacted. As a result of this, by the mid-1870s working hours for adults had been reduced to an average of about 55 per week. Save for improvements in the hours of the sweated trades, they remained at roughly this level (when work was available) until the end of World War I. This contrasts very favourably with the development in the United States, where weekly hours (outside agriculture) did not fall to 56 hours until 1900. The slower decline in weekly hours in the United States reflected, among other things, the less effective and extensive regulation of hours by the government, and also the comparative weakness of the American unions.

A few London craft unions achieved the ten-hour day before 1830, but it was not until the 1850s that the "new model" trade unions (especially the Amalgamated Society of Engineers and the builders' unions) began to push for shorter hours. After many vicissitudes in the '50s and '60s, by the early '70s the nine-hour day had been established in a large number of trades. The nine-hour law of 1874 was primarily a means of enabling the textile operatives to catch up with what the other skilled trades had already achieved.

During the 19th century Australia was well ahead of Great Britain and the United States in achieving the eight-hour day. Because of the general labour shortage unions were very successful, and the eight-hour day was established in the skilled trades by the 1850s. In 1874 in the colony of Victoria the eight-hour day was made mandatory for women employed in factories; a few years later a law to the same effect was applied to both men and women working in mines. These laws were later developed and extended, and by the end of the century the 48-hour week had become nearly universal in Australia.

On the continent of Europe there was strong eight-hour-day sentiment, but the unions were generally too weak to limit the working day and the little that was accomplished came through legislation. The French revolutionary government of 1848 decreed 10 hours per day to be the legal maximum in Paris, for both men and women, and 11 hours elsewhere. Later the same year, the law was amended to permit no more than 12 hours of work per day. This law remained formally in effect throughout the second empire, but it became largely inoperative through poor enforcement and numerous exemptions. After 1880 the French Socialist parties began to agitate for the eight-hour day, and in 1890 there were a number of unsuccessful eight-hour-day strikes.

In Germany there was some legislation in the '70s and '80s restricting the working hours of women and children, but the laws were poorly enforced. It was not until the end of the 1880s that unionized artisans and miners began to make some headway in limiting the working day.

1890–1918.—The era from the turn of the century to the beginning of World War I saw a marked extension of hours legislation in the United States. Between 1896 and 1917, 27 states passed laws imposing maximum hours on women's work, and most of these were enforced. The laws themselves tended to broaden in coverage as time went on. At the beginning of the period they usually imposed only ten-hour maximums, but toward the end they often prescribed eight-hour days. There was also a strong tendency to restrict or forbid night work. The restriction on women's hours was paralleled by a movement to limit child labour or abolish it outright. During 1909–14, when this wave of legislation was at its height, the percentage of manufacturing workers with full-time weeks in excess of 55 hours fell from 69% to 49%. It is likely that the aforementioned legislation made a sizable contribution to this result.

In addition to passing laws governing women's hours, a number of states made declarations of public policy regarding men's hours on public works. These laws, which also applied to government contractors, usually limited the working day to eight hours.

Apart from legislative activity, the decline of the work week moved slowly prior to 1914. The American Federation of Labor's eight-hour drive, which had bogged down in the 1890s, was never started again on a large scale. The general failure of unions to invade the manufacturing industries greatly limited union influence.

In the relatively few unionized manufacturing industries, the average standard work week declined from 54 hours in 1890 to fewer than 49 in 1915, a drop of about 10%, compared with a 6% decline in the hours of nonunionized manufacturing workers (from 62 to 58). From 1890 to 1915 the building trades, where unionism was strong, cut standard weekly hours from 51 to fewer than 45 (about 13%), but "all industry" workers' scheduled weekly hours dropped only 5 hours (from 58.4 to 53.5), or 9%. Though causal relations are obscure, the association of unionism with shorter hours in the period 1890–1915 is clear.

In the period 1915–20 the reverse was the case. Under the pressure of the wartime labour shortage, unionized and nonunionized industries alike were compelled to reduce weekly hours in order to retain their workers. In this period, the eight-hour day was a demand for which higher wages were not an adequate substitute. As a result, labour market competition compelled nonunion manufacturers to reduce average weekly hours more than unionized manufacturers did. Furthermore, the building tradesmen, whose weekly hours had been fewer than 45 in 1915, reduced them during this period by an average of only about 1 hour, or roughly one-quarter of the decline in the hours of nonunion factory workers.

World War I was the period when the eight-hour day, six-day week became standard in U.S. factories. In 1914 only 11.8% of all factory workers worked a standard week of 48 hours or less; by 1919, 48.7% worked 48 hours per week or less, and by 1921 this was true of 51.7%. The coal miners also achieved a 48-hour week during this period, and in 1916 the federal government passed the Adamson act establishing a basic eight-hour day, with compensation for overtime, on railroads. This law was the culmination of a prolonged campaign by the railway unions and was enacted to forestall an imminent major rail strike.

In Great Britain hours of work were not greatly altered between the mid-1870s and 1918, despite a campaign for the eight-hour day that began in the 1880s. In 1909 parliament passed an eight-hour-day law for coal mines, but otherwise little change was made until the beginning of 1919. At that time the engineering and shipbuilding trades renewed their prewar demands for a shorter work week and succeeded in reducing it to about 47 hours. The cotton operatives, iron and steel workers and most other unionized workers also obtained approximately a 48-hour week during the first half of 1919.

Although the 48-hour week had become practically universal in

Australia by the end of the 19th century, the unions continued to push for still further reductions in hours. In 1913 the building tradesmen were awarded, through arbitration, a 44-hour week. This opened the way for a general drive toward the 44-hour week, which continued through the war and after. During the 1920s there was slow but steady progress toward a general 44-hour week, with both state legislation and awards of the Federal Arbitration tribunal playing major roles. It is worth noting, however, that in the '20s and '30s Australian workers lost the very substantial advantage over others, with respect to hours, that they had enjoyed at the turn of the century.

The 1920s.—The 1920s saw only moderate changes in weekly hours in the United States and none at all in Great Britain. In the depression of 1920–21 U.S. unions lost many members, and some employers tried to withdraw the newly achieved 44- or 48-hour week. While the more strongly unionized trades successfully resisted this campaign, the work week of many manufacturing workers was lengthened during the decade of the 1920s. Between 1921 and 1929 the percentage of manufacturing workers having a standard work week of 48 hours or fewer decreased from 51.5% to 45.5%. There were crosscurrents, however; for the more fortunate workers, notably in the building trades, the five-day week had become common by the end of the 1920s, and very long weeks of 60 hours and over diminished. The outstanding case of the latter was the abandonment by the steel industry in 1923 of the 12-hour day and the "13 out of 14 days" work schedule; this was replaced by the basic eight-hour day, with payment for overtime.

During the 1920s most European countries made substantial gain toward achieving the 48-hour week. Prior to 1914 the 60-hour week or longer was common on the continent. In the social upheavals that followed World War I, most of the newly created countries, as well as France and Germany, adopted eight-hour-day laws in 1919.

Many of these countries also signed the international convention, sponsored by the newly formed International Labour organization, which declared the eight-hour day or 48-hour week to be a standard at which to aim. (In 1935 the International Labour organization adopted a convention embodying the principle of the 40-hour week, but as this convention was ratified only by New Zealand it never went into force.) Enforcement of the eight-hour laws in Europe was poor, and the exceptions permitted were numerous. It was not till the end of the 1920s that the 48-hour week became widespread, and in 1930 many exceptions still existed, especially in France.

After 1929.—The depression that began in 1929 caused a drastic decline in the weekly hours worked in all countries. This did not have any lasting effect upon full-time hours in Great Britain or Germany but it caused a drastic and permanent reduction in the standard work week in the United States. During the early 1930s the advocates of shorter hours encountered little opposition to their argument that technological progress had destroyed millions of jobs and that it was necessary to "share the work." This philosophy was found in the various codes of "fair competition" adopted under the National Industrial Recovery act of 1933. Most codes required a 40-hour, five-day week. Although the law was declared unconstitutional in 1935, its hours' provisions remained a part of standard U.S. labour practice. In part, this was attributable to the fact that in the years 1935–39 labour was plentiful and employers had no strong incentive to lengthen the work week. Another factor was the growth of unions in the manufacturing industries in 1936–38; had employers attempted to lengthen the work week during those years, it would only have helped the unions' organizing campaigns. Still another, though minor, reason was the existence of a 40-hour requirement for government suppliers imposed by the Walsh-Healey act of 1936.

Whatever employers might have done eventually to lengthen the work week was effectively blocked by the Fair Labor Standards act (FLSA) of 1938, which replaced the invalidated National Industrial Recovery act. Among other things it virtually prohibited child labour, established minimum wage rates and required that all hours in excess of 40 per week should be compensated at 1½ times the standard rate. The law applied to the major part of the economy, though such important sectors as retail trade and agriculture remained practically uncovered.

The Fair Labor Standards act did not establish a maximum work week of 40 hours; it merely imposed a financial penalty upon employers who hired workers for more than 40 hours, which had the effect of deterring the use of overtime without prohibiting it. Because of the overtime pay requirement, workers who wished to work more than 40 hours per week at straight-time rates were prevented from doing so on their "main" job, but after 1940 it was usually possible for such persons to get extra jobs to earn extra income. In the early 1960s about 5% of the U.S. labour force had more than one job, the percentage appearing to vary inversely with the state of the labour market.

In France the popular front government of 1936 enacted a law establishing the 40-hour week with no change in weekly wages. As a result of this law the government by decree set wage levels and the 40-hour week for individual industries. One result of the law was to make 40 hours the effective work week in France, a condition that still existed in the early 1960s.

Canada also had a 40-hour week by the early 1960s but most other industrialized countries had a 48-hour week. In Latin America, for example, the 48-hour week prevailed in such countries as Mexico, Brazil, Chile, Uruguay, Venezuela, Peru and Colombia. In Europe the 48-hour week was established by law or collective bargaining in Belgium, Denmark, Norway, Sweden, Italy, Spain and Portugal.

Conclusion.—The long-run trend in the hours of labour has been downward. Despite the spectacular developments connected with legislation and union activity, the prolonged growth of per capita real income has been the major force behind this trend. That is, as workers' incomes have risen they have come to want more leisure in which to enjoy it.

The demands of unions, sometimes for higher wages, sometimes for shorter hours, and the related pressure exerted upon legislatures to limit daily or weekly hours ultimately reflect the choices of individuals within and without unions and are not separate forces. Union bargaining power and legislative enactment at times accelerated the decline of weekly hours, but it is unlikely that over a period of a half century their influence has been predominant.

See LABOUR LAW; *see* also references under "Hours of Labour" in the Index volume.

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HOUSATONIC, a river in southwestern New England, originates at the confluence of the east and west branches at Pittsfield, Mass., flows southerly for about 148 mi. through Massachusetts and traverses the breadth of Connecticut to Long Island sound. Its mouth is four miles east of Bridgeport, Conn. Several hydroelectric plants utilize the drops of 959 ft. in the first 119 mi. to Derby, Conn. Below Derby the river is tidal for about 12 mi.

The basin is a major centre in the production of brass, copper and clocks in the Connecticut communities of Waterbury, Torrington and Ansonia; electrical and other products are produced in Pittsfield, Mass.; hats are produced in Danbury and rubber and chemical products are made in Naugatuck, Conn. (A. S. Cx.)

HOUSE, EDWARD MANDELL (1858–1938), U.S. diplomatist and confidential adviser to Pres. Woodrow Wilson, was born in Houston, Tex., on July 26, 1858. His father had come to Texas when it was still under the Mexican flag and had become a prosperous planter and export trader in Houston. The younger House attended school in England and later studied at Cornell univer-

sity, Ithaca, N.Y. After extensive travel in Europe he returned to establish his permanent residence in Austin, Tex. Financially independent, he turned from cotton planting and banking to political activities. He refused all opportunities to hold public office, but served as an intimate political adviser to successive governors of Texas from 1892 to 1904. Gov. James S. Hogg appointed him to his staff with the title of colonel, and he was always thereafter popularly known as Colonel House.

House early assumed an active role in Woodrow Wilson's presidential campaign of 1912 and immediately won the confidence and affection of the new president. He refused any cabinet position for himself, but came to be regarded as Wilson's "silent partner" in all administrative and political matters. His personal influence with cabinet members and congressional leaders served powerfully to promote Wilson's legislative program. House was deeply concerned with problems of foreign affairs and through close contact with U.S. ambassadors abroad and personal intimacy with important European statesmen he acquired broad influence in this field. After the outbreak of the European war in July 1914, he was recognized as Wilson's chief agent in all matters of foreign relations.

Under the president's direction, House actively explored every possibility of mediation among the European belligerents, visiting London, Berlin and Paris early in 1915 and again in 1916. In February of the latter year he drafted with Sir Edward Grey, the British foreign secretary, a memorandum proposing peace negotiations and promising that if Germany refused a conference or rejected terms calculated to ensure a just settlement, the United States would enter the war on the side of the Allies to enforce such terms. This memorandum was approved by the president but the Allies failed to take advantage of the prospective offer. Nonetheless, the House-Grey conversations carried important consequences. They led Wilson to sponsor active U.S. co-operation in an organization for the maintenance of world peace; they helped to place the ultimate intervention of the U.S. on high moral grounds.

United States participation in the war brought a vast enlargement of House's role. He co-operated intimately with the war missions of the Allies to the United States. He headed the U.S. mission to the Inter-Allied conference in London and Paris in Dec. 1917 that led to co-ordination of Allied effort in the fields of finance, supply, tonnage and manpower. The president turned to House for advice in drafting his war aims speeches, especially that containing the fourteen points. In the autumn of 1917 he entrusted him with the organization of an American program for the peace conference.

When the Germans requested peace negotiations in Oct. 1918, Wilson chose House as his representative in the inter-Allied conferences where the reply to the German appeal was formulated. In this capacity House won a diplomatic victory of the first importance in persuading the Allied chiefs of state to accept Wilson's fourteen points as the basis of the ultimate peace settlement. The German surrender was thereby facilitated and for the first time the Wilsonian program was given formal recognition by the Allied states.

With the arrival of Wilson as an active participant in the peace conference, the role of House became that of general assistant to the president, who named him one of the five U.S. commissioners. House sat with the president on the commission that drafted the covenant of the League of Nations. His influence was pervasive and his share in the settlement of critical issues important; but the ties that held him to the president were gradually loosening. House was a realist and served as the apostle of compromise. Wilson himself came to find the process of compromise unavoidable, but it was extremely distasteful to him. His implicit confidence in House was weakened, perhaps unconsciously, and at the close of the conference the gap was becoming apparent.

On the day of the signing of the Versailles treaty, June 28, 1919, Wilson and House parted, never to meet again. The latter returned to the United States in the early autumn after completing the organization of the mandates system in the League of Nations. He received no invitation to visit Wilson, who by this time was desperately ill and physically helpless. Those close to the president were not friendly to House and permitted nothing to bring the two together. The letters that House wrote urging Wilson to compromise with the senate in order to save the League were not acknowledged. Thus without any dramatic incident the friendship lapsed.

The personal influence of House in national and in world affairs continued long after the separation from Wilson. He maintained his intimate friendships with European political and intellectual leaders such as Grey, Balfour, Paderewski and Clemenceau. He set forth his political ideas in numerous articles which provide a more accurate impression of his philosophy than the fanciful novel he published anonymously in 1911, *Philip Dru: Administrator*. In 1921 he edited (with Charles Seymour) *What Really Happened at Paris*, a series of essays by members of the American delegation at the peace conference. House's activities and personal contacts in his later years were only slightly curtailed by uncertain health, but in the summer of 1937 he was grievously weakened by an attack of pleurisy. He died in New York, March 28, 1938.

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HOUSE: *see* HOUSE DESIGN; RESIDENTIAL ARCHITECTURE; APARTMENT HOUSE; DWELLINGS, PRIMITIVE.

HOUSEBOAT. In its simplest form a houseboat consists of a cabin of one or two rooms built on a flat-bottomed scow, drawing only from 12 to 24 in. of water and usually with a platform or porch at either end. In the eastern hemisphere, the houseboat is an established institution as the residence for a number of inhabitants, because of overcrowding. In the west such boats are found in great numbers on small rivers or streams, especially where there is good fishing and shooting, on the shallow waters of inland lakes and on the numerous harbours along the coasts. When used as summer homes, houseboats have been developed into quite elaborate craft, having four or more rooms, with a broad porch or veranda on top protected by awnings, the hull construction still retaining the characteristics of a flat-bottomed scow, having great stability. In this form the boats have no motive power and have to be towed from place to place when it is desired to change their position.

With the introduction of the internal-combustion engine, power houseboats were developed and became popular because they could be moved from place to place easily and combined the roominess and comfort of the houseboat with the convenience of the power cruiser. They are for the most part screw-driven and range in length from 45 ft. to 100 ft. or more. Being of shallow draft, they have living quarters in the superstructure, with large windows giving plenty of light and ventilation; they also have broad decks, making ideal summer homes.

In the United States many of these power houseboats are used in northern waters during the summer months and taken south under their own power, to be used in Florida or along the Gulf coast during the winter months. (H. L. ST.)

HOUSE DESIGN, in this article, refers to the process through which a single-family dwelling is planned and built. Information about the fundamental principles of building will be found in ARCHITECTURE. The reader will also find relevant information in INTERIOR DECORATION and LANDSCAPE ARCHITECTURE.

GENERAL CONSIDERATIONS

The Site.—A house must be attached to a piece of land, and the decision as to which piece of land is as important as the design of the house itself. The design of the house can only determine the environment within the house walls: the environment outside the walls is determined by the neighbourhood. A family about to build or buy a house will want to evaluate both the preseht and the future character of the neighbourhood. The relation of the neighbourhood to other parts of the city is an important consideration. The orderly and controlled development of residential building may be greatly influenced by zoning and planning regulations; their absence should be regarded as a danger signal. Regulations will

have a great effect on the surrounding neighbourhood, as well as on the particular house to be built. Schools, churches, paved roads and highways are obviously of fundamental importance. Water, electricity and sewage disposal should be available at the house site; long connections may be subject to future assessments. Local government and fire and police protection affect the value of property. Taxes should be examined and the probable annual tax bill estimated.

In evaluating the particular piece of land to be built on, soil conditions are important. Building lots with rock or water below grade can cause additional expense and hardship in a building operation. Subsurface conditions can be determined by investigating neighbouring building operations. If there is a water problem, the possibility of economical drainage by gravity should be considered. Clay- and water-bearing shale which hold water instead of carrying it off are potential hazards. If there is rock below grade, money may be saved by shifting the position of the house on the site or by reducing the size of a cellar. Soil conditions must be known before the house is designed to avoid unexpected expenses. If there is any question about subsurface conditions, test pits should be dug or borings made; their cost is not great and may be recovered many times over.

The character of the site will in part determine whether a cellar should be built. Cellars have been prevalent in northern climates and were virtually a necessity when gravity heating was used. However, the storage space in a cellar can usually be more advantageously placed above grade. There is little reason for building a cellar today, unless the site makes it easy.

An accurate survey of the property is essential for legal purposes, for the design and for construction operations. The survey forms an important adjunct to the deed. It should be made by a legally recognized surveyor. If there is any easement (*q.v.*) on the property it should be noted. For example, an easement may have been granted to an electric light company to string power lines over the property, and a house would have to be built so as not to interfere with them. Another example is that known as ancient lights (*q.v.*) in England, involving rights to natural light. Some New England farms have easements for roads over which wood from back lots was carried.

If the house site is at all irregular in surface the survey should indicate the differences in level. Levels are measured at regularly spaced points over the property; the points are plotted and those of identical height are connected with contour lines. Differences in ground level can be deceptive to the eye. On simple sites a few readings with an eye level will suffice, but it is important to know exactly what slopes there are on the property. A well-designed house will belong to the land; by working with natural contours the architect can build a house of character and distinction. An irregular site can insure an interesting design; changing the particular characteristics of a site often results in banality and stiffness. Economy is another welcome result of taking advantage of the inherent possibilities of the site.

The Program.—Before the site is selected, and certainly before any active design work proceeds, a program should be drawn up of the particular requirements and tastes of the family who will occupy the house. Even within one locale there are wide differences of income, family size and way of life. A designer must understand the needs and preferences of a family before he can explore ways of satisfying them.

The program starts with a statement of space needed and funds available. These two factors often conflict, but they should be clearly stated. The space needed, especially the number of bedrooms, will relate directly to the number of members of the family, but, in large part, size will be determined by amenities. Therefore, the way of life should be analyzed and set down; it may have been largely unconscious until the writing of the program.

The program should state the members of the family, how they live, and how they expect to live. Children grow up and parents develop new interests, but houses are made of rather unyielding materials. Families differ in the degree of formality with which they live; tastes vary widely. These should be stated. The program for the house will almost invariably need disciplining, a necessary step when ideas are translated into bricks and mortar. But it is well in writing a program to start with ideal objectives; some are bound to come through and add distinction to the final results. The program will have to state whether the living room is to include dining space; the kitchen must be characterized and needed equipment listed. Number and sizes of bedrooms, closets, baths, storage spaces, and special spaces for family vocations and avocations should be listed.

There will be elements in the program which will not have to be listed since they are common to well-designed houses in a particular area. Local climatic conditions have considerable influence on design, as do availability of materials and craftsmen. These are important parts of the program, though they do not have to be spelled out in each case. A well-thought-out program will help produce satisfactory results as much as the careful selection of the site. Both are necessary before the house can be planned.

Planning.—It is well to work with floor plans before turning to such photogenic architectural details as doorways, porches and fireplaces. A well-organized plan can result in satisfactory appearance as well as efficient use. Although there are many books and magazines full of house plans, there never has been a perfect one. But good plans result from careful study of various solutions to a clear program; with study, the preferred solution emerges.

The great change that has taken place in house planning during the 20th century is in the openness of the plan. Small northern European or New England houses of traditional style were compact; they had an inward look and the rooms were distinctly separate. The contemporary house throughout the world is more loosely articulated; interior spaces open into one another. A distinct outward look is obtained through the use of larger areas of glass between indoor and outdoor living spaces. With houses of modest size simple, economical forms such as rectangles are still used. But however small the units, the contemporary trend is expressed by joining the living and dining areas into a single space or by relating the kitchen and dining areas.

There are two important factors in considering the size of interior spaces. A space has to be large enough for use; a well-designed room will take furniture well and allow for movement. If linear dimensions of walls are kept to multiples of four-foot units, there are some savings on construction where modular building materials are used. Experience and ingenuity in planning are required if floor areas are to be kept within reason; the interior of a trailer is perhaps the ultimate in space planning. The second requirement of living spaces is that they be visually satisfying. It has become increasingly important as rooms have become smaller that they appear as spacious as possible. Economic pressures, the trend toward built-in furniture and the transposition of many activities from the home to automobiles or public places have contributed to the reduction in room size. Living rooms, for example, on utilitarian grounds now need to be only a fraction of the size that was considered a decent minimum at the beginning of the 20th century. But contents that are adequate for use can leave our visual needs unsatisfied. Screen walls that let the surfaces of ceiling and floor run visually uninterrupted do much to capture within limited volume the satisfaction of adequate space. Interior spaces, though densely planned and compact, are further enhanced visually by running the line of vision through glass-wall areas, reaching from floor to ceiling into the garden. Rooms should be both efficient and visually satisfying; the openness of contemporary planning is a tool for the accomplishment of both.

Kitchen planning has received much attention in the U.S. The kitchen has changed from an ample icebox inconveniently disposed to a streamlined galaxy of gadgetry; the housewife has been studied thoroughly, and every conceivable labour-saving device has been offered her. There is little to do in planning this portion of the house except to evaluate what is offered and decide how much is wanted.

Templates of furniture, cut to scale and manipulated on proposed floor plans, are very useful. Beds should be free of windows and doors, and with room around three sides for the daily round of bed making. The extent of built-in cabinets must be determined. Drawers and shelves can often be concealed behind walls, freeing

valuable floor space. Circulation spaces such as halls, vestibules and corridors can be kept at a minimum through a careful study of relationships. Living and circulation space should be distinctly separated. The area around a fireplace should be kept clear of passageways; doors should be located so as not to encourage traffic through spaces furnished for sitting, conversation or quiet.

The site must be studied and determined in conjunction with the planning of the house proper. Topography, garden location, outlook from windows and the points of the compass are important factors in the design of the house. Zoning regulations may limit the percentage of the lot to be built on and may state minimum setbacks from property lines.

Throughout the planning process, projection of floor plans into the third dimension will be desirable. Often a simple model will be of value, built of cardboard or plasticine. The design process consists of continual adjustments made during the various stages.

Finally, it is important that the best professional advice be sought in the design and construction of the house. The cost of such service, when competently given, can be recovered several times over in reduced construction costs, and greater satisfaction results from the use of a well-designed house.

Appearance.—Most people start thinking about a house with a definite picture in mind, and the purpose of the design process is to arrive at a house that properly reflects the dweller's likes and dislikes. Houses in a specific historical style such as Georgian or Tudor are seldom designed today. The character of the present time is achieved by using the past for inspiration rather than imitation. (*See* also RESIDENTIAL ARCHITECTURE.)

Proportion, material and colour are the fundamental factors in appearance, good or bad. The over-all proportions of the house are naturally related to room dimensions and ceiling heights. There are no universally accepted formulas for these relationships. Dimensions for projected rooms should be compared with existing rooms whose measurements are known and whose visual impact can be observed. Interiors are most satisfactory when spaces are clear and simple. Too many corners indicate bad planning and result in visual confusion and increased cost. There is a constant relationship between a clear program, clean planning, aesthetic satisfaction and financial economy.

Small rooms can be made to appear larger by a number of devices. Properly scaled furniture and not too much of it, placed in a room designed with the furniture in mind, is the best way of achieving this effect. With open planning and the use of screen walls, rather than solid walls with doors, the eye can look beyond the limits of the immediate room; visual awareness of adjoining spaces gives a feeling of increased space.

Colour selection is important, not only for its own effect, but also for its effect on space. Colour is greatly affected by both form and lighting. The same pigment will look different on a wall opposite a strong light such as comes from a large window, than on a wall in shade. Colour has an important effect on apparent size. In general it can be said that light, cool colours enhance apparent size, and strong, warm colours reduce it.

If the earlier planning stages in house design have been logically and carefully undertaken, the house will tend naturally and easily toward good appearance. Unfortunately, this tendency is not quite automatic and there is a constant need for modification until satisfactory appearance is attained. The mass of the house and its component spaces should be pleasing. The over-all impression is greatly affected by the relationship of the heights of walls to each other and to their lengths. Also roof pitches and projections, such as porches or sun shades, greatly affect the appearance of the mass.

The placing and sizing of openings is another critical consideration. The windows and doors must look well from the interior as well as from the exterior. Satisfactory functioning is also involved; windows must be sized and located for the best possible lighting and ventilation, and to provide good wall space for furniture. The pattern of light and shade created on the interior is of obvious importance. Size, shape and character are dependent on climate, orientation and structure.

In a world where news flashes almost instantly around the world, home owners are quickly aware of what is being built everywhere, and there is a constant urge to copy what is admired, too often without understanding it. The special qualities that are indigenous to particular regions are lost in this way. Local materials, local customs and local climates are factors that add distinction to houses. Indigenous materials such as stone or lumber that are quarried or cut in the vicinity add a special quality, particularly when they have had the refining influence of long tradition. The architectural expression of a way of life in California or New Mexico properly characterized as a ranch house is anomalous when built in a New England village which has its own tradition. Climates vary enormously throughout Europe and throughout the United States; a large glass area that is reasonable in the northern latitudes will tend to turn a house into an oven if used on the west side of a house in a southern area.

Details should be consistent in scale. Too many materials on one house should be avoided; this admonition applies also to colours. Simplicity is important; emphasis of detail should be concentrated. Chimneys usually are made larger for visual reasons than they need be. In the last analysis, appearance is a product of taste. In building, good appearance comes from good taste that is trained and disciplined.

Estimating.—Unless there is a constant and clear understanding of what designs under consideration may cost, a great deal of time and study can be wasted. It is important that there be an early and continuing consideration of this factor.

As a rule of thumb, a unit cost per cubic foot can be assumed and then multiplied by the cubic contents of the projected house in its various design stages. Such unit costs are available as a result of local experience. With the tendency to reduce or eliminate cellars and attics, it can be understood that a cubic figure unit becomes less valid. By changing from a pitched to a flat roof and thereby eliminating a large attic, the cubic contents of a house would be materially reduced, while the cost of the house, which would still have the same amount of living space, would not be proportionately changed.

A better method is to estimate on the basis of floor space, with a unit price per square foot. This method probably comes closer to reality, since floor space is what has most value. A price per square foot will vary with quality of construction, type of design and locale, but it is generally available as a yardstick in most communities where building goes on. It may be well to use it for the house proper and to add lump sums for elements such as garages and porches. As the design becomes more precise, so can estimates; a firm price or controlling estimate may be secured before construction.

To the estimated cost of construction of the house, allowances are added for cost of land, utilities, legal fees, cost of financing and architect's fee. Landscaping and finished grading have to be provided for as do any other special requirements.

Financing.—A house usually represents the greatest capital expenditure that a family ever makes and it is customarily paid for in major part through mortgage loans. A useful and comparatively simple home mortgage finance structure has been established in the U.S., largely through the operations of the Federal Housing administration. The FHA was established as an agency of the federal government to insure mortgage loans made by lending institutions such as banks, insurance companies, and building and loan associations. It also establishes standards and supervises the quality, location and marketability of houses on which insured loans are made.

The general practice on mortgage loans, whether FHA insured or not, is to limit financing to a single loan, not exceeding a maximum percentage of the value of property. Monthly payments, within the capacity of the family's income, are mandatory regularly over a period of years. The provisions are sound for the borrower as well as the lender. In order to equalize the payments over the time of the mortgage, the amount of each payment for the repayment of the loan is less during the earlier stages while interest is high, but it becomes greater as interest payments decrease on the diminishing balance.

The cost of the house during the amortization period, sometimes

called a rental equivalent, includes interest and amortization of the mortgage, taxes, insurance, maintenance and repairs. It is generally accepted as sound principle that the total of these charges should not exceed one quarter, or preferably one fifth, of the family income. Another rule of thumb for use in preliminary budgeting is that the cost of the house, including land and all other capital charges, should not exceed much more than twice the annual income of the family. This is a flexible rule, due to variations in interest rates, amortization periods and construction costs.

The development of house design has been discussed primarily from the point of view of a family building its own house, but the statements also apply to the development builder who is designing houses to sell or to rent. It is not always wise or expedient for a family to build or to own a house, and in many instances rental will be preferable. Furthermore, there are desirable types of housing other than single-family residences, such as attached row houses, garden apartments and multistory apartment buildings. Similar principles of good design procedure apply to all these.

Professional Services.—The design and construction of houses is an intricate process requiring competent professional advice. Most countries and all the states in the United States have laws licensing and regulating the practice of architecture. It is often very difficult to apply the professional services of the architect to a single small house. This can be indirectly done through the development builder who is able to portion the time and cost of architectural services to a number of houses which are sold or rented individually. Often the services of an architect can be made available for the builder of a single small house on a limited basis. But whatever the procedure, the design of a house is a science and an art. It requires practical experience, technological understanding and visual sensibility. *See* also ARCHITECTURAL ENGINEERING.

STRUCTURAL ELEMENTS

Materials.—Technology has produced a multitude of building materials that were unknown only a few decades ago. The home builder is deluged with a wealth of choices for almost every element of the building.

The structure of the house is not a complicated engineering problem. Loads are modest, spans are seldom great and two or three stories is the limit for height except for apartments. Bearing walls of masonry, such as brick, stone or concrete block, and framed walls of studs, usually of lumber but sometimes of steel, are the two basic alternatives.

Masonry walls are economical where the materials are indigenous, since they are too heavy to ship long distances. In northern or wet climates they should be furred between masonry wall and interior finish to prevent passage of dampness. Stone requires the greatest amount of labour. Brick can look well painted; concrete block needs to be well made and carefully laid. Masonry bearing walls are the almost universal method in Europe and Latin America and are widely used in the U.S.

The development in the U.S. of the balloon and platform type of lumber frames followed the earlier post and lintel construction used by the settlers. Frame construction is remarkably strong. Lumber of a nominal two-inch thickness (actually finished to one and five-eighths inches) and a nominal width of four inches is usually used for studs, and a depth from six to twelve inches for floor joists and roof rafters. The basic module for spacing is usually sixteen inches. At all framing points it is important to have an equal depth of wood at right angles to the grain, since wood does shrink in that direction and shrinkage can cause uneven settlement, cracks in walls and bumps in floors. The frame was traditionally sheathed on the outside with one-inch boards and plastered on the inside. There are now various sheet materials to take the place of sheathing and plaster. (*See* CARPENTRY.)

Gypsum, which is used in plaster, is made into paper-faced sheets of gypsum board, usually four feet wide and at least eight feet long. By masking the recessed joints with tape and filler, a dry wall interior finish that is economical and satisfactory is obtained. The elimination of the great quantities of water needed for plaster, together with the saving of labour and time, has led to wide use of this and other dry sheet materials such as plywood for interior finish.

Plywood (*q.v.*), made from wood veneers glued together with the grain alternately at right angles, is strong and durable. Considerable structural strength in relation to weight is characteristic of plywood made from Douglas fir, and considerable beauty can be obtained with the use of a variety of woods. Plywood finishes include exotic grains from the far east, hardwoods such as oak and walnut from Europe and the Appalachian regions in the U.S. and mahogany from Central America.

Gypsum board can be waterproofed and used for exterior sheathing, as can plywood. Plywood for exterior finish is made with waterproof glues. Boards of cellular fibres pressed into rigid sheets have structural value for wall sheathing and interior finish, as well as insulation value against heat transmission.

Wood flooring is available in oak and other traditional hardwoods, in addition to composition floor materials, including rubber tile, asphalt tile, cork composition and linoleum. Ceramic tile is available for floors and walls. Sheets of synthetic resins (plastics), having various properties, are available for floors and walls, as well as for counter tops and trim.

For exterior finish, brick veneer over wood framing is highly satisfactory, sometimes giving better insulating value and weather protection than solid brick masonry. Wood clapboards and shingles, flush boarding and asbestos siding are other possibilities. Asbestos siding is made of lapped strips of asbestos cement board, which is also available in large sheets. This fire resistant material is made of portland cement reinforced with asbestos fibres. There is also a process by which wood is ground and pressed into a hard board of good finish and strength. A variety of sheet materials of good properties have been made from waste wood products.

Roofing materials include the traditional wood shingles, slate and tile, as well as the newer asphalt and asbestos shingles. Asphalt shingles are made of asphalt impregnated felt, surfaced with slate or ceramic granules to give colour and protection. Aluminum, copper, stainless steel and galvanized steel are available for roofs as well as for leaders, gutters and flashings. For roofs that are flat, or practically so, built-up layers of felt in asphalt or tar, surfaced with gravel, are the standard. Walking surfaces of tile are available.

The trend in building materials is toward larger, lighter and stronger building units which can be efficiently assembled at the job site. Building units the size of bricks are being supplanted by building units the size of wall board.

Factory Fabrication.—The building industry was traditionally one of handicraft operations. Technological change has not been swift in comparison with many manufacturing industries, but it has been steady. Craft operations at the building site are being replaced by mechanized operations at the factory, and houses are increasingly becoming assemblages of factory-made elements. Windows and doors, once made and fitted by carpenters at the site, now arrive from a factory, fitted and finished with hardware and glass, ready to be set in place.

Modular design (*i.e.*, design in which the elements are dimensioned in combinations of a fixed unit) has led to standardization of elements, interchangeability of parts and increased possibilities for mass production, with resultant economies. A wide variety of mass-produced elements from which substantial portions of the house can be assembled are now available. Examples are kitchen cabinets and mechanical equipment and window and door units. Entire house assemblages are available from manufacturers and are being used to an increasing extent.

Doors and Windows.—Flush doors of plywood veneers are gradually replacing the older paneled doors. A sliding door eliminates the floor area necessary for the swing of a hinged door. Glazed double doors can be used effectively for wide exterior openings; glazed sliding or folding exterior doors are often desirable in joining interior to exterior living space. Since correlation with hardware is important for smooth operation, these units are usually factory assembled. (*See* DOOR.)

The traditional types of window are double hung and casement.

Originally made in wood, they are now also in various metals. The double-hung window is economical, easy to operate and excellent for use in wood-framed houses, since it adjusts itself to shifts in the house due to lumber shrinkage. To insure easy raising and lowering of sash, good hardware is important. Double-hung windows are easily screened.

The casement sash has the advantage of providing a complete opening, but it is more likely to warp if made of wood. Therefore it is usually made of metals which do not warp if properly treated. Steel sashes finished for long life without painting, and aluminum alloy sashes are widely used. Casement sashes are more easily made weathertight if they swing outward, but this requires inside screening, with under-screen operators.

In addition to double-hung and casement windows, there are top-pivoted sash windows, which have the advantage of shedding the rain when open. They are made in groups with a common operator. Sashes that are centrally pivoted, either horizontally or vertically, are available, but offer screening problems. Sliding sash windows are simple to operate, particularly when made in metal. (*See* WINDOW.)

Window screens are made of copper, aluminum, stainless steel, plastics and galvanized steel. They can be replaced during the winter with prefitted storm sash.

It is well to watch thickness of glass in relation to size when installing large areas of fixed glass. Various types of double glazing with an air space between help to reduce heat losses. Consideration should be given to both outlook and to orientation. The picture window is of doubtful visual value when facing the neighbour's clothesline, and it can act as a heat trap in summer if placed, for example, on a west wall.

Considerable information is available about the relationship of house design to climate. Houses are, in one sense, filters between human beings and climate. The design of a house should be such as to take advantage of some climatic impacts such as the heat of the sun on a cold day or a prevailing breeze in hot weather. On the other hand, during hot weather it is desirable to keep the sun off glass areas. This can be accomplished by orienting the house properly in relation to latitude, by placing glass areas on walls which the sun does not reach until low, and by using various shading devices. A canvas awning is an obvious shading device, but projections can be built as projecting cornices or porch roofs.

Since the angle of the sun's rays to the earth is greater in summer than in winter, houses can be designed to shade glass areas when the sun is high in warm weather and to let in the lower winter sun. The maximum benefit from sun and wind can be derived from proper design. The design of a house in Massachusetts will, of course, be quite different from that in Florida, in shape and orientation and in the size and location of openings. Working with natural forces substantially reduces heating bills in the north and the cost of air conditioning in the south. *See* ORIENTATION.

Heating and Air Conditioning.—Man is usually most comfortable when the air about him has a temperature of 70° F. and a relative humidity of 50%. To obtain this condition within a house is the purpose of heating equipment in cold weather and air-conditioning equipment in hot weather. A source of heat has to be provided, generally in the form of a furnace which burns either coal, oil or gas. It should be centrally located to minimize circulation runs. To distribute the heat from the furnace so as to balance temperatures throughout the house requires ducts or pipes. A simpler heat source is, of course, a stove or fireplace.

In a warm-air system the air is heated by passing over a heat chamber surrounding the burning fuel and carried through ducts to outlets in rooms. Warm air naturally tends to rise and if the furnace is below the outlets or registers, the circulation of air can work by gravity, a most dependable source of energy. This requires, however, ducts that are constantly rising and of considerable size. By forcing the air with an electrically driven blower, ducts can be reduced in size and more control gained over the system. Filters are installed in the duct system to eliminate dust, and the air can be humidified. In warm-air systems the heat is transmitted largely by convection.

Radiation is another method of heating. The sun heats by radiation and, in a lesser way, so does any object the sun has heated, such as a stone bench at noon. Hot-water or steam-heating systems utilize this principle; radiators are usually placed under cold glass areas and hot water or steam is piped to them from the furnace. A steam system maintains a temperature high enough to change water into steam. The steam enters the radiators where it cools while giving off heat and returns to the furnace as water to repeat the cycle. A hot-water system operates at a lower temperature; hence it is an easier, more pleasant heat than steam, but it requires larger radiators. If the water can be pumped, higher temperatures are possible, with quicker response, and pipes may be inclined downward.

Radiators heat by convection as well as radiation, since air passes over the radiators and circulates in a warmer state. Radiators can take the form of continuous elements between walls and floor (baseboard radiation). While radiators usually are made of a heavy, heat-holding material such as cast iron, the steam or hot water may be passed through elements with copper fins, known as convectors. The fins accelerate the emission of heat, largely through the movement of air across them. Convector type radiation equipment can be recessed in the wall in less space than cast iron radiators.

It is widely held that a true radiant heating system is the most satisfactory physiologically, resembling as it does the action of the sun. It is accomplished by circulating hot water through heating pipes embedded in floors, walls or ceilings, thus heating large surfaces to relatively low temperatures. The large surfaces emit heat gently in contrast with the more intensive, concentrated sources of other systems. Radiant heat makes possible a lower air temperature without discomfort.

Radiant heating was used by the Romans in their baths, with warm air in floor cavities as the heating agent. It has been used in England for many years. Its possibilities are now enhanced because low-temperature hot water can be circulated by pumps, making for quicker response to temperature changes. Any one of the automatic heat sources can be used. Piping can be either iron, steel or copper. There are alternatives as to the location of the radiant surface. If the pipes are in the floor, a concrete slab on grade acts as a substantial, heat-holding agent. It is important that the slab be insulated from the ground around the perimeter. An advantage of pipes in the ceiling is that they permit higher temperatures, and therefore quicker responses. Reflective insulation, such as aluminum foil, should be placed over the ceiling pipes. Where there are large glass areas, auxiliary pipes in walls are sometimes necessary. (*See* HEATING AND VENTILATION.)

The cooling of houses in warm climates can be greatly simplified by proper design. Where mechanical means are used, the choice lies between a central system with ducts and separate wall units. If a warm-air heating system has been installed the ducts can be used for cooling. A central unit can be conveniently installed in an attic. (*See* AIR CONDITIONING.)

Proper insulation of a house adds greatly to comfort and reduces fuel bills. The roof is probably the most important place for insulation. Double glazing of windows, most economically through storm sash, is desirable in cold climates. A warm floor is essential to comfort. Rigid insulation board can serve both as structure and insulation. Loose insulation is formed of rock wool, glass fibres, wood fibres or other porous combinations. It is vital that such insulations have vapour seals on the warm side, since the vapour in warm air condenses when it reaches a cooler point inside the insulation. This renders the insulation ineffective, and the moisture has a detrimental effect on structure and finish. Reflective insulations, such as aluminum foil, are efficient and act as vapour barriers themselves. (*See* INSULATING MATERIAL.)

Fireplaces.—The fireplace was an important element of early houses that has survived in all forms of modern planning. Although inefficient in its heat output, it is a symbol that has a remarkably strong power. It is usually placed along one wall of a room, but it can also be located between two spaces, opening on both sides, or even in the centre of a room. Great care should be given to adequate chimneys since flue sizes should bear a definite

relationship to the size of fireplace openings to provide good draft.

Plumbing.—The kitchen and bathroom should be located as close as possible to each other in order to economize on supply and waste lines. Code requirements will set the standards in most communities. If the house is built outside any such jurisdiction it is well to follow the code of a nearby town or city. Venting is important. Care should be taken to avoid back syphonage when a supply faucet contacts waste material in a basin or tub. The service line from the street, of generous size, should be placed below the frost line in cold localities. It is well to know the degree of hardness and acidity of the local water. If unusually hard, allowance should be made for some future constriction from calcium deposits within pipes. Water-softening devices can control this.

Supply lines to and within the house are generally of copper tubing. There may be local conditions which would indicate other materials. Waste lines have generally been made of galvanized steel and iron, with heavier lines of cast iron. Copper is used because it can be shop fabricated and it takes up less room in walls and floors than cast iron, which has projecting hubs and must be caulked and soldered on the job.

Great technological advances have been made in plumbing. There is no valid objection to standardization in the design and arrangement of the three basic bathroom fixtures. Much progress has been made with respect to standardization and production of the elements of kitchen equipment. The same principles are being applied to factory fabrication and assemblage of supply and waste connections. (*See* PLUMBING.)

Electricity.—The electric load of most houses has increased enormously as standards of lighting rose and mechanical and household equipment multiplied. Wiring can soon become obsolete so it is well to provide for future increase of electric load. The power should come into the house at a convenient but inconspicuous point where the meter is installed. From the entry switch and panel box a network of wiring leads to the fixtures and equipment. The wiring is occasionally run in rigid conduit, but more often consists of steel-armoured or plastic-covered cable.

The network of wiring throughout the house is divided into circuits, each of which is connected to the panel box, which in turn is tied to the service line from the power main in the street. The panel box has circuit breakers which shut off power to any line which is overloaded or develops trouble. It is important to provide plenty of convenient outlets throughout the house into which lamps and electric appliances can be plugged. There should not be too many outlets to a circuit, to avoid overloading, but outlets should be available where they might be needed. A tangle of extension cords is hazardous. *See* also HOME EQUIPMENT; RESIDENTIAL ARCHITECTURE; ARCHITECTURAL ENGINEERING.

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HOUSEFLY (*Musca domestica*), a common and virtually cosmopolitan dipterous insect of the family Muscidae (*see* FLY). Comprising about 90% of all flies occurring in human habitations, houseflies formerly constituted a major nuisance and hazard to public health in cities and are still a problem on farms and in other places where substances suitable for development of their maggots are allowed to accumulate.

The adult housefly is dull gray, the thorax being marked with four darker, longitudinal stripes and the abdomen variegated with dirty-yellowish areas. Body size ranges from about 5 to 7 mm. The conspicuous compound eyes are composed of approximately 4,000 individual facets. The mouthparts are of a sponging or lapping type, consisting of an extensible proboscis with a bilobed, fleshy tip, on the lower surface of which are many slender grooves that conduct liquid foods to a central point, from which they are drawn up by means of a bellowslike pharyngeal pump within the head. The ability of the housefly to overcome the force of gravity in walking on vertical window panes or hanging upside down on a ceiling has been attributed to the surface-tension properties of a secretion produced by tiny, glandular pads (pulvilli), one beneath each claw, on the feet.

Female houseflies often deposit more than 100 eggs at a time on decomposing organic wastes such as horse manure or fermenting garbage. The eggs are slender, whitish and 0.8–1.0 mm. long. In her lifetime one female may produce 600 to 1,000 eggs; thus, where larval food is abundant, houseflies may become extremely numerous by late summer. The eggs hatch in about eight hours at 24° to 35° C. (75° to 95° F.), and the young maggots attain the first molt (shedding of skin) in 24 to 36 hours. Passing through two additional growth stages, the dirty-whitish maggots reach a length of about 12 mm. in four to five days after the first molt, then transform into pupae. Pupation occurs within the last larval skin (puparium), which contracts into an oblong shape, hardens and turns dark brown. When the adult fly has developed, it expands an eversible pouch (ptilinum) on its head, breaking the end off the puparium. Making its way to the open air, the fly spreads its crumpled wings, then takes flight, beginning the life cycle anew.

When they fly from their filthy breeding sites into human habitations, houseflies may carry on their feet millions of bacteria and thus may contaminate human food, causing bacillary dysentery. It is thought that in this same way these flies act as vectors of typhoid fever, cholera, amebic dysentery and perhaps poliomyelitis. Control of houseflies is directed against both maggots and adults. Where garbage, manure and similar wastes cannot be made inaccessible to flies, they are treated with larvicidal drenches or dusts. Residual insecticidal sprays remain effective against flies for several weeks. However, in many localities houseflies have developed resistance to chlorinated hydrocarbon insecticides such as DDT and Lindane and must be attacked with other compounds.

The belief persists that the housefly from time to time will bite; however, it cannot, because of its soft mouthparts. This confusion arises from the fact that its near relative, the stable fly (*Stomoxys calcitrans*), does bite and is often very annoying in rural areas. Other flies often seen in houses include large, noisy blow flies or bluebottles (*see* BLOWFLY), cluster flies, which sometimes hibernate in large groups in attics, and other species of *Musca*, some more numerous than the common housefly in Australia and parts of the tropics.

See Luther West, *The Housefly* (1951). (G. W. Bs.)

HOUSEHOLD, ROYAL. In all the medieval monarchies of western Europe the general system of government sprang from and centred in the royal household. The sovereign's chief domestics, bearing titles suggestive of purely personal service, gradually became the great administrators of the realm. Thus, in England, with which this article is primarily concerned, the chancellor (*q.v.; see* also LORD HIGH CHANCELLOR), originally merely the head of the king's writing office, became, as keeper of the great seal, responsible for the authentication of all major state documents, and was, during the later middle ages, the principal officer of state. In France this primacy of position was achieved at about the same time by the constable (*q.v.*), who, originally the master of the stables, became in due course commander in chief of the army.

In modern times members of the royal household no longer hold government office but are concerned only with the organization of the various royal establishments and with personal and ceremonial attendance on the sovereign.

THE MEDIEVAL HOUSEHOLD

The early English poems which recall conditions of the migration age of the Anglo-Saxon tribes describe feasts in the king's hall, where his praises were sung to the harp. As the migration age passed into the time of settled kingdoms the king's household appears as the centre of government and his hall its focus. Following their conversion to Christianity in the 7th century, Anglo-Saxon kings began to acquire a staff of learned clerks who could record their gifts to churches or to great men, the decisions of the king and his advisers and the laws of the land. Very early in English history the royal household can be seen falling into three main divisions: the chapel with its staff of clerks, the hall where the daily life of the household was passed and the chamber (*see* CHAMBER, KING'S) where the king could retire for sleeping and privacy and where his clothes, jewels and muniments were stored. A similar threefold division can be seen in all the royal households of the

new Europe and in the households of great magnates in every land.

In England no one officer stood out as head of the king's household staff in the way that the mayor of the palace (*q.v.*) dominated the Frankish Merovingian court. The "discthegns, hraeglthegns and birele," that is, seneschals, chamberlains and butlers, to each of whom King Edred (946–955) bequeathed 80 golden coins, were his chief servants whom he regarded as deserving of equal rewards. No constable or marshal is mentioned in his will by name or office. But from his time until the end of the Anglo-Saxon period a considerable anonymity among officeholders can be seen. From the reign of Canute (d. 1035) the Norse loan word *staller* was used to describe a man who had a permanent office in the king's hall without indicating his relative status or exact duties. The indefiniteness of this title in no way indicates any lack of organization in the households of the last Saxon kings. The king's writing office, which can be traced back to the reign of Aethelstan (d. 939), was, indeed, the most efficient in Europe. It attracted foreign clerks to the king's service and the Anglo-Saxon writ or royal letter had become an instrument of government. A successful royal clerk could hope to rise to a bishopric, but there is no adequate evidence that before the Norman Conquest the writing office was ever styled the chancery or its head the chancellor. The appearance of the chancellor at the head of an office called the chancery (from the *cancella*, or screen, which shut off the clerks from the main body of the king's hall) is a development of the immediate post-Conquest generation, resulting from the immense pressure of work caused by the changes in land ownership after the battle of Hastings.

No account of the household staff of the Norman kings was written down before the early years of Stephen's reign (1135–54) when the *Constitutio domus regis* was compiled. Like the household ordinances of the later middle ages it is primarily concerned with the daily wage in money and the allowance of bread, wine and candles due to each household officer, and ignores the fact that the less important royal servants generally held land of the king in serjeanty (*q.v.*). The *Constitutio* begins with the royal chapel under the chancellor, who received the highest daily wage of all the king's officers—5*s.*, whether he ate at the king's expense or his own. His second in command, the master of the writing office, had formerly received tenpence, but Henry I had increased his wage to 2*s.* and given him appropriate additions to his allowance of bread, wine and candle ends.

The king's hall was under the care of two officers of equal rank, the seneschal (steward) and the master butler, who each received a standing wage of 5*s.* a day, but when they actually served in court and were fed at the king's expense their daily wage was 3*s.* 6*d.* Their two parallel departments provided food and drink through a series of officers carefully graded as to pay and allowances down to the man who counted the loaves, and the slaughterers who had no pay but "customary food" only.

After the hall came the chamber under the master chamberlain (*see* CHAMBERLAIN), but beside him stood the treasurer, each of these officers receiving the same pay and allowances as the seneschal (*q.v.*) and master butler. Below them were less well-paid chamberlains: the man who looked after the king's bed with a man and a packhorse for its transport, the king's tailor and his bath man. The appearance in this household department of the treasurer, head of the new financial department, the exchequer, shows that in origin the exchequer and treasury were regarded as household departments. This does not mean that the treasure always traveled with the king. At Winchester a strong place had long been established for the receipt and custody of the king's treasure, but it was staffed by household officers and was essentially a department of the household.

The *Constitutio* concludes with the two departments which between them cared for the safety, peace, order and comfort of the household and for the king's sport. The chief constable had the same pay and allowances as the master chamberlain, but the marshal (*q.v.*) had not yet achieved the higher rate. He had to keep the tallies (that is, the receipts) for all the gifts and liveries made from the king's treasury and chamber and oversee the hearthman who made the fire in the hall from Michaelmas to Easter.

The framework and many details of this organization continued to some extent from medieval into modern times. In the 1445 Ordinance of the Household, bread, wine and ale "for the night" were still allowed to members of the household in accordance with their status. When the *Constitutio* was compiled the chancery and exchequer were still departments of the household. A hundred years later the enormous momentum of a developing nation had carried them out of court and the household had been obliged to create a financial and clerical department of its own. Hence the gradual appearance in Henry II's reign of the chamber as the department which received and spent money on household and national business. A generation later the wardrobe (*q.v.*) appeared as a well-established department of the household using the king's small or privy seal for the conduct of business which might range over any matter concerning the king or kingdom.

The earliest household accounts come from John's reign (1199–1216) and display the continual theme of public business, war and politics running through the household's daily life. In the reign of Henry III (1216–72) the king's increasing dependence on his wardrobe staff at the expense of the old great offices of state, the exchequer and chancery, was one of the causes of the Barons' War, but the barons failed to effect the reform of the household which they had planned. Edward I elaborated the organization of the wardrobe so that able young men could regard service there as a desirable career.

Already at the beginning of the 12th century the chief household officers, important barons in their own right, had become too great to perform their household tasks as a matter of routine. But on occasions of high ceremony, and in particular at a coronation, there was fierce competition among the greatest magnates of the land for the right to discharge any household duties which they could claim by inheritance. At a modern coronation the Anglo-Norman royal household for a moment once again comes to life.

Even parliament was in origin itself a development of the royal household. When it began to appear in the 13th century it was no more than a meeting of the king's council reinforced by representatives of the knights of the shires and the burgesses. Every European kingdom was growing richer and the need to make a display before foreign ambassadors forced every ruler into more expenditure than his resources could easily allow. From the late 13th century households were set up for royal children.

The middle ages are punctuated by household ordinances (1318, 1323, 1445, 1454, 1471, 1478) which by insisting on economy and strict accounting had the common aim of enabling the king to pay his way. The Yorkist Edward IV (1461–83), enriched also with the lands of Lancastrian rebels, succeeded in achieving reasonable economy and magnificence and his Tudor successors followed his example. Their household ordinances of 1493, 1526 and 1539–40 elaborated Edward IV's reforms so effectively that until the 18th century the royal household was running on the lines then laid down. The semiofficial descriptions of England which for the late 17th and 18th centuries provided the equivalent of *Whittaker's Almanack* set out a royal household which in minutest detail was essentially that of the medieval sovereign. The six maids of honour of Queen Charlotte, wife of George III (1760–1820), correspond to the six "dauncelles" who attended Margaret of Anjou, wife of Henry VI (1422–61). (D. M. S.)

THE ROYAL HOUSEHOLD IN MODERN TIMES

The history of the royal household in England from the mid-19th century has been mainly one of reorganization in order to achieve increased efficiency. Formerly there was much overlapping and confusion in the duties of the various departments. The prince consort undertook a thorough reorganization of the household in 1844, thereby effecting great economies and abolishing various sinecures and other abuses. Further changes were made by King Edward VII and by subsequent monarchs.

In its main outlines, however, the household is essentially the same as it was in earlier times, the three principal departments being still controlled by the lord chamberlain, the lord steward (*qq.v.*) and the master of the horse. Until 1924 these three officials

were appointed by the prime minister, but since then, in practice, they have been appointed by the sovereign, subject to the proviso that they do not vote against the existing government. The treasurer, comptroller and vice-chamberlain of the household, who are always members of the house of commons, together with the lords in waiting, and the captains of the corps of gentlemen at arms and of the yeomen of the guard (*q.v.*) remain, however, political appointments which change with the government. All other appointments in the household are made by the sovereign.

Perhaps the most notable feature of the period under review has been the increase in importance of the sovereign's private secretary and his assistants. The office is an ancient one, but after the death of the prince consort (1861), who had virtually constituted himself the queen's private secretary, Queen Victoria and successive sovereigns have come more and more to rely on the help and impartial advice of their secretaries not only in dealing with their immense correspondence on home and commonwealth affairs but in arranging and organizing the annual royal program. In addition to the private secretary there are two assistant secretaries and a press secretary (first appointed by King George VI).

The head of the household is the lord chamberlain, who has an office in St. James's palace under a comptroller and deals with all matters connected with ceremonial. He is also responsible for other departments, such as the ecclesiastical and medical households, and for stage censorship, a survival from the time when he was responsible for court entertainments.

The administrative duties of the lord steward are now carried out by the master of the household. This was an office created by the prince consort and it took over and co-ordinated the somewhat miscellaneous duties of the old Board of Green Cloth. The master of the household is responsible for the staffing and administration of all the royal residences.

The whole of the financial side of the royal household is controlled by the keeper of the privy purse (*q.v.*) and personal treasurer to the sovereign. He also deals with the sovereign's charitable donations and subscriptions and administers the grant made to the royal almonry, although the ceremonial side of the latter, the annual distribution of the royal maundy (*see* MAUNDY THURSDAY), is carried out either by the sovereign in person or by the high almoner (an office dating from the 12th century and always held by a high ecclesiastic) and his assistants (*see* ALMONER).

The last of the principal officials of the household is the master of the horse, whose administrative duties are carried out by the crown equerry. He is in charge of the royal mews and of travel in its widest sense. One of the extra equerries, for instance, is the captain of the queen's flight, a service instituted by King Edward VIII on his accession to the throne.

On all state occasions the mistress of the robes, always a duchess, is in personal attendance on a queen regnant; at other times the ladies of the bedchamber and the ladies in waiting, together with the equerries, take their turns for being in waiting according to a rota.

There is a separate household in Scotland, and the consort of a queen regnant, the queen mother or dowager and the sons and daughters of a sovereign also have their own households.

(L. E. TA.)

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HOUSEHOLD APPLIANCES: *see* HOME EQUIPMENT.

HOUSEHOLD TROOPS: *see* GUARDS AND HOUSEHOLD TROOPS.

HOUSELEEK, common name for *Sempervivum*, a genus of ornamental succulent plants, also called "hen-and-chickens," belonging to the family Crassulaceae (*q.v.*). About 30 species are known, some of which are hardy perennial herbs, and grow well in dry or rocky situations; the others are evergreen shrubs or undershrubs, fit only for cultivation in the greenhouse or conservatory. The genus *Sempervivum* is distinguished from the nearly allied *Sedum* by having six or more petals, whereas *Sedum* has four or five petals.

The common houseleek (*S. tectorum*) was originally Eurasian but became widely distributed in Europe and was introduced into America. It is often met with in Great Britain on roofs (where it is sometimes planted to keep slates in position) and wall tops. The leaves are thick, fleshy and succulent, and are arranged in the form of a rosette, lying close to the soil. The plant propagates itself by offsets on all sides, so that it forms after a time a dense cushion or aggregation of rosettes. The flowering stalk, which is of rather rare occurrence, is about one foot high, reddish, cylindrical and succulent, and ends in a level-topped cyme, recurved at the circumference, of reddish flowers, which bloom from June to September.

Sedum acre (stonecrop) is styled the little houseleek. *S. arachnoideum*, the cobweb houseleek, is often cultivated for ornament (*see* SEDUM).

HOUSE OF REPRESENTATIVES: *see* CONGRESS, UNITED STATES.

HOUSE PLANTS. From paintings and sculptures the practice of indoor gardening can be traced at least to the early Greeks and Romans, who grew plants in pots and perhaps brought them into their homes. The older civilizations of Egypt, India and China also made use of potted plants but usually in out-of-doors situations, and for centuries the Japanese have carried on the dwarfing of trees and other plants for room ornaments (*see* BONSAI). But the popular art of growing house plants did not receive much comment till the 17th century. In the *Garden of Eden* (printed in 1660) Sir Hugh Platt wrote of the possibility of cultivating plants indoors. Shortly thereafter, glasshouses (greenhouses) and conservatories appeared in England and elsewhere to house exotic plants (*see* GREENHOUSE). In the mid-19th century, in England and France, books began to appear on the growing of plants in private residences, and the use of enclosed portable cases of plants (wardian cases or terrariums) became popular. Since that time interest in house-plant cultivation has become so great that today few houses in civilized countries are without some form of plant life.

Although hundreds of plants can be grown successfully indoors, there are certain groups that, because of their attractiveness and relative ease of culture, are considered house plants par excellence. Such are the aroids (arums), bromeliads, cacti and succulents, sansevierias, ferns, begonias, palms and others, which have long been favourites in the home. Somewhat more demanding are the African violets, camellias, gardenias, geraniums (*Pelargonium* species), orchids and others, grown primarily for their flowers, they are dealt with in separate articles.

GENERAL CARE

For success in growing house plants it is important to select plants that will readily adapt to the conditions present in a particular indoor situation. This article presents only the basic knowledge of house-plant culture, chiefly of foliage plants; each species of plant will of course respond particularly well when given the special care that comes with experience.

CULTURAL REQUIREMENTS

The cultural requirements of house plants can easily be determined by a check of the original habitats of the various kinds. Some plants originate in the humid jungles of Malaya or the rain forests of the Amazon; others are found in the semiarid regions of Mexico or southern Africa.

Light.—Some of the shade-loving foliage plants (aspidistras, India rubber plants, ivies, ferns and some philodendrons) can subsist for months and even thrive in darkened locations such as wall

pockets, niches, mantels or alcoves. Even in these cases some bright light—not necessarily direct sunlight—during a part of the day is desirable. Artificial light is often sufficient for some of these plants. Flowering plants, however, need much more light if they are to flower. Flowering of some kinds of plants can be regulated by the duration of exposure to light, natural or artificial (*see* PHOTOPERIODISM: *Plants*).

The best place for growing most house plants is near a window. Southerly or westerly exposures are preferred for sun-loving plants, including flowering sorts (except African violets and begonias, which do better in easterly exposures), cacti and succulents; northerly or easterly exposures are best for shade-loving plants. Many bulb plants (hyacinths, narcissuses, tulips) can be forced in dim or even totally dark places, then moved into the light.

Temperature and Humidity.—The proper levels of these two factors, so essential to success with house plants, are the most difficult to obtain in modern houses, especially during the winter months when most rooms are too hot and dry for the majority of house plants. Actually, the problem is more a matter of aridity than high temperature. When moisture in the air is constant, a rise in temperature is accompanied by a drop in relative humidity. A rule of thumb is to keep the temperature as low as possible, consistent with comfort; 60°–70° F. (15°–20° C.) is a good average during the day, with a drop of 5°–10° F. (2°–5° C.) at night. African violets, poinsettias, cacti and succulents fare best in the high part of the range; cinerarias, cyclamens and most foliage plants respond best in the lower part.

Humidity can be raised around plants by placing the containers on a layer of pebbles in a shallow tray in which water is held below the surface so that the pots are not resting directly in the water all the time. Occasional spraying with an atomizer, especially during hot, sunny days, is helpful for glossy-leaved but not fuzzy-leaved plants. A more expensive solution is to install mechanical humidifiers.

Potting and Soil Mixtures.—Pottery bowls and dishes of all descriptions serve as containers for growing house plants. Unglazed pottery with drainage holes are generally preferred to glazed containers without drainage holes because the former afford better aeration of the soil. To aid in drainage and to prevent soil from washing out of the holes, gravel, stones or pieces of broken pot should be placed in the bottom of pots and other containers; this rubble is frequently covered with a layer of sphagnum or peat moss.

When, after a time, the soil mixture becomes depleted or encrusted with an accumulation of salts, or the plant becomes potbound (*i.e.*, the roots require more space to grow), repotting can be done. The plant, with its soil ball intact, should be transferred to a larger container and fresh soil mixture packed around the ball. Decorative boxes filled with sand, gravel or moss into which potted plants can be put ensure less drying of the containers; the boxes may be filled with a soil mixture and allowing for necessary drainage the plants can be grown directly in them.

Some plants require a rich soil with much humus and decomposed manure; others thrive in acid soil; and still others prefer a light soil mixture with much sand. Desert plants usually thrive in a light gritty soil composed of sand, gravel or other coarse material, while acid-loving plants benefit from a greater amount of leafmold and peat moss. Generally speaking, most house plants will grow well in a standard mixture composed of good garden loam, peat moss and regular (coarse) builder's sand in equal amounts. (For soilless culture, *see* HYDROPONICS.)

Watering.—Plants grown indoors require regular watering, the amount of water depending largely upon the type of plant, the kind and size of the container, the soil mixture and, chiefly, the surrounding atmosphere. The technique of watering is undoubtedly the most difficult part of indoor gardening. The soil in pots of desert plants, like the cacti, should be allowed to dry out before the next watering, while that in pots of jungle plants must never be allowed to dry for even a day or two lest the plants show wilt, which if prolonged may result in death. Where rooms are kept at high temperatures and the air is dry, frequent watering must be given to all jungle plants. It is always best to water thoroughly rather than scantily, a little at a time. To accomplish this, watering by immersion is advocated when the collection is small: place the pots in a tub or bucket (a sink or bathtub can be used) in which the water level is no higher than the pots and permit the water to soak up through the drainage holes. When moisture shows on the soil surface, remove the pots (or drain the water) and allow them to drain about a half hour before placing them in their original locations. This operation may have to be done weekly to moisture-loving plants (ferns, palms, cyclamens, hydrangeas, etc.) and every two weeks to the desert kinds (cacti and succulents). Observe the plants for a few weeks to determine how quickly they dry out and regulate watering accordingly. When the top inch of soil is dry and powdery to the touch or the pot gives a ringing tone when it is tapped, water is needed.

Watering by immersion is not always practicable, however. Pots should always be filled with soil to not less than an inch or so of the brim to allow sufficient space for watering from above. A meager supply of water applied to the surface will not penetrate deeply to the roots where it is needed; watering, when done, should be thorough. Water-filled saucers placed under the pots are also beneficial but slower acting; water should not be kept in the saucers all the time as this may waterlog the soil and cause root rot. The microscopic root hairs, active in absorption of water and minerals, should not be allowed to wither and dry. Moreover, a dry ball of earth is a good environment for mealy bugs and root lice (see *Control of Ailments*, below).

Feeding.—House plants must be supplied with the necessary minerals to produce the food for healthy growth. These minerals are initially supplied in the original potting soil but are gradually depleted. Although many organic fertilizers, such as well-rotted animal manures, bone meal, cottonseed meal and others, are good sources of nutriment, they are not so convenient as many commercial preparations for use indoors. Many kinds of balanced commercial plant foods are on the market in either tablet, powder or liquid form. All of them are good, but the grower must carefully follow the directions for use because too much food can easily burn plants.

Foliar feeding has been practised by florists for many years; this is one reason why such luxuriant foliage plants are on display in their shops. This type of feeding, which is relatively inexpensive, can be likened to the mild feeding that tropical plants receive in their native habitats through daily rain showers. This is particularly true of all epiphytes (*e.g.*, bromeliads, certain orchids and ferns, gesneriads and others that cling to trunks and branches of trees). Rain brings to these plants food-laden dust of the atmosphere, and the plants absorb the nutrients through their leaves. Foliar feeding will often revive plants from a dormant spell. Foliar feeding can be done about once or twice a month with most foliage plants; however, this type of feeding is not meant to entirely replace root feeding but rather to supplement it, being applied occasionally to bolster the plants. Foliar foods that are powders or crystals are readily dissolved in water, the resulting solution being applied from a spraying device. The diluted solution should be applied immediately and not stored. (*See* also FERTILIZERS AND MANURES.)

CONTROL OF AILMENTS

House plants are not usually troubled with fungus or bacterial diseases (probably because of the warm, dry conditions that usually prevail in heated rooms), but they are prone to attacks by insects and mites. General unthriftiness is sometimes traceable to improper care.

Pests.—*Insects.*—Plants should be inspected frequently for any sign of insect pests, for if insects are allowed to get a start they are not easily eradicated. Hardly any house plant is immune to attack by mealy bugs. These are soft-bodied insects with a protective cottony, white covering. Ordinarily they cluster on the branches and undersides of leaves or other places where some measure of protection is afforded. Mealy bugs have microscopic needlelike mouth parts, which enable them to pierce plant tissues and extract sap. If the infestation is heavy, the affected plant part will turn yellow and drop off. Colonies of mealy bugs can be

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COMMON AND UNUSUAL HOUSE PLANTS

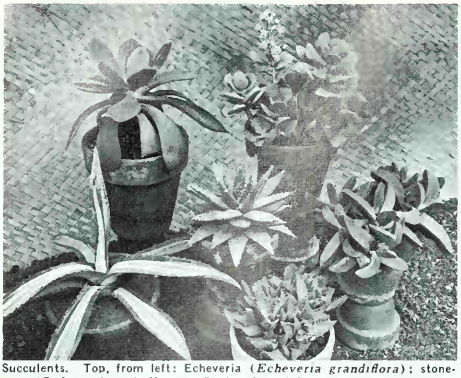
Top row (*left to right*): Primrose (*Primula malacoides*); primrose (*P. obconica*); spurge (*Euphorbia pseudocactus*); giant dioon (*Dioon spinulosum*)

Second row (*left to right*): Grizzly-bear cactus (*Opuntia erinacea*); two specimens of copperleaf (*Acalypha wilkesiana macafeana*); flamingo flower (*Anthurium andreanum* hybrid); cyclamen (*Cyclamen indicum*); coleus (*Coleus blumei*, four varieties)

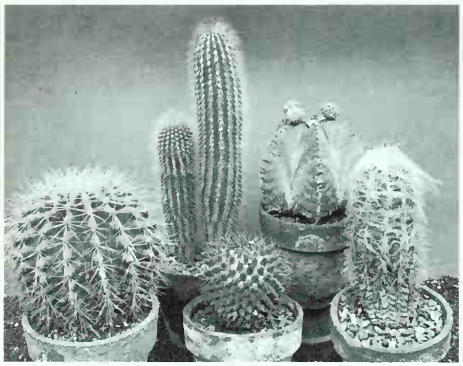
Third row (*left to right*): Scarlet sage (*Salvia splendens*); croton (*Codiaeum variegatum*); snake-plant (*Sansevieria trifasciata*); amaryllis (*Hippeastrum*, hybrid); fancy-leaved caladium (*Caladium*); geranium (*Pelargonium zonale*)

Bottom row (*left to right*): Boston fern (*Nephrolepis exaltata bostoniensis*); rex begonia (*Begonia rex*); strawberry cactus (*Echinocereus engelmannii*); feathery asparagus fern (*Asparagus plumosus*); gold-tooth aloe (*Aloe nobilis*); tail flower (*Anthurium*)

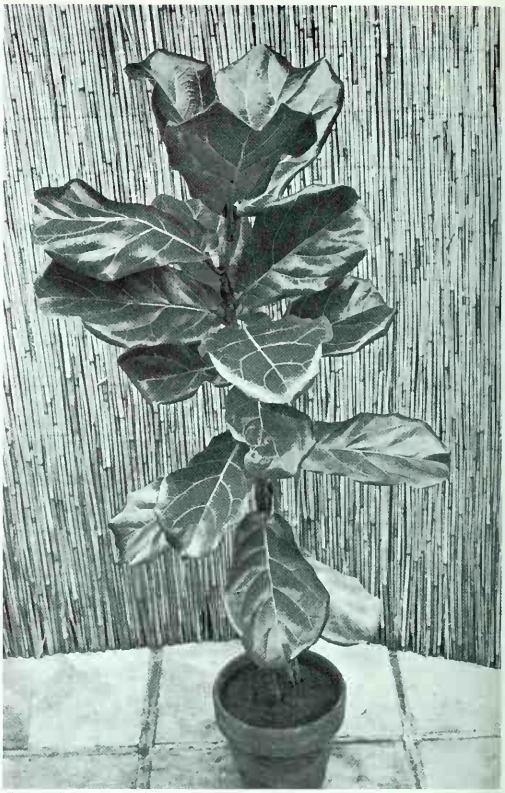
HOUSE PLANTS



Succulents. Top, from left: Echeveria (*Echeveria grandiflora*); stonecrop (*Sedum platyphyllum*). Centre, from left: century plant (*Agave americana variegata*); aloe (*Aloe brevifolia*); stone plant (*Pleiospilos simulans*). Bottom centre: tiger jaws (*Faucaria tigrina*)

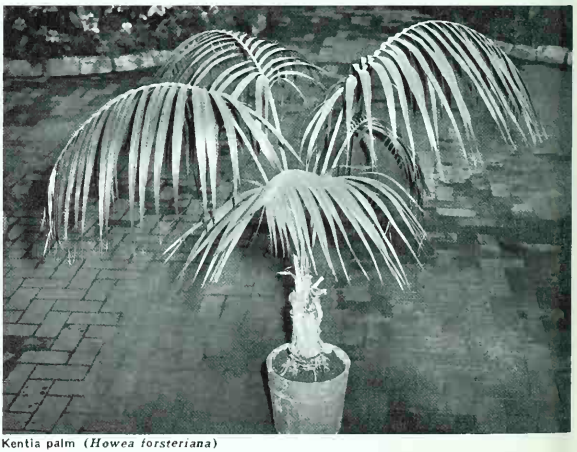


Small cacti. Top, from left: torch cactus (*Vatricania guntheri*); bishop's-cap (*Astrophytum myriostigma*). Bottom, from left: golden ball cactus (*Echinocactus grusoni*); pincushion (*Mammillaria*); old man cactus (*Oreocereus celsianus*)



Fiddleleaf fig (*Ficus lyrata*)

Aspidistra (*Aspidistra elatior*), or cast-iron plant



Kentia palm (*Howea forsteriana*)

SUCCULENTS, CACTI AND OTHER FOLIAGE HOUSE PLANTS

MISSOURI BOTANICAL GARDEN, PHOTOGRAPHS, JOHN H. GERARD © ENCYCLOPÆDIA BRITANNICA, INC.

eradicated by touching them with a small brush or a cotton swab dipped in grain or rubbing alcohol. If a plant is heavy-textured, like a cactus, India rubber plant or philodendron, a dousing of water under pressure will often eliminate the bugs. Organic insecticides such as malathion, marketed in aerosol spray cans with no measuring or mixing needed, are also effective controls.

Besides the mealy bugs, scale insects of both the soft and armoured variety may get into a plant collection; generally they are much harder to eradicate than mealy bugs. They are characterized by a shield or scale above the body, and become tightly attached to a plant, upon which they feed by sucking the sap. A light-oil-emulsion insecticide such as Volck is effective, especially when the young are still crawling about.

Plant lice, or aphids, usually appear on tender growth. They are about the size of a pinhead; soft-bodied; yellow, black or green; and do damage by sucking plant juices, causing stunted growth and curling of leaves and preventing normal opening of the flowers. They are easily controlled by nicotine sulfate sprays, but several applications may be necessary to kill all the hidden eggs.

Thrips also may occur on house plants. These are small, slender, blackish insects, that hop when disturbed. The characteristic injury that they cause is a blotching and streaking of leaves; their mode of feeding consists of rasping the plant tissues to suck up the sap. They can usually be detected by the presence of small black dots, the excrement that they leave behind. For their control a nicotine sulfate solution prepared with soap is effective, as are some of the newer commercial products.

Root lice are more common in dry soil; these insects gather about the roots, from which they suck the plant juices. Their damage causes wilting and loss of leaves. The best way to eliminate them is to de-pot the plant, discard the infested soil, wash the roots under running water and then replant in fresh soil. Chlordane is also effective, applied either directly to the soil and watered in immediately or dissolved in water and the affected pots watered with the solution; this treatment also eliminates worms, ants and other pests that may be living in the soil.

Mites.—Red spider, a mite, is another troublesome pest. Ornamental plants suffer greatly from its attack, especially if they are kept in a warm, dry atmosphere. These tiny mites spin fine strands of silk, particularly on the underside of the leaves, where they are not easily detected until the infestation is severe. Their damage causes a speckled condition on leaves, which eventually drop off. A daily syringing with water helps to eliminate these pests; miticides such as Aramite also aid in their control.

Unthriftiness.—Plants are often disfigured by a drying or browning of portions of the leaves. This may be due to a food deficiency; to the presence of artificial gas or coal gas; to sudden exposure to brilliant sunlight or cold drafts; to improper application of fertilizer or insecticide; or to high room temperatures, very low humidity and either an excess or deficiency of water.

All house plants require sunlight in some degree, otherwise they cannot manufacture food to grow. When a plant shows no signs of growing or the growth becomes spindly, gradual exposure to more light may revive it. (Plants that are grown in subdued light should never be transferred to a location where direct sunlight will hit them until they have been toughened sufficiently. Even a cactus, which ordinarily thrives in direct sun, grown as a house plant in insufficient light all winter will sunburn if suddenly exposed to the direct rays.) However, it is common for all plants to enter a period of rest or dormancy, the season and length of which vary with the species. Many foliage plants, notably ferns and palms, produce fewer new leaves during winter; cacti and succulents are often quiescent in early autumn; and some flowering plants after blooming appear on the verge of death. During such dormant periods house plants require much less water and warmth, and should not be fed.

SOME COMMON HOUSE PLANTS

Only a few of the numerous plants suitable for house culture can be mentioned here. The reader will find nursery catalogues helpful in choosing plants adaptable to his own needs and liking.

The aroids (family Araceae), which include such favourites as philodendrons, *Monstera* (*e.g.*, Swiss cheese plant), *Anthurium* (*e.g.*, flamingo flower), *Syngonium*, *Dieffenbachia* (*e.g.*, dumb cane or mother-in-law plant) and *Aglaonema* (Chinese evergreen), are apparently the most popular, and among these are creeping and vining plants, self-heading types and low- to tall-growing kinds. The fig genus (*Ficus*) contains many ornamentals of easy culture, for example the India rubber plant (*F. elastica*) and the fiddle-leaf fig (*F. lyrata*); these types of plants are excellent for patios, stores, factories or wherever bold effect is desired. The bromeliads (family Bromeliaceae) include some of the finest of all house plants; typical genera are *Aechmea*, *Billbergia*, *Tillandsia*, *Vriesia* and *Cryptanthus*, all producing either loose or compact rosettes of leaves, from which issue spectacular flowerstalks which remain in colour for several weeks to months. Begonias have endeared themselves to house-plant enthusiasts because of their richly coloured flowers, coupled with the beautifully marked foliage, and their free-growing and free-flowering habits. Palms and cycads lend character and distinction to a scene, and are fitting for patios, lighted lobbies, display rooms or spacious entranceways.

Ferns, usually found in shaded places in moist forests, beside waterfalls and in humus-filled pockets on rocky ledges, mostly prefer humid surroundings, but some, like the Boston ferns (*Nephrolepis exaltata* varieties), holly ferns (*Cyrtomium*) and *Pteris*, make ideal house plants. Spectacular subjects in the lily family (Liliaceae) are species of *Dracaena* and *Cordyline*, varying greatly in size and general appearance. The aspidistras, or cast-iron plants (*Aspidistra elatior* varieties), are among the hardiest of house plants. Sansevierias, or snake plants, are a close second because they thrive in any kind of soil, with either a liberal or scanty amount of water, and are relatively free from insect attacks. The cacti and succulents, large and diverse groups, are especially suited for the dry conditions of most rooms; these slow growers make a good appearance all year round. Ivies (*Hedera* and *Cissus*), baby tears (*Helxine soleiroli*), prayer plant (*Maranta*), painted nettles (*Coleus*), sweet potatoes (grown from tubers) are only a few of the plants that grow well in sun and shade; *Coleus* and sweet potatoes can be grown in water alone. Certain varieties of citrus fruits are very attractive house plants, particularly when the dwarf trees are laden with fruit.

In addition to the above plants, many potted plants are available in the florist trade in season; among them are Easter lilies, poinsettias, hydrangeas, gloxinias and amaryllises (*see* FLOWER: *Commercial Flower Growing;* HORTICULTURE: *House Plants*).

For the general principles of propagation of plants, *see* PLANT PROPAGATION.

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HOUSE SPARROW (*Passer domesticus*), a familiar bird of the weaverbird family (Ploceidae), is about six inches long. The male has a brown-edged gray crown, a streaked back and grayish-white underparts with a black bib. The female and young are plainer and duller, streaked above and grayish-white below. Birds in cities and towns are often dingy with dirt so that these features are hidden. The original home of the house sparrow was Europe, north Africa and Asia, but it has been successfully introduced into many other temperate parts of the world, notably New Zealand, Australia and North America (introduced 1851, and often called English sparrow).

House sparrows live about cultivated fields and human habitation, from large cities to solitary farms. They are perky chirping birds, found usually in flocks. They feed on the ground, where they hop, but perch in trees and on buildings. These adaptable birds feed on grain where it is available, exist on refuse in towns and also eat many insects. (When horses were common in cities, waste grain from their food supported swarms of sparrows. When motor vehicles ousted horses, sparrows decreased in number in the cities, and now local centres of sparrow abundance are where poultry and livestock are fed.)

JOHN MARKHAM

HOUSE SPARROW (PASSER DOMESTICUS)

Nesting and breeding occur in almost any month, but usually two or three broods are raised in the spring and early summer. Noisy squabbling marks the breeding season. The untidy, domed nest, of straw lined with feathers, is usually built in a crevice in a building or sometimes among branches of a tree. Both birds of the pair share in nest-building. Three to five eggs is the usual number per clutch; the eggs are variable in colour but often grayish-white spotted with brown. After 13 days of incubation, chiefly by the female, the young hatch naked and helpless. Both parents care for the young, which leave the nest in about 15 days. (A. L. RD.)

HOUSING. This article is divided into four broad sections dealing with the principal aspects of housing and the development of housing policies and programs in the United States and in Great Britain and western Europe. For additional information *see* POVERTY; PUBLIC HEALTH; SOCIAL SERVICE. Planning and zoning programs are discussed in CITY PLANNING; ZONING; and GARDEN CITY. *See* also HOUSING AND BUILDING LAWS.

Population trends which affect housing needs are treated in the articles BIRTH RATE and POPULATION. The program of the Farmers Home administration is described in the article AGRICULTURAL ECONOMICS: *Agricultural Credit Systems*. For additional information on specific aspects of housing *see* SAVINGS AND LOAN ASSOCIATION; RESIDENTIAL ARCHITECTURE.

Following are the main divisions and subdivisions of this article:

I. Housing: a Perspective
II. Trends in World Housing
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  2. Urbanization
  3. Housing Needs
  4. National Policies
  5. Mobilization of Resources
  6. The Building Industry
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  8. Major Issues
III. Housing in the United States
  A. Early Housing Development
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    3. Octavia Hill and the Growth of the Housing Management Profession
    4. Beginning of Housing Legislation
    5. Town Planning and the Garden City Movement
    6. Private Enterprise Houses and the Building Society Movement
    7. World War I and the Beginning of Rent Control
    8. The Interwar Period
    9. Wartime and Immediate Postwar Policy
    10. The Post-World War II Period
    11. Town Planning After World War II
    12. Design of Dwellings and Neighbourhood Planning
    13. New Problems
  B. Commonwealth of Nations and Republic of South Africa
V. Europe

I. HOUSING: A PERSPECTIVE

Home is the place where people in general fulfill the basic domestic and personal functions of family life. Physical and mental health, working efficiency, emotional security and social status are all likely to be influenced by housing conditions. Housing and household equipment are normally a major item of consumer expenditure, often larger than food, and the purchase of a house is likely to be the biggest single financial commitment a family ever makes. A suitable home is vital to the modern family, but the average family cannot produce such a home on its own initiative.

Housing is also of direct significance to the community and the nation, even apart from its importance to the individual family. The largest single use for urban land is for residence, and most of the value of urban real estate is in residential property. Services for home protection and convenience are a major item in the municipal economy, while the neighbourhood social pattern created by housing practice may be a dynamic factor in class and race relations. Moreover, since each dwelling is a base point in the web of urban activity, traffic and transportation are primarily a problem of communication between homes and other facilities. Insanitary, obsolete, ugly, overcrowded or inefficiently located residential districts not only affect the lives of the occupants but are also a burden and a threat to the rest of the community.

At the national level, housing is important not only because it affects health and welfare and is closely related to such political principles as "equal opportunity" and "minimum standards," but also because it is a vital factor in the national economy. A large number of workers are dependent on residential construction for employment, directly or indirectly, and housing credit is an important aspect of both the investment market and fiscal policy.

Housing emerged as a major problem and public issue because of dissatisfaction with existing conditions. Housing problems are continuously created by population movements of all kinds and by industrial changes and the development of new resources. Deficiencies in the home production mechanism were almost universally evidenced in western countries by: (1) the enforced occupancy of an enormous number of dwellings seriously substandard by accepted criteria; (2) the rapid spread of physically and economically blighted areas, undermining civic amenity and efficiency; (3) the frequent recurrence of severe housing shortages, causing overcrowding and an inflexible or exploitive housing market; (4) a narrow "effective market" for new dwellings constructed by ordinary private enterprise, often limited to upper income families; (5) the inadequate planning and design of much new housing; and (6) extreme fluctuations in the rate of home production, endangering the national economy.

As a result of these deficiencies a strong movement for housing reform gradually took shape, beginning in mid-19th-century England as an offshoot of the public health movement. Specific emphasis varied in different situations, but the over-all trend was remarkably continuous and consistent. The housing movement became international in scope, attacking common problems, and working toward more or less common goals.

There were numerous private efforts to reduce costs and improve quality. A long series of experimental community developments demonstrated new standards of design, often gradually adopted in general practice. Building and loan societies endeavoured to make cheaper capital available on a more responsible basis, primarily for individual home purchase in the United States and England, more particularly for large-scale rental housing on the continent. Co-operative initiative was encouraged to eliminate speculative profits. Technical research sought, via rationalization and prefabrication, to lower costs by increased efficiency. There was a fairly steady trend toward standardized building units and large-scale operations.

But progress by private initiative alone was inadequate to meet the demand, and housing became an important chapter in the political modification of the laissez-faire system for social ends. The history of the housing movement is primarily the history of expanding public responsibility—restrictive standards applied to new and old construction in the interests of health and welfare; rent control in periods of shortage, financial aid of all kinds to private housing, subject to various conditions; direct public construction of homes; subsidies for the clearance of slums and blighted areas; guidance on the location of new housing; and laws and policies against racial or other types of discrimination. In the

United States quite as much as in Europe, home building and ownership became a thoroughly "mixed" enterprise in terms of public and private participation. Throughout Latin America, Asia and Africa, as a result of rapid urbanization and rising social demands after World War II, housing conditions have increasingly become a major issue.

Along with the trend toward large-scale operations and public intervention, the movement for housing reform is inevitably related to the broader land use and social economic problems of cities and regions. In addition to signifying a necessary but troublesome physical commodity, "housing" has come to mean a basic instrument for community planning and civic development and redevelopment. (C. B. Wu.)

II. TRENDS IN WORLD HOUSING

In all countries housing is prominent among the factors affecting the level of living. It plays a multiple role in creating or retarding employment and economic growth, in maintaining health and social stability and in preserving the values of decent family life. Housing constitutes the physical environment in which society's basic unit, the family, develops. The improvement of that physical environment represents a concrete and visible rise in the general level of living.

From the family's perspective, "housing" is not shelter alone but comprises services, facilities and utilities which link the individual and the family to the community. These include such amenities as easy access to schools, medical facilities, shopping, recreation and cultural institutions; and a reasonable travel time to and from work. Because of the complexity of the problems involved, approaches to housing in the second half of the 20th century emphasize regional and national programs—instead of local housing projects—and comprehensive community planning in order to prevent a further haphazard growth of cities. Housing standards also are changing, from establishing minimum requirements of habitable area and space, or of materials, to controlling overcrowding and promoting better sanitation, greater safety and more privacy. As a rule they provide for high levels of community services, facilities and utilities even in cases where the family's income does not allow for high levels of shelter accommodations. Governments thus promote adequate levels of community activity when for reasons of economy shelter standards must be set temporarily at relatively lower levels. High community standards promote in such cases the realization of suitable patterns for the development of urban and rural communities in accordance with anticipated economic and social advances and the improvement of dwellings as family incomes rise.

1. The General Problem.—By the second half of the 20th century the world's population had reached 2,500,000,000, increasing at a rate that indicated it might swell to as much as 6,000,000,000 by the end of the century. Progressive industrialization will most probably have to be relied on for the livelihood of most of this added population, expected to be concentrated in urban areas. An explosive growth of cities has been in the past and is expected to be in the future a direct result of the rapid transformation of a fundamentally rural and agricultural mode of life into an essentially urban society.

Technological advances in construction, transportation and utilities have been notable but they have not been applied at a sufficient rate in urban development. Economic imbalances have grown out of this situation. Their outward physical symptoms are poor housing and inadequate community services; choked-up city traffic and excessive travel time to work; and filth, squalor and disease. Gang activity, juvenile delinquency, crime and vice are the more conspicuous social problems of economic disorganization and the physical decay of the city. These conditions affect an ever growing number of people but primarily they involve newcomers in the lower-income groups who become slum dwellers and squatters in the communities to which they migrate.

The problems of housing and urban reconstruction have grown into major political issues in most countries. Governments have assumed increasing responsibility for the planning and financing of housing and community improvement programs and separate governmental departments or agencies for housing and urban development have been established. In order to facilitate the execution of housing and urban development programs separate financial, loan and banking institutions of a public or semiprivate character have also been organized, and great efforts have been made by governments to stimulate private financing of housing. Individual ownership in the United States covers nearly 70% of all households; and in the U.S.S.R. and the other socialist countries more than 50% of all dwellings are built for individual or co-operative use. At the same time maintenance and management of a steadily growing housing stock have become serious problems for public authorities. Special agencies therefore have been established to take care of social aspects of housing, urban redevelopment, slum clearance and squatting.

The share of the family budget spent for housing varies considerably. However, low-income families in most countries find it more and more difficult to obtain adequate accommodations without jeopardizing other essential needs. To overcome the serious gap between the "economic" and the "social" rent (that is, between the cost of construction and maintenance of acceptable housing accommodations and the amount families are able and willing to pay for them) governments directly or indirectly subsidize builders, as well as householders in the lowest-income groups. These measures are sometimes supplemented by rent controls to ensure (1) an adequate security of tenure; (2) rents within a reasonable proportion of the family budget; and (3) the maintenance of existing housing accommodations. While rent controls have tended to disappear in the high income countries there has been a growing interest in this measure in the developing countries.

2. Urbanization.—In most parts of the world more people already live in cities and industrial centres than can be supported by employment opportunities in existing industries. The levels of living of the migrant population are therefore declining both in terms of physical and social environment and from the point of view of family income.

Measures are being instituted in town and country to discourage the transplanting of rural poverty into the urban environment. In this context housing and community services and facilities play a crucial role. However, the progressive concentration of people, a scarcity of resources, the rising cost of building and a growing shortage of suitable land in urban and industrial areas retard improvement. Economic development programs have tended to intensify urban-rural differences, and to stimulate migration when insufficient attention has been paid to a corresponding development of agriculture and the improvement of rural life. Rural residents generally, and large sections of the urban population, have failed to benefit from economic progress; living conditions in the villages continue to deteriorate and growing numbers of people continue to drift into towns. Thus the demand on national resources for housing and urban development has greatly increased at the time when large investments are also required to create the many jobs needed for the employment of new city dwellers.

3. Housing Needs.—In 1950, when every fifth inhabitant of the world already lived in a city with a population of more than 20,000, studies indicated that within 25 years between 280,000,000 and 540,000,000 persons would be added to the populations of such cities in Asia. In Latin America 62 metropolitan cities (with over 100,000 inhabitants each) accounted for some 40% of that continent's population and a group of 11 among them had reached a level of employment in industry comparable to that of New York, Paris and London, namely about 39%. In Africa the population was expected to grow from nearly 200,000,000 to more than 330,000,000 by 1975 with urban population showing the highest rate of increase. The studies showed that 70,000,000 people would be added to North America's population by 1975, practically all of whom would have to live in cities and work in industry, commerce, transport and various services. The same was true for the 177,000,000 people who would swell Europe's population (including that of the U.S.S.R.) during the same period.

Although the second half of the 20th century was characterized by the greatest technological advances in man's history, there was no country without a housing problem. With very few exceptions

the supply of housing for the lower-income families was in fact worsening, especially in the less developed countries.

Physical congestion and blight are affecting many areas, and they are presenting seemingly insoluble problems of reorganization, reconstruction and financing. It has been estimated for India, for instance, that considering only cities with more than 100,000 inhabitants, during the 25 years ending in 1975 housing and site improvement for new dwellers would require 60,000,000,000 to 110,000,000,000 rupees (or U.S. $12,000,000,000 to $22,000,000,000). The Organization of American States estimated that a yearly investment of U.S. $1,400,000,000 was required in Latin America over a period of 30 years to wipe out the housing deficit, to replace obsolescent dwellings and to provide new homes for new households. These examples assume an ominous significance against world-wide needs. According to rough estimates by the United Nations, as many as 150,000,000 families in the less developed countries required more adequate homes in better physical surroundings; and in the industrially advanced countries, there was a deficit of more than 30,000,000 units.

4. National Policies.—In the countries that have legislation controlling rents (eastern Europe for instance) families pay on the average less than 5% of their incomes for rent. In some Asian countries a 10% share of family income is considered to be a reasonable allowance for rent. Among the more highly industrialized countries, between 15% and 20% is regarded as normal (in western European countries), while 25% and more is customary in North America. The interplay of needs, resources, rights and habits has produced a variety of housing policies corresponding to varying conditions. The general trend has been toward establishing national policies for housing and urban development on a comprehensive scale; to enact requisite legislation including the appropriation of necessary public funds to supplement private and co-operative resources; to set up the organizations required at the central, regional and local levels for the planning and execution of these programs; and to institute corresponding research and training activities. The methods applied in different countries to facilitate the financing of housing and urban development programs are influenced by their general economic and social policies. They include such measures as tax concessions, state-guaranteed mortgages, granting of loans, capital subsidies, direct subsidies to householders and building of rental housing with public funds. In addition some countries plan and finance with public funds the provision of certain community services and facilities and the acquisition and development of land required for new neighbourhoods or residential communities.

In most countries the housing requirements exceed the capacity of the building industry and the supply of readily available building materials. At the same time rural residents transplanted to urban communities do not usually have facilities to build their own homes as they often did in the country. Furthermore, the qualitative standards of urban dwellings continue to rise so that they have come to include many amenities usually not found in rural homes. Thus the cash cost of urban dwellings rises while the ability of the householder to contribute labour or building materials decreases. The desire to bring the cost of housing within the reach of low-income families underlies the policy of public aid for the development of building and building-materials industries and the growing practice of using the householders' own savings and labour in the financing and execution of urban and rural housing programs.

5. Mobilization of Resources.—The use of the future householder's own labour or of cash and his potential savings represented a way of reducing the burden of financing housing programs from public sources. In most countries the establishment of suitable credit facilities and of savings and loan mechanisms created a sufficient incentive for mobilizing the residents' own financial means for home building. In a number of countries with strong inflationary tendencies a special device was used to attract private savings. In addition to the normal interest rates an "index clause" was introduced which provided for an allowance for any rise in home building costs as reflected in the fluctuations of a specified price index, such as the cost of construction or of some basic building material.

All societies have traditionally used self-help and mutual aid for building family shelters and community facilities. Organized versions of these methods are applied with enthusiasm in villages and small towns throughout the world under the guidance of community development workers; in Scandinavian cities under the *egnahem* (one's own home) arrangement; in squatters' resettlement and slum clearance projects carried out by a number of municipalities; in the newly established industrial communities of the U.S.S.R. under the leadership of labour unions; and in North America by enthusiasts of the do-it-yourself movement. The motivating force may vary, but the general principle is the same: the people concerned contribute their own labour to reduce the required capital outlay for the building of homes and community facilities; or governments use this method to obtain for housing construction labour which may be in short supply in situations of full employment.

In Africa, Asia and Latin America self-help and mutual aid have often been means for improving the physical environment and health and general living conditions in villages and towns through the construction of public works. In these instances efforts to better one aspect of the community environment have often led to improvement in others, as evidenced by pilot projects in Nigeria, Haiti and India; by cultural missions in Mexico which used as their main vehicle a suitable system of education; by fundamental education programs in village reconstruction projects in Egypt; and by rural centre projects in Africa and the Caribbean which demonstrated in a practical way what rural families can do for themselves. In Ceylon, Indonesia, Jamaica and the Philippines self-help projects have been developed in connection with broad programs of rural resettlement; and in Puerto Rico self-help and mutual aid were applied also in urban resettlement and slum-clearance projects. These latter included the transfer of families from slums or squatters' camps to new communities in which they were granted building lots and supplied with basic utilities.

In Greece thousands of homes were cheaply and quickly constructed after World War II, despite a shortage of building materials and skilled labour, through a "materials-in-aid" plan. The new town of Faridabad in India proved that 40,000 ordinary persons could erect homes for themselves, largely with their own labour. It was possible to build the new town in about two years, and the cash outlay per house was at the same time drastically reduced. As many as 500 dwellings a month were produced without elaborate mechanical devices.

Because of the steady influx of immigrants into Israel about 100,000 persons were at one time sheltered in tent colonies, shacks and abandoned army camps. As a solution to the restiveness of the immigrants and to the waste of potentially productive labour the work village, or *maabarot* plan, was developed. Under this plan teams of immigrants built their own permanent homes. In most cases they also built the factory in which they eventually were employed.

In Ghana a self-help program of great promise was developed. Home ownership has such appeal that many people there invest their savings in cement blocks for future building. The government in 1956 also started a program under which persons who had built their homes up to the roof level were provided roofing materials and doors and windows on credit. A similar arrangement was tried out with success in Burma. It involved five-year loans for aluminum roofing for rural dwellings, for structures for agricultural uses and for communal buildings such as schools, community centres and health clinics.

The rehabilitation of areas stricken by disasters such as earthquakes, floods or hurricanes has offered opportunities for effective co-operation. The National Reconstruction board in Lebanon (established in 1956 following an earthquake) is financed by a special tax on imports, an entertainment tax and a postal tax. Some 300 villages affected by earthquake were rebuilt initially through paid labour and ultimately by using self-help and mutual aid methods.

The urban housing program known as *egnahem* is used in Stockholm, Swed. The municipality supplies the building components,

provides technical advice and negotiates contracts for skilled jobs such as plumbing and electricity. The neighbourhood is planned as an urban residential unit with all needed facilities and services. House construction is financed by a single government loan at 3½% for 40 years. This scheme combines savings gained through industrial prefabrication of elements of the house with the savings achieved through self-help labour of the householder, his family and friends. In the U.S.S.R. another approach was used. Participants were paid full wages by the labour union or other organization sponsoring the project, with the government subsidizing any difference between wages in the factory and wages earned by the householder as temporary construction worker. Industrial communities in the Gorki region built after 1957 about 60% of the state housing plan for that area. Such housing projects are financed through a fund constituting 1% to 6% of anticipated productivity of the industrial community thus created and from savings due to lower production costs. Larger deductions of from 20% to 50% are obtained from production in excess of that anticipated. In large enterprises the assembly-line method is applied and local building materials are used as much as possible, including industrial waste products.

In the United States the future householder's labour (his "sweat equity") has in some instances been accepted in place of the down payment in cash required by law in connection with mortgages guaranteed by the government. The do-it-yourself method is widely employed for improving or finishing one's own home and a large industry exists to supply tools and materials. In a number of other countries, from Morocco and Tunisia to the Congo, Indonesia and Poland, self-help and mutual aid have been applied with varied success. Projects combining the contribution of the people's own labour with the technical skills and equipment provided by public or private construction enterprises have proved to be most productive. In France and Sweden savings in cash through contributed labour have been estimated at about 10% and savings in the cost of building materials through bulk purchase accounted for another 20% to 30%. In less developed countries, where construction is generally simpler and more unskilled labour can be used, savings up to 60% have been reported.

6. The Building Industry.—The backwardness of the building industry with respect to design, technology and organization has been one of the major causes of the relatively high costs of housing in comparison with other industrial products. The lack of a stable market and the seasonal character of the building industry are partly responsible for the high outlays required for dwellings and for other structures. The major causes remain the lack of integration of the different phases of building and the uneven application of technological improvements and innovations in the factory and on the site. Thus most of the remarkable but isolated improvements in house building in the 20th century have not reached the general consumer in the form of lower rents or lower monthly payments for his home and related services. The building and building-materials industries are consequently under pressure to reorganize. In some countries this is being done with state aid, aiming at a higher output of better structures at lower cost. The first step in this process usually is the assembly (or prefabrication) of structures in shops. However, the costs of transporting the materials to the shop and the prefabricated house or its parts to the site are higher when this method of building is used. Reduction of weight and bulk is, therefore, a prerequisite for factory-built housing, which also implies a high degree of standardization of materials, accessories and structural elements as well as modular co-ordination of products and designs. The more interchangeable the structural elements are and the more their dimensions are co-ordinated the greater the economy in their erection and the flexibility in their use.

The modern house is composed of two functionally distinct parts: the shell and partitions enclosing, dividing and connecting the built-in space, and the mechanical equipment (primarily utility systems) controlling and conditioning that space. Rising housing standards are reflected in the ever growing share of mechanical equipment in the total cost of building. Integrated utility systems, however, are "naturals" for prefabrication and can be used in existing and in new urban and rural homes.

The availability of local materials, wages, transport costs, regional customs and building codes continues to determine the extent to which shell elements are prefabricated, but the use of local building materials in combination with elements fabricated on the site or in the factory encourages economies and variety in design.

7. Housing in the National Economy.—Expenditure on residential housing amounts to at least 1% to 2% of the gross national product of most countries; in rapidly developing countries it is 4% or more. Residential construction has constituted at least 12%, and frequently more than 25%, of all capital formation.

Housing competes for investment funds with other fields of development. The comparatively low ratio of returns in the housing field in the high-income countries and the general shortage of capital in the low-income countries heighten this competition. Also, large housing programs have tended to stimulate inflationary pressures when they were not accompanied by appropriate counteracting measures (for instance, control of credit facilities and allocation of scarce materials and manpower). While it is generally recognized that the financing of housing must come largely from domestic sources, external financing becomes necessary, particularly in the less developed countries, where resource development projects also involve a certain amount of housing, community facilities and utilities. The problem of obtaining foreign exchange to pay for imported materials, equipment and services for such programs is particularly acute in countries in which the building and building-materials industries are insufficiently developed. If it is well planned, external financing is directed toward programs that will develop the country's own building industry.

Housing, together with education and health, belongs to the category of so-called "social overhead" projects which are basic to economic development. They can be compared with the "economic overhead" projects such as transport, communications and power, which are also generally considered to be requisite for effective economic development. Overhead projects, whether social or economic, usually provide few if any direct financial returns in the short run; their benefits are derived from the more balanced development of economic activities that they make possible.

Provision of adequate housing and community facilities should accompany, if not precede, resource development in order to avoid serious obstacles to economic activity and high social costs of haphazard urbanization. But there appears to be a considerable area of conflict, in the sphere of national policy formulations in the developing countries, between the "economic" and the "social" approach. The housing enthusiast seeks prompt fulfillment of housing needs; the development enthusiast sees the problem of economic development in terms of scarce capital resources which should be diverted to "more productive" tasks. Housing finance therefore involves determining the share of investment funds which a country can and should allot to housing and community improvement programs in the interest of balanced economic growth and stability.

Housing is deeply involved in the process of saving and investment: it is a type of capital formation that both encourages and strengthens long-term patterns of saving. Persons will save for better housing who would not otherwise make their savings available for capital formation. As the shortage of savings is a severe obstacle in the developing countries, this additional mobilization of capital makes an important contribution to their economic and social growth.

8. Major Issues.—The principal issue in the developing countries remains the assessment of an appropriate share of national resources that must be devoted to the financing of housing and urban development programs in relation to over-all economic development. In several of the highly industrialized countries, however, part of the problem may be to determine what resources should be invested in housing and urban reconstruction to obtain and maintain full employment; for example, in a situation of reduced armament production or as a consequence of automation and other technological advances in agriculture and industry. At the same time the financing of housing for people in the lower-income

groups continues to be a critical problem. New ways of stimulating the flow of private capital and of individual savings into the housing and urban development fields need to be evolved, preferably from sources not previously used.

In the highly developed countries a major issue is the development of a house-building industry that is highly integrated and capable of translating the benefits of higher productivity into lower costs to the consumer. In the less industrialized countries, however, a two-front attack is needed: large sections of the population which are still living in rural areas require assistance in adjusting the use of local materials and building methods to the progress that has been made in engineering, chemistry and technology without undue additional cash outlays. The use of stabilized earth and bamboo preservation are examples of this approach. At the same time, a highly productive building industry must be developed to provide the required volume of house construction in congested urban areas at a cost within the reach of lower-income families.

A growing volume of resources will be required merely to maintain the present levels of living in addition to providing new jobs for the 50,000,000 to 75,000,000 people being added every year to the world's urban population. Suitable planning on a regional scale (territorial planning) may help to guide urbanization and internal migration so that they facilitate rather than impede development. Such planning could first of all help to strengthen the economic bases of the existing urban agglomerations (thus fully utilizing the "external economies" present there); and secondly, it could create alternative centres of attraction for the movement of rural people to the cities, the brunt of which has been borne almost entirely by large metropolitan centres. Judicious location of new industries within a region and the development of transport in a more rational and perhaps also a more decentralized pattern could facilitate the creation of these new centres.

The world-wide problems of housing and urbanization represent an area in which the role of the social scientist comes into sharp focus, not only in the realm of theory and planning but especially in the realm of action. In view of the growing concentration of people in urban areas, failure to plan for and guide the growth of cities would inevitably deprive a very substantial part of humanity of the right to a decent living in a decent environment. Three types of research and surveys may be useful in this connection. For the determination of national policies and broad, regional development programs a general but true picture of social and economic trends may suffice. More precise data are necessary for action at the local level in connection with community planning and land use. Finally, a specific project for a residential community or neighbourhood must be based on definite knowledge of a multitude of economic, social, cultural, physical and other facts. Suitably designed surveys can provide an appropriate basis for a continuing evaluation of the social implications and consequences of various development programs. (Et. W.)

III. HOUSING IN THE UNITED STATES

A. Early Housing Development

Housing production and conditions in the United States have reflected the economic, social and political stages of development in the country's history. In the early period of colonial America, the establishment of settlements was a prime necessity for economic development, and community and private efforts both played a role in encouraging residential buildings. The responsibility of the private owner to contribute to town growth was also recognized. Thus, at the beginning of the 18th century, the city of Williamsburg, Va., required that a buyer of a lot on Main street must build a house of given dimensions within 24 months or lose title to the lot. In the latter part of the 18th century a similar provision bound purchasers of lots available for $2 to $4 in the townsite of what is now Cincinnati, O. Sites such as the Cincinnati development were obtained by large speculators at nominal prices from the continental congress, and later from the young federal government and the states, which sold land to obtain revenue. Opportunities for land sales, speculation and westward migration were enlarged after the federal government consummated the Louisiana Purchase in 1803, making a vast area available for development. Westward migration was facilitated by canal building by state governments and private companies during the first half of the 19th century. Many of the western settlers were squatters and in 1841 the congress legalized the squatter's possession by giving him first priority for purchase of his land.

During the nation's early years, the abundance of forests led to the widespread use of timber for construction. On the frontier, settlers built cabins out of logs while carpenters in the cities used large quantities of lumber. Houses on Cape Cod resembled English homes. Mansions in the Hudson valley bore Dutch characteristics. Admiration for the Greek and Roman civilizations prompted southern aristocrats to build their plantation houses in classical styles. Some housing in New Orleans, La., had French antecedents and the Spanish influence could be seen in the flat roofs and stucco coverings of homes in Florida and the southwest.

Another cause of regional variation was climate. Workers' homes in the temperate south had light frame construction, but the rigorous climate of the north required more substantial frameworks, often of masonry and burnt clay brick. Differences in economies also had their effect: agriculture required that labourers be close to the crops they tilled; farmers accordingly were scattered in single-family detached buildings. At the same time, growing industries in the cities of the northeast required large concentrations of labour; commonly these labourers lived close to their factories in row housing, and, later, in multiple-family structures.

The need to finance home building in the expanding eastern seaboard cities gave rise to state chartering of mutual savings banks. In 1816 the first two mutual savings banks opened in Philadelphia and Boston and they soon multiplied in those and other New England and middle Atlantic cities. In 1831 the first building and loan association was founded in Frankford, Pa.

B. Evolution of the Housing Problem

By the fourth decade of the 19th century, the use of steam power was ushering in the Industrial Revolution and urbanization. The establishment of factories using power required the concentration of large numbers of working families in urban areas. In some of the mill towns, such as Lowell, Mass., employers were providing housing for their workers in the 1830s. Between 1820 and 1840, the urban population of the country trebled. The housing problem developed in proportion to the population, and the situation was not merely one of hastily built substandard shelter but also one of inadequate water and sewer facilities. As early as 1834 a sanitation report called attention to the relationship of bad housing to public health conditions in New York city, and subsequent investigations yielded similar reports for Boston, Philadelphia and Washington, D.C. The building of railroads in the middle and late 1800s accelerated the westward movement of population and later brought similar experiences to inland cities.

These growing problems brought governmental action to regulate city housing construction in the interest of public health and safety. Through the second half of the 19th century and the first three decades of the 20th century, however, this action was confined almost exclusively to the exercise of local police powers to enforce certain minimum standards for residential construction. The first action of this type was taken in New York city with the establishment of a board of health in 1866 and the adoption of the New York city tenement house law in 1867.

These municipal and state building regulations prohibiting or controlling more flagrant housing practices injurious to health and safety did nothing of a positive nature, however, to promote construction of better housing for urban families of low or modest incomes. Whatever actions were taken were sponsored by private groups. In Philadelphia, for example, the building association movement provided a sounder basis for home purchase by moderate income families. Construction of model tenements for workingmen's families in Brooklyn, N.Y., reflected a growing public concern of a small segment of the population, typified by such articulate leaders as Alfred T. White, who sponsored construction of nonspeculative, limited-yield housing, and Jacob Riis, the journalist, who aroused public indignation and demands for demolition

of New York's worst slums with his book *How the Other Half Lives* (1890).

At the turn of the century employers frequently constructed "company housing" to recruit and retain work forces. Such housing was particularly prevalent in the bituminous coal mining areas and the new steel production centres of western Pennsylvania. Aside from the fact that this housing was often of poor quality and tied workers to company-owned stores and other facilities, it was frequently used as a weapon against union recognition and collective bargaining, with union members being evicted from company houses (*see* STRIKES AND LOCKOUTS: *United States*). Even where better housing was provided in communities such as that constructed by George Pullman, manufacturer of railroad sleeping cars, the heavy paternalistic overtones wherein the landlord tried to impose his standards of conduct and deportment upon his tenants caused deep resentment.

A more successful plan for improving workers' housing was the Boston Cooperative, started in 1871. It was also in Boston that Edwin Ginn founded the Charles bank houses, a five-story, 500-room fireproof structure to provide cheap housing for the poor and a prototype of philanthropic housing for low-income families. Scholarly studies of housing conditions began to appear and in 1894 the U.S. commissioner of labour issued a special report, in effect representing a federal recognition of such problems as inadequate amounts of cubic air space per individual in dilapidated housing.

By the early part of the 20th century, the voices of housing reformers were receiving wider attention. There was growing awareness that the social consequences of unbridled laissez faire house building constituted legitimate areas of public concern. In 1901 New York city greatly strengthened its tenement housing act. The law was made more precise and detailed; it imposed more severe penalties; and it conferred more power upon administrative departments. Numerous other large cities followed New York's example.

Despite the industrial and urban growth in the latter half of the 19th century, only 37% of the residents of the United States were in urban areas at the beginning of the 20th century. Furthermore, the residents generally were located within a limited transportation radius of the urban centre which could be served by horse drawn trolley cars. Within the circumscribed area land values were high. That factor, combined with the comparatively low levels of real wages, the inadequacies of credit, and the costly and hazardous forms of mortgage financing, had severely curtailed private home ownership. Two-thirds of the almost 11,000,000 nonfarm dwelling units in 1900 were tenant occupied.

C. Early 20th Century Changes

The pattern of residential development began to change during the first two decades of the 20th century, as waves of immigration swelled the population of the metropolitan areas. There was more vertical construction in steel supported office and factory buildings with electrically powered elevators. At the same time, the use of electric power for suburban trolley and railroad lines began to increase the radius of acceptable commutation. An increasing proportion of house-building began to take place in urban areas (57% in 1890–99; 65% in 1900–09; and 73% in 1910–19), with the suburban areas beginning to outpace central cities in their rate of population growth. The proportion of housing units that were owner occupied increased slowly, from 37% in 1900 to 41% in 1920.

During World War I, the government engaged in a modest program of constructing defense-worker housing in selected localities, notably for those engaged in shipbuilding. After the war these facilities were sold and there appeared little need for federal action. After recuperating from a brief postwar recessional adjustment, the nation went into a high rate of private home building and even on the basis of a risky and unsound mortgage financing structure constructed 937,000 houses during a peak year of the 1920s. In other than savings and loan association (*q.v.*) financing, the typical mortgage loan of the 1920s consisted of a nonamortizing, short-term first mortgage, equal to 50% or 60% of the property value and fully due upon maturity, with one or more junior lines (second or third mortgages), each bearing successively higher rates of interest. Most of the residential construction provided housing for owner-occupancy, as the increasing number of automobiles facilitated suburban development. The proportion of housing units that were owner-occupied increased from 41% to 46% during the decade. In the latter part of the decade, however, a relatively high proportion of new housing starts were in multifamily rental housing structures. Many of the latter were high-rent units financed with mortgage bond participation certificates sold to the public, on the basis of private company guarantees of the mortgage bonds.

The collapse of the U.S. economy, starting with the Wall street crash in 1929, and reaching its nadir in 1933 when unemployment affected almost one worker out of every four, greatly depressed the home-building industry and significantly injured the mortgage-financing industry. Declining incomes and unemployment drastically reduced the market for new housing; during 1930–34 the cumulative new building activity barely met the home-building volume of any single year during the mid-1920s. Inability of homeowners and rental property owners to meet mortgage payments brought on a wave of foreclosures, causing, in turn, the failure of numerous lending institutions.

D. Government Programs

1. Antidepression Measures.—To strengthen the faltering mortgage financing mechanism of the country and help stabilize the plunging real estate values, the congress established the Federal Home Loan bank system in 1932 and the Home Owners' Loan corporation (HOLC) in 1933. The regional Federal Home Loan banks (originally 12, reduced to 11) were designed to provide special sources of liquidity for savings and loan associations which could obtain from the banks advances of funds for mortgage lending. This reduced the dependence of savings and loan associations upon the commercial banking system during periods of credit stringency. The Federal Home Loan bank system could also operate to bring funds from capital surplus to capital shortage areas, since the banks could borrow in the open market through consolidated debenture issues, co-ordinated by their Federal Home Loan Bank board, and the funds could be advanced to savings and loan associations in areas suffering from a shortage of funds.

The Home Owners' Loan corporation purchased from financial institutions about 1,000,000 home mortgage loans of borrowers who were having difficulty in meeting required repayments. The loans were recast into long-term (as long as 15 years) loans to be amortized through monthly payments over the life of the loan. Although the HOLC had to acquire some of the properties securing the loans, by 1951 the HOLC was able to liquidate its $3,500,000,000 total investment without loss.

The economic and financial crisis grew worse in the early 1930s, however, and failure of a few large banks brought on a general loss of public confidence in banks. One of the first emergency measures of Pres. Franklin D. Roosevelt after his inauguration in 1933 was the declaration of a national bank holiday. Later the establishment of federal deposit insurance covering deposits in banks and in savings and loan associations helped establish lasting confidence in the financial institutions, encouraging the accumulation of savings which are necessary for home financing and other long-term capital financing.

Another antidepression measure that was to have a lasting effect was the creation of the Federal Housing administration (FHA) in 1934. Designed to restore lender confidence in mortgage loans, broaden effective housing demand through liberal loan terms, and thus to stimulate construction employment, the National Housing act provided for FHA mortgage insurance. The borrower pays a mortgage insurance premium, equal to $\frac{1}{2}$ of 1% of the outstanding loan balance, and the lender is insured by FHA against loss of principal, interest and part of foreclosure costs. Insurance claims are paid in long-term FHA debentures, guaranteed by the U.S. treasury, enabling the FHA to utilize its reserves to pay interest on debentures. Under this plan, acquired properties can be held off the market in order to avoid a glut that could depress existing home

values and cause a sharp decline in home building.

The borrower benefits from an FHA-insured mortgage whose interest rate cannot exceed a prescribed maximum. The loan may be in an amount equal to a high percentage of the property value and is amortized over a long term. Lower down payments and monthly debt service requirements helped broaden the effective demand for housing. Over the years, lenders making noninsured home mortgage loans have competitively liberalized their mortgage terms to further broaden the market base. An additional and highly important aspect of the mortgage insurance program was the element of consumer protection provided under FHA staff appraisal and construction inspection services, with the latter related to development and application of sound building standards. With the aid of such stimulants, the volume of home building in the five years 1935 through 1939 almost doubled that of the preceding five years.

FHA project housing mortgage insurance was also made available to stimulate multifamily rental housing construction. An additional FHA program of insuring home improvement loans stimulated employment in the home repair and modernization industry.

Toward the end of the depression period it was recognized that additional aids were required to stabilize the flow and improve the distribution of funds for mortgage investment. The Federal National Mortgage association was established to function as a secondary mortgage market in the purchase and sale of government-insured mortgages, and through these marketing activities helped accelerate the flow of funds into mortgage investment and from areas of mortgage money surplus to areas of shortage.

The scope of federal programs in the field of direct housing construction was more limited and of a more temporary nature. An outstanding phase of the pump-priming program of the Public Works administration was the demolition of slums and the construction of low-rent public housing in urban communities, a program which affected 37 cities in which 50 projects with almost 22,000 housing units were built. A subsequent supreme court decision found that this type of program was unconstitutional, and in 1937 legislation was enacted fixing responsibility with local communities under state enabling laws. The basic provisions of the housing act of 1937 still prevail. Under this act, local public corporations, known as local housing authorities, borrow temporary funds from the Public Housing administration and in the private market (with PHA backing the notes) for the planning and construction of low-rent public housing units. After construction, long-term financing is provided through sale of local tax-exempt bonds to the private investment market, and the temporary notes are redeemed. The ready marketability of these bonds is assured by a federal guarantee to pay to local housing authorities an annual contribution sufficient to meet the debt service on the bonds. The annual contribution covers the deficit between the economic rent required to operate and amortize the projects and the rents obtained from the low-income occupants.

Additional federal programs to stimulate construction industry employment included efforts of the government to demonstrate advanced techniques in the field of land planning by construction of a small number of "greenbelt" towns in Maryland, Ohio and Wisconsin. These have since been sold to the project occupants. Also, under the rural resettlement program the government constructed a number of small communities to help resettle families from areas where the deteriorated economic base could no longer support previous levels of population. Small additional direct construction programs were undertaken in the fields of rural housing and in housing of migratory farm workers.

Also of great importance during this depression period was the program of research and data collection which developed with respect to urban housing. Real property inventories were carried out in numerous market areas, and these, in turn, contributed to the introduction in 1940 of the first national census of housing.

2. War and Postwar Housing.—During World War II, housing production was placed on a wartime basis, in which it shared in the rationing of critical labour and building materials, and in which production was accommodated to wartime requirements. Private construction produced new housing to meet the needs of in-migrant defense workers in defense production centres. Where such housing could not be privately produced in time to meet defense needs, the federal government undertook direct construction, much of it temporary, and much of the demountable type that could be shifted from one area to another as more pressing needs developed. In conjunction with these construction programs, there were programs of "share your home" with defense workers, and also conversion of larger structures into additional rental units.

Especially in the field of direct federal construction, there was emphasis upon job standardization and, as a result, home-building techniques graduated from their prewar craft status to new levels of technological advance, utilizing such techniques as offsite prefabrication, precutting, use of modular panels, and large-scale site planning. These, in turn, provided a technological base for the private large-scale housing project operations which came to characterize postwar construction.

With cessation of World War II hostilities and rapid demobilization of 12,000,000 men in the armed forces, a drastic housing shortage developed. The depression and wartime circumstances of the previous 15-year period had held new building activity below the levels required to meet the needs of an enlarged population. The shortage was made more acute by the large number of new family formations which occurred during the immediate postwar years, some deferred by previous wartime separations, and most occasioned by the high level of economic prosperity which prevailed immediately after the war.

Numerous steps were taken to stimulate housing production and overcome these shortages. Under the Servicemen's Readjustment act, veterans could obtain no-down-payment financing on the basis of the government guaranteeing a substantial portion of the mortgage loan made by a private lender. The FHA instituted a program of liberal mortgage financing insurance for construction of rental housing in which occupancy preference was accorded to veterans. To overcome the extreme competition for available construction workers and materials, the government instituted programs to speed production of construction materials, train and expand the construction labour force and, so far as possible, channel these increased resources into housing production. One aspect of this program, for example, was the extension of loans to manufacturers of prefabricated housing, an effort that had only limited success. As a result of wartime restrictions on production of consumer goods, accumulated savings provided a plenitude of mortgage funds. With ready availability of mortgage funds, the stimulus of a substantial backlog of housing demand and an increased supply of building materials and construction labour, the building industry rapidly responded. By the end of the 1940s production had reached 1,000,000 units a year, and during the decade of the 1950s attained a peak of over 1,500,000 units a year. A continued high level of housing production during the 1960s enabled the nation to meet its most pressing needs for additional shelter resources.

3. Farm Housing.—Since farm housing is an integral part of the source of income and employment and is not readily separable from the farm as a whole as security, the nonfarm housing programs have generally not been applicable to farm housing problems. Farm housing, therefore, has been dealt with chiefly as an agricultural matter, the principal government program having been the farm ownership loan program under the Farmers Home administration in the U.S. department of agriculture. The Housing act of 1949 set up in the department of agriculture a sizable, but still experimental, program of loan and grant assistance and technical advice for farm housing and other farm buildings, and for rural nonfarm housing, in an effort to provide a practical method of bringing assistance to farm and rural housing comparable to that available for urban housing. The Consolidated Farmers Home Administration act of 1961 provided for direct loans for farmers' housing and for insurance of loans advanced by private lenders. (*See* also AGRICULTURAL ECONOMICS: *Agricultural Credit Systems.*)

Data on farm housing have been particularly inadequate. However, greater farm prosperity in the war and postwar years was reflected in substantial improvement in the condition of occupied

farm housing. Highway expansion in farm areas and the spread of electrification accelerated improved standards of housing and housing activities.

4. Slums and Slum Clearance.—Slums are residential areas that are physically and socially deteriorated and in which satisfactory family life is impossible. Bad housing is a major index of slum conditions. By bad housing is meant dwellings that are lacking in light and air, without adequate toilet and bathing facilities; that are in bad repair, damp and improperly heated; that do not afford opportunity for privacy in family living; that are subject to fire hazard; and that are overcrowded on the land, leaving no space for recreational use. Such, in varying combinations, are the characteristics of slum housing. To these may be added other indexes of slum conditions. They are to be found in congestion of population, both on land and in dwellings, high death and morbidity rates from contagious and chronic diseases, high infant mortality, a general prevalence of destitution, deteriorated or even degenerating neighbourhood conditions, the lack of adequate municipal or social services and a high incidence of dependency, child delinquency and crime. It should always be noted that slums involve people as well as buildings.

The growth of slums became an acute problem in cities of the eastern seaboard of the United States, especially in New York city, with the heavy immigration that began about the middle of the 19th century. The problem spread westward as successive waves of immigrants colonized in urban areas, taking over housing accommodations that were already deteriorated, and which quickly became slums.

Factors contributing to the development of slums may be cited as follows: low wages and poverty, preventing people from paying for decent dwellings; the invasion of business and commerce into residential areas, leading to the neglect and abandonment of dwellings; the haphazard, uncontrolled growth of cities; leniency toward the owners of dilapidated property in the matter of tax assessments, and in the toleration of low standards in the remodeling of old dwellings; racial or other restrictions limiting the location or quality of housing available to certain groups; and municipal government that neglects the adoption and enforcement of regulations with respect to sanitation and safety. Finally there has been general apathy regarding the menace of slums.

Initial efforts in the late 19th century and the first three decades of the 20th century to halt the growth of slums and improve housing standards sought unsuccessfully to correct conditions through the exercise of the police powers of the states (see *Evolution of the Housing Problem*, above).

5. A National Housing Policy.—After World War II there was recognition that, despite the rapid pace of housing construction, much blighted housing remained in the slums of the central cities. In 1949 a definitive statement of the nation's long range goals and objectives was set forth in a new housing act. The 1949 act declared that the government's actions should be directed to remedying "the serious housing shortage, the elimination of substandard and other inadequate housing through the clearance of slums and blighted areas, and the realization as soon as feasible of a goal of a decent home in a suitable living environment for every American family. . . ."

Of special significance in this act was the acceptance by government of a new area of urban housing responsibility—slum clearance and redevelopment. Hitherto, slum clearance had been carried out only in connection with construction of low-rent public housing, and then only in those cases where slum sites had been selected; in many instances, vacant or marginal sites had been utilized for this type of construction. Under the new slum clearance and urban redevelopment program, the reuse of the cleared land could be for private as well as public purposes.

The Housing act of 1954 expanded the concept of slum clearance to one of "urban renewal," and assistance was provided for rehabilitation and conservation programs as well as clearance efforts. It also placed upon local communities the obligation to combat blight through such measures as improved codes and code enforcement practices, local planning, long-range capital improvement programs, neighbourhood analyses, relocation plans and other requirements. This was designated as the Workable Program for Community Improvement, and it became a prerequisite for numerous types of federal housing assistance. The Housing act of 1954 also provided for federal assistance to promote metropolitan area planning and planning by small communities.

E. Housing Supply and Needs

Despite the progress made in the years following World War II, several large areas of housing need remained in the United States. The 1960 housing census revealed continuing qualitative deficiencies, with one housing unit out of every four either dilapidated, deteriorating or lacking adequate plumbing facilities.

Within these over-all magnitudes of housing deficiency there were areas of serious concern. One of these was the part of the housing inventory occupied by the nonwhite segment of the population. A combination of lower incomes and restricted access to the housing supply contributed to a situation where relatively three times as many nonwhite families occupied substandard housing as white families. In 1960, moreover, one out of seven nonwhite families were severely overcrowded compared with only one out of 40 white families.

Another area of deficiency was in the field of housing for elderly persons, where occupancy of substandard housing was some 25% greater than among nonelderly families. Because of their much lower incomes, the elderly were generally paying substantially higher proportions of income for rent than the rest of the population, and much of this housing was considered unsuitable in view of the reduced physical mobility of the occupants.

Several governmental actions were undertaken. In the field of housing for the elderly, three program activities—the low-rent public housing program, an FHA-insured rental and sales program, and a below-market rate of interest program—stimulated substantial housing production. In the field of minority housing a supreme court decision in 1948 (*Shelley* v. *Kraemer*) denied local court enforcement of restrictive real estate covenants which previously had prevented sale of private housing to various minority groups. During the late 1950s and early 1960s a number of individual states and municipalities enacted open occupancy or other antidiscrimination laws in the field of housing. In November 1962 President Kennedy issued an executive order which forbade racial discrimination in the rental or sale of new housing constructed with federal mortgage insurance and loan guaranty aids or with direct federal loans or financial assistance.

The housing situation revealed by the 1960 census indicated that the "filter down" process by which older housing is supposed to provide adequate shelter within the means of lower income families does not satisfy all the housing needs of this group. Thus, more new construction must be aimed directly at the low and lower middle income housing markets. The Housing act of 1961 created a special below-market rate of interest program under FHA for the financing of such housing. Under the act existing programs were continued and in some cases expanded with increases in housing and over-all community development. The mortgage insurance program of the FHA was continued and further liberalized. An additional 100,000 dwelling units were authorized for low-rent public housing and additional capital grant funds for urban renewal were approved. Authorizations for urban planning, college housing and community facilities were increased. The law provided for FHA insurance for long-term loans for home improvements and permitted insurance of mortgages for condominium ownership; *i.e.*, mortgages constituting a first lien covering a fee simple or leasehold interest in a one-family unit in a multifamily structure, together with an undivided interest in the common elements—hallways, service areas, grounds, etc. The expansion of the scope of the programs administered by the Housing and Home Finance agency was marked by authorization of grants to local public bodies for aid in the acquisition of open land for recreational and other purposes. The act also provided for grants for comprehensive planning of urban mass transportation, for demonstration projects and for loans for transportation facilities. The program for housing for the elderly was expanded and in 1962 the Senior Citizens Housing act provided for additional appropriations for a

revolving loan fund for the erection of housing for tenants 62 years of age or older.

1. Housing Expense-to-Income Ratio.—The housing expense-to-income relationship provides a quantitative measure of the need for financial assistance in order to obtain decent housing. A rule of thumb that has been adopted in connection with various government-assisted programs is that families should be able to obtain adequate standard housing with an expenditure of no more than 20% of income. It is known from census of housing and other data sources, however, that the housing expense-to-income ratio varies over a wide range. A basic tendency is for the ratio to decrease with increasing income, since expenditures for housing are apt to increase less in proportion to income increases after an acceptable level of housing standards has been attained. Therefore, while lower income families may spend 25% to 30% or more for housing, middle and upper income families are more likely to spend between 20% and 15% or less.

Another variable influencing the housing expense-to-income relationship is the size of the family. A smaller family, with less need for food and clothing, can devote a higher proportion of income to housing. Thus, elderly families frequently combine the characteristics of small size and low income, so that a greater proportion of elderly families are apt to pay more than 30% of their income for housing. Among the population as a whole, the long-term trend has been toward a decline in the average size of households. Since the start of the 20th century, the number of households has increased more than 200%, yet the nation's population has only risen by about 120%. This difference results from the fact that the average household has dropped in the period from nearly 5 persons to less than 3½.

Housing expenditures as a percentage of total consumer expenditures declined from a 20th century high of 19% in 1909 to a depression low of 9% during the 1930s. Since World War II, however, the average number of children per family has increased slightly, creating pressures for larger housing units, and there has also been an increasing demand for more bathroom facilities and built-in mechanical appliances. In addition, cost of new housing has been rising faster than the cost of many other goods and services. Consequently, housing expenditures as a percentage of total consumption expenditures have again been on the rise—from 10.9% in 1950 to 12.8% in 1960.

The increased housing expenditures also reflected a continuing increase in home ownership concentrated in the suburbs. A significant rise in real incomes, greatly increased auto ownership and large-scale production of moderate-priced homes in suburban developments created the conditions for increased home ownership supported by liberal mortgage financing. In the second half of the 20th century more than 3 out of every 5 dwelling units in the United States were owner occupied.

2. Home Building Industry.—Private builders construct practically all of the new housing built in the United States, and their effort is directed almost entirely toward the private housing market. Public housing under federal and state programs ordinarily accounts for no more than 2% to 3% of total annual housing output. The annual value of new residential nonfarm construction in the 1960s ranged between $21,000,000,000 and $25,000,000,000, approximately 4% of the gross national product. About 2,000,000 people were engaged in building construction, of which home building absorbs a major part.

Residential construction volume is subject to wide year-to-year fluctuations. Housing is in essence a very durable capital good, which provides housing services to consumers over 40, 50 or more years of economic life. Since housing is so durable, most of the housing required by families is provided by existing structures, and the volume of new units built in any year is equal to only 2% or 3% of the existing stock of units. A year-to-year change in new housing construction volume, equivalent to a change from 3% to 2% of existing stock, would mean a one-third decline in annual volume; an increase from 2% to 3% of existing stock would mean a 50% increase in annual construction volume. Such fluctuations are accompanied by entries of many small, new building firms when annual demand and production are increasing, and the withdrawal of many small builders when a curtailment of demand dictates a smaller production volume.

Housing production is also unlike most other goods in that the finished product is immobile. The builder, therefore, is concerned with local housing market conditions. Even the manufacturer of prefabricated houses is likely to be confined to a region of the country because transportation costs limit the radius of his operations. Offsetting differences in local market conditions tend to introduce an element of stability in total housing production when general economic conditions are relatively stable. When there is a significant change in the national economy, however, the national housing production volume undergoes a significant change.

About two-thirds of urban single family homes are built by operative builders, who as "organizer-merchandisers" seek to attract buyers to their developments and merchandise housing within fairly narrow price ranges. The housing shortage years following World War II permitted large-scale speculative activity by many builders who completed large numbers of houses and merchandised the finished units with customer choices limited essentially to minor modifications of interior. The subsequent development of a balanced supply-demand relationship, however, sharply curtailed this practice and in most developments the builder constructs one or several sample houses, or model homes, and regulates the volume of his activity in accordance with the rate of his sales. Under these conditions, the purchaser has a wider range of choice with respect to interior and exterior modifications to the structure, known in the trade as "extras," for which he pays additional costs. Another one-sixth of new housing is "custom built," *i.e.*, erected in accordance with customer specifications. The remaining one-sixth of new homes are constructed by the owners themselves, utilizing their own labour or that of family or friends and employing outside labour and subcontractors for skills which they lack or for which licensed practitioners are required, such as plumbing and electrical work.

During most of the post-World War II period multifamily housing accounted for 10% to 20% of total private housing units started. In the early 1960s, however, this proportion climbed to between one-fourth and one-third. In large projects, the builder generally acts as the general contractor, perhaps doing the foundation work and some other part of the work with his own labour force. Most, if not all, of the work, however, is done by specialized subcontractors, as for steel frame erection and electrical, plumbing and masonry work.

The builder is primarily an organizer and entrepreneur, rather than a mechanic or craftsman. In earlier times he often performed one or several of the craft operations such as carpentry or masonry, but today these operations are typically executed on contract. The builder exercises his entrepreneural talents directly in such areas as land acquisition and also in purchase of materials where his wholesale scope of buying may effect substantial economies. He also engages the various skills required for the job, frequently acting as his own general contractor. Large builders often maintain their own sales organizations; medium-size and smaller operators frequently use real estate firms on a commission basis.

Prior to World War II the home-building industry was characterized by its small scale of operations. In 1938 a department of labour study in 72 cities showed that almost two-thirds of the builders of single-family housing constructed only one house a year, and only 14% of the surveyed builders constructed more than four houses a year. The postwar years witnessed the emergence of large-scale builders operating on a tract construction development basis. A 1959 study by the homebuilders' professional trade association showed that 10% of the nation's builders constructed almost 60% of all single-family homes, with the typical builder in this group constructing more than 350 houses a year.

A large proportion of this tract building has been financed under federal mortgage insurance and loan guaranty programs. Land planning requirements of the federal agencies administering these programs have promoted improvements in site planning, expressed in such advances as use of superblocks to deter through traffic from use of residential streets.

As home building graduated into "big business" status, the ac-

tivities of speculative builders responded more directly to advantages and disadvantages of federal tax structure. The builders and owners of rental housing projects utilize the fast depreciation rates which reduce taxable income during the early years of ownership. After a period of five to ten years, a project will have a low depreciated book value. It may then be sold at a profit, taxed at the much lower capital gains rate than ordinary income. Large-scale builders often combine construction of a shopping centre with a housing development, which provides a market base for the shopping centre. The shopping centre in turn provides a long-term source of income and also benefits from the lower capital gains tax rate upon profitable resale.

The short-term merchandising goals of the project developer have not always been consistent with the longer-range objectives of sound urban planning. Although he can help shape public tastes and preferences, the project developer, in a highly competitive market, is necessarily cautious regarding basic innovations. As a result, project development has frequently been aimed, at least in the popular price ranges, at mass tastes, with frequent criticisms leveled against the unnecessary use of "gingerbread" design which adds to construction cost but does not produce added liveability. These large housing projects have also been criticized because they are not co-ordinated with local school, transportation and water and sewer capabilities, with the result that inadequate facilities are often overtaxed and local officials must adapt capital improvement expenditures to emergency conditions rather than be able to plan for sensible and orderly long-term growth.

Suburban development has also been frequently characterized by unimaginative and wasteful land utilization, with each detached house occupying its own separate plot of ground. This not only adds to the cost of street and utility installations, but such planning frequently precludes a possibility for the builder to create large-scale common green areas for recreational purposes. In addition, driven by his desire to obtain cheaper land, the developer will frequently leapfrog beyond the fringe of existing housing development, leaving behind unused acreage which must wait for years before surrounding densities can support its economic development. This latter characteristic of suburban land utilization has caused concern among many urban planners, and numerous proposals have been developed for a more orderly utilization of this rapidly diminishing strategic land resource.

The rapid rate of suburban development has created serious problems of urban services for many localities. Previously semi-rural communities within a very brief period often have found themselves facing problems of providing greatly expanded services in such areas as education, police and fire protection and rubbish and garbage disposal. The costs of these services must be obtained, essentially, from a residential real estate tax base, and the resultant sharp tax increases have disillusioned many suburban residents. This disillusionment has triggered a return movement to the city, but this has been negligible when compared to the movement of central city residents to the suburbs.

Since about 1930 mobile homes have provided an increasing number of primary dwelling units in the total housing supply. A mobile home is a movable or portable dwelling designed for year-round living and built on a chassis without a permanent foundation but capable of being connected to electric and other utilities. Mobile homes commonly are referred to as trailers or house trailers, and sites developed for their location are known as trailer parks. There are more than 16,000 such parks in the United States, with more than 500,000 spaces. Large mobile homes are towed to their sites by truck tractors and are moved infrequently; expandable-type units feature living rooms that will expand from 10 to 20 ft. in width. By the 1960s more than 3,000,000 people were reported to live in mobile homes. The increasing number of mobile homes and the growth of mobile-home parks, however, created additional problems for many communities in relation to the provision of community services and facilities, schools and city and county planning, zoning and taxation.

3. Cost Trends.—Post World War II housing construction was dominated by the demands of "first-time" buyers represented by newly formed households or by previous renters who took advantage of extremely liberal financing terms and their improved earning powers to purchase new homes. Wartime personal savings also buttressed this "first time" home-buying market. Consequently, the relatively short supply of housing put a premium on resources for new housing and residential building costs increased by more than 50% between 1945 and 1950.

With easing of the housing shortage during the 1950s, the home-buying market became characterized to a larger degree by the "second time" buyer, the household which had physically outgrown its original quarters and whose improved earning capacity permitted purchase of larger and more expensive housing. This development encouraged production of higher priced and better quality housing, reflected in a 50% increase in the average price of single-family housing between 1950 and 1960, as compared to a 30% increase in building costs during the same period. Additional evidence was provided by the increased production of homes with more than one complete bath and with three or more bedrooms.

Although the upward trend of building costs has become greatly moderated since 1960 and market competition has tended to hold down the price of new housing, land costs continue to exert upward pressure on prices. This arises because of the shortage of vacant prepared land with utilities, in and close to central cities, while the preparation and marketing of additional peripheral land remains unplanned and poorly organized in many areas.

4. Technology and Research.—Since World War II, a number of innovations in home building have tended to reduce costs. Thus, plasterboard for dry-wall construction has come to be widely used. Many prefabricated components, such as roof trusses and window sash, have also received widespread acceptance. Despite progress, however, the house-building industry lags far behind others in adopting modern technology to reduce costs. A factory-produced house has more than half of its major components shipped directly from the factory to the site; only one out of every five new single-family homes has the benefits of this mechanization.

Most general contractors operate within a given metropolitan area. Few have grown large enough to finance research on consumer preferences or effects of their housing on occupants. Some builders have made production, material or design innovations but there have been no clear channels for making such changes widely available to buyers. Each contractor would have to be separately convinced of the value of the innovation and then teach his crew how to apply it. As a result, a gap exists between technological potential and actual building practice.

There is a lack of adequate basic research such as the development of criteria to measure new material performance standards. In the absence of such criteria, there is a lag in acceptance of new materials and methods and in revision of building codes to make such innovations acceptable. Industrial researchers concentrate primarily on developing and refining their own products. The federal government conducts research on such matters as local housing markets, measures of performance in certain materials and equipment and designs of low-income and experimental houses. However, many of its investigations are limited to providing data required by federal programs.

5. Continuing Needs.—Increasingly, housing problems in the United States have been identified with the needs of special groups and with the burgeoning problems of urbanism and urban growth. Quantitatively, at least, the private home-building industry has shown its ability to meet the needs of the great majority of the rapidly expanding urban population. Pockets of need remain, however, among those families whose incomes are too low to permit them to buy or rent adequate housing. These include the unemployed, the unemployable and the underemployed, many of whom are victims of a rapidly changing technology. It also includes the physically handicapped and elderly of low incomes. Government housing aids in these areas provide only a partial answer to this problem. Other governmental programs in the fields of area economic redevelopment, vocational training and elimination of racial discrimination in employment are required to bring many of these families to full earning potential and make them effective participants in a competitive economy.

The problems of urban blight and urban renewal have com-

manded increasing governmental attention. Federal and state pre-emption of such taxing areas as personal income, excise taxes and corporate profits have left to local communities a residuum of the real estate tax base. Blight and decay of urban centres have left this base increasingly incapable of yielding the revenue required to provide needed local public services. This tax base must be restored through clearance, rebuilding, and rehabilitation and the limited financial capabilities of local communities point to continued participation by the federal government. In addition, other sources of revenue besides real estate taxation must be sought by local governments.

The sheer pressure of increasing populations has continued to cause tremendous growth in suburban and metropolitan area populations, and this has emphasized the need for continued efforts to solve the problems of mass transit. The basic economics of mass transit which call for huge capital investments for a system that can perform at peak capacity during only 20 hours of a 168-hour week have prompted suggestions for governmental assistance, local, state and federal.

The rapid rate at which outlying suburban acreage is being wastefully consumed by new housing construction suggests the need for more effective urban land controls than existing local zoning regulations. Such action, both in planning and execution would require a co-ordinated interjurisdictional approach to the problem within metropolitan areas. The political structure of most metropolitan areas, characterized by a multiplicity of small, independent communities and governing bodies does not, however, point to the establishment of general governments covering entire areas. Rather, metropolitan approaches to planning, transportation, sewer, water, recreation and needs may have to operate through a variety of interlocal arrangements and understandings.

See also CITY; CITY PLANNING; METROPOLITAN AREA; ZONING. *See* also UNITED STATES (OF AMERICA): *Administration and Social Conditions: Living Conditions.* (RO. C. W.)

IV. GREAT BRITAIN AND THE COMMONWEALTH

A. GREAT BRITAIN

There probably has been a housing problem in Great Britain, as elsewhere, for as long as there has been a settled population, in the sense that a proportion of the people has always had to live at a standard below what was technically possible and desirable at any particular date. The 20th-century housing problem, however, had its more immediate origin at the end of the 18th century. After the mid-19th century the movement for housing reform endeavoured to improve conditions in three ways: by overcoming shortage; by replacing and improving slums and obsolete dwellings; and by raising standards of accommodation and amenity. A brief survey of progress made through the agencies of philanthropic effort, state intervention and private enterprise will provide a background to an assessment of the housing situation and the outstanding problems after the mid-20th century.

1. Housing Conditions in the 19th Century.—The population of England and Wales was estimated at about 6,000,000 in 1750. By 1801 it was nearly 9,000,000, and in less than two generations it had doubled itself, a process which was to be repeated before World War I, by which time the population was over 36,000,000.

It was not alone the increase in population which so radically altered the whole aspect of the country but the fact that the industrial revolution was concentrating the population in towns, so that places such as Liverpool, Manchester, Birmingham and Sheffield, which were small country towns of from 4,000 to 10,000 inhabitants at the beginning of the 18th century, had increased from five- to tenfold by 1800 and continued a steady and rapid growth up to, and in most cases even after, World War I.

Hands were needed for the new factories, and families could no longer maintain a livelihood in the countryside; this created a sudden and enormous demand for accommodation in the cities. Such accommodation had to be within walking distance of the main centres of employment and it had to be cheap since wages were low. There was as yet no appreciation of the danger to public health from the crowding of population into towns or from the lack of proper water supply, town sewerage and house drainage. It is not surprising that employers of labour in mine or factory, who were often prepared to allow men, women and children to work under inhuman conditions, should show no concern for the conditions under which they lived. Town landlords were interested only in obtaining the maximum rent at least cost, and local and central authorities were frequently ignorant, indifferent or corrupt. Thus the only accommodation which the town labourer, and even the more skilled artisan who had become a factory hand, could afford or obtain was little more than the bare essentials for shelter.

Evidence of the resulting conditions is contained in reports of mid-19th-century inquiries, the warnings of medical officers and sanitarians and in the novels and other writings of such authors as Charles Dickens, who thus supported a reform movement. For the most part the dwellings of the English urban poor were of two stories, built in rows, or terraces, sometimes back-to-back so that each house had only one outside wall, and sometimes around narrow courts opening from the main thoroughfares. Their construction was shoddy, walls were not dampproof and floors were frequently the bare earth. There was no paving or drainage and the cesspool, if such existed, could often only be built under the house itself. Outside toilets and pumps were shared by many households, and in many districts people had to beg or steal water. Overcrowding was rife. Thus all these circumstances, together with the prevailing poverty and often poor working conditions, resulted in appallingly low standards of health. Cholera epidemics swept through the country. The general death rate was 22 per 1,000 population in 1838, and death rates from epidemics among the industrial population were three times as high as among the gentry. Eventually the relationship between public health and living conditions was realized, and an indifferent public was persuaded of the need for reform.

2. Period of Sanitary Reform.—The first efforts at housing reform started in the countryside, when enlightened landlords repaired and improved their tenants' cottages; however, in the newly overgrown cities where there was as yet no tradition of civic responsibility, and where local government was still inefficient and negligent, it was some time before the reform movement could make any headway. Sir Edwin Chadwick (*q.v.*), a pioneer of sanitary reform, without which slum conditions could not be improved, worked together with others for the cleansing and paving of streets, the provision of water and drainage and the proper construction and ventilation of dwellings, thus preparing the ground for the Public Health act of 1875 and the building bylaws which enforced a minimum standard of building and ensured adequate drainage and ventilation. This led to a rather more open layout. Terrace houses with through ventilation, aligned along streets of the minimum width by law, took the place of the back-to-back cottage and congested court.

During this time also the first philanthropic trusts were set up to provide model dwellings for working people. The Society for Improving the Conditions of the Labouring Classes was first established in 1830 and was followed by similar model-dwellings companies and charitable trusts, the latter endowed by their founders to build dwellings to let at low rents, any financial return being reinvested to provide further dwellings. In 1851, at the Great exhibition, a block of dwellings was erected under the auspices of the prince consort, as an example to enlightened landlords.

With the example of the philanthropists and the support of a growing public opinion, reinforced by reports from the poor-law commissioners and later the royal commission on the health of towns, housing reform became the concern of parliament. In 1848 the first Public Health act was passed, and a central health department was established for a limited period, but not until 1871 was a permanent local government board set up to become the direct predecessor of the ministry of housing and local government.

3. Octavia Hill and the Growth of the Housing Management Profession.—An independent contribution to housing reform which was to have far-reaching results was started by Octavia

Hill (*q.v.*) when, in 1865, John Ruskin bought for her three houses in a court in Marylebone, where she was to try out an experiment in housing management. Having come into contact at an early age with the London poor and their housing conditions, and believing that "you cannot deal with people and their houses separately," she set out to show that, if landlord and tenant honoured their responsibilities to each other for the right use and maintenance of dwellings, not only would the physical environment of working-class tenants be improved, but their whole standard of living would be raised. By training fellow workers in her methods, Octavia Hill initiated a new profession of housing management for women, which had spread to the Netherlands and Sweden before her death in 1912.

4. Beginning of Housing Legislation.—During the second half of the 19th century, housing legislation proper first reached the statute book, and the basis of housing law was already laid down before 1900 on principles which remained in force in the second half of the 20th century. In 1851 the Labouring Classes Lodging Houses act and the Common Lodging Houses act (the Shaftesbury acts) were passed. The first gave power to local authorities to build lodginghouses, including housing accommodation of a type suited to the labouring classes, whether single men and women or families. The second enabled local authorities to inspect and regulate common lodginghouses. Toward the end of the century, philanthropic enterprise entered this field when Lord Rowton endowed the building of lodginghouses with a separate cubicle for each occupant.

The Artisans and Labourers Dwellings act, 1868 (the Torrens act), gave local authorities powers for the demolition or improvement of insanitary dwellings and so started legislation for slum clearance. In 1879 an amending act empowered local authorities to build houses with state loans to replace those closed or demolished and to charge a rate (local property tax) up to 2*d.* in the £1 toward the cost. The Artisans and Labourers Dwellings Improvement act (the Cross act), 1875, amended four years later, provided for the improvement and clearance of large areas. Although powers were thus enacted for the whole range of housing activity —that is, for the inspection and closing or demolition or improvement of existing dwellings, the clearance and improvement of unhealthy areas and the provision of new accommodation as a public service—little was done to put them into practice. The acts were complicated and permissive only and, especially in respect of compensation for the compulsory purchase of property, costly to operate. The Housing of the Working Classes act, 1890, which clarified and consolidated existing legislation, was designed to ease these difficulties and to encourage further clearance and building by local authorities.

Nevertheless, private enterprise was still regarded as the main source of supply of houses of all kinds, and local authorities built only about 5% of all dwellings up to World War I. The royal commission on housing, which reported in 1885, had taken evidence from many who were genuinely concerned about housing improvement but who opposed subsidized municipal housing on the ground that it would pauperize the tenants. The prevailing political philosophy regarded the operation of a free economy as adequate incentive to ensure that supply would meet demand.

However, by 1914 a great improvement had taken place in the condition of towns. Wages had increased, standards were rising and public health legislation had probably had more influence than the housing acts themselves. As a result new residential districts were being built to a better standard. Frequently they were monotonous and ugly, and the minimum of the bylaws became the maximum of practice; but at least they were more sanitary, and the houses were better built and ventilated and received more daylight.

5. Town Planning and the Garden City Movement.—Already during the 19th century a few idealistic and humanitarian industrialists, anxious to improve the living conditions of their workers, sought to create for them a better environment by providing new homes within a planned community. Such new towns or villages were to be experiments in social improvement as well as in better housing conditions. By the end of the 18th century, Robert Owen was attempting something of the kind at New Lanark, Scot., and James Silk Buckingham published an elaborate project for a new town in 1849. The first to go further in practice was Sir Titus Salt, a self-made Bradford woolen manufacturer, who built first a new mill and then new dwellings and community buildings around it for his labourers between 1853 and 1876.

Near the turn of the century George Cadbury at Bournville, W. H. Lever at Port Sunlight and Joseph Rowntree at New Earswick were building new communities. In 1898 Ebenezer Howard published his book *Tomorrow: a Peaceful Path to Real Reform*, setting out the theory of the garden city, self-contained, with its own diverse industries and separated from other towns by a green belt. He and his friends propagated the idea through the Garden Cities association. Letchworth Garden city, founded by them in 1903, was the first practical result. (*See* also GARDEN CITY.)

As cheap passenger-transport services were developed, towns were able to extend at their fringe, and to secure that such development should be properly planned, the first Housing and Town Planning act was passed in 1909. Its main feature was the town planning section, which empowered local authorities to make a plan to ensure good layout of any land in course of development or likely to be used for building purposes. Low-density development of houses at about 12 to the acre, as advocated by the garden-city movement, became the accepted standard.

6. Private Enterprise Houses and the Building Society Movement.—Although the lower-paid wage earner and casual labourer had to rely on rented housing, the needs of the rising lower middle class and skilled artisans could to an increasing extent be met by the purchase of houses for owner occupation. The growth of the building society movement helped the man with a little capital to acquire a house on mortgage. The Small Dwellings Acquisition act of 1899 empowered local authorities to make advances on favourable terms to assist individuals to purchase a house for occupation. These powers were later amended to keep pace with changing conditions.

7. World War I and the Beginning of Rent Control.—At the outbreak of war in 1914, in spite of the general improvement in standards, house production had not kept pace numerically with need. The Rent and Mortgage Interest Restriction act, 1915, was passed to control the exploitation of the shortage of houses, particularly in the industrial towns and in centres of munitions manufacture, by fixing rents and giving tenants security against eviction. It also prevented increases in the rate of interest on mortgages and the calling in of mortgages.

During the war building ceased while the population continued to increase. But at the same time standards rose and popular opinion demanded better housing for returning servicemen.

8. The Interwar Period.—*Housing Standards.*—There had been little conscious attempt to set a standard for working-class housing before World War I, but a committee was appointed by the local government board in 1917 under Sir John Tudor Walters. Raymond (later Sir Raymond) Unwin, the architect and town planner, was a member, as was Barry Parker of Letchworth Garden city. In a pamphlet, *Nothing Gained by Overcrowding*, and in his practice, Unwin advocated better layouts which took account of contours and natural features and used the cul-de-sac in place of gridiron planning; and these principles were embodied in the committee's report.

The Tudor Walters report also laid down standards of room sizes below which it was not considered desirable to build, and discussed plans for two-story houses with over-all floor areas varying from 755 sq.ft. to 1,150 sq.ft. These standards were interpreted generously at first, and the building of parlour-type houses with two living rooms downstairs was encouraged immediately after the war.

Housing Subsidies.—The problem facing the postwar coalition government was how to provide dwellings quickly and cheaply at a time of high interest rates and high building costs with a disorganized and inadequate building industry. Rent restriction was prolonged by two acts of parliament in 1919 and 1920, which extended control to houses of higher ratable values but allowed a

limited increase in rents.

Private enterprise could not compete on an economic basis with controlled rents, and for the first time government subsidies were made available to stimulate house building. The Housing and Town Planning act, 1919 (the Addison act), made local authorities responsible for supplying houses to meet the need in their areas. A subsidy was offered amounting to the whole of the annual loss on approved schemes or houses less the product of a penny rate—generous but leaving no inducement to local economy. Under this arrangement 176,000 houses were built, but costs rose and efforts to find more labour and alternative forms of construction largely failed. When the slump came two years later this subsidy was repealed and replaced by one limited to a fixed sum per house, although the amount was varied by acts of parliament in 1923 and 1924. Assistance was given in the form of a block grant for small houses built by private enterprise. Furthermore, by a "treaty" with labour in 1924, which convinced the building-trades unions that there would be a long-term program of house building, John Wheatley, minister of health in the Labour government, was able to encourage more men to enter the trade.

But prices had remained high and, with interest rates at about 5%, only skilled workers could afford the rents. Subsidies were regarded as one cause of high prices, and an attempt was made to remove them when unemployment in the building trade began to increase. They were, however, reinstated by a Labour government in 1929 in an attempt to bring rents down to what the lower-paid workers could afford. They were finally withdrawn for general-purpose housing in 1933 when costs had fallen, leaving only the slum clearance and overcrowding subsidies introduced in 1930 and 1935 respectively (*see* below).

Housing Societies.—Soon after the armistice of 1918, some societies were originated to provide new housing for the working classes or to improve or convert existing houses. These societies (legally termed associations) were recognized under the Housing acts provided that they conformed to certain rules, including the limitation of dividends on borrowed capital. They were in the tradition of the older charitable trusts and model-dwellings companies, some of which also undertook new building. Although not responsible for a numerically significant contribution to house production, they have frequently led the way in experimental work and have provided for special categories of persons, including large, poor families, families with a bad health record, old people, single people, etc.

Slum Clearance and the Abatement of Overcrowding.—Slums or, more precisely, dwellings unfit for habitation, although to be found mostly in the great cities, also exist in smaller towns, in rural communities and even among scattered cottages. They are houses in which the structure, accommodation and convenience are of an insufficient standard or which fall below the accepted minimum in respect of at least one of these requirements: houses which by reason of their layout are inadequately lit or ventilated; and houses which, while primarily suitable in themselves, have become slums through being let out in separate tenements without adaptation so that, for example, what was originally a dwelling for one family has come to be occupied by as many as four, five or more.

Although sanitary authorities had powers for dealing with unfit houses and unhealthy areas, by 1914 only 182 of them had taken any action, and their combined efforts from 1890 to 1913 inclusive produced 13,810 new dwellings. During World War I it was estimated that, in order to replace slums, 796,000 houses were needed in England and Wales and 115,000 in Scotland. Slum-clearance legislation passed soon after the war was somewhat cumbersome and expensive to local authorities, and housing effort was concentrated on the production of additional dwellings to overcome the shortage. The Housing act, 1930 (the Greenwood, or Slum Clearance, act), in order to encourage local authorities to clear slums and rehouse slum dwellers, provided a subsidy at a fixed rate per person rehoused, with special additional financial help for agricultural workers and for rehousing in flats on expensive sites.

The economic crisis in 1931 held up progress with slum clearance under this new act for the first year or two, but public opinion was by now again aroused. In 1929 the National Housing and Town Planning council had published its *Policy for the Slums,* and in 1931 a group of voluntary societies held the first New Homes for Old exhibition, presenting the facts about slum conditions. The Housing centre was inaugurated as a permanent organization for housing propaganda and information. In 1933, the minister of health initiated the antislum campaign with a five-year program for local authorities to clear 280,000 insanitary houses and replace them with nearly 300,000 dwellings. The program was extended to some 464,000 dwellings by 1938.

In 1935 the Overcrowding act was passed, setting a penal standard beyond which persons per room were not to be crowded and providing a subsidy for dwellings to abate such overcrowding. A national survey in 1936 showed 341,554 houses overcrowded out of nearly 9,000,000 inspected according to this standard, which was by no means a high one. In some boroughs and districts, particularly in northeast England, 20% and more of the dwellings inspected were overcrowded as compared with the national average of 3.8%. The London average was 7% and 9 out of the 28 metropolitan boroughs had between 10% and 17%. Orders making overcrowding a punishable offense were brought in to cover almost the whole country by 1939.

In 1938 the slum-clearance and overcrowding subsidies were brought into line with one another and paid on the basis of a fixed sum per dwelling, with a higher rate for flats.

Rural Housing and Reconditioning.—The Overcrowding act was the first act to offer a special subsidy for houses for agricultural workers, although previously local authorities had had powers under the Housing (Rural Workers) act, 1926, to give grants for the reconditioning of obsolete but structurally sound rural cottages. These grants remained in operation until after World War II although they were not extensively used.

House Production.—After World War I, house production was slow to get under way but was stimulated by the subsidies. It reached a peak in the year ending March 31, 1928, when 239,000 houses were built, of which 104,100 were subsidized houses built by local authorities and 74,600 were subsidized houses built by private enterprise. Production fell after 1928, and output by local authorities did not again reach the 100,000 mark until the year before World War II.

Low building costs and interest rates, and a wide extension of lending by building societies giving favourable terms for house purchase by the owner-occupier, enabled private enterprise to increase production until by 1934 it was well over 200,000. Local authorities also increased their production as the antislum campaign gained momentum. Total annual production varied between 325,400 and 347,000 for the five years before the outbreak of war in 1939.

Altogether, between 1918 and 1939 about 4,000,000 new houses were built, of which about 1,500,000 were built by local authorities for letting and about 2,500,000 were built by private enterprise and sold mainly to owner-occupiers.

Although between World Wars I and II the shortage of houses had been reduced, the supply of dwellings to let at rents which the lower-paid tenant could afford was still insufficient to enable the Interdepartmental Committee on Rent Control, reporting in 1937, to recommend further general decontrol of rents, except of the more expensive rents of houses already subject to decontrol on vacant possession.

The majority of houses built by local authorities between World Wars I and II were of the three-bedroom nonparlour type with a superficial area of about 760 sq.ft., reductions in standards occurring in the 1920s and again during the economic depression early in the 1930s to meet the needs of tenants with a low rent-paying capacity, particularly those rehoused as a result of slum clearance. Nevertheless, the provision of a fixed bath was stipulated, and in 1924 it was laid down that this should be in a bathroom.

In London, Liverpool, Leeds and other big towns some rehousing took place in blocks of flats at comparatively high densities, most blocks being five stories high and without elevators. Such blocks were often laid out around asphalt courtyards and were dreary

and barracklike. Nevertheless, experiments were made in providing amenities such as central hot water, water-borne refuse disposal, facilities for drying clothes, baby-carriage sheds, private balconies, clubrooms and children's playgrounds.

Town Planning.—This building activity, although relieving the housing shortage and improving general conditions, was called into question on the count that the new developments lacked urbanity and coherence. Sporadic, unplanned development round big cities resulted in waste of agricultural land, spoliation of natural beauties and danger from traffic. Closely associated with the physical shortcomings of housing estates were their social inadequacies. They were collections of houses, not communities; and many, although the size of small towns, were at first almost totally without churches, schools, shops and clubs.

Although another Town and Country Planning act had been passed in 1932, and a Restriction of Ribbon Development act in 1935, they were not very effective. London attempted to acquire a green belt of open land, and planning projects were drawn up to control development in many areas, but the cost of compensation where land had to be acquired for public purposes, or where development was adversely affected, restricted the effective operation of town planning proposals. The second garden city had been started at Welwyn in 1921 by E. Howard, and the city of Liverpool at Speke and the city of Manchester at Wythenshawe had developed housing estates which were to varying degrees self-supporting in social amenities. But these were isolated examples. The great cities, and particularly the London region, continued to attract population and industry, and the extension of electric suburban railways and motor traffic enabled more and more people to seek better living conditions on the periphery. Most local authorities built estates for rehousing slum dwellers on the edge of the built-up area, because redevelopment of the original sites at lower densities meant that fewer persons could be accommodated on them. The daily journey to work was costly and time-wasting and kept workers so long away from their homes that these outlying residential areas became mere dormitories.

9. Wartime and Immediate Postwar Policy.—On the outbreak of World War II rent control was again promptly imposed and covered almost all dwellings other than the most expensive (those of over £100 ratable value in London and of over £75 elsewhere) and nearly all those owned by local authorities. Civil building was generally stopped, and only some special housing and lodgings for key workers in war industry and agriculture were built during the next six years. Billeting (of civilian war workers, bombed-out families or women and children evacuated to safe areas) was relied upon to cope with the shifts in population caused by the war. Compulsory powers were available.

The situation in 1945 was not unlike that in 1919, and again the need and the popular demand was for additional houses for those who had lost their homes through the war or who had never had an opportunity of setting up homes. About 200,000 houses were totally destroyed by air raids, but about this number had been built during the six years of war. About 3,000,000 had received some war damage and 250,000 were so badly damaged as to be uninhabitable. The number of new households was estimated at about 550,000. The actual shortage in 1945 was estimated at between 750,000 and 1,000,000 dwellings, but this did not take account of any rise in standard, which in fact led to a much greater demand than had been expected.

The first attempt to meet the shortage was the mass production of temporary prefabricated bungalows, financed by and remaining the property of the state but managed by local authorities. By requisitioning and adapting empty houses, also as agents of the central authority, local authorities in badly war-damaged areas were able to add a little to the pool from which they could allocate tenancies. Both projects were somewhat costly to the exchequer, and neither could have any long-term effect. The first project was finished by the end of 1948, after 125,000 emergency bungalows had been provided. Requisitioning powers were brought to an end in 1955.

10. The Post-World War II Period.—For the main long-term contribution to post-World War II housing, national policy looked to local authorities to produce houses to let.

Between 1945 and 1952 control of all civil building was secured by a licensing system which gave priority to work considered to be of urgent national importance and restricted the building of houses by private enterprise according to number, size and price. Local authorities were provided with an allocation related to the resources of their area and the central authority was thus able to regulate output.

Subsidies.—In 1946 subsidies were again made available to local authorities at higher rates to meet postwar costs, in the form of a fixed annual amount per dwelling, borne three parts by the exchequer and one part by the rates. Although the amounts of subsidy were later varied somewhat, this form of financial assistance was adhered to until 1956, when the rates contribution was made optional.

Under the Housing Subsidies act, 1956, the minister had power to vary or to abolish subsidies; thus by the end of that year the subsidy for general-purpose houses was withdrawn, but a reduced subsidy was retained for one-bedroom dwellings with the object of encouraging local authorities to build dwellings suitable for old persons. Subsidies were retained in respect to dwellings built for slum clearance or redevelopment and to accommodate overspill population from overcrowded and congested areas. Additional subsidies on a sliding scale were available for dwellings in blocks of flats of four or more stories or on expensive sites and for some other special cases. These provisions were consolidated in the Housing (Financial Provisions) act, 1958.

Nontraditional House Construction.—To counteract the shortage of skilled labour and of traditional building materials, alternative forms of building were sought. A number of these systems, using various concrete and steel constructions, were approved for local-authority housing work, and several hundred thousand dwellings of permanent nontraditional construction were completed. Some Swedish timber houses were imported and allocated to local authorities mainly in Scotland and northern England. There was a severe postwar shortage of building timber, and the amount used per house was rationed for a considerable period. This led to the development of solid (concrete) ground floor constructions and systems which largely dispensed with softwood. However, as supplies became normal, new systems of construction could not compete either economically or in popularity with the traditional brick two-story house.

Trailers, or Caravans.—With the housing shortage after World War II makers became interested in building trailers, or caravans as they are called in Great Britain, for permanent residence. In the 1930s about 250 trailers a year were made in the U.K.; in the 1960s the number produced annually exceeded 35,000, with a retail value of about £17,000,000. Of these it was notable that 5,000 were exported, and interest in this type of home was growing on the continent of Europe in the second half of the 20th century.

British light touring caravans, 10 ft.–18 ft. long, and the static holiday vans, up to 22 ft. long and 7 ft. 6 in. wide (maximum legal width for British roads), may be towed by road in the U.K. The luxurious "mobile home" types up to 40 ft. long and 10 ft. wide must be transported on special vehicles. The interior of such quarters must be carefully designed to make best use of limited space. Beds can usually be folded upright against walls; kitchen units are compact, and cupboards are built into the structure. Full glass fibre insulation in ceiling, roof, walls and floor is often provided, as well as space for television, washing machine, fitted refrigerator and full household plumbing—boiler, copper hot water cylinder, radiator, fully fitted bath, wash basin and flush toilet. To meet the need of such homes local authorities have built caravan parks, where water, electricity and main drainage are provided. On these sites caravans often stay for long periods.

Allocation of Dwellings.—In the first postwar years the local authorities were responsible for the letting of about four out of every five new permanent dwellings built and for the allocation of the licence for the other one. The ministry of housing advised local authorities when allocating to consider such things as the housing conditions of the family (*e.g.*, overcrowding, sharing,

condition of dwelling); the number of dependent children; any special health needs; war service; etc. Authorities who introduced differential renting (*see* below) found it easier to observe these principles when letting their own dwellings. Also, in 1949 the Labour government removed the term "working-classes" from the Housing acts, thus making them apply to all sections of the population.

Housing Management.—Already between World Wars I and II, as the number of council houses increased, more local authorities employed professional housing managers. The Society of Housing Managers (basing their training on the principles initiated by Octavia Hill and at first training only women) and the larger Institute of Housing together had by the 1960s about 1,500 qualified members, both men and women, trained to take responsibility for lettings, rent collection, repairs, supervision of estates and housing welfare and to advise on local housing needs and programs.

Private Enterprise and Owner-Occupation.—After 1952 a Conservative government gradually relaxed the licensing restrictions, and the proportion of private enterprise to local authority houses rose until in 1958 the former had outstripped the latter. In 1954 a joint-guarantee plan between the ministry, the local authorities and the building societies was designed to encourage owner-occupation of small houses. Local authorities were empowered to sell council houses to tenants in appropriate cases, but few authorities were in a position to reduce the numbers of houses available for letting in this way. The House Purchase and Housing act, 1959, made exchequer funds available to approved building societies with the object of encouraging the purchase and improvement of older houses for owner-occupation. Local authorities who already had been empowered to make bigger advances for house purchase by owner-occupiers were enabled by this act to lend even more freely. The sale by private enterprise of flats for owner-occupation also became popular.

During the 1930s, when the building of small houses by private enterprise for speculative sale had also enjoyed a boom period, some builders had been criticized for low standards of layout, design and construction. Before World War II the National House Builders' Registration council had been formed among reputable firms prepared to conform to a minimum standard. After the war, awards were made by the minister of housing for good design and layout of both private and municipal housing projects to encourage the wider employment of architects for estate housing and a higher standard of taste among purchasers.

Housing Societies.—During the immediate postwar years housing societies were discouraged by rent control from undertaking extensive new building. Nevertheless, several societies were set up in association with industry to build for key workers, and several self-build societies were formed, mainly among ex-service men, the members and their families working on the construction of houses to accommodate each member household.

Several large societies, sponsored by the government before World War II to supplement the work of local authorities in Scotland and the northeast of England, greatly increased their output. The Northern Ireland government set up a similar trust in 1945.

After 1954, when recognized housing associations were exempted from rent control, many undertook new programs, especially of new building and conversions for the elderly. Societies were eligible for the same subsidies from the exchequer as local authorities when they carried out housing for recognized purposes.

The Second Slum Clearance Program.—After World War II extensive slum clearance was again postponed until the acute shortage of dwellings had been met. Meanwhile the older dwellings, after minimum permissible maintenance during the war, deteriorated further. Repair costs had increased threefold, which, with the control of rents at 1939 levels, made adequate maintenance uneconomic. However, by 1954 nearly 2,000,000 new dwellings had been built and the shortage was easing in some areas. It was adjudged time for a shift in housing policy similar to that which had taken place in 1930. The Housing Repairs and Rents act, 1954, to encourage the replacement and improvement of old houses and the raising of standards of repairs, modified procedure regarding slum clearance and required local authorities to submit a preliminary five-year program. In 1955 returns showed 847,112 houses scheduled as slums, of which local authorities estimated that they could deal with 375,484 within five years. The 1954 act also made provision for the acquisition and temporary repair of slum and obsolete property for deferred demolition by local authorities.

Under the Housing acts as consolidated in the Housing act, 1957, which became the principal act, no dwelling may be let unless it is in all respects fit for habitation. There are four main types of procedure open to local authorities for securing the closure or demolition of unfit houses and the clearance and redevelopment of slum areas. (1) They may require a landlord, in the case of a single dwelling, to carry out specified work and in his default they may do the work and recover the cost. If it is deemed that the dwelling cannot be made fit at reasonable expense and no offer by the owner to do necessary repairs is made or accepted, the local authority must order the closing or demolition of the dwelling. (2) A whole area may be declared a "clearance" area if the dwellings in it are unfit or dangerous and unhealthy by reason of their bad arrangement, and if these conditions can be most satisfactorily remedied by the demolition of all the buildings. (3) A "redevelopment" area must contain a certain proportion of working-class dwellings, at least one-third of which must be overcrowded or unfit, and the site must be redeveloped according to the local authority's plan, substantially for rehousing purposes. (4) "Comprehensive development" procedure, which allows for urban renewal on a wider scale, may be used to designate any area for redevelopment as a whole in order to deal satisfactorily with extensive war damage, obsolete development or any other purpose of the development plan drawn up by the planning authority under the Town and Country Planning act, 1947 (see *Town Planning After World War II*, below). Any person affected may appeal against these procedures. Compensation for compulsory acquisition of an unfit dwelling is normally payable for the site value only, plus an allowance for certain classes of owner-occupiers or business-occupiers. The local authority is responsible for rehousing tenants displaced by slum clearance and an exchequer subsidy is available toward the cost of new dwellings for this purpose.

Improvements and Conversions.—The Housing act, 1949, provided grants to landlords, owner-occupiers, local authorities and housing associations for the improvement, other than repair, of houses to bring them up to modern standards or for the conversion of larger houses or other buildings into two or more dwellings.

The House Purchase and Housing act, 1959, introduced new "standard" grants for the provision of standard amenities to improve old dwellings. These grants covered half the cost up to a maximum fixed figure in respect to a fixed bath or shower in a bathroom, a hand basin or lavatory, a hot-water supply, a water closet and food storage facilities, and could be claimed as of right under stated conditions.

Rents.—Between 1939 and the passing of the Housing Repairs and Rents act, 1954, there had been virtually no increase in permitted rents in spite of a more than threefold increase in repair costs. The 1954 act allowed an increase of rents of rent-controlled houses up to a maximum figure related to ratable values, with the proviso that the landlord had to prove the expenditure of an appropriate sum on repairs. Certificates of disrepair, which could be obtained from the local authority by the tenant of a badly maintained house, enabled him to withhold the original 15% rent increase allowed by the act of 1920 in respect to repair costs. The Labour party opposed the relaxation of rent control and proposed the compulsory acquisition of all rented dwellings by the local authorities; however, during 1957 a Conservative government passed a new Rent act introducing decontrol of higher rated dwellings and of all dwellings in vacant possession, and allowing for gradual increases in rents of all controlled houses within limits related to ratable values and conditions of tenancy. The effect of this act was delayed in some respects because landlords were encouraged to give three-year agreements to sitting (occupant)

tenants and, by 1960, when the majority of such agreements expired, the shortage of higher-rented accommodation had been somewhat relieved except in London and several other large cities. To minimize exploitation in such areas the minister of housing approved compulsory purchase by the local authority of dwellings where exorbitant rents were being imposed.

After 1930 local authorities had powers to pool the subsidies which they received under different acts and provisions in a single housing revenue account, and to use them to fix rents according to the individual financial needs of the tenant. Some authorities introduced such projects during the 1930s to enable them to rehouse families with low incomes and a number of dependent children, who otherwise would have been unable to afford the rents of new houses. After 1945 full employment, children's allowances and other forms of welfare assistance greatly improved the rent-paying capacity of many tenants, but high building and maintenance costs, high interest rates and, after 1956, the withdrawal of the normal-needs subsidy resulted in high rents. Council houses had been let to tenants with widely varying incomes according to housing rather than financial need. Local authorities were now therefore encouraged to rationalize their rents in order to avoid too wide a gap between prewar and postwar rents, and between rents of houses built with and without subsidy and at different periods when different interest rates prevailed. Many also introduced new differential rent plans based on a proportion of the income of the head of the household, income from other wage earners, lodgers, etc., and the number of dependent children.

11. Town Planning After World War II.—The close association between housing and town planning had been realized when interwar town planning acts were passed to attempt to control the overgrowth of the great cities. National and regional planning of physical environment including the right location of new or existing industry were regarded as the key to the problem of the unplanned sprawl of the big towns. The reports of the Barlow commission on the Geographical Distribution of the Industrial Population (1940), of the Uthwatt committee on compensation and betterment and of the Scott committee on land utilization in rural areas (both 1942) together set up the principles for a national planning policy which was partially accepted as a basis for legislation.

The Town and Country Planning act, 1944, gave special assistance for the reconstruction of war-damaged areas. In 1947 a comprehensive Town and Country Planning act introduced a new principle to deal with the problem of compensation and betterment made necessary by town-planning action. This involved the acquisition of development rights of all land on behalf of the community and made all development subject to permission by the local planning authority. This act also required the preparation of development plans covering the whole country. Thus postwar housing development, wherever it took place, was subject to town planning control. The financial provisions covering development rights were, however, repealed in 1953, on the general grounds that they constituted a hindrance to development.

New Towns and Town Expansion.—Even more significant in relation to housing policy was the New Towns act, 1946, empowering the minister to appoint development corporations and to designate sites for development as New Towns, with finance from public funds (*see* NEW TOWNS). During World War II an advisory plan for central London by J. H. Forshaw and Sir Patrick Abercrombie and a plan by Abercrombie for the greater London region both recommended the development of New Towns, for which sites were suggested. By the early 1960s development was well under way in 15 New Towns, 8 of them being in the London region, 3 in Scotland, 1 in Wales and 1 in the midlands. Further New Towns for the relief of towns in the north and midlands were under consideration.

By 1961 the New Towns in England and Wales had completed about 80,000 dwellings, but London and the big cities were still crying out for sites where surplus population could be settled. At the same time many small country towns, although finding it difficult to maintain the standards expected of a modern community, could well absorb families from congested areas. Under the Town Development act, 1952, agreements could be made by means of which a large, overgrown local authority could promote housing development in another authority's area and could provide financial and technical assistance. The exchequer could make grants toward major expenditure on water and sewerage services; the county council could also assist. The higher rates of subsidy for rehousing overflow population from congested areas were continued after the repeal of the general housing subsidy in 1956, and exporting authorities could make a rates contribution in respect of applicants nominated by them as tenants of such town expansion programs.

In spite of this decentralization, employment opportunities, particularly in office work, multiplied in the big conurbations, which became increasingly congested with traffic. Town planners looked to comprehensive redevelopment to rehabilitate obsolete urban areas. London, Birmingham and other big towns undertook construction of many such projects. The redevelopment of the Barbican area in the City of London, with housing, amenity open spaces, offices and community buildings and with segregation of traffic, was a noted example. (*See* also LONDON: *Housing.*)

12. Design of Dwellings and Neighbourhood Planning.—After World War II the standards of accommodation and design for council houses were based on recommendations of a government advisory committee (the Dudley committee) in their report, *The Design of Dwellings*, published in 1944, which advocated larger, better-built and better-equipped houses and flats. In spite of several economies made to prevent greatly increased building costs there was a marked improvement in postwar dwellings, and particularly in their heating and hot-water systems and kitchen and sanitary fittings. Many tenants could also afford better furnishings; and some installed their own modern cookers, washing machines, refrigerators, etc., often by means of hire purchase, or installment buying.

Most postwar housing took the form of two-story single-family houses of about 900 sq.ft., in pairs or rows, although later more multistory flats and maisonettes, or apartment buildings, were used, especially for central area redevelopment, frequently in conjunction with two-story houses and four-story maisonettes for larger families and even with bungalows for old persons.

Before the war, town planners had evolved a theory of neighbourhood planning, somewhat obscure in origin, but brought into prominence in England by the analysis of existing communities in the two London advisory plans and the suggestions made in them for new development. The size and space requirements of neighbourhoods were analyzed also in the Dudley report, and this principle was adopted as a guide in most postwar residential areas.

During the interwar years, a movement for the provision of community centres in residential areas had arisen to counteract the lack of social and cultural facilities in the new districts. Although immediately after World War II licences for such building were severely restricted, more estates were planned with local centres and interesting experiments were made in providing for social and communal services.

The increase in the use and ownership of motorcars concentrated attention on garaging, parking and traffic considerations in the design of layouts. Pedestrian shopping precincts and groups of dwellings planned with footpath access segregated from traffic became experimental features in some New Towns and redevelopment areas. Some authorities planned for one car to each household, even on low-cost estates.

Greater attention was also paid to the landscaping of housing areas and the provision of play space for children.

13. New Problems.—The 1951 census showed an excess of households over dwellings of about 1,169,000. Despite the building of 2,478,000 new dwellings in the next 10 years, which brought the total of dwellings in Great Britain to about 15,750,000 by 1961, it was estimated that 1,500,000 dwellings would still be needed within the next 20 years to provide for new households. The 1961 census showed that overcrowding had decreased markedly and it was a serious problem only in a few areas and in isolated cases. The fragmentation of the population into small households, and the

economic and social conditions which enabled the large number of aged to live as separate households, increased the demand for small dwellings suited to their needs. The movement of people within the country and to a lesser extent immigration from overseas concentrated pressure for accommodation disproportionately on the London and southeastern regions and to some degree on other big city regions.

About 4,000,000 dwellings were enumerated in 1951 as being without certain amenities and it has been estimated that over 4,000,000 existing dwellings had been built before 1881. Between 1945 and 1960, 350,000 unfit houses were cleared and more than 1,000,000 persons rehoused. The rate of slum clearance increased after 1956 and 60,000 dwellings were cleared in 1960. More than 318,000 dwellings were improved or converted with assistance under the Housing acts between 1945 and 1960, by which time work under the 1959 act was just beginning to gather momentum.

The rise in income levels and full employment reduced the number of housing difficulties due to poverty except in a hard core of problem families. But old persons, too, found difficulty in meeting the rent of a modern dwelling out of an old-age pension or small fixed income, despite supplementary pensions in aid of rent, which assisted many. This meant that the aged were often left behind in low-rent slum areas, so that small, suitable dwellings were especially needed when redevelopment took place.

Several social surveys emphasized the interdependence of different members of the extended family, particularly that of mothers and daughters. Young couples moving to newly developed areas missed the practical and moral support of their parents in the early years of marriage and the bringing up of children. Conversely these young persons were anxious about elderly parents left behind in the old central areas.

Until after World War II Great Britain was predominantly a country of single-family dwellings of two or at most three stories. The greater space requirements for the redevelopment of overcrowded central areas after 1945 necessitated the building of multistory blocks of flats and maisonettes with elevators, besides the rehousing of part of the population outside these areas. The high flats created certain new social problems, in particular that of providing for children's play.

Large old houses in obsolete districts often fell into the hands of landlords who exploited them. In large industrial centres, particularly, immigrant workers frequently obtained lodgings in such houses at scarcity rents which they could ill afford, with the result that the houses became overcrowded. Provisions for ensuring proper management of houses in multiple occupation were included in the Housing act of 1961.

By 1960 local authorities were building mainly for slum clearance, overspill population and for old-age pensioners; and private enterprise was increasing the output of houses and flats for owner-occupation. There was still a need for modern dwellings for those in the middle-income range, including those better-off single and elderly persons who neither needed nor qualified for subsidized accommodation but who were unable or unwilling to purchase. The Housing act of 1961 envisaged the expansion of the housing-association movement, and provided a special government loan to finance the building of dwellings to let at economic rents to meet the needs of such persons.

This act also introduced a new principle for allocating subsidies to local authorities. Those authorities with limited financial resources for housing would receive subsidy at a higher rate than those whose potential income from rents was already high. It was hoped that this would encourage authorities to introduce differential rent systems, so that those households most in need would benefit to a greater degree from the subsidies.

B. Commonwealth of Nations and Republic of South Africa

In the earlier years of European settlement in most of the Commonwealth countries, the traditional single-family house was adapted to local conditions. For the most part densities were low, as there was no shortage of land. Urbanization and increasing populations led to the need for planned housing policies during the 20th century; thus in the larger towns of Canada, Australia and New Zealand more flats were built. Government agencies in these countries provided mortgages to assist owner-occupiers. Low-rental public-housing developments, particularly in relation to slum clearance, began mainly after World War II.

In India, after independence, five-year programs envisaged the building of modern housing units. The second program included 1,000,000 such units in assisted projects and 800,000 in private projects.

Pakistan, with its housing situation aggravated by large-scale immigration of displaced persons, also planned for settlement of refugees on agricultural land and for a number of satellite towns.

In Singapore and Hong Kong, where the need was extremely urgent, housing trusts and authorities produced large estates of multistory dwellings. Similar trusts or government agencies in the West Indies and other smaller communities built for letting, or gave assistance toward home ownership.

In many cases officers were appointed who had had experience in public-housing administration in Britain. The management principles of the Society of Housing Managers and of the Institute of Housing were adapted to the needs of overseas development and native workers were trained to take over in the fields of administration, management, town planning and building.

Methods of house construction varied widely according to the climate and indigenous materials of the different territories. In comparatively temperate areas, such as parts of Canada, Australia and New Zealand, more or less traditional constructions were used (although including more timber than in the United Kingdom). In Hong Kong, where an enormous population was concentrated in a limited area and immigration had been very rapid, density standards even of new dwellings were among the highest in the world.

In South Africa the influx of native workers into urban areas to obtain employment in mines, factories, etc., led to the mushroom development of shanty towns which rapidly deteriorated into slums owing to the temporary nature of the buildings and the lack of adequate services. In some territories housing authorities were set up to build simple dwellings for renting and to provide financial assistance to encourage home ownership and self-build programs. Extensive building was undertaken after World War II to house detribalized African workers in segregated communities.

(M. C. Br.)

V. EUROPE

The housing situation in continental Europe varies widely in quantitative and qualitative aspects. Housing shortage and overcrowding result in the first place from the failure of house building to keep pace with growing populations and the rate of urbanization. Urban housing levels, compared with the other essential components of standards of living, are lower in those countries which were industrialized earlier and which have a high proportion of obsolete dwellings in industrial areas. Nevertheless, taking Europe as a whole, rural areas have a higher proportion of substandard dwellings lacking in amenities than do the towns.

Public responsibility for housing standards and production developed in most western and central European countries toward the end of the 19th and the beginning of the 20th centuries. In some countries the principal agencies for home building for the lower income groups have been co-operatives or housing associations, for example in the Scandinavian countries, the Netherlands, Belgium and Germany. In others, for instance in Austria between World Wars I and II, municipalities built and rented dwellings. Private enterprise also played a big part both in building for owner-occupation and for renting, mainly for the higher-income groups, and has sometimes been assisted by special tax concessions, mortgage guarantees and similar measures.

Between the two wars, in most continental cities in western and central Europe, low-cost housing was built in flats and although the popularity of the single-family house was marked, living in flats was accepted as normal. Nevertheless, development of low-density housing on garden-city lines took place extensively. Much

thought was also devoted to the development of low-cost flats at fairly high densities. In Austria the municipality of Vienna erected blocks of dwellings, at first arranged around large central courtyards, provided with facilities such as laundries, nurseries, schools, etc. In France a water-borne system of refuse disposal was first used and after World War II the French architect Le Corbusier received world-wide acknowledgment for the bold conception of one large high building containing dwellings and communal facilities designed to a standard module; this first "United Habitation" was erected outside Marseilles. German layouts generally took the form of slab blocks, orientated to give the best aspect to every dwelling and allowing greater openness than the earlier courtyard layouts. In Scandinavia almost all building by the co-operatives was of flats, although Sweden developed a self-build program for smaller houses, particularly in the suburbs of Stockholm where many single-family timber houses were built (*see* also *Trends in World Housing*, above). These countries were also pioneers of the tower block.

A survey by the United Nations Economic Commission for Europe of the housing situation, published in 1956, gave a general picture of housing shortage, including some information about the condition and equipment of dwellings. This same survey attempted some classification according to basic services, such as electricity, inside running water and bath, showing a generally higher standard in the Scandinavian countries, the United Kingdom, Ireland, Switzerland, western Germany and the Netherlands. France and the United Kingdom contained a higher proportion of obsolescent housing than other European countries for which information was available.

In spite of greater interwar activity, no European country could boast a fully adequate housing stock at the outbreak of World War II. All suffered from the lack of building during the war years, and war damage resulted in great losses in some countries and districts.

By 1955 the over-all housing situation had improved, and since then in most countries in northern and central Europe the rate of construction has been stabilized at approximately prewar levels. *See* also references under "Housing" in the Index.

(M. C. Br.; Et. W.)

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For current developments and statistics *see* the *Britannica Book of the Year*.

HOUSING AND BUILDING LAWS. The object of housing laws is to protect the health and safety of the community by fixing minimum standards for the construction and maintenance of buildings. Housing laws, as distinguished from building laws, are concerned with prescribing standards for buildings used for habitation. Such laws apply to existing buildings and require that they conform to minimum standards of sanitation, maintenance and habitation, even though the structure as originally built did not conform to this standard.

Building laws are designed to achieve minimum standards in new construction as well as in the alteration of existing buildings. These laws apply not only to housing but to industrial and commercial buildings as well. In general, they deal with basic construction, electric and plumbing installations, and fire prevention.

Housing and building laws are not mutually exclusive, and their provisions may overlap. Modern building laws reflect the impact of 19th-century urbanization, which focused attention on the need for legislation to assure the preservation of safety and health.

United States.—*Housing Laws.*—The growth of cities in the U.S. brought about a concentration of population, swelled by the large immigration of the 19th century. With this concentration came the tenements, and with the tenements came the squalor so vividly portrayed by Jacob Riis in *How the Other Half Lives* (1890). Then came the New York Tenement House law of 1901—a pioneer effort to meet the onslaught of the slums.

In their modern context, housing laws are one element in the over-all attack against urban blight. The National Housing act of 1949, as amended, has stimulated an eagerness by communities to adopt housing laws. This eagerness derives from the need to meet the requirements under the act for a "workable program" to eliminate slums and thereby be eligible for federal grants and loans.

Though there are instances of state-wide housing laws (*e.g.*, Michigan and New York), normally such legislation is the product of the local municipal government. The general pattern is to define those dwellings falling within the ambit of the law; to fix standards for such matters as space and occupancy, sanitation, safety, heating and electricity; and to provide procedures for enforcement. Definitions are important in that the specific standards applicable to different types of occupancy must be clearly stated. Standards for space and occupancy are designed to avoid the overcrowding of dwelling units. An illustration of this is the requirement prescribing minimum floor area and air space for sleeping units, depending upon the number of occupants and their ages.

Sanctions for enforcement vary from fines and imprisonment to demolition in the case of dwellings unfit for habitation or dangerous for occupancy. As to the latter, enforcing officers are authorized to order the building to be vacated and also to order the making of repairs as well as the demolition of the building, with power to carry out the order if it is not obeyed.

These rights of the enforcing officer derive from the legal doctrine of nuisance and the power of the sovereign authority to abate nuisances (*Miller* v. *Foster*, 244 Wis. 99, 153 A.L.R. 845). A necessary element in enforcement procedure is the power to make inspections of buildings, a provision usually found in housing laws.

In U.S. law, with the constitutional requirement of due process (*q.v.*), the legal justification for regulatory measures dealing with housing derives from the police power of the state to enact legislation for the common welfare. "At the point where economic self-interest ceases to be a sufficiently potent force for the promotion of the general welfare, or, indeed, becomes a force which may actually injure the general welfare, the Legislature may intervene and require that buildings intended for use as . . . multiple dwellings shall conform to minimum standards which may reasonably be regarded as essential for safe, decent, and sanitary dwelling places" (*Adamec* v. *Post*, 273 N.Y. 250, 255). Furthermore, singling out existing buildings for special treatment (*e.g.*, new fire regulations for lodginghouses though they complied with the law when originally constructed) does not necessarily transgress constitutional guarantees against deprivation of property without due process of law or necessarily create an invidious distinction that is contrary to the constitutional guarantee of equal protection of the laws; there may be ample justification in the facts for such special treatment (*Queenside Hills Realty Co., Inc.* v. *Saxl*, 328 U.S. 80).

Building Laws.—These laws, commonly called codes, though prescribing standards for new construction and embracing nondwelling structures as well as those used for dwellings, are as important a component as housing laws in the workable program for the control of blight.

The general pattern of administration and enforcement is to require the approval of building plans before beginning construction; to provide for the issuance of a permit allowing the project to go forward if the plans are found to comply with code requirements and for the inspection of the work during the period of construction; to sanction the issuance of "stop orders" if inspection reveals violations; and to authorize the issuance of a certificate of occupancy upon final completion in accordance with code requirements. These preventive measures are usually coupled with punitive sanctions for willful violations of the code.

On the substantive side, the code may describe the particular materials or construction that are to be employed in a given situation. Alternatively, in accord with the modern trend, the code may use the so-called functional principle and indicate a standard of performance to be achieved, thus allowing greater flexibility in the use of new materials made available by technological advances. An illustration of a functional requirement would be that a certain column shall have a fire-resistance rating of not less than a certain number of hours in accordance with a recognized testing procedure. The use of recognized standards reduces the necessity of manufacturing several items serving the same function in order to satisfy the rigid requirements of different codes. As standards are changed or new ones developed, it is important that there be no lag between the sanctioned procedures of the community and those that have been accepted by disinterested groups. These legislative lags, however, are an ever present problem, particularly where the functional principle is not employed.

There are several complete codes that have been prepared by private groups as models for enactment by local municipalities, and several states have enacted legislation which permits municipalities to adopt such codes by reference. This practice relieves a municipality from complying with any state law requirement that makes publication of a proposed ordinance a prerequisite for its enactment—a costly procedure, considering the bulkiness of most codes; in the absence of state legislation allowing such adoption by reference there may be questions under state law regarding the legality of this procedure.

The question of legality may arise, however, wherever the adoption by reference includes the possibility of amendments to the code that may be made by the municipality in the future (*City of Tucson* v. *Stewart*, 45 Ariz. 36, 96 A.L.R. 1492). A few states (*e.g.*, New Jersey, New York and Connecticut) have initiated their own programs for a model code available for adoption by municipalities within the state.

England.—Legislation respecting housing that is unfit for habitation is covered in the Housing act, 1957, which enumerates the particular matters to be taken into account in determining fitness. These embrace collectively, safety, plumbing and sanitation, and facilities for storage and the preparation of food, with a special part of the act devoted to overcrowding. Local authorities are required to make periodic inspections to ascertain if houses are unfit for habitation.

Similar to U.S. housing laws, provision is made for ordering repairs and for the demolition and closing of houses. If, upon appeal to a court or judge, it is determined that a repair which has been ordered cannot be made at a reasonable expense the local authority, if so empowered by the minister of housing and local government, may compel the owner of the house to sell it to the authority, in which event the latter must carry out the repairs. There are similar provisions for compulsory sale in lieu of a demolition or closing order if it appears that the house "can be rendered capable of providing accommodation which is adequate for the time being . . ." (s. 17).

By the Public Health act, 1936, local authorities outside of London may adopt building bylaws which, together with the act itself, control the construction and alteration of buildings. The matter of adopting bylaws is not wholly optional; the minister of housing and local government may require a local authority to make bylaws, and if it fails to do so after a lapse of three months, the minister himself may make such laws. Bylaws must include certain matters specifically set forth in the act; these cover, in general, items of construction and items pertaining to sanitation. Bylaws cease to have effect after ten years unless extended by the minister of housing and local government. Model bylaws issued by the ministry of housing and local government adopt the functional principle described above in connection with U.S. codes. Local authorities, in addition to the right to take measures for the collection of fines, may require an owner to remove any construction that contravenes a bylaw or to make appropriate alterations.

In addition to the Public Health act of 1936, the planning requirements of the Town and Country Planning act, 1947, also has an impact on building operations. The administrative county of London is governed in the matter of building not by the Public Health act, 1936, but by a series of acts collectively known as the London Building acts, 1930–1939, with their appropriate bylaws.

Scotland.—By the Building (Scotland) act, 1959, local authorities have a uniform building code. Provision is made for building standards to be established by regulations of the secretary of state after consultation with the building standards advisory council. The standards may employ the functional principle. Certificates of completion are provided for, similar in function to the certificate of occupancy in U.S. codes.

Canada.—Building codes are matters within the jurisdiction of the provincial and municipal governments. A National Building code, issued under the auspices of the associate committee on the national building code (National Research council, Ottawa), is purely advisory. The code includes a part devoted to housing accommodations, with standards for heating, room heights, plumbing and windows.

See also HOUSING; CITY PLANNING; ZONING.

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In addition to the English model bylaws and the Canadian National Building code, the following model codes are available: *A Proposed Housing Ordinance* (American Public Health Association, New York city); *Model Minimum Housing Standards Ordinance* (National Institute of Municipal Law Officers, Washington, D.C.); *Uniform Building Code* (International Conference of Building Officials, Los Angeles, Calif.); *Basic Building Code* (Building Officials Conference of America, Chicago, Ill.); *Southern Standard Building Code* (Southern Building Code Congress, Atlanta, Ga.); *National Building Code* (National Board of Fire Underwriters, New York city, Chicago, San Francisco). A survey of several local U.S. housing laws is contained in *Provisions of Housing Codes* (Urban Renewal Bulletin No. 3, Housing and Home Finance Agency, Urban Renewal Administration, 1956). For a description of the "workable program" under the National Housing act of 1949, as amended, see *Program for Community Improvement* (Housing and Home Finance Agency). (B. H. G.)

HOUSMAN, ALFRED EDWARD (1859–1936). English scholar and poet, best known as a writer of lyrics expressing an elegiac pessimism in strikingly simple form, was born on March 26, 1859, at Fockbury, Worcestershire. He was educated at Bromsgrove school (1870–77) and was a scholar (1877–81) and afterward honorary fellow of St. John's college, Oxford. After leaving Oxford he held a post in H.M. patent office till he was appointed professor of Latin at University college, London, in 1892. In 1911 he was made a fellow of Trinity college, Cambridge, and professor of Latin in that university. His chief publications, besides many papers in classical journals (see *A List of Adversaria*, Cambridge, 1926) are editions of *Juvenal* (1905), *Manilius* (I, 1903; II, 1912; III, 1916; IV, 1920; V, 1930) and *Lucan* (1926); two volumes of lyrics, *A Shropshire Lad* (1896) and *Last Poems* (1922); and a lecture, *The Name and Nature of Poetry* (1933).

As a scholar Housman invites comparison with Richard Bentley for learning, ingenuity and controversial vigour. He led the attack on superstitious fidelity to the "best manuscript" and "paleographical probability," and brought to the defense of common sense in scholarship an armoury of sarcastic wit which helped to make him the most widely feared of contemporary scholars. It was not these powers, however, nor the range, depth and unfailing accuracy of his learning, but the strength and keenness of his intellect, that gave to his work its quality of greatness and to him his claim to pre-eminence in the world of scholarship.

As a poet Housman appealed to a larger public. The popularity of *A Shropshire Lad* grew slowly but so surely that *Last Poems* had an immediate success greater than that of any other book of poetry published in England during the century. The poems are enjoyed by those readers whose interests are not literary because the language is simple and the verse melodious and the thought is easily understood; they are admired by critics because they are flawless in taste and execution and possess a quality both in their form and in their feeling which it is equally vain to imitate and to seek elsewhere in literature: they are as romantic as ballads, as classical as the Greek anthology. The poems number little more than 100; about a third are written in the character of a country boy exiled in London; they deal with the vicissitudes of friendship, the passing of youth, the beauty and the cruelty of nature, and the vanity of human wishes.

Housman died on April 30, 1936. By his will he permitted his brother, Laurence, to publish such of his unpublished poems as appeared not inferior in merit to his other works, and in Oct. 1936 a volume appeared under the title *More Poems*. These verses did not alter, for better or worse, Housman's reputation as a poet, but, like two books of reminiscences by his brother—*A. E. H.* (1937)—and his publisher, Grant Richards—*Housman 1897–1936* (1941)—they partially threw aside the veil of reserve which had hidden Housman's personality during his lifetime. The best account of Housman's life and his work is that contained in A. S. F. Gow's *A. E. Housman* (1936). (J. SP.)

HOUSSAY, BERNARDO ALBERTO (1887–), Argentine physiologist and Nobel laureate, was born on April 10, 1887, in Buenos Aires. At the University of Buenos Aires, Houssay received a degree in pharmacy in 1904 and became an M.D. in 1911. Appointed to the faculty of the university veterinary school in 1907, he was given the chair of physiology in the medical school in 1919. He was dismissed for political reasons in 1943 and, although he was reinstated shortly afterward, he was asked to resign in 1946. He founded the privately endowed Institute of Biology and Experimental Medicine in Buenos Aires in 1944 and served as its director after 1946. In 1955 he was again appointed professor and director of the physiological institute of the university.

Houssay's researches demonstrated that the hormone secreted by the anterior lobe of the pituitary gland prevents the metabolism of sugar and that the injection of pituitary extract induces symptoms of diabetes. His work in this area won him, jointly with C. F. and G. T. Cori, the Nobel prize for medicine in 1947. In addition to hundreds of research reports, he wrote a comprehensive text of physiology, *Human Physiology* (1951).

HOUSTON, SAM (SAMUEL) (1793–1863), U.S. soldier, politician and leader of the movement for the independence of Texas, was born near Lexington, Va., on March 2, 1793. His father, who had fought in the Revolutionary War, died in 1807 and soon afterward Samuel moved with his mother to the frontier in Blount county, Tenn. When he was about 15 his elder brothers obtained for him a place as clerk in a trader's store, but he ran away and lived with the Cherokee Indians of east Tennessee for nearly three years. On his return he opened a country school, and later attended a session or two of the academy at Maryville. During the War of 1812 Houston served under Andrew Jackson in a campaign against the Creek Indians.

In 1817 he was appointed subagent in managing the removal of the Cherokees from east Tennessee to a reservation in what is now Arkansas. Offended at a rebuke from John C. Calhoun, then secretary of war, for appearing before him in Indian garments, as well as at an inquiry into charges affecting his official integrity, he resigned in 1818. He entered a law office in Nashville, and was admitted to the bar. From 1823 to 1827 Houston represented the 9th district of Tennessee in congress, and in 1827 was elected governor of the state by the Jackson Democrats.

He married Eliza Allen in Jan. 1829, but she left him three months later. Houston thereupon resigned his office of governor, again took up his residence among the Cherokees, who were at this time about to remove to Indian territory, and was formally adopted a member of their nation.

In 1830 and again in 1832 he visited Washington to expose the frauds practised upon the Cherokees by government agents. Commissioned by President Jackson, Houston went to Texas in Dec.

1832 to negotiate treaties with the Indian tribes there for the protection of American traders on the border. He decided to remain in Texas, and was elected a delegate to the constitutional convention which met at San Felipe on April 1, 1833, to draw up a memorial to the Mexican congress. This memorial asked for the separation of Texas from Coahuila, in which the anti-American party was in control, and framed a constitution for the commonwealth as a new member of the Mexican republic. In Nov. 1835, soon after the outbreak of the War for Texan Independence, he was chosen commander in chief of the Texan army. On April 21, 1836, while in command of 743 raw troops, he met on the bank of the San Jacinto about 1,600 Mexican veterans led by Santa Anna and completely routed them; on the next day Santa Anna was taken prisoner.

Texan independence was won by this victory and Houston was elected president of Texas, Sept. 1, 1836. His term expired in Dec. 1838; he was elected again in 1841 and served until 1844. During his first term a newly founded city was named in his honour and this was the seat of government in 1837–39 and in 1842–45. Meanwhile, in 1840 he had married Margaret Lea of Alabama.

Texas having been admitted as a state of the American union in 1845, Houston was elected one of its first two U.S. senators. He served as a stalwart Union Democrat from 1846 until 1859; he opposed the Kansas-Nebraska bill in an able speech and spoke frequently in defense of the rights of the Indians. But his views were not popular with the Texas legislature, and he was not reelected to the senate. After returning to Texas in 1859 he won election as governor and tried unsuccessfully to prevent the secession of his state. Upon his refusal in March 1861 to swear allegiance to the Confederacy, he was declared deposed. He died at Huntsville, Tex., on July 26, 1863.

See Marquis James, *The Raven: a Biography of Sam Houston*, 2nd ed. (1953); Donald Day and H. H. Ullom (eds.), *The Autobiography of Sam Houston* (1954); Llerena Friend, *Sam Houston: the Great Designer* (1954).

HOUSTON, an inland port city of southeastern Texas, U.S., and seat of Harris county, is located on the Gulf coastal plain and linked by the Houston Ship channel to the Gulf of Mexico, 52 mi. S.E., at Galveston (*q.v.*). It is a leading oil and petrochemical centre, manufacturer of oil-field equipment and the focal point for networks of natural-gas pipelines. Its corporate limits of 328.1 sq.mi. surround 14 of 23 cities in Harris county, its standard metropolitan statistical area. Its principal suburbs are Bellaire, Pasadena (*qq.v.*), West University Place and Galena Park.

History.—Houston was planned as a real-estate promotion. Harrisburg, which became part of Houston in 1926, was laid out in 1826 for John Richardson Harris. Mexican forces burned Harrisburg five days before the battle of San Jacinto (April 21, 1836) in which Gen. Sam Houston led Texans to victory and independence from Mexico. Land speculators, among them Augustus C. and John K. Allen, eyed the Harrisburg area with interest. It was early seen that Buffalo bayou, a tidewater stream extending through the present site of the city about 45 mi. E. to the San Jacinto river, would become valuable as a means of access to the rich agricultural lands along the Brazos.

The Allens tried to buy the Harrisburg property, but its title was involved in fraudulent claims against the estate of Harris, who had died in 1829; therefore, they chose a site 12 mi. farther up the bayou at the most interior point of navigation in Texas. The brothers bought the Houston town site on Aug. 24 and 26, 1836, and shrewdly named the town for the Texas hero. Four days later they advertised their proposed town but it was not until October that Moses Lapham, a surveyor, staked it out.

In October also, when Houston was still an unoccupied town site, John Allen made a proposal to the congress of the Republic of Texas (of which he was a member) meeting at Columbia to move the seat of government to Houston, and he promised to build a capitol. The Texas congress voted accordingly to move the capital temporarily to Houston and the Allens began building in fact what had succeeded in fancy. They sold the first lots in Jan. 1837; the government moved to Houston in May of that year before the building to house it was finished; and the city was incorporated in June.

Houston was the capital of the republic until Jan. 1840, and was briefly the capital again in 1842. Muddy and beset by recurring epidemics of yellow fever, the town grew slowly until the Civil War. When the Civil War began, its citizens voted overwhelmingly for the secession of Texas from the United States. The town became a lair for blockade runners and on Jan. 1, 1863, using two small vessels fortified with bales of cotton, an amphibious attack was mounted by Houstonians down Buffalo bayou to help recapture Galveston Island which had been seized by Federal forces three months earlier. In the same year Houston became the headquarters for the Confederate district of Texas, New Mexico and Arizona. The period of Reconstruction lasted from June 20, 1865, when Houston was occupied by Federal troops, until Jan. 1874. Houston's growth between Reconstruction and World War I came largely as a result of its importance as a railroad centre. Houston took a decisive lead in its long competition with Galveston after the Galveston flood and tidal wave of Sept. 8, 1900. The greatest proportional growth of the city's population, 111.4%, came in the 1920s largely as a result of the impetus given by World War I, and the most important period in its history was the decade following World War II.

Industrial and Commercial Growth.—Houston owes its remarkable growth after World War II to its industrial complex. This consists of the ship channel, abundant natural resources (petroleum, natural gas, sulfur, lime, salt and water) and the fact that the product or by-product of one chemical plant is often the raw material of another. This combination created on the banks of the ship channel, is one of the world's greatest concentrations of petrochemical industries.

The shift in the city's character is shown by two contrasting popular names. Houston called itself the "Magnolia city" until the 1920s, when industry had effaced the magnolias and other natural beauty on Buffalo bayou, the lower part of which became the ship channel. After World War II, but not from its own conception, the city was called the "Land of the Big Rich." This name, which became a liability, was a fanciful allusion to Houston's supposed prevalence of oil millionaires. Since the 1920s Houston has given the impression of being continually new; nothing old was allowed to exist for long. No historic structures were preserved except the Noble house, built in the 1840s. The city showed little concern for its history until 1954 when a society was formed to preserve any remaining evidence of the past. Houston is a restless city spread across grazing land, and is one of the largest cities in the U.S. without a zoning ordinance.

The metropolitan area alone, which has seven oil refineries, was producing nearly 80,000 bbl. of oil daily in the late 1950s, when oil rigs were within a few yards of South Main street and the city was receiving oil royalties from wells drilled at the city garbage dump. Two major oil companies and hundreds of small ones have headquarters in Houston, most of whose downtown skyscrapers were either built by petroleum or banking interests. The city is the geographic and financial centre of the Texas Gulf coast region. In the 1960s most of the nation's sulfur deposits, nearly 7% of its petroleum reserves and about 11% of its refining capacity were located in a 19-county area surrounding Houston. An estimated three-quarters of the nation's petrochemical production was also coming from the Texas Gulf coast area. Shipbuilding, an integrated steel mill, tool and oil-field equipment, paper mills, synthetic rubber, cement, grain elevators, tile milling, cottonseed oil, paints, furniture, breweries and food processing are other important aspects of Houston's industry. In 1961 the National Aeronautics and Space administration established a research, development and astronaut-training centre near Houston.

It was a paradox that Harris county, which is hundreds of miles from the state's chief cattle-raising areas, and despite the great industrial and commercial expansion of the Houston metropolitan area, had more cattle than any other county in Texas in the 1950s. Irrigation made the county a rice producer of importance; about 28% of the nation's rice is grown within a 100-mi. radius of Houston, and the city is one of the world's leading spot cotton markets.

The Port of Houston and the Houston Ship Channel.—The histories of the port, which is virtually devoid of the colour and romance of most U.S. ports, and the ship channel are one. In 1837 the first steam vessel of size succeeded in reaching a boat landing at Houston. Within two years steamboats were making daily runs between Houston and Bolivar roads at the entrance to Galveston harbour. The improvement of the Buffalo bayou channel was begun in 1839 with funds raised by public subscription and lotteries. The first local dock was built in 1840 and the Port of Houston was established by city ordinance in 1841. Widening and deepening of the channel was begun in 1869 and continued in the 1960s, by which time the minimum depth of the channel was 36 ft. and the minimum width was 300 ft. The port handles more than 50,000,000 tons of foreign, coastwise and internal canal shipping annually and is linked with the Gulf Intracoastal waterway.

Population.—Though the reality of Houston is obscured by the myth of its millionaire legend, it is primarily a city of working people. They came in mass during World War II—40,000 to the shipyards alone—and most remained. Unlike the state, whose population growth was mainly due to natural increase, Houston grew more from people moving in from the rest of Texas and from other states. Its population differs from that of most U.S. urban areas, having proportionally fewer industrial craft workers and more professional, technical and white-collar workers. The difference is caused by automation and the technical nature of three of the four dominant industries: processing oil, natural gas and petrochemicals. The comparatively high pay received by workers in the three industries has caused Houston to have fewer apartments and more houses than older U.S. cities of comparable size.

Germans, immigrating to Texas in great numbers in the 19th century, once dominated Houston's population and continue to be a major element. In 1960, one-fifth of the population was Negro and nearly one-twelfth was Mexican. Many traders, scientists and executives were drawn to the city from other countries, first by cotton and later by oil and chemicals. Though the city's heritage is southern, the southwest gradually became dominant in its character in the first half of the 20th century. Houston's population, 2,396 in 1850, grew to 44,633 by 1900; in 1960 the city had a population of 938,219 and there were 1,243,158 in the standard metropolitan statistical area. (For comparative population figures *see* table in TEXAS: *Population.*)

Culture.—The chief aspects of the city's cultural life were the Houston Symphony orchestra (1913), a grand opera company, three chamber music groups of distinction, a contemporary music society (founded by Leopold Stokowski), three professional theatres operating the year round and two art museums. The older museum, the Houston Museum of Fine Arts, became an example of architectural excellence when a new wing, designed by Ludwig Mies van der Rohe, was opened in 1958. The city is notably lacking in parks, but the nearness of the Gulf of Mexico, the bay shore area and Lake Houston make it a centre of sailing, boating and fishing. The principal colleges are Rice university (nonsectarian, 1912), the University of Houston (1934), Texas Southern university (Negro, 1947), University of St. Thomas (Roman Catholic, 1947), Baylor university college of medicine and the University of Texas school of dentistry. Except for one hospital, the site of the Texas Medical centre was a forest within the city in 1946. At a cost of more than $50,000,000, most of which was paid by oil and cotton philanthropies, one of the nation's leading medical, research, educational and hospital centres was established there.

The San Jacinto battleground on the banks of the ship channel is a state park 22 mi. S. of Houston. It is the site of the San Jacinto monument, 570 ft. high, and the permanent berth of the battleship "Texas."

Houston is the home of the National Baseball league Colt .45s and the American Football league Houston Oilers. (G. M. F.)

HOVE, a municipal (1898) and parliamentary borough in East Sussex, Eng., adjoining Brighton (*q.v.*) on the west. Pop. (1961) 72,973. During the 19th century Hove became the most exclusive town on the Sussex coast, and the lawns on the sea front were among the most fashionable parade grounds in England. It is a well laid out residential and seaside resort town with the Sussex county cricket ground in its centre.

The name seems to be connected with an Old English word *hufe* meaning "shelter" and a settlement existed at Hove at the time of the Roman invasion.

HOVER FLY, the common name for most species of the dipterous family Syrphidae (*see* FLY), derived from their habit of hovering, seemingly almost motionless, in flight. They are also extremely agile in maneuvering on the wing. Hover flies are sometimes known as syrphid flies or flower flies, as they are commonly seen on blossoms. Many of the approximately 4,000 known species, of cosmopolitan distribution, are conspicuously marked with yellow on a darker ground colour, giving them a striking resemblance to certain wasps; others mimic bees; and still others have a metallic appearance. All may be distinguished from other flies by the presence of a false (spurious) vein closely paralleling the fourth longitudinal wing vein. Larvae of many hover flies are predaceous on plant lice or aphids, mealy bugs and other small Homoptera, a single larva consuming the body fluids of hundreds of aphids before it pupates. In this respect, and in that many species are important in pollination of flowers, hover flies are beneficial to man. However, a few, such as the narcissus bulb fly (*Merodon* [or *Lampetia*] *equestris*) and the lesser bulb fly (*Eumerus tuberculatus*), tunnel in bulbs of cultivated flowers, in onions and in flower corms. These bulb flies were introduced into North America from Europe. Larvae of *Microdon* live in ant and termite nests; those of *Volucella,* in nests of bumblebees; others inhabit decomposing vegetation.

JANE BURTON FROM COLEMAN AND HAYWARD

HOVER FLY POISED ABOVE A FLOWER

A species closely resembling the male honeybee and hence known as the drone fly (*Tubifera* [formerly *Eristalis*] *tenax*) occasionally produces a gastrointestinal myiasis (infestation) in man. The larvae normally inhabit liquid organic wastes or polluted water, utilizing atmospheric oxygen by means of a long caudal respiratory tube, which they extend to the surface. Because of this tube, larvae of the drone fly and related species are called rat-tailed maggots. They may be accidentally ingested, in the early stages, in contaminated water, rotting fruit and the like. The drone fly frequently breeds in carrion, a circumstance that probably led to biblical accounts of the production of swarms of bees from carcasses.

Mimicry of wasps by some hover flies is perfected by buzzing and simulated stinging behaviour; actually, however, no syrphid fly can either sting or bite. Small, wasplike species attracted to human perspiration are often called sweat bees as a result of confusion with certain small bees similarly attracted. Size and shape of hover flies vary from small, elongate and slender species of *Baccha* to large, hairy, yellow and black *Criorhina* that mimic bumblebees. (G. W. Bs.)

HOWARD, the name of a famous English family of which the duke of Norfolk, premier duke and hereditary earl marshal of England, is head, while the earls of Suffolk, Carlisle and Effingham and the Lord Howard of Glossop and Lord Stafford represent in the peerage its younger lines.

The founder of the family was a lawyer, William Howard or Haward of East Winch, Norfolk, who was summoned to parliament as a justice in 1295 and appointed a justice of the common pleas in 1297. William Howard's eldest son, Sir John Howard, served in Edward II's wars in Scotland and Gascony, was sheriff of Norfolk and Suffolk and governor of Norwich castle. When he died in 1331 he was seised of many Norfolk manors. His son and heir, another Sir John, admiral of the king's navy in the north, was a banneret who displayed his banner in the army that

laid siege to Calais. By the admiral's wife Alice, sister and heir of Sir Robert de Boys, the Howards had the Boys manor of Fersfield, near Diss, which is still among the possessions of the dukes of Norfolk. His son Sir Robert Howard, who had married a daughter of Sir Robert Scales (Lord Scales), died before his father in 1388. From Sir John Howard, the only son of Sir Robert, two branches of the house of Howard sprang. The elder line was soon extinct. By his first wife, Margaret, daughter and heir of Sir John Plays, Sir John Howard had a son who died before him, leaving a daughter who married John de Vere, 12th earl of Oxford, and through whom descended to their issue, the Veres, earls of Oxford, the ancient Norfolk estates of the Howards at East Winch and elsewhere with the lands of the houses of Scales, Plays and Walton, brought in by the brides of her forefathers. By his second wife, heir of the Tendrings of Tendring, Essex, he had a second son, Sir Robert Howard, a knight who fought under Henry V in France, and died, like his half brother, before the old knight's career ended in 1436 in Palestine.

Robert Howard married Margaret Mowbray, daughter of Thomas Mowbray, 1st duke of Norfolk. Their son John (*c.* 1430–85) eventually, on the death of the 4th duke's daughter Anne, inherited the lion's share of the Mowbray estates and by a patent of June 28, 1483, was created duke of Norfolk and earl marshal of England with a remainder to the heirs male of his body (*see* Norfolk, Earls and Dukes of; Mowbray).

The eldest of the cadet branches of the ducal house has its origin in William (*c.* 1510–73), eldest son of the 2nd duke by his second marriage. William's eldest son, Charles (1536–1624), was lord high admiral and commanded the fleet which defeated the Spanish Armada (*see* Nottingham, Charles Howard, 1st Earl of).

On the death of the 3rd earl of Nottingham in 1681 Sir William Howard of Lingfield, younger brother of the great admiral, carried on the Effingham line, his great-grandson succeeding to the barony on the extinction of the earldom. Francis, 7th Lord Howard of Effingham, was created earl of Effingham in 1731, a title extinct in 1816 with the 4th earl, but revived again in 1837 for the 11th baron, who had served as a general officer in the Peninsular campaign. Henry (1540–1614), eldest son of Henry Howard, earl of Surrey, and brother of the 4th duke of Norfolk, was created earl of Northampton in 1604, but the title died with him (*see* Northampton, Earls and Marquesses of).

Thomas (1561–1626), son of the 4th duke of Norfolk's marriage with the daughter and heir of Thomas, Lord Audley of Walden, founded the line of the present earls of Suffolk and Berkshire and of the extinct Lords Howard of Escrick. His barony of Howard of Walden has descended to his heirs general. Another son, Lord William Howard, married in 1577 one of the three co-heirs of the Lord Dacre of Gillesland. His great-grandson Charles Howard was created, in 1661, earl of Carlisle, Viscount Howard of Morpeth and Baron Dacre of Gillesland, titles which are still held by his descendants (*see* Carlisle, Earls of). From Sir Francis Howard, a Cavalier colonel and a younger son of "bauld Willie," come the Howards of Corby Castle in Cumberland, a branch without a hereditary title.

William Howard (1614–80), Viscount Stafford, was the fifth son of Thomas, earl of Arundel. Marrying the sister and heir of the 5th Lord Stafford, who died in 1637, he and his wife were created Baron and Baroness Stafford by a patent of 1640, with remainder, in default of heirs male, to heirs female. A grant of the precedence enjoyed by the bride's father being held illegal, he was in 1640 created Viscount Stafford. Roger Stafford, cousin of the 5th Lord Stafford and heir of the ancient Staffords, had been forced to surrender his barony in 1639. The viscount, accused by Titus Oates, was sent to the Tower in 1678 and beheaded in 1680. He was beatified in 1929. In 1688 his widow was created countess of Stafford for life, and his eldest son, Henry, had the earldom of Stafford, with special remainder to his brothers. This earldom ended in 1762, but the attainder was reversed by an act of 1824 and in the following year Sir George Jerningham, the heir general, established his claim to the Stafford barony of 1640.

See G. Brenan and E. P. Statham, *House of Howard,* 2 vol. (1907).

HOWARD, CATHERINE: *see* Catherine (Catherine Howard).

HOWARD, SIR EBENEZER (1850–1928), founder of the English garden-city movement, was born in London on Jan. 29, 1850. He started work in a stockbroker's office at the age of 15 and learned shorthand, in which he became an expert. He took down a sermon by Joseph Parker, then at the Poultry chapel, and sent it to the famous preacher, who engaged him as his secretary. Advised on account of his health to take to an outdoor life, in 1872, at the age of 22, he set off to the United States. After a few months on a farm in Nebraska, he became a legal stenographer in Chicago but by 1876 was back in England, where he worked as a shorthand writer for the rest of his life. In 1879 Howard joined a debating club called the Zetetical society, where he met Sidney Webb and Bernard Shaw. In 1881, when Henry George visited London, Howard read *Progress and Poverty* and was at once a land reformer. A decisive influence was Edward Bellamy's *Looking Backward* (1889). Howard had already met Thomas Davidson, the Utopian philosopher, and, fired with enthusiasm, wrote *Tomorrow: a Peaceful Path to Social Reform* (published eventually in 1898). He proposed the building of a new town called Garden City based on land ownership on behalf of the community, combining the principle of decentralization of industry and population from the great cities with the repopulation of the countryside. He called it "the marriage of town and country." In 1899 the Garden City association was formed with wide support and in 1902 his book was republished as *Garden Cities of Tomorrow* (new ed. 1946). His enthusiasm and concentration brought his dream to actuality when Letchworth was planned in 1903 and again when Welwyn Garden City was founded in 1920. (*See* also Garden City.)

Howard's outstanding gift was that of persuading practical men that his idea was financially sound, economically workable and socially desirable. He was a liberal rather than a socialist, believing in free enterprise and co-operation. He had no aptitude for administration and his influence upon the development of the two garden cities was small. Howard was knighted in 1927 and died at Welwyn Garden City on May 1, 1928. (C. B. P.)

HOWARD, JOHN (1726–1790), English philanthropist and prison reformer, was born on Sept. 2, 1726, probably at Hackney. His father, a merchant and dissenter, lived after retirement at Cardington, near Bedford. On his father's death in 1742 Howard inherited considerable wealth and traveled widely in Europe. He was on his way to Portugal in 1756 to see what help he could give to the victims of the Lisbon earthquake when his ship was taken by a French privateer. The crew and passengers were treated with great barbarity, but Howard himself was eventually permitted to return to England. He settled at Cardington, proving himself a model philanthropic landlord.

Howard became high sheriff of Bedfordshire in 1773 and as part of his duties visited Bedford jail and was appalled by what he saw there. He found that like all prisons at that time it was wretchedly defective in its arrangements. Neither the jailer nor his subordinates were salaried officers, but depended on fees from prisoners. Some prisoners were men who had been acquitted by the courts but were kept in prison because they had not paid their fees to jailers, clerks of assize and other officials. Howard was so shocked by this that he applied to the justices of the peace to pay a salary to the jailer in lieu of fees. The justices, sympathetically inclined, asked Howard to find a precedent before they committed the county to additional expense. Howard accordingly visited other county jails, but could find no precedent, although he discovered further abuses in prison management. He was prompted by what he described as "the sorrows of the sufferers and love to my country" to dedicate himself to prison reform.

In 1774 he gave evidence on this subject to a committee of the house of commons. Soon afterward two acts were passed reflecting a growing public interest in humanitarianism, which made possible Howard's success. The first enacted that discharged persons should be set at liberty in open court and that discharge fees should be abolished, while the second required justices to see that everything should be done to restore and preserve the health of prisoners.

Walls and ceilings of prisons should be whitewashed at least once a year, rooms should be ventilated and infirmaries and medical advice should be provided for the sick. Howard had the provisions of these acts printed at his own cost and sent to every jailer and warder in England. Years afterward, however, he complained that only in a small number of prisons had the acts been "strictly obeyed."

Howard continued to travel widely. In 1774 he was almost returned as a member of parliament for Bedford. He then abandoned any idea of a parliamentary career and again traveled further in order to collect comparative data about prisons. After a tour of Scotland and Ireland, he visited France, the Netherlands and Germany in 1775. The only important prison he was unable to see in Paris was the Bastille. In Holland Howard was impressed by the comparative absence of crime, attributing this state of affairs to improved methods of reformatory treatment, but in Hanover he was indignant to find traces of torture under the rule of a British sovereign. After further traveling in England he returned to Europe to inspect Swiss prisons in 1776.

In 1777 he published *The State of the Prisons in England and Wales, with Preliminary Observations, and an Account of Some Foreign Prisons.* The book bore fruit in an act of 1779 which among other provisions ordered the building of two penitentiary houses where, by means of solitary confinement, regulated labour and religious instruction, prisoners might be reformed. Howard was appointed one of the three commissioners under the act, but he quickly resigned, preferring travel and research to administration. After writing a second appendix to his book in 1784 he spent the last years of his life in studying means of preventing plague and limiting the spread of contagious diseases. As a result of his experiences he prepared *An Account of the Principal Lazarettos in Europe* (1789).

Howard died on his last great journey in 1790. Traveling overland to Russia, which he had visited previously in 1781, and visiting the principal military hospitals that lay on his route, he reached Kherson. In attending a case of camp fever which was raging there he contracted the disease and died on Jan. 20, 1790. The *London Gazette* recorded his death, "the first instance of the death of a private individual being given in that paper." Howard was buried at Kherson where two monuments were erected to him and a street named after him. There are English statues to his memory in St. Paul's, London, and Bedford.

See D. L. Howard, *John Howard, Prison Reformer* (1958); M. Southwood, *John Howard: Prison Reformer,* with full bibliography (1959). (A. Brl.)

HOWARD, LESLIE (Leslie Stainer) (1893–1943), an actor of quiet, persuasive and peculiarly English charm, was born in London on April 3, 1893. He first appeared on the stage in 1917 and first acted in London in 1918 in Sir Arthur Pinero's *The Freaks.* In 1920 he went to New York, becoming a fashionable and popular actor on Broadway; after a short return to London in 1928, he enjoyed a long run with Tallulah Bankhead in *Her Cardboard Lover.* Soon after this he appeared in London in *Berkeley Square,* a dramatization from Henry James, in which his acting was at its best—quietly and delicately emotional. He took this play to New York and returned to London in 1933 as the man Shakespeare in *This Side Idolatry,* which failed. He returned yet again to New York to play Hamlet in his own production.

In films, Howard was an incomparable Henry Higgins in the first major Bernard Shaw film, *Pygmalion.* He gave a memorable portrayal of Reginald J. Mitchell, designer of the Spitfire airplane, in *Spitfire* (*The First of the Few*).

Howard died June 1, 1943, on a flight from Lisbon to London in a plane that was shot down because it was presumed to carry important political personages. (A. H. D.)

HOWARD, OLIVER OTIS (1830–1909), Union officer in the American Civil War and later head of the Freedmen's bureau, was born in Leeds, Me., on Nov. 8, 1830. He graduated from Bowdoin college, Brunswick, Me., in 1850 and from the U.S. Military academy in 1854. At the beginning of the Civil War he resigned his regular army commission to become colonel of a Maine volunteer regiment. He attained the rank of major general of volunteers in March 1863 after participating in the first battle of Bull Run, the Peninsular campaign, the battle of Seven Pines (Fair Oaks), where he lost his right arm, and Antietam. At Chancellorsville (*see* Wilderness) he commanded a corps which was routed by Gen. Thomas J. "Stonewall" Jackson. His corps helped gain victories in the Tennessee and Atlanta campaigns of 1863–64. Promoted to command the army of the Tennessee in July 1864, he took part in Gen. W. T. Sherman's "march to the sea" and the Carolinas campaigns.

Howard was deeply interested in the welfare of the former slaves and served as commissioner of the Bureau of Refugees, Freedmen and Abandoned Lands (known as the Freedmen's bureau) from 1865 to 1872. The bureau's most significant achievement was the provision of financial aid for the establishment of industrial schools and colleges. Howard was not a skilled administrator and many abuses appeared in the bureau. Howard university, Washington, D.C., which received a charter from the federal government in 1867, was named for him in recognition of his work as commissioner and as one of the founders of the university. Although Howard university was founded without special reference to Negroes, they soon constituted the largest part of the student body. General Howard served as the university's third president from 1869 to 1873 when he resigned to return to military service. He fought against Indians in the west and served as superintendent of the U.S. Military academy. He wrote several books on military history in addition to his autobiography, published in 1907. He died at Burlington, Vt., Oct. 26, 1909. (R. W. Ln.)

HOWARD, PHILIP (in religion Thomas) (1629–1694), called the cardinal of Norfolk, a Dominican who restored the English province of the order, was born in London on Sept. 21, 1629, into the ducal house of Norfolk. He was brought up a Roman Catholic, although the head of the house had been an Anglican since 1615, and became a Dominican at Cremona, Italy, at the age of 16 against the wishes of his family. Thereafter he directed all his energies to reconverting England to the Roman Catholic Church and to restoring the English Dominican province.

Howard was ordained priest in 1652, and in 1657 he became prior of the new Dominican house he had founded at Bornem, Flanders, to house the remnant of the former English province then exiled on the continent. In the reign of Charles II he was made grand almoner to the queen, Catherine of Braganza, but an outbreak of Puritan violence drove him back to Flanders. After being created cardinal by Clement X in 1675, he lived in Rome, where his cardinalitial church was Sta. Maria sopra Minerva. In 1679 he was made cardinal protector of England and Scotland. He died in Rome on June 18, 1694.

His literary remains consist of letters, which are of no small interest to historians. These were edited by B. Jarrett in *Publications of the Catholic Record Society,* vol. xxv (1925).

Bibliography.—C. F. R. Palmer, *Life of T. P. Howard* (1867); W. Lescher, *Cardinal Howard* (1905); G. Anstruther, *A Hundred Homeless Years* (1958). (H. J. Cr.)

HOWARD, SIR ROBERT (1626–1698), English dramatist, remembered chiefly for his dispute with John Dryden on the use of rhymed verse in drama, was born in 1626, the sixth son of Thomas Howard, 1st earl of Berkshire. He was knighted by the royalists at Newbury in 1644. During the Commonwealth he was imprisoned at Windsor castle, but after the Restoration he was elected member of parliament for Stockbridge, Hampshire, in 1661 and became auditor of the exchequer and then a member of the privy council on Feb. 13, 1688. His proud and pretentious character provoked frequent attack, especially from Thomas Shadwell in the character of Sir Positive At-All in *The Sullen Lovers.*

Howard's first play, "The Blind Lady," was published in a volume of *Poems* (1660), judged by Sir Walter Scott as "productions of the most freezing mediocrity." It suffered from a tenuous and complicated plot and amateurish workmanship, faults also to be seen in "The Surprisal" and "The Vestal Virgin" published in *Four New Plays* (1665). But the other plays in the volume have more merit. "The Indian Queen" (first performed 1664), a tragedy written with the advice and probably the collaboration of Dryden, gained success due to elaborate staging and some fine

verse passages. "The Committee" (first performed 1662) is a humours comedy, satirizing the Commonwealth regime, which gained lasting popularity due to the character of the Irish footman Teague. His final play, *The Great Favourite, or, the Duke of Lerma* (1668), is written in a puzzling mixture of heroic couplets and blank verse but it has a simple plot and strong characters. Howard's preface to *Four New Plays* began his dispute with Dryden who had married his sister Lady Elizabeth Howard in 1663. He opposed the view maintained in Dryden's dedicatory epistle to *The Rival Ladies* (1664) that rhyme was better suited to heroic tragedy than blank verse. Dryden replied in *Of Dramatick Poesie, an Essay* (1668), putting Howard's arguments in the mouth of Crites and refuting them through Neander. In the preface to *The Duke of Lerma* Howard replied in a rather more personal tone, but Dryden had the final word in the crushing *Defence of an Essay of Dramatick Poesie* prefaced to *The Indian Emperor* (1668), which nevertheless ends on a note of respect for his opponent. Howard died on Sept. 3, 1698.

See *The Committee*, ed. with biographical and critical introduction by C. N. Thurber (1921); D. D. Arundell, *Dryden and Howard* (1929).

HOWARD, SIDNEY COE (1891–1939), U.S. playwright and author, was born in Oakland, Calif., on June 26, 1891. He graduated from the University of California, Berkeley, in 1915 and during the next year worked under George Pierce Baker at Harvard university. During World War I he served with the American ambulance corps and was later a captain in the U.S. air corps. He served on the editorial staff of *Life*, 1919–22, and in 1923 was a feature-story writer for Hearst's *International Magazine*. In 1922 he was married to Clare Eames, the actress. Among his plays are *Swords* (1921); *Casanova* (1923); *They Knew What They Wanted* (1924), which won a Pulitzer prize in 1925; *Lucky Sam McCarver* (1925); *The Silver Cord* (1926); *The Late Christopher Bean* (1932); *Alien Corn* (1933); *Yellowjack* (1934); an adaptation of Sinclair Lewis' novel *Dodsworth* (1934); and *Madam, Will You Walk* (1939). He died in an accident at Tyringham, Mass., Aug. 23, 1939, at a time when he was dramatizing Carl Van Doren's *Benjamin Franklin*. He translated and adapted European dramas and published a volume of stories, *Three Flights Up* (1924).

HOWARD OF EFFINGHAM, CHARLES HOWARD, 2ND BARON; *see* NOTTINGHAM, CHARLES HOWARD, 1ST EARL OF.

HOWARD UNIVERSITY, a nonsectarian, coeducational university in Washington, D.C., under federal and private control, was established in 1867. Originally intended to be biracial, it soon became a predominately Negro institution. *See* WASHINGTON, D.C.

HOWE, ED(GAR WATSON) (1853–1937), U.S. editor, novelist and essayist, was born at Treaty, Ind., on May 3, 1853. He went to work at the age of seven on his father's homestead near Bethany, Mo. An apprentice printer at 12, he worked at the trade in Missouri, Iowa, Nebraska and Utah (1867–72). At 19 he was publisher of the *Golden* (Colo.) *Globe* and in 1877 founded the *Atchison* (Kan.) *Daily Globe*, made famous by frequent reprinting of his paragraphs throughout the U.S. His first and most successful novel, *The Story of a Country Town* (1883), was the first realistic novel of midwestern small-town life. He published and edited *Howe's Monthly* (1911–33) and wrote essays, travel books and an autobiography, *Plain People* (1929). He died Oct. 3, 1937.

HOWE, ELIAS (1819–1867), U.S. sewing-machine inventor, was born in Spencer, Mass., on July 9, 1819. As a boy he worked on his father's farm and in his gristmills and sawmills, taking particular interest in the machinery. After learning the machinist's trade he conceived the idea of a sewing machine and for five years spent all his spare time in its development. In Sept. 1846 a patent for a practical sewing machine was granted to him; and Howe spent the following two years (1847–49) in London, employed by William Thomas, a corset manufacturer, to whom he had sold the English rights for £250. Years of disappointment and discouragement followed before he was successful in introducing his invention, while several other machines, particularly that of Isaac Merrit Singer (*q.v.*), had already been introduced and were widely used. Howe's rights were established after much litigation in 1854, and thereafter until the expiration of his patent in 1867 he received royalties on all sewing machines made in the U.S. He died in Brooklyn, N.Y., on Oct. 3, 1867. (W. E. HD.)

HOWE, JOHN (1630–1705), English Puritan minister and writer noted for his efforts to bring together Christians of different denominations, was born on May 17, 1630, at Loughborough, Leicestershire, where his father was curate. He studied at Cambridge, graduated at Oxford and held the curacy of Great Torrington, Devon. In 1656 Howe became domestic chaplain to Oliver Cromwell. Holding tolerant views, he helped not only his fellow Puritans but also pious and learned men of other schools of thought. In May 1659 he returned to Torrington but was ejected in 1662 on the passing of the Act of Uniformity. He lived for several years as domestic chaplain to John, Viscount Massarene, of Antrim castle, Ireland, where he produced the most eloquent of his shorter treatises, *The Vanity of Man as Mortal* and *Of Delighting in God*. In 1676 he became joint pastor of a Nonconformist congregation at Haberdashers' hall, London, and published the first part of his best work, *The Living Temple*. For a while Howe enjoyed comparative freedom and was on friendly terms with many eminent Anglicans; but in 1685, after James II's accession, he left England with Philip, Lord Wharton. In 1686 he settled for a time at Utrecht, officiating in the English chapel. He returned to England the following year, and in 1688 headed a deputation to William of Orange asking for toleration and comprehension in religious matters. He died in London on April 2, 1705.

See R. F. Horton, *John Howe* (1895); T. Gasquoine, *John Penry and Other Heroes* (1909). (G. HU.)

HOWE, JOSEPH (1804–1873), Canadian statesman, champion of responsible government for Nova Scotia and long an opponent of confederation, was born at Halifax, N.S., on Dec. 13, 1804, the son of John Howe (1752–1835), a United Empire Loyalist from Boston, Mass., who was for many years king's printer and postmaster-general for the maritime provinces and the Bermudas. In 1827 Howe started the *Acadian*, a weekly nonpolitical journal, but soon sold it, and purchased the *Novascotian*, which became one of the leading newspapers of British North America. Successfully defending himself in a trial for criminal libel, in 1836 he was elected member for Halifax in the provincial assembly. During the next 12 years his agitation for responsible government for Nova Scotia brought him into conflict with the lieutenant governor, Lord Falkland (1803–1884), whom he forced to resign. Responsible government was finally conceded in 1848 by the imperial authorities. In 1850 he was sent to England on behalf of the Intercolonial railway, for which he obtained an imperial guarantee. In 1854 he resigned from the cabinet, and was appointed chief commissioner of railways.

From 1860 to 1863 he was premier of Nova Scotia. Though his eloquence had done more than anything else to make practicable a union of the British North American provinces, he opposed confederation, but finally entered (on Jan. 30, 1869) the cabinet of Sir John Macdonald as president of the council. In May 1873 he was appointed lieutenant governor of Nova Scotia, but died in Halifax on June 1 of the same year.

His *Speeches and Public Letters* were published in 1858 in Boston, Mass., in two volumes, edited nominally by William Annand, really by himself. His collected *Poems and Essays* were published in 1874.

HOWE, JULIA WARD (1819–1910), U.S. author and lecturer, best known for her "The Battle Hymn of the Republic," was born in New York city, May 27, 1819, and died in Newport, R.I., Oct. 17, 1910. In 1843 she married Samuel Gridley Howe of Boston, Mass., reformer and teacher of the blind. The "Battle Hymn" was first published in the *Atlantic Monthly*, Feb. 1862. Moved by the economic plight of Civil War widows, Mrs. Howe worked for equal education, professional and business opportunities for women. She was the author of travel books, biography, drama and verse and a composer of songs for children.

See Louise Hall Tharp, *Three Saints and a Sinner* (1956). (L. H. T.)

HOWE, RICHARD HOWE, EARL (1726–1799), British admiral who commanded the channel fleet at the battle of the

First of June (*q.v.*) was born in London on March 8, 1726. He entered the navy in 1740, saw much active service and was rapidly promoted. In 1755 he went with Edward Boscawen to North America as captain of the "Dunkirk" (60 guns), and his seizure of the French "Alcide" (64) was the first shot fired in the war. From that date till the peace of 1763 he served in the English channel in various more or less futile expeditions against the coast of France, with a steady increase of reputation as a firm and skilful officer. On Nov. 20, 1759, he led Hawke's fleet as captain of the "Magnanime" (64) in the victory of Quiberon.

By the death of his elder brother, killed near Ticonderoga on July 6, 1758, he became Viscount Howe—an Irish peerage. In 1762 he was elected M.P. for Dartmouth. During 1763 and 1765 he was a member of the admiralty board, and from 1765 to 1770 was treasurer of the navy. In that year he was promoted rear admiral, and in 1775 vice-admiral. In 1776 he was appointed to the command of the North American station. The rebellion of the colonies was making rapid progress, and Howe was known to be in sympathy with the colonists. He had sought the acquaintance of Benjamin Franklin, and it was perhaps because of his known sentiments that he was joined in commission with his brother, Gen. Sir William Howe, to make a conciliatory arrangement. A committee appointed by the Continental Congress conferred with the Howes in Sept. 1776 but nothing was accomplished. The appointment of a new peace commission in 1778 offended the admiral deeply, and he sent in his resignation. Before it could take effect France declared war, and a powerful French squadron was sent to America under the Count d'Estaing. Being greatly outnumbered, Howe had to stand on the defensive, but he baffled the French admiral at Sandy Hook, and defeated his attempt to take Newport in Rhode Island by a fine combination of caution and calculated daring. On the arrival of Adm. John Byron from England with reinforcements, Howe left the station in September. Until the fall of Lord North's ministry in 1782 he refused to serve, assigning as his reason that he could not trust Lord Sandwich. He considered that he had not been properly supported in America, and was embittered both by the supersession of himself and his brother as peace commissioners, and by attacks made on him by ministerial writers in the press.

On the change of ministry in March 1782 he was selected to command in the English channel, and in the autumn of that year he carried out the difficult operation of the final relief of Gibraltar. The French and Spaniards had in all 46 line-of-battle ships to his 33, and his ships were ill-equipped and manned. He was, moreover, hampered by a great convoy carrying stores. But Howe handled his ships well, the enemy was awkward and unenterprising and the operation was brilliantly successful. From Jan. 28 to April 16, 1783, he was first lord of the admiralty, and again from Dec. 1783 until Aug. 1788, in William Pitt's first ministry.

On the outbreak of the French Revolutionary War in 1793 he was again named to the command of the channel fleet. In 1794 he won the epoch-making victory of the First of June (*see* First of June). Though Howe was then nearly 70 and had been trained in the old school, he displayed an originality not usual with veterans, and not excelled by any of his successors in the war, not even by Nelson, since they had his example to follow and were served by more highly trained squadrons than his. In 1797 he was called on to pacify the mutineers at Spithead, and he showed great influence with the seamen. He died on Aug. 5, 1799, and was buried in his family vault at Langar.

In 1782 he was created Viscount Howe of Langar, and in 1788 Baron and Earl Howe. In June 1797 he was made a knight of the garter. His nickname of "Black Dick" was given because of his swarthy complexion, and the portrait by Thomas Gainsborough shows that it was apt.

The standard *Life* is by Sir John Barrow (1838). Interesting reminiscences will be found in the *Life of Codrington* by Lady Bourchier. Accounts of his professional services are in Charnock's *Biographia Navalis*, vol. 457, and in Ralf's *Naval Biographies*, i. 83. *See* also Beatson's *Naval and Military Annals*, James's *Naval History*, and Chevalier's *Histoire de la Marine française*, vol. i and ii.

HOWE, SAMUEL GRIDLEY (1801–1876), U.S. educator and first director of the Perkins School for the Blind, was born at Boston, Mass., on Nov. 10, 1801. He attended Harvard medical school and was admitted to practice, but abandoned the medical field to take part in the Greek revolution. After six years with the Greek army, acting as fighter and surgeon and helping in reconstruction of the devastated country, he returned to the United States and in 1831 received a proposal to direct the establishment of a New England asylum for the blind at Boston. Howe set out at once for Europe to investigate the problem. There he was temporarily diverted from his task by becoming involved in the Polish revolt, suffering arrest and imprisonment. Returning to Boston in July 1832, he began receiving a few blind children at his father's house in Pleasant street, the beginning of what was to become the Perkins school. One of his notable successes was in teaching Laura Bridgman (*q.v.*).

In 1843 he married Julia Ward (*see* Howe, Julia Ward) and with her made a prolonged European trip. Upon return to the United States, Howe interested himself in the condition and treatment of mentally defective children. He was also an ardent abolitionist and a member of the Free-Soil party. He died on Jan. 19, 1876, at Boston.

HOWE, WILLIAM HOWE, 5TH VISCOUNT (1729–1814), English soldier, commander in chief of the British army in America from 1776 to 1778 and brother of Admiral Lord Howe, was born on Aug. 10, 1729. He joined the army in 1746 and by 1759 had risen to the command of the 58th foot regiment, at the head of which he took part in the siege of Louisburg. Later he commanded a newly raised light infantry battalion which climbed the Heights of Abraham before the battle of Quebec. He was also present at the capture of Montreal in 1760. Later he distinguished himself in the Belle Isle and Havana campaigns, earning for himself a reputation as one of the most brilliant of the army's younger generals. In 1774 Howe devised and introduced a new system of light infantry training which was officially adopted for use throughout the service. Though as a Whig he disapproved of the American Revolutionary War he was sent to Boston as second-in-command to Gen. Thomas Gage and led the left wing in the three costly but finally successful assaults on Bunker hill. When in 1776 he succeeded to the supreme command he transferred his army southward by sea to Staten Island and later captured New York; his army then occupied the whole area around the city as far south as the Delaware river and went into winter quarters. It was not until June 1777 that active operations were resumed. Howe then again shipped his army to the south bank of the Delaware where it inflicted two defeats on the Americans at the Brandywine river and Germantown. The winter was spent at Philadelphia. Before the start of operations in 1778 Howe resigned his command and returned home. He saw no more active service, but held a number of important home commands. He succeeded to the viscountcy on the death of his brother, the admiral, in 1799. He died at Plymouth on July 12, 1814.

See also American Revolution and references under "Howe, William Howe" in the Index volume. (E. W. Sh.)

HOWEL Dda ("the Good") (d. 950), called in the prologues to the Welsh lawbooks "king of all Wales," did for the last years of his life more nearly hold that position than any earlier ruler, including even his grandfather Rhodri Mawr ("the Great"). Howel became ruler of Seisyllwg (roughly modern Cardiganshire and the Towy valley), jointly with his brother Clydog after the death of their father Cadell (*c.* 910), and alone after Clydog's death in 920. Dyfed came to him through his wife Elen, daughter of Llywarch ap Hyfaidd, the last king of its dynasty, who died in 904; he acquired Gwynedd, and probably Powys, on the death of his cousin Idwal Foel ap Anarawd in 942.

Howel's reign was remarkable in its age for its peacefulness, which can be attributed to his consistent policy of friendship with England, a policy followed even at the price of the name of independence. Thus Howel's first recorded act is his homage to Edward the Elder in 918, in which his brother Clydog and also Idwal Foel of Gwynedd joined. Thereafter he often attended the English court and his name is found as a witness to 12 charters of Aethelstan and Edred between 928 and 949. Further signs of his pro-English sympathy are found in the English name, Edwin, given to

one of his sons and—most significant of all—the absence of the Welsh from the alliance of Danes, Scots and Strathclyde Britons which Aethelstan defeated at Brunanburh in 937; for there is evidence of keen Welsh propaganda in favour of the alliance in the poem *Armes Prydein* (modern edition by Ifor Williams, 1955) now preserved in the *Book of Taliesin*.

It was no doubt the consequence of this pacific policy that Howel was unique among Welsh kings in several respects. His visit to Rome in 928 had indeed been anticipated by two Welsh princes of the 9th century; but both these died in Rome and must be regarded as elderly penitents, whereas Howel made his journey in the prime of life. He was the only Welsh ruler who issued his own coins; and he was the only Welsh ruler who received the epithet "the Good." It is natural to associate the epithet with the work for which he was chiefly remembered in later ages, the codification of Welsh law which is attributed to him (*see* WELSH LAWS). There is no contemporary record of this work and the detailed accounts given in legal manuscripts of the 12th century and later must be treated with great circumspection; but Howel was certainly responsible for a co-ordination of pre-existing law which justified the Welsh in calling their law by his name. It was no doubt this work which led the chronicler who recorded his death to call him "the head and glory of all the Britons."

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HOWELL, JAMES (*c.* 1594–1666), English writer, is known for his *Epistolae Ho-Elianae*, an early and lively example of essays written in the form of letters and in most cases intended for publication. Howell came of an old Welsh family and was born probably at Abernant, Carmarthenshire. From the grammar school at Hereford he went to Jesus college, Oxford, and then traveled abroad, becoming a versatile linguist and, as he himself said, "a true cosmopolite." Minor posts in government service and election (1627) as M.P. for Richmond, Yorkshire, added to his many acquaintances in literary and public life. From 1643 until 1651 he was held in the Fleet prison, whether principally on account of unpaid debts or royalist opinions is uncertain, and was there obliged by necessity to make writing his profession. At the Restoration the post of historiographer royal was created for him. He was buried in the Temple church, London, on Nov. 3, 1666. His writings include translations, dictionaries, imaginative works, political pamphlets and the *Epistolae Ho-Elianae*, 4 vol. (1645–55). Howell plagiarized freely and added fictitious dates so that, notwithstanding their vivid impressions of contemporary events and opinions, the letters live for their qualities as essays rather than as reliable reporting. The standard edition is edited by J. Jacob, 2 vol. (1890–92).

HOWELLS, WILLIAM DEAN (1837–1920), U.S. novelist and critic, distinguished in American history and literature as the editor and friend of Henry James and Mark Twain, the most influential critic of his day and a prolific, able novelist, was born at Martin's Ferry, O., March 1, 1837. From his father, a printer-journalist, the boy acquired equalitarian ideas, and from the family reading of Swedenborg a persisting ethical bent. Howells spent his formative years in Jefferson and Columbus, O., as typesetter, reporter and editor with various newspapers, teaching himself Spanish and German, reading Cervantes, Heine and Shakespeare and writing poetry late into the night. They were years at times shadowed by sleeplessness, overwork and youthful recurring fears of hydrophobia and insanity. Writing his campaign biography of Lincoln (1860) became a turning point in Howells' life, for it financed the journey to New England during which he met James Russell Lowell and the established American writers, and led to his appointment as U.S. consul at Venice, his marriage to Elinor Mead and the Italian years (1861–65), in which he completed his education as a writer.

With the publication of *Venetian Life* (1866) he entered upon a period of influence and renown as assistant editor and then editor of the *Atlantic Monthly* (1866–71; 1871–81). Howells transformed the *Atlantic* into a national magazine, introducing new features, making the style more colloquial and enlisting the aid of writers as different in all but talent as Henry James and Mark Twain. Meanwhile he was adapting his skill in writing sketches of travel to creating travel novels, *Their Wedding Journey* (1872) and *A Chance Acquaintance* (1873), and international novels contrasting European and American manners, *A Foregone Conclusion* (1875), *The Lady of the Aroostook* (1879) and *Indian Summer* (1886). He was also beginning to write plays, and without much success to lay siege to the theatre.

Howells' leaving Boston for New York in 1888 signalized an expansion of his intellectual and imaginative horizons. In the essay "Henry James, Jr." (1882), he had unconsciously precipitated an international controversy over realism by asserting that "The art of fiction has become a finer art in our day than it was with Dickens and Thackeray," and in the "Editor's Study" of *Harper's Magazine* he carried the battle to the romantic critics for six years, 1886–92. Tolstoi's art and ethics and the social ferment of which Laurence Gronlund, Henry George and Edward Bellamy were a part stirred Howells mightily. In 1887 he risked both livelihood and reputation, as he thought, by writing an open letter asking clemency for the Chicago anarchists involved in the Haymarket riot, on the ground that they had been convicted for their political beliefs. The effect of these experiences appears in the broader scope of *The Minister's Charge* (1887), *Annie Kilburn* (1889), *A Hazard of New Fortunes* (1890) and *A Traveler From Altruria* (1894).

The death in 1889 of his elder daughter, Winifred, a talented girl long an invalid, set in Howells for the rest of his life the conviction that material gain and personal happiness were secondary or even delusory human aims. Thus in the 1890s he was championing new writers like Hamlin Garland, Stephen Crane, H. B. Fuller and Frank Norris, and collected a portion of his polemical "Editor's Study" in *Criticism and Fiction* (1891). Thus at the turn of the century he played an active role in the anti-imperialist movement with Mark Twain. Honours accrued to him thereafter as the dean of American letters and his official reputation increased; but the number of his readers began to dwindle, and before his death on May 10, 1920, he knew, as he said, that he had become "comparatively a dead cult with my statues cut down and the grass growing over them in the pale moonlight."

His Value as Critic.—Though Howells undervalued criticism he was himself a lifelong practising critic, whose reviews and articles evinced a taste both catholic and sensitive and interpreted the work of three generations of writers. He was an admiring, rather uncritical interpreter of Lowell, Longfellow and Holmes (*Literary Friends and Acquaintance*, 1900) partly because he was their heir: Lowell had first accepted his poems, and the three Brahmins with J. T. Fields had made him editor of the *Atlantic*. Walt Whitman's apparent formlessness put Howells off, though he thought Whitman's best poems were "stellar." Hawthorne he greatly admired. But the remote Emerson, with his idea that the vulgar tongue is the true language of poetry and that the "familiar, the common, the low" are proper poetic matter, probably influenced Howells most, among Americans.

Howells judged his own contemporaries with great shrewdness. From the beginning he valued the stories of Henry James, predicted that James would have to create his own audience, and during his writing life helped to create that audience by publishing his work, reviewing his books, and even at times acting as his agent. Similarly, he was the first critic consistently to acknowledge Mark Twain's powers as satirist and storyteller, and to gauge the "depth of fury" beneath his fun; he was Mark Twain's trusted editor; and in their collaborative failures the two writers enjoyed "gaudy times" together. In the 1890s Howells praised discriminatingly both Emily Dickinson's metaphysical verse and Thorstein Veblen's sardonic analysis of leisure class behaviour. This breadth of taste was due in part to his knowledge of European literature. With T. S. Perry, he persuaded Americans to read Turgenev, Björnson, Ibsen, Zola, Pérez Galdós and Verga, as well as Jane Austen, George Eliot, Hardy and Shaw. Tolstoi was his great modern writer.

Howells' practical criticism, then, was very often just and penetrating. His critical theory was simple. He classified fiction, for

example, historically and qualitatively as novel, romance and romanticistic novel (an inferior kind), and formally as autobiographical (first-person novel), biographical (point-of-view novel) and historical (omnipotent-author novel, the primal or epic form). More generally Howells held that the writer should (1) render with scrupulous honesty his own impressions of life; (2) create a perspective in his work, wherein men and events might be seen in true "proportion and relation"; (3) present motives in their manifold, recondite, "God-given complexity"; (4) treat action dramatically, without comment, subordinating it to character; (5) by fulfilling these artistic standards, achieve the aim of "dispersing the conventional acceptations by which men live on easy terms with themselves and obliging them to examine the grounds of their social and moral opinions."

Novels.—Three general phases may be distinguished in Howells' career of 40 years as a novelist:

1. After publishing two popular stories of travel, he wrote his first true novel in *A Foregone Conclusion*, a study of misunderstandings between an American girl and a Florentine priest, her tutor, who falls in love with her. The tale ends on a note of pathos with the death of the disillusioned priest. *Indian Summer*, the culminating novel of the first phase, is almost pure comedy. Yet both of them, like *The Lady of the Aroostook* and *A Fearful Responsibility* (1881), are *nouvelles* presenting only three or four characters dramatically and intensively, in the manner of Turgenev or Hawthorne. The action is antiromantic, and arises out of sectional or international differences. The setting is finely drawn and often symbolically shaded, as in the Italian fountain and garden scenes. The tone tends to be ironic and witty. From 1875 to 1886, in short, Howells, like James, became famous as the creator of novels in which "the American girl," innocent, beautiful, willful and morally strong, was portrayed against a splendid, often sombre European background.

2. Howells consciously abandoned his international romances, for he did not intend to compete any longer with James, and he was increasingly drawn to a new field, the depicting of American social conflicts. Thus *The Undiscovered Country* (1880), which initiates the second period, takes as its motive spiritualism replacing religious faith in New England. *Dr. Breen's Practice* (1881) imagines a woman in medicine with the same quietly satirical detachment. *A Modern Instance* (1882) became Howells' "strongest novel" as he thought because he had in it a "great but simple" theme—love turned to indifference and to hatred. Inspired by Euripides, he produced a new Medea and Jason whose New England marriage of passion ends in an Indiana divorce court. In *The Rise of Silas Lapham* (1885), his best-known novel, Howells at once touched American experience and imagination with the newly rich Lapham's effort to rise into Boston society. Silas' financial ruin and, in spite of tempting evasions, his preserving his integrity in the end. The last novel of the period, *The Minister's Charge* (1887), recounted the failure of Lemuel Barker, a country boy, to succeed in Boston. In general, the novels of 1880–87 are full length. They may be told in part from a central character's point of view. Certain figures like the Rev. Mr. Sewell or Bromfield Corey tend to reappear. The novels deal with social problems rather than with manners, and nearly all of them represent a provincial character in Boston who is defeated by the city.

3. In the third phase, 1888–94, Howells' social and economic views tended to become more explicit. The Tolstoian doctrine of complicity, the belief that a man is ultimately responsible for the poverty or misery or criminality of any other man, first touched on in *The Minister's Charge*, was here fully explored. Howells drew his characters from varied social, racial and political groups, multiplied their number and rendered his background in closely realistic fashion, with less symbolic reference than in the early novels, New York replacing Boston. A strongly prolabour novel embodying a plea for justice rather than charity, *Annie Kilburn* (1888), marked the beginning of the period. *The Quality of Mercy* (1892), in which he shows the far-reaching effect of a banker's defalcation upon others, and *The World of Chance*, the haphazard world of book publishing, preceded Howells' most formulated criticism of contemporary capitalism in the utopian novel, *A Traveler From Altruria* (1894). But it was *A Hazard of New Fortunes* (1890) that Howells rightly considered the "most vital" of his fictions, dramatizing and picturing the teeming competitive life of New York city by means of a representative group of characters struggling to establish a magazine there. They range from the ignorant and aggressive backer, a millionaire in natural gas, to his opponent, the German socialist exile of 1848 who had lost an arm in the American Civil War, and who is killed in a trolley strike as the novel ends.

This three-phase schematization of Howells' more than 40 volumes of fiction does not, it must be noted, account for the experimental novel, *The Shadow of a Dream* (1891), a study of psychotic jealousy; or the ghostly tales; or the late ironic novels of courtship like *April Hopes* (1888) or *Fennel and Rue* (1908). With his last major novel, *The Landlord at Lion's Head* (1897), Howells partially reverted to his earlier manner, coming to believe that "fiction can deal with the facts of finance and industry and invention only as the expression of character."

In the 1920s, reacting against his long-held primacy, H. L. Mencken and Sinclair Lewis damned Howells' realism as genteel, his treatment of love as namby-pamby and his "optimism" as unjustified. Critics of the depressed 1930s revised this judgment somewhat by praising his political and economic views, though they largely ignored other essential aspects of his thought and literary accomplishment. Still later, critics distinguished his best work from the dated or mediocre, and reappraised the nature and the extent of his influence. A number of readers as well rediscovered the style and humour which charmed his contemporaries, the truth of his characters and the moral vein of iron in his best novels.

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HOWLAND ISLAND, a coral atoll in the central Pacific ocean (latitude 0° 48′ N., 176° 38′ W.), about 1,620 mi. S.W. of Honolulu. It is low and flat, about 2 mi. long and ½ mi. wide. Discovered in 1842 by Capt. George E. Netcher of New Bedford, Mass., it was taken into possession by the American Guano company in the name of the United States in 1857. American, British and German interests worked the guano deposits until 1890. A small U.S. colony was established there in 1935, and on May 13, 1936, Pres. Franklin D. Roosevelt placed it under the jurisdiction of the department of the interior. An airfield was constructed in 1937 for Amelia Earhart's round-the-world flight. She took off from New Guinea for Howland on July 2, 1937, but disappeared. The Japanese attacked the island on Dec. 8, 1941, killing two of the four colonists. The two survivors were evacuated by a U.S. destroyer on Jan. 31, 1942, and the colony was not re-established after World War II. (J. H. K.)

HOWLING MONKEY (HOWLER), a name applied to tropical American monkeys of the genus *Alouatta*, known for their roaring cries. They are the largest new world monkeys, with thick red or black fur, and are characterized by the inflation of the hyoid bone (which in the male supports the tongue) into a large shell-like organ communicating with the windpipe and giving peculiar resonance to the voice. The muzzle is projecting, the profile of the face sloping sharply upward at the eyes. The long tail is prehensile, thickly furred, with the under surface of the extremity naked, to secure a better grip.

ROBERT HERMES FROM NATIONAL AUDUBON SOCIETY

RED HOWLER (ALOUATTA)

Howlers dwell in companies, and in the early morning and evening the woods resound with their cries, which are often continued throughout the night. They feed on leaves, and are in the habit of sitting on the topmost branches

of trees. When on the move they progress in orderly clans, usually led by an old male. *See* also MONKEY; PRIMATES.

HOWRAH, an industrial city within greater Calcutta, is the capital of the district of Howrah in the Burdwan division of West Bengal, India. Pop. (1961) 512,598. Howrah stands on the right (west) bank of the Hooghly river opposite Calcutta and is connected with the latter by a wide cantilever bridge, the only one of its kind in Asia. Its river port is lined with shipbuilding and repairing docks, and on the river bank and elsewhere are jute, flour and oil mills, ropeworks and iron and steel rolling mills. The botanic garden with the famous banyan tree is in Sibpur, a southern suburb. The Bengal Engineering college is also located there. There are three other colleges affiliated to Calcutta university. The Howrah Maidan, a spacious open ground, provides sites for major festivals. The city is the terminus of two principal railways of India, the Eastern and South-Eastern, and serves about 5,000,000 people of greater Calcutta. A regular bus service operates between Howrah and Calcutta.

HOWRAH DISTRICT covers 575 sq.mi. and has a population (1961) of 2,038,477. The entire area is a dead level through which the rivers meander southward. The principal rivers are the Hooghly, the Damodar and the Rupnarayan. The Damodar fails to carry the excess of floodwater during the rains so that the entire countryside then becomes flooded. The floodwaters find an easy access into the channel of the Rupnarayan through surface flow or underground seepage. The Rupnarayan has therefore grown at the expense of the Damodar, and it surpasses the latter both in width and depth of channel and in discharge of water. The once powerful Saraswati river is almost dead, and during the rains its former drainage basin forms a vast sheet of water which cannot be adequately drained even by the Rajapur drainage channel. Rice, jute and betel nut are the principal crops of the district. The bank of the Hooghly from Bali to Bauria has most of the factories. Bali (pop. [1961] 130,896) is a historical town. Belur, the headquarters of the Ramakrishna mission, has a magnificent temple. Uluberia is noted for its cattle market. Bauria and Ghusuri are cotton towns, and Amta on the left bank of the Damodar is a trade centre. There are five colleges, including a teachers' training college at Belur, all affiliated with Calcutta university. (S. P. C.)

HOY (Norse HAEY, "high island"), the second largest island of the Orkneys, county of Orkney, Scot. Pop. (1951) 957; area 53 sq.mi. It is situated 2 mi. S.W. of Pomona, from which it is separated by Hoy sound. It is a lofty island and its shore line is much broken; Long Hope forms a good natural harbour.

Off the eastern coast lie the islands of Graemsay, Cava, Risa, Fara (Pharay), Flotta and Switha, while the peninsula of South Walls, forming the southern side of the harbour of Long Hope, is almost cut off by the sea. Red sandstone cliffs, sometimes more than 1,000 ft. in height, stretch for 10 to 12 mi. on the Atlantic front. The detached pillar called the Old Man of Hoy (450 ft.) is a landmark to sailors and a remarkable example of sea denudation. The only break in this remarkable run of rocky coast is at Rackwick in the bight below Rora head. In the interior, Ward hill (1,565 ft.) is the loftiest summit in either the Orkneys or Shetlands while the Cuilags reach 1,420 ft. and the Knap of Trewieglen 1,308 ft. Between Ward hill and the ridge of the Hamars to the southeast is the famous Dwarfie Stone, a block of sandstone (20 by 44 ft.) associated with Scandinavian folklore and with signs of ancient habitation. The island is thought to be the most southerly point in the British Isles where the great skua breeds.

HOYLAKE, a seaside town and urban district of Cheshire, Eng., is on the Wirral peninsula near the mouth of the Dee estuary. Pop. (1961) 32,268. The district, entirely residential, includes West Kirby where St. Bridget's church, though much restored, has Norman remains on a Saxon foundation. Calday Grange Grammar school was founded in 1636. In 1689 William III sailed from Hoylake to Ireland. Along the Dee estuary are the links of the Royal Liverpool Golf club (1869) and these include the site of a race course used by the Liverpool Hunt club until 1876. There are facilities for tidal and nontidal yachting. The Hilbre, Middle Eye and Little Eye islands are frequented by a large number and variety of birds, particularly waders. (FR. B.)

HOYLE, EDMOND (1672?–1769), first systematizer of the laws of whist, and author of a book on games. His birthplace is unknown. For the use of his pupils in whist he drew up a *Short Treatise* (1742). The laws of Hoyle continued to be regarded as authoritative until 1864, after which they were gradually superseded by the new rules adopted by the Arlington and Portland clubs in that year (*see* WHIST). The weight of his authority is indicated by the phrase "according to Hoyle," which, doubtless first applied with reference to whist, has gained currency as a proverb. Hoyle died in London on Aug. 29, 1769.

HOYSALA, the name of an Indian dynasty which ruled in the southern Deccan (*q.v.*) and (for a time) in the Cauvery valley between *c.* A.D. 1006 and *c.* 1346. The first kings emanated from the hills northwest of Dorasamudra (mod. Halebid), which became their capital *c.* 1060. With their hardy, hill-dwelling, Kanarese-speaking followers they gradually absorbed Gangavadi (Mysore state) and the rich lands beyond the Tungabhadra toward Dharwar and Raichur. The imperialistic programs of the Chalukyas of Kalyana helped them, for under Vinayaditya (ruled *c.* 1047–98) and his grandson Vishnuvardhana they gained wide experience as feudatory generals.

Vishnuvardhana won much territory from the tough Kadambas of Hangal, but his weak son Narasimha I lost it. Yet Vishnuvardhana's expulsion of the Cholas (*see* CHOLA) from the plateau succeeded. His grandson, Ballala II, was invited into the plains to help the Cholas. He agreed because his northern gains from the Chalukya beyond the Malprabha and Krishna river proper (1189–1211), gains which entitled him to imperial status, had diminished under pressure from the Yadava of Devagiri. His grandson Somesvara (*c.* 1235–1260?) resided in the principality on the Cauvery given by the Cholas, and his son Ramanatha (1254–95) was allowed to reign there by the Pandya emperor. On his eviction he attempted to take the plateau kingdom from his brother Narasimha III, weakening Hoysala resources. Ballala III (*c.* 1292–1343) helped the sultan of Delhi against the Pandyas. His futile ambitions led to his dynasty's downfall and the rise of Vijayanagar (*q.v.*).

Hoysala architecture and sculpture, exceptionally ornate and intricate, is best seen at Halebid, Belur and Somnathpur. The family liberally patronized Kanarese and Sanskrit letters.

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HRABANUS MAURUS: *see* RABANUS MAURUS, MAGNENTIUS.

HRADEC KRALOVE (Ger. KÖNIGGRÄTZ), one of the oldest towns in Bohemia, Czech., and chief city of East Bohemian *kraj* (region), is situated at the confluence of the Orlice with the upper Elbe, about 100 km. (62 mi.) E. of Prague by road. Pop. (1961) 57,221. The old town stands on a low outcrop of Cretaceous sandstone between the two streams, and the new town is spread out on the plain on the Elbe's west bank between the fertile lowland of Polabi and the Orlicke hills. This position gave Hradec Kralove importance as a nodal point of routes. The road from Brno joins that from Prague to Wroclaw (Breslau), Pol., there. The railway north from Pardubice to industrial Silesia, Pol. also passes through the town. Some industry is long established, including the manufacture of musical instruments. After World War I the production of agricultural machinery began and later the textile industry increased considerably.

Hradec Kralove grew from a settlement of one of the Czech clans and was known in early medieval history as Chlumec Dobroslavsky. Like Dvur Kralove farther north, it takes the name Kraiove ("of the queen") from its connection in the early 14th century with Elizabeth of Poland (the wife of Wenceslas II of Bohemia) who founded the early Gothic cathedral in 1303. In that century it was the second city of Bohemia, but it suffered severely during the Thirty Years' War. Sadowa, a village northwest of Hradec Kralove, gave its name to the decisive battle of the Austrian-Prussian struggle in 1866.

HRDLIČKA, ALEŠ (1869–1943), U.S. physical anthropologist, an expert on early man in America, was born at Humpolec,

Bohemia, on March 29, 1869. His early education was received in Bohemia. He studied at the New York Eclectic, Homoeopathic and Allopathic colleges, graduating in medicine in 1892 and 1894. In 1894 he joined the New York state service and in 1896 became associate in anthropology in the state pathological institute.

In 1898 Hrdlička was given charge of physical anthropology in the Hyde expedition to Mexico and the southwestern United States, in connection with the American Museum of Natural History of New York. In 1903 he was called as assistant curator to organize the division of physical anthropology at the U.S. National museum, Washington, D.C., becoming curator in 1910. He retired in 1942 and served as associate in anthropology at the Smithsonian institution. He died Sept. 5, 1943.

Hrdlička was an early exponent of the theory, later accepted, that the North American Indian is of Asiatic origin; he also proposed that the cradle of man's development was not in Asia but in Europe and that the Neanderthal man was not a separate species of man but only a phase of his evolution. He was the founder (1918) and editor of the *American Journal of Physical Anthropology* and the founder (1929) and first president of the American Association of Physical Anthropologists. His works include *Ancient Man in North America* (1907); *Ancient Man in South America* (1912); *Old Americans* (1925); *Anthropology of the American Indian* (1927); *The Skeletal Remains of Early Man* (1930); *Practical Anthropometry* (1939).

HRÓLFR KRAKI (Hrolf Pole-Stick), king of the Danes, has been equated with Hrothulf, who is mentioned in *Beowulf* and must have reigned in the 6th century. Reliable sources of history have little to say of Hrólfr, but he figures prominently in Scandinavian legend. The greatest moment in his legendary career was when he attacked Athils, king of the Swedes, at Uppsala. His heroic death in battle against his brother-in-law, Hjörvarthr, was celebrated in the *Bjarkamál*, a poem of the 10th century, of which fragments survive. His life is also told in the Icelandic *Hrólfs Saga Kraka*, probably written in the 14th century.

See A. Olrik, *The Heroic Legends of Denmark*, Eng. trans. (1919); G. Turville-Petre, *The Heroic Age of Scandinavia* (1951). (G. T.-P.)

HROSVITHA (Roswitha) (*c.* 935–1000), German nun, writer of Latin comedies and narrative poems, who is customarily regarded as the first German woman poet. Born of a noble Saxon family, she entered the Benedictine nunnery at Gandersheim, near Hildesheim, as a girl, and seems to have spent the rest of her life there.

Her literary works, all in Latin, fall into three groups—comedies, religious poems, and verse chronicles. Her six moralizing comedies, which are based in form on those of Terence, are written in a kind of rhythmic, partly rhymed prose; their subjects—martyrdoms, miraculous conversions—are drawn from the legends of the saints. Hrosvitha's purpose is to provide edifying reading matter for the nuns, and she reproaches those who prefer the vain pleasure of well-written secular books to the solid worth of sacred writings.

Whether her works are in fact isolated phenomena in 10th-century Germany is not known, but it was literary monastic drama of this kind, together with the popular dramatic productions of the *joculatores* and the *mimi*, that prepared the way for the mysteries and miracle plays of the following centuries.

Hrosvitha's series of narrative poems, written in leonine hexameters and elegiacs, is also based on Christian legends and designed for the edification of the reader. The poems are generally undistinguished in tone, and, like most 10th-century German metrical poetry modeled on the classics, are deficient both in style and technique. The third group of Hrosvitha's works consists of two verse chronicles: the *Carmen de gestis Oddonis*, an epic in the grand Roman manner on the feats of Otto the Great, and *De primordiis et fundatoribus coenobii Gandersheimensis*, a history of the convent of Gandersheim from its foundations in 856 down to the year 919.

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HROZNÝ, FRIEDRICH (Bedřich) (1879–1952), Czech archaeologist who succeeded in deciphering the Hittite language, was born on May 6, 1879, at Lysa nad Labem, Bohemia. He studied in Prague, Vienna, Berlin and London. In 1904 he took part in the Sellin excavations in Ta'anuk (north Palestine), on the basis of which he wrote *Die Keilschrifttexte von Ta'annek* (1904) and *Die neugefundenen Keilschrifttexte von Ta'annek* (1906). In 1905 he was appointed professor at Vienna, and in 1919 professor of cuneiform research and ancient oriental history at the Charles university in Prague. Hrozný left the solution of the Hittite hieroglyphics to chance, proceeded to work on the basis of Hittite documents from the Bogazköy archives written in cuneiform script and, in 1915, deciphered the language, proving it to be an Indo-European tongue. His solution was attacked from many quarters, but he substantiated his claim by the success with which he read and translated a number of documents, among others a Hittite legal code (published in Paris, 1922, under the title *Code Hittite provenant de l'Asie Mineure, I Partie: Transcription, traduction française*). In 1925 excavations for the purpose of further research were made under his direction by a Czech scientific expedition to Asia Minor. He died on Dec. 18, 1952, in Prague. *See* also Hittites.

HSIANG-T'AN (Siangtan), industrial city in Hunan province, China, on the Hsiang river, 20 mi. S.S.W. of Ch'ang-sha (*q.v.*), the provincial capital. Hsiang-t'an is situated on the Hunan-Kweichow railroad, begun in 1958. The city trades in rice, tea, tung oil, textiles and paper. After 1949, it became an important industrial centre, producing electrical goods, cotton textiles, wire, machine tools, cement and ammonium sulfate fertilizer. As a result of industrial development, the city's population more than doubled in the first four years under Communist rule, rising from an estimated 80,000 in 1949 to 183,600 (1953 census). (T. Sd.)

HSI CHIANG (Si Kiang), main river system of south China, rising in the Yünnan-Kweichow plateau, at an elevation of more than 6,000 ft., and flowing 1,200 mi. E. to the Canton delta on the South China sea. The name Hsi Chiang, which means "West river," is applied only to its lower course. The headwaters consist of a number of major branches. The principal headstreams are the Nan-p'an Chiang and Pei-p'an Chiang (South Pan and North Pan rivers) which join on the Kweichow-Kwangsi border to form the Hung-shui Ho. The Hung-shui flows through the deeply dissected karst-type landscape of western Kwangsi, dropping rapidly to an elevation of about 600 ft. At Shih-lung, the Hung-shui receives the Liu Chiang on the left, thus forming the Ch'ien Chiang. The Liu Chiang is formed near Liu-chou (*q.v.*) by the junction of two other headstreams—the Jung Chiang (Pei-liu Ho) and the Lung Chiang, both of which rise in southeastern Kweichow.

The Ch'ien Chiang flows through a rapid-strewn gorge, extending for 20 mi. between Wu-hsüan (Mosün) and Kuei-p'ing (Kweiping) and forming an obstacle to navigation. At Kuei-p'ing, the Ch'ien Chiang receives a major tributary on the right, the Yü Chiang, to form the Hsüan Chiang. The Yü Chiang is formed near Nan-ning by the junction of two headstreams, the Yu Chiang and the Tso Chiang (Li Chiang), which rise in the uplands of northern Vietnam and easternmost Yünnan. The Hsüan Chiang flows past T'eng-hsien (Tengyün) where it receives the Jung Chiang on the right, and then past Wuchow, where it receives the Kuei Chiang on the left.

It is only below Wuchow that the river is strictly the Hsi Chiang, the name by which the river system is generally known. At San-shui (Samshui), the Hsi Chiang joins the Pei Chiang (North river) to form the vast Canton delta, which is also joined from the east by the Tung Chiang (East river).

The Hsi Chiang is the great commercial waterway of south China, linking Hong Kong, Canton, Macao and other delta centres with Wuchow and the interior. In flood time, the river is navigable for vessels drawing 16 ft. as far as Wuchow. At ordinary times, the same city can be reached by vessels drawing 6 ft. or more. The headstreams are navigable in part for shallow-draft junks. (T. Sd.)

HSI-HSIA (Chinese for western Hsia), or Tangut, is the name of a kingdom in western China which arose out of a combination of several smaller states at the time of the Sung dynasty (10th century) and flourished in the 11th to the 13th century. Its territory centred in modern Tsinghai province and at the height of its power extended south to eastern Tibet and east to the bend of the Yellow river, where the kingdom adjoined the western boundary of the contemporary Liao dynasty. The northern parts of Hsi-Hsia included portions of modern Ningsia and Kansu provinces. The kingdom was one of a number of semi-independent pastoral or partly pastoral states that flourished on the northwest borders of the Chinese empire, to which they were linked by ties of tribute, trade, war and raid. As was the case with other border states, the political fortunes of the Hsi-Hsia flourished as the indigenous Chinese Sung dynasty declined.

The Hsi-Hsia people have been placed in the Tibeto-Burman linguistic family of Sino-Tibetan-Burman stock; however, some authorities feel they stemmed from a tribal complex of Tibetan background, and eschew any solution of the language problem. Their mixed economy included herding and farming. The medieval Persian historian Rashid al-Din Fadlullah refers to the country as Kashin, and describes many centres of trade and one chief city, modern Ningsia (seized during the last campaigns of Genghis Khan in 1225–27). Rashid al-Din reported the people to have been Buddhist and it is known that Buddhist Turks lived among them. Marco Polo came there after the downfall of the Hsi-Hsia kingdom and described monasteries that may have been either Buddhist, Nestorian Christian or both. However, his description of a shamanist animal sacrifice may shed light on earlier Hsi-Hsia cult and rite.

The Hsi-Hsia were absorbed as Tangut province by the 13th-century Mongol empire, later to be joined to the Chinese empire.

See also CHINA: *History: Early Modern Period.* (L. K.)

HSIN-CHU (SIN-CHU), a city of Taiwan (Formosa), pop. (1956) 125,814, is on the main north-south railroad 38 mi. S.W. of T'ai-pei and three miles inland from Formosa strait. The capital of Hsin-chu county, the city is located near sources of natural gas, coking coal, glass sand, stone and both hard and soft timber. It is a major tea and citrus marketing centre.

Hsin-chu lies at the junction of three railway routes. It is a growing industrial centre, producing fertilizers, wood products, electric light bulbs, matches, glass, cosmetics and hand-carved furniture. Hsin-chu became the nuclear research centre of Taiwan in the late 1950s. (N. S. G.)

HSIUNG-NU, a nomadic pastoral people who at the end of the 3rd century B.C. formed the principal power north of the Great Wall of China. Probably of Turki stock, as some evidences of their language suggest, the Hsiung-nu were constantly at war with the great Han dynasty of China between 135 and 51 B.C. In that year the Hsiung-nu broke into two hordes, the eastern horde submitting to China, while the western horde was driven into central Asia. Three hundred years later the eastern Hsiung-nu were still sufficiently powerful to take part in the general nomad invasion of China which attended the collapse of the Tsin dynasty (A.D. 304–317). In later centuries the name disappears from Chinese historical records, but the dominant nomad people in the Mongolian steppe in the 7th century A.D., the T'u Chüeh, identified with the Turki, claimed the Hsiung-nu as ancestors. A number of recorded Hsiung-nu customs also suggest Turkish affinities. It is possible that the western Hsiung-nu may have been the ancestors of the western Turks of later centuries. The belief held in Europe since the 18th century that the Hsiung-nu were identical with the Huns (*q.v.*) who later invaded the Roman empire in the 5th century A.D., though possible, cannot be substantiated with historical evidence. The Hsiung-nu were ruled by supreme chiefs called Shen Yu. The graves of several Shen Yu in the Selenga valley (U.S.S.R.) contained remains of Chinese, Iranian and Greek textiles, indicating a wide trade between the Hsiung-nu and distant peoples. (C. P. F.)

HSÜAN TSANG (*c.* 602–664), Chinese Buddhist scholar noted for his travels in India, was a member of a family of state officials. He early became a monk and, after 15 years of study and teaching, determined to make a pilgrimage to India, the home of Buddhism. In 629 he evaded the government prohibition from crossing the frontier and left Liangchow in Kansu on an arduous journey through the Gobi desert to Turfan and Samarkand, crossed over the Hindu Kush and entered India at Peshawar. He then spent many years in travel, from the Indus to the Ganges and to south India, visiting the great Buddhist shrines, collecting Buddhist scriptures and mastering Sanskrit. Finally he resolved to return to China, recrossing the Hindu Kush, traversing the Pamir and passing through Kashgar and Khotan to Lo-yang where in 645 he was well received by the Emperor T'ai Tsung. He declined official employment and devoted the rest of his life to the translation of Buddhist texts. He died at Ch'ang-an in 664.

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HSÜAN-T'UNG (P'U-I; HENRY P'U YI; K'ANG-TE) (1906–), the last Chinese emperor of the Ch'ing (Manchu) dynasty and Japan's puppet emperor of Manchoukuo from 1934 to 1945. In anticipation of the death of the emperor Kuang-hsü, P'u-i, the infant son of Prince Ch'un, was selected by the empress dowager Tz'u-hsi on Nov. 13, 1908, to succeed his uncle under the reign title of Hsüan-t'ung. The emperor died on Nov. 15, whereupon Prince Ch'un became regent for his son, and ruled the empire in co-operation with the emperor's widow, Empress Hsiao-ting. The reign lasted for three years. On Feb. 12, 1912, Prince Ch'un and Empress Hsiao-ting agreed that P'u-i should abdicate the throne in favour of a republican form of government, thus ending the Manchu rule of China.

P'u-i was permitted to live in the palace in Peking after his abdication, a subsidy being voted for the maintenance of the imperial family. In July 1917 an attempt by Gen. Chang Hsün to restore the emperor was frustrated by Tuan Ch'i-jui after a nominal reign of 12 days. P'u-i again abdicated. He chose Henry as a given name and was thereafter known as Henry P'u Yi. In 1922 he married a daughter of Jung Yuan, a Manchu noble. In Nov. 1924, during the occupation of the capital by the troops of the Kuomintang or Nationalist party, he left the palace under duress to reside in the Japanese concession at Tientsin. On March 9, 1932, he was installed as president, and from 1934 to 1945 was emperor, of the Japanese puppet state of Manchoukuo (Manchuria) under the reign title of K'ang-te. He was taken prisoner by the Russians in Aug. 1945 and returned to the Chinese mainland for trial as a war criminal in 1950 for his collaboration with the Japanese. He was, however, pardoned in Dec. 1959 by order of the Chinese Communist government. *See* also CHINA: *19th Century and Revolution; The Republic;* CH'ING; MANCHURIA. (E. W. WU.)

HSÜN-TZU (3rd century B.C.), Chinese philosopher, is the third member in the great Confucian triumvirate of Chinese antiquity which includes Confucius himself and Mencius (*qq.v.*). His surname was Hsün, his personal name K'uang, and he bore the honorary cognomen of Ch'ing, so that he may be called either Hsün K'uang or Hsün Ch'ing. Most commonly, however, he is known simply as Hsün-tzu, "the Master Hsün" (*tzu* being an honorific suffix attached to the names of many philosophers of his time).

Hsün-tzu's exact dates are unknown; and little is known of his life save that he was a native of the state of Chao (in modern Shansi province, north central China), that he belonged for some years to the Chi-hsia academy of philosophers maintained in Ch'i by the ruler of that eastern state and that, later, because of slander, he moved south to the state of Ch'u, where he became magistrate of a small district and later died in retirement.

The position of Confucius, Mencius and Hsün-tzu in Chinese thought has been likened to that of Socrates, Plato and Aristotle in the west. Hsün-tzu exceeded his predecessors in erudition and was the first of the three to express his ideas not merely by means of the sayings and conversations recorded by disciples, but also in the form of well-organized essays written by himself. The

book today known as the *Hsün-tzu,* in 32 chapters, is regarded as being in large part from his own hand.

Hsün-tzu's most famous dictum is that "the nature of man is evil; his goodness is only acquired training." What Hsün-tzu preached was thus essentially a philosophy of culture. Human nature at birth, he maintained, consists of instinctual drives which, left to themselves, are selfish, anarchic and antisocial. Society as a whole, however, exerts a civilizing influence upon the individual, gradually training and molding him until he becomes a disciplined and morally conscious human being. Of prime importance in this process are the li (ceremonies, rules of social behaviour, traditional mores) and music (which Hsün-tzu, like Plato, regarded as having a profound moral significance).

Hsün-tzu's view of human nature was, of course, radically opposed to that of Mencius, who had optimistically proclaimed the innate goodness of man. Both thinkers agreed that all men are potentially capable of becoming sages, but for Mencius this meant that every man has it within his power to develop further the shoots of goodness already present at birth, whereas for Hsün-tzu it meant that every man can learn from society how to overcome his initially antisocial impulses. Thus began what became one of the major controversies in Confucian thought.

The difference between Mencius and Hsün-tzu is metaphysical as well as ethical. T'ien (Heaven) for Mencius, though not an anthropomorphic deity, constituted an all-embracing ethical power; therefore it is inevitable that man's nature should be good, since he receives it from Heaven at birth. For Hsün-tzu, on the other hand, T'ien embodied no ethical principle and was simply the name for the functioning activities of the universe (somewhat like our word Nature). These activities he conceived of naturalistically and almost mechanistically. Moral standards, therefore, have no metaphysical justification but are man-made creations.

One may ask how, if man is born "evil" (by which Hsün-tzu really meant uncivilized), it is possible for him to create the higher values of civilization. Hsün-tzu's reply was that man differs from other creatures in one vital respect: besides his instinctual drives, he also possesses an intelligence which enables him to form co-operative social organizations. Hence the sages, realizing that man cannot well survive in a state of anarchy, used this intelligence to formulate the social distinctions and rules of social behaviour (li), which would check the encroachments of one individual upon another and thereby ensure sufficiency for all. In this utilitarian explanation of the creation of social institutions, Hsün-tzu shows probably indebtedness to the non-Confucian thinker Mo Ti (*q.v.*).

Hsün-tzu's denial of supernaturalism led him into a sophisticated interpretation of popular religious observances and "superstitions." These were merely poetic fictions, useful for the common people because they provided an orderly outlet for human emotions, but not to be taken as true by educated men. There Hsün-tzu inaugurated a rationalistic trend in Confucianism which has been congenial to scientific thinking. At the same time, however, Hsün-tzu's distrust of "nature in the raw" caused him to warn men to shun the investigation of natural phenomena and to keep to humanistic studies; his own conception of the universe, moreover, was a static and antievolutionary one, in which past and present are the same and the many are like the one. In these respects, therefore, Hsün-tzu's influence was hostile to scientific development.

Hsün-tzu nevertheless made important contributions to psychology, epistemology and dialectic, yet his primary interest in dialectic was as a tool for exposing the "fallacies" of rival schools; and he bitterly lamented the need for dialectic in the absence of a centralized political authority that could impose ideological unity from above. Hsün-tzu, indeed, was an authoritarian who formed a logical link between Confucianism and the totalitarian Legalists; it is no accident that among his students were two of the most famous Legalists, the theoretician Han Fei-tzu (*c.* 280–233 B.C.) and the statesman Li Ssu (*c.* 280–208 B.C.). Hsün-tzu himself remained Confucian in his firm rejection of the amoral philosophy and compulsive techniques of the Legalists, and his insistence on Confucian morality as the basis for society.

For several centuries after Hsün-tzu's death, his influence remained higher than that of Mencius. This is indicated, for example, by the borrowings from Hsün-tzu found in such ritualistic compilations as the *Li Chi* ("Book or Record of Rites"). Only with the rise of Neo-Confucianism (9th century A.D. onward) did his influence wane, and it was not until the 12th century that the triumph of Mencius was formalized through the inclusion of the *Mencius* among the Confucian classics. *See* also CONFUCIANISM; CHINESE PHILOSOPHY.

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HUAI HO (HWAI HO), a river of eastern China, between the Yellow river and the Yangtze, rises in Honan province in the northern foothills of the Ta-pieh Shan (Huai-yang-shan) and flows eastward for about 620 mi. (1,000 km.) past the cities of Huai-nan (Hwainan) and Pengpu (Pang-fou) through Anhwei and Kiangsu provinces to the lake Hung-tse Hu. In the 11th century the Huai Ho ran directly into the Yellow sea, but after one of the frequent course changes of the Yellow river the Huai Ho was diverted into the lake. From there its waters passed through the Grand canal (Yün Ho) to the Yangtze and finally to the sea. The absence of a direct outlet to the sea has resulted in floods affecting most of the 60,000,000 inhabitants of the area. The Communists, after 1949, embarked on an ambitious flood-control program. Old river dikes were repaired, new dikes built and silted channels dredged. A 105-mi. (169-km.) canal was dug in 1952 from Hung-tse Hu to the Yellow sea, providing a direct outlet for the flood waters. Storage reservoirs were built on many tributaries. (T. SD.)

HUAMBO, a central district of the Portuguese overseas territory of Angola in western Africa, occupies a large part of the Bié plateau, which on the western border rises to about 8,500 ft. (2,591 m.). Pop. (1960) 598,441. Area 11,815 sq.mi. (30,601 sq.km.). Lying at an elevation of 5,000–6,000 ft., Huambo has a dry temperate climate which favours European settlement. Thriving pastoral and agricultural activity includes, beside stock raising (about 90,000 cattle, 42,000 pigs and 21,000 sheep), the cultivation of maize (corn), wheat, rice, cassava, fruit, vegetables, sisal, castor beans, peanuts, *arabica* coffee and tobacco. Among the industries are pottery, brewing, milling and the processing of meat, dairy products, sisal, timber and lime. Huambo, crossed by the Benguela railway, is divided into four *concelhos* (counties), of which the headquarters are Nova Lisboa, the capital, Bela Vista, Vila Teixeira da Silva and Vila Robert Williams, named after the founder of the railway. (A. A. G. P.)

HUANCAVELICA, a department in central Peru, bounded by Junín on the north, by Ayacucho on the east and south and by Ica and Lima on the west. Area 8,830 sq.mi. (22,870 sq km.); pop. (1961) 298,892. It is a rugged mountain region, with a high-level surface of gentle relief about 15,000 ft. (4,572 m.) above sea level, surmounted by a few clusters of ranges of very high mountains and cut by deep canyons, chief of which is the Mantaro. Huancavelica city (pop. [1961] 11,038), the departmental capital, is located about 50 mi. (80 km.) S. of Huancayo and 140 mi. (225 km.) S.S.E. of Lima. The city is connected with Lima by rail and an all-weather highway. The chief products of the department include wheat, barley, maize and potatoes. It is a source of meat for Lima and also of some wool for local use. Silver, lead and mercury are mined.

Huancavelica was made famous by its mercury deposits, which were of great importance during the colonial period. The Santa Bárbara mine, some 2,000 ft. (610 m.) above the town, was acquired by the Spanish crown in 1570. Mercury was essential in the extraction of silver from the native ore; and with the decline of silver mining in the 19th century, mining of mercury also decreased. Mining was resumed by the Fernandini interests after the railroad gave access to a shipping port in 1926, but the Huancavelica mines were

high-cost producers at mid-20th century.

See A. P. Whitaker, *Huancavelica Mercury Mine* (1941). (P. E. J.)

HUANCAYO, a city of central Peru (pop. [1961] 46,014), capital of the department of Junín (*q.v.*). It lies at 10,690 ft. above sea level on a plain watered by the Mantaro river and has a temperate climate. The city, founded by the Spaniards in 1538 on an old Inca highway, became an important centre for mining and agriculture. Mineral resources of the surrounding region include copper, silver and coal; wheat, barley, maize (corn) and potatoes are cultivated there. Of greatest interest to the tourist are the renowned Sunday market, attended principally by Indians from nearby areas; the Carnegie Magnetic observatory (now a facility of the Peruvian government); the Saturday fair at Chupaca; and the convent of Ocopa. Huancayo is situated 77 mi. S.E. of La Oroya and may be reached by the central highway from Lima to Cuzco and by the central railroad. The distance from Lima is 195 mi. (J. L. Tr.)

HUÁNUCO, a central sierra department of Peru (pop. [1961] 361,688; area 13,635 sq.mi.), bounded north by La Libertad and San Martín, east by Loreto, south by Junín, west by Lima and Ancash. The department, forming a saddle between the central and eastern cordilleras, is watered by the Ucayali, the Huallaga and the Marañón rivers. It is crossed by the trans-Andean highway extending from Lima to Pucallpa on the Ucayali, a distance of 522 mi.

The city of Huánuco (pop. [1961] 24,606), the departmental capital, is a popular overnight stop on the two-day journey. It lies at 6,271 ft. above sea level on the upper Huallaga. Founded in 1539 by Gómez de Alvarado, Huánuco city is situated in a beautiful valley, and the climate is referred to as "perpetual spring." Crops cultivated in the region include fruits, cereals, maize (corn), potatoes, coffee, sugar, cotton, tobacco and coca. Cattle, sheep and hogs are bred extensively. Important mineral resources of the department are gold, silver, mercury, coal, iron, copper and petroleum. The population is chiefly Indian and mestizo. Tingo María, located in the montaña, lies 83 mi. N.W. of Huánuco city. (J. L. Tr.)

HUÁSCAR (Inti Cusi Huallpa Huáscar, "sun of joy") (d. 1533), Inca emperor of Peru. He was, according to Peruvian historian Garcilaso de la Vega, the legitimate heir of the Inca Huayna Capac and succeeded him in 1525. But he was only given part of the empire (Cuzco), about one-fifth of it (Quito) being left to a younger half brother, Atahualpa (*q.v.*). Atahualpa soon began to tire of the limits upon his power and started an armed rebellion. The troops of Huáscar were utterly routed at Tumibamba and Atahualpa installed himself in a favoured Inca residence at Cajamarca. From there he sent his generals to conquer central Peru and Huáscar fled Cuzco with the remnants of his dwindling army. He was finally apprehended by Atahualpa's men. This was the state of affairs when Francisco Pizarro arrived with his Spanish force in Tumbes in 1532. Pizarro at first posed as a friend of the captive, claiming to aid the legitimate Inca, but he was unable to prevent the assassination of Huáscar. Just how Huáscar came by his death is not known.

See J. Alden Mason, *The Ancient Civilizations of Peru* (1957). (U. S. L.)

HUASTEC, an isolated group of American Indians belonging to the Maya linguistic family, who live west of Tampico to Ciudad de Valles and southeast to Tantoyuca, in northeastern Mexico. In the 1960s the majority lived scattered on government-owned land, a minority on family-owned plots. The economy is based on agriculture, with "slash and burn" methods persisting and the planting stick and machete being used for cultivation. The major crops are corn, beans, squash, sesame, sweet potatoes, chili and coffee, and wild fruits are also gathered. Clay jugs, fibre bags and palm mats are manufactured.

Religion centres around the belief in evil winds (*espanto*) and the evil eye, as well as witchcraft. Witches (*brujos*) are held to effect their ends by injecting material objects, and curing specialists (*thimanchic*) are believed to cure the victims by locating and extracting the objects. Alligator teeth and other amulets are believed to protect children from misfortunes. Omens, particularly bird calls, are said to portend misfortune and death. Personal belongings are buried with the corpse for use in the future world along with candles of beeswax thought to light the path of the dead. Violations of tabus during life are held to change the violator to animal form after death. Schools brought about increased acculturation and weakened the authority of the elders. Local government is under regional supervision. Older marriage practices involving a go-between are breaking down in favour of individual arrangement.

The Huastec are divided into two dialect groups, San Luis Potosí (Potosino) and Vera Cruz (Veracruzano). The first Huastec publication appeared in the mid-16th century, and *Vocabulario Huasteco,* simple stories and portions of the Bible are extant in Huastec. The problem of the relation of the Huastec to the Maya Indians of Yucatán and Guatemala is a subject of continuing research. *See* Indian, Latin-American. (R. S. La.)

HUBAY, JENŐ (1858–1937), Hungarian violinist and composer, the most influential figure of his time in the Hungarian school of violinists. Son of the violinist, composer and conductor Karl Huber (d. 1885), his name was originally Eugen Huber. Born at Budapest on Sept. 15, 1858, he studied the violin at Berlin with Joseph Joachim. Following his success in 1878 in Paris, where he had been recommended by Liszt, he came under the influence of Henri Vieuxtemps, whose works he later edited. He taught at the conservatories at Brussels (1882) and Budapest (1886), his pupils including Joseph Szigeti and Jelly d'Aranyi, and he also formed celebrated string quartets in these towns. His works for the violin, including four concertos, show the influence of Vieuxtemps and of Hungarian folk music. The most successful of his operas was *A Cremonai hegedüs* ("The Violinmaker of Cremona," Budapest, 1894). He died at Budapest on March 12, 1937.

See *The Memoirs of Carl Flesch,* Eng. trans. by H. Keller (1957).

HUBBARD, ELBERT GREEN (1856–1915), U.S. author, editor and publisher, was born in Bloomington, Ill., on June 19, 1856. He founded his Roycroft press at East Aurora, N.Y., on the model of William Morris's (*q.v.*) communal Kelmscott press, which he had visited in England. Beginning in 1894 he monthly issued the famous "Little Journey" booklets, pleasant biographical essays in which fact was interwoven with comment and satire, and *The Philistine,* an avant-garde magazine. In an 1899 number of *The Philistine* "A Message to Garcia" appeared, the most famous single piece he wrote (the importance of perseverance was drawn as a moral from a Spanish-American War incident).

In 1908 Hubbard began to edit and publish a second monthly, *The Fra.* His printing establishment in time expanded to include furniture and leather shops, a smithy and an art school, the aim being to create articles of the fine craftsmanship that had prevailed before the Industrial Revolution. He died in the sinking of the "Lusitania" on May 7, 1915.

Hubbard's writings contain a bizarre mixture of radicalism and conservatism. He apotheosized work and efficiency in a vigorous, epigrammatic style. His works include *Time and Chance* (1899); *So Here Cometh White Hyacinths* (1907); *The Man of Sorrows* (1908); and the *Roycroft Dictionary* (1914). Valuable collections are "Little Journeys" (14 vol., 1915), and "Selected Writings" (14 vol. 1923). His *Scrap Book* (1923) and *Note Book* (1927) were published posthumously.

HUBBLE, EDWIN POWELL (1889–1953), U.S. astronomer, who, working with the large telescopes of the Mount Wilson and Palomar observatories, accumulated a wealth of significant data that was fundamental in character and important to the theories of cosmology. Hubble was born Nov. 20, 1889, in Marshfield, Mo. Following undergraduate study at The University of Chicago, he attended Oxford as a Rhodes scholar. He returned to Chicago and in 1917 received the Ph.D. degree. After a period of research at the Yerkes observatory (1914–17), he enlisted in the U.S. army and served with the American expeditionary force in France. In 1919 he joined the astronomy staff of the Carnegie Institution of Washington's Mount Wilson observatory, where he remained until his death, Sept. 28, 1953, in San Marino, Calif.

Hubble's discovery in 1923 of a distance-indicating Cepheid variable star in the Andromeda nebula furnished the first certain

evidence that extragalactic nebulae were situated far outside the boundaries of our own galaxy, in fact were independent stellar systems. He surveyed nebulae to very faint limits and found the large-scale distribution approximately uniform in all directions with numbers increasing at a constant rate as fainter limits were reached. From a study of several thousand photographs he derived the first significant classification system for extragalactic nebulae. He announced in 1929 his important finding that velocities (red shifts) of nebulae increase in a linear manner with distance. The relation, $H = 180$ km./sec. per 10^6 parsecs, is known as "Hubble's law of the red shifts" or "Hubble's constant."

Other important research results appear in papers on extragalactic nebulae as stellar systems, novae in nebulae, distribution of luminosity in elliptical nebulae, nebulous objects in the Andromeda nebula identified as globular clusters, angular rotations of spiral nebulae, the luminosity function of nebulae and the direction of rotation in spiral nebulae.

In addition to Hubble's long scientific bibliography are the Silliman lectures at Yale university published under the title of "The Realm of the Nebulae"; reference should be made also to the Rhodes Memorial lectures given at Oxford, Eng., entitled "The Observational Approach to Cosmology." (M. L. Hn.)

HUBER, JOHANNES (1830–1879), German philosophical and theological writer, and one of the original leaders of the Old Catholics (*q.v.*) in Germany, was born in Munich, Aug. 18, 1830. He became professor of philosophy there in 1864. He strongly opposed the growing influence of the Jesuits and of scholasticism in the Roman Catholic Church, but was also a vigorous adversary of such writers as Darwin and D. F. Strauss with their apparent threat to the foundations of faith. Huber wrote many works, but his quarrel with the church dated from the publication in 1859 of *Die Philosophie der Kirchenväter*, which was placed on the Index the following year. In 1869 he joined Döllinger (*q.v.*) in the "Janus" letters, a series of newspaper articles criticizing the Vatican council, later published as *Der Papst und das Konzil*. He was also joint author with Döllinger of the *Römische Briefe vom Konzil*. Huber died in Munich, March 20, 1879.

See E. Zirngiebl, *Johannes Huber* (1881).

HUBER, LUDWIG FERDINAND (1764–1804), German playwright, critic and newspaper editor; the husband of Thérèse Huber (1764–1829), a notable woman of her time who was one of the first to recognize Goethe's significance. Huber was born in Paris; the exact date is uncertain. He was brought up in Leipzig, where he became the friend of Christian Körner and of Schiller. From 1787 to 1792 he was secretary to the Saxon legation at Mainz. There he conceived a passion for Thérèse, wife of the naturalist Georg Forster, and married her after Forster's death in 1794. From 1798 to 1803 he edited the *Allgemeine Zeitung*. He died in Ulm, Dec. 24, 1804. Huber wrote plays (*e.g.*, *Das heimliche Gericht*, 1790) as well as political commentary. His criticism may be found in his *Vermischten Schriften* (2 vol., 1793). The stories published under his name were by Thérèse, who published his works with a biography (4 vol., 1806–19).

See L. Geiger, *T. Huber* (1901); F. Ernst, *Essays*, vol. 2 (1946).

HUBERT, SAINT (d. 727), the "Apostle of the Ardennes," succeeded St. Lambert as bishop of Maastricht in 705 after Lambert's murder. He had Lambert's remains buried at Liège, then only a village, in a church which Hubert built at the site of the murder and made his cathedral church, transferring to Liège the see of Maastricht. Hence Hubert is regarded with great devotion in Belgium as the founder of the city and diocese of Liège. Most of the incidents related of him—such as his conversion while hunting on Good Friday by the miraculous appearance of a stag bearing between its horns a cross or crucifix surrounded by rays of light—first occur in lives written in the 12th and 14th centuries. Because of that legend he is regarded as the patron of hunters; he is also invoked against rabies. His feast day is Nov. 3.

(J. N. G.)

HUBLI, the principal city of Dharwar district in the Belgaum division of Mysore state, India, lies 13 mi. S.E. of Dharwar, with which it was incorporated in 1961. Pop. (1961) 171,326. The city, properly Hubballi or Pubballi ("old village"), centres around an 11th-century stone temple of Aharanishankar. The new Hubli was founded in 1727. The places of interest include the Mahadi mosque, the Bhavani Shankar temple and the town hall. The colleges in the city, affiliated to Karnatak university (Dharwar), include those of arts, sciences, commerce, medicine and engineering. Hubli is a trading centre and has cotton mills, ginning and pressing factories and railway and road transport workshops. It is the divisional headquarters on the Southern railway and also a road junction with roads radiating in all directions. (M. R. P.)

HUC, ÉVARISTE RÉGIS (1813–1860), French Vincentian (Lazarist) missionary traveler in central Asia, was born at Caylus (Tarn-et-Garonne) on June 1, 1813. He entered the Paris seminary of the Congregation of the Mission and in 1839 was sent to Macao. Living first in south China and later in Peking, he was posted to Hei-shui, 300 mi. north of Peking. In 1844, with another Vincentian missionary, Joseph Gabet, and a Tibetan Christian, he set out from Dolon Nor and after an exacting journey he and his companions arrived in Lhasa in Jan. 1846, the first Europeans since Thomas Mann (1811) to set foot in the city. Though the Tibetans were friendly, the Chinese imperial commissioner had the missionaries expelled. They reached Canton in Sept. 1846. Huc returned to Europe in 1852 and left the Congregation in 1853. He took part in the negotiations which preceded the Franco-Cochin Chinese war in 1858. On March 26, 1860, he died in Paris.

Huc's most important work, *Souvenirs d'un voyage dans la Tartarie, le Thibet et la Chine* (1850), has been much reprinted (English translation by W. Hazlitt [1851]; new edition, introduction by P. Pelliot [1928]). Recent editions are by J. M. Planchet (1924) and H. d'Ardennes de Tizac (1925–26). The authenticity of his journey was questioned by the Russian explorer N. M. Prjevalsky (1839–88) but was vindicated by H. Yule in the English translation of Prjevalsky's *Mongolia* (1876) and by Prince H. P. d'Orléans in *Le Père Huc et ses critiques* (1893). (R. L. Hl.)

HUCBALD, the name of two medieval musical theorists.

Hucbald (*c.* 840–*c.* 930), scholar and humanist, was born *c.* 840, possibly at Tournai. Mention of him is found at Nevers, St. Amand (near Valenciennes), St. Omer, Reims and again at St. Amand, where he died, *c.* 930. A pupil of his uncle, the scholar Milo of St. Amand, he became *magister scholarum* and later an abbot and appears to have spent his life teaching. He is the author of the treatise *De harmonica institutione*, which describes the gamut and the eight modes. He was also the author of a number of poems, metrical prayers for the offices and hymns.

His homonym, known as Pseudo Hucbald, lived somewhat later. J. Smits van Waesberghe identifies him with Count Otger of Laon, a lay abbot of St. Amand. Almost no information is available concerning his activities but his theoretical works are of great importance. These include *Musica enchiriadis* (more correctly *Enchirias de musica*), *Scholia enchiriadis* and *De alia musica*, a treatise dealing with a notational system known as daseian notation. Pseudo Hucbald was the first theorist to describe the theory of parallel organum, put forward not as a new theory, however, but as based on ancient writings that unfortunately have not survived.

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The treatise of Hucbald is published in *Scriptores ecclesiastici de musica*, vol. i (1784), ed. by M. Gerbert, which also contains the treatises of Pseudo Hucbald. (S. Co.)

HUCH, RICARDA (1864–1947), the most distinguished German woman writer of the early 20th century, was born at Brunswick on July 18, 1864. After studying history at the University of Zürich she worked for a short time as library assistant and then schoolteacher. Her lyrical poetry, written from youth onward, is in traditional forms, with simple, bare strength and sincerity. The first novel, *Erinnerungen von Ludolf Ursleu dem Jüngeren* (1893; Eng. trans., *Eros Invincible*, 1931), reflects the rebellious passion of her love for her cousin Richard Huch, a law-

yer, whom she married in 1907 after separating from her first husband, Ermanno Ceconi, a dentist. *Aus der Triumphgasse* (1902) gives a striking picture of life in the poorest quarters of Trieste, where she and her first husband lived for a time. In addition to these and other novels, Ricarda Huch wrote a number of shorter tales which are among her best-known work; here she follows in the traditions of such 19th-century writers as C. F. Meyer and Gottfried Keller. After literary criticism in *Die Romantik* (1899, 1902) much of her energy was devoted to sound historical writing, as in *Der grosse Krieg in Deutschland* (3 vol., 1912–14) and other works. After separating from her second husband in 1910 she lived mainly in Munich until 1927, and then in Berlin, Heidelberg and Jena. During World War I she turned from the aesthetic romanticism of her earlier years to an ethical and religious outlook which found its centre in Lutheran Protestantism. She was from 1933 a decided opponent of National Socialism. She died at Schönberg near Frankfurt am Main on Nov. 17, 1947.

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HUCHOW (HU-CHOU, formerly WU-HSING or WUHING), a Chinese city in northern Chekiang province, lying south of Tai Hu (lake). Pop. (1953) 62,700. The T'iao Ch'i (river) runs through the city, which lies about 40 mi. N. of Hangchow and 120 mi. W.S.W. of Shanghai. Huchow was the last stronghold of the T'ai P'ing rebellion (1864). Its *hsien* or district is the centre of the Yang-tzu delta silk region where mulberry bushes are cultivated. To the east is the small town of Nan-hsin, a silk and salt mart which is linked to Huchow by a canal that continues eastward into the Grand canal (Yün Ho). Southwest of the district rises the beautiful forested mountain and noted resort of Mo-kan-shan. Although competition from Shanghai, Wu-shih and Hangchow prior to World War II had decreased its silk industry, Huchow retained many silk filatures, or reeling establishments, which processed most of the local cocoons, while it exported cocoons as well as raw silk. (H. J. Ws.)

HUCHOWN "of the Awle Ryale," a poet who lived, if he lived at all, in the 14th century. The only reference to him is in Andrew of Wyntoun's *Oryginale Chronykil of Scotland* (*c.* 1420):

> He made a gret Gest of Arthure,
> And the Awntyr of Gawane,
> The Pistil als of Suet Susane.
> He was curyousse in his stille,
> Fayr of facunde and subtile,
> And ay to pleyssance hade delyte. . .
> (Cott. Ms. V. 11, 4308 ff.)

Of the three poems here attributed to Huchown, the third is the only one which can be identified with certainty. *The Pistill of Susane*, a version of the story of Susannah and the Elders in 13-lined alliterative stanzas, survives in five manuscripts: Add. Ms. 22283 (*c.* 1390) and Ms. Cott. Caligula A II (*c.* 1430) in the British museum, London; Vernon Ms. (*c.* 1375) in the Bodleian library, Oxford; and two others privately owned (ed. by D. Laing, *Select Remains* [1822]; E. Horstmann in *Anglia*, vol. i [1877]; F. J. Amours, *Scottish Alliterative Poems*, for the Scottish Text society, 2 vol. [1892, 1897]).

The "Gest of Arthure" has been reasonably identified as the *Morte Arthure*, a romance based on Geoffrey of Monmouth's *History*, in more than 4,000 unrhymed alliterative lines, and surviving in the Thornton Ms. in Lincoln Cathedral library (ed. by E. Brock for the Early English Text society [1871]; *see* E. Trautmann in *Anglia* [1877]).

The identity of the "Awntyr of Gawane" is disputed; suggestions include *The Awntyrs of Arthure at the Terne Wathelyne*, a romance in 13-lined romance stanzas surviving in the Thornton Ms. and in two others (ed. by D. Laing and by F. J. Amours, as above). Taking account of these attempts to identify the poems mentioned by Wyntoun, common authorship is unlikely; and it is probable that Wyntoun was misled by the chance contiguity of the three in a single manuscript.

It has been assumed from Wyntoun's reference that Huchown was a Scottish poet. But the *Pistill of Susane* shows no linguistic traces of Scottish origin; the extant copies are English, and it is very unlikely that a Scottish poem could be taken south early enough for an anglicized copy of it to occur in a southern manuscript written before 1400 (*see* W. A. Craigie in *The Proceedings of the British Academy*, xxviii [1942]). There is only the interest of misdirected ingenuity in the attempts to identify Huchown with Syr Hew of Eglintoun (d. 1377), justiciary of Lothian, and perhaps lamented in Dunbar's *Timor mortis conturbat me* but otherwise unknown as a poet (*see* G. Neilson, *Sir Hew of Eglintoun and Huchown* [1901] and *Huchown of the Awle Ryale* [1902]). Henry Bradley thought Huchown of Cumbrian origin (*Collected Papers*, [1928]); S. O. Andrews in *The Review of English Studies*, vol. v (1929) places him in the northwest midlands. But he remains a shadow. (J. Ky.)

HUCHTENBURGH (HUGTENBURG), **JAN VAN** (1647–1733), Dutch painter of hunting and battle scenes, was born in Haarlem, where he studied under Thomas Wijck. As a youth he traveled to Italy, where he joined his elder brother, the landscape painter Jacob van Huchtenburgh (1640/43–1675), in Rome. In 1667 he was in Paris, where he was employed as a tapestry designer at the Gobelins factory under Charles Le Brun and A. F. van der Meulen. In 1670 he was back in Haarlem and was married there in the same year. He worked in Haarlem and Amsterdam (where he died in July 1733), and in 1708–09 went to Italy in the service of Prince Eugene of Savoy. The style and subject matter of his pictures derive from Philips Wouwerman and Van der Meulen, progressing from hunting scenes, robber encampments and cavalry skirmishes to large-scale battle pictures. Many of these are in the major European galleries, including a series, depicting Eugene's battles, in the Turin (Italy) gallery. (R. E. W. J.)

HUCKABACK, or huck, in modern usage usually refers to a coarse linen or cotton cloth employed for toweling. In the 18th and early 19th centuries in the U.S. the weave was used for handwoven linen or linen and cotton tablecloths as well as towels. The origin of the name is unknown.

The weave is composed of warp and weft which cross each other in units of three, five or seven threads, producing a uniform figure. The foundation is a strong, plain weave; the floats produce a fabric which is also soft and absorbent. (V. P. P.)

HUCKLEBERRY, the popular name in the United States for small fruit-bearing branching shrubs of the genus *Gaylussacia* (family Ericaceae). They resemble in habit the English bilberry (*Vaccinium*), to which they are closely allied, and bear fleshy fruit with ten nutlike seeds, differing in this respect from the blueberry. The common huckleberry of the northern states is *G. baccata* (also called black or high-bush huckleberry), while *G. brachycera* and *G. dumosa* are known respectively as box and dwarf or bush huckleberry. The florists' or evergreen huckleberry is actually a blueberry. Cultivation of huckleberries is essentially the same as for blueberries (*see* BLUEBERRY).

HUDAYDAH, AL (HODEIDA), the chief seaport of Yemen, capital of a *liwa* (province) and seat of the governor, lies on the Arabian coast of the Red sea. The population numbers over 30,000 and includes Somalis, Eritreans and other Africans and Indians. The harbour is an open unprotected anchorage, though there is a small boat harbour. Al Hudaydah is a nondescript town with few buildings of distinction left, but it usually presents a picture of considerable activity. The walled inner town has large stone-built houses. In the outer town are the well-stocked bazaars, covered by sacking, and there too, in open spaces, are stores of country produce, hides, skins, coffee and imported stocks of rice. An insanitary mass of thatched houses and sheds cluster close to the walls. There are extensive palm groves and gardens near the town but immediately beyond there is a wide expanse of desert. The water supply is poor and the wells are brackish. The principal government offices are near the sea front.

Al Hudaydah was of little importance until after the second Turkish conquest in 1849. It expanded as Turkish influence increased but declined again after their departure in 1918, when it was occupied by the British and handed over to the Idrisi. The Zeidi Imam recovered it in 1921 and during the Saudi-Yemeni war of 1934 it was occupied for a short time by the Saudis. After

World War II it again became an important port. In 1961 the Russians completed a deepwater harbour at the Katib (Ra's al Kathib) to the north and the Chinese a road to San'a' (90 mi. N.E.). There is telegraphic communication with San'a' and Al Luhayyah (Luhaiya), a port to the north. An airfield lies north of the town. (W. H. Is.)

HUDDE, JOHAN VAN WAVEREN (1628–1704), Dutch mathematician and statesman, who promoted Cartesian geometry and philosophy in Holland, was born at Amsterdam on April 23, 1628 and died there on April 15, 1704. He is regarded as the first to take literal coefficients in algebra as indifferently positive or negative. Two of his discoveries, dating from 1657–58, are known as Hudde's rules: (1) If r is a double root of the polynomial equation $a_0x^n + a_1x^{n-1} + \ldots + a_{n-1}x + a_n = 0$, and if $b_0, b_1, \ldots, b_{n-1}, b_n$ are numbers in arithmetic progression, then r is a root also of $a_0b_0x^n + a_1b_1x^{n-1} + \ldots + a_{n-1}b_{n-1}x + a_nb_n = 0$; (2) if the polynomial $a_0x^n + a_1x^{n-1} + \ldots + a_{n-1}x + a_n$ takes on a relative maximum or minimum value for $x = a$, then a is a root of the equation $na_0x^n + (n-1)a_1x^{n-1} + \ldots + 2a_{n-2}x^2 + a_{n-1}x = 0$. These were published in *Geometria a Renato Des Cartes*, edited by Frans van Schooten (2nd ed., vol. i, 1659). Hudde anticipated the power series expansion (1656) for $\ln(1+x)$ and the use of space co-ordinates (1657).

Born of a patrician family, Hudde served 19 times as burgomaster of Amsterdam, and in 1672 he directed the work of inundating Holland to obstruct the advance of the French army. He corresponded with Christiaan Huygens on problems of canal maintenance, probability and life expectancy; and Leibniz reported that Hudde's manuscripts, never published, contained many excellent results. (C. B. Br.)

HUDDERSFIELD, a municipal, county and parliamentary borough in the West Riding of Yorkshire, Eng., 15 mi. S.W. of Leeds and 184 mi. N.N.W. of London by road. Pop. (1961) 130,302. The town is on slopes of the Pennines where they merge, to the east, in the Lower Coal measures, and on the left bank of the Colne river, a tributary of the Calder. It has connections by rail and road with all the important towns of industrial northern England, and the Sir John Ramsden's canal links it with the Calder navigation.

Though there are traces of prehistoric and Roman occupation, Huddersfield (Oderesfelt in Domesday Book) rose to importance only after the introduction of the woolen trade in the 17th century; the suburb of Almondbury, where the Tudor Woodsome hall is now a golf club, was probably the original settlement. On Castle hill is an ancient British encampment. After the Conquest, William I granted the manor to Ilbert de Lacy. It passed to Thomas Plantagenet, earl of Lancaster, through his marriage with Alice de Lacy, and so to the crown. In 1599 Elizabeth I sold it to William Ramsden, whose descendants held it until 1920, when it was bought by the corporation. It contained 4,300 ac., mostly in the centre of the town. By the beginning of the 18th century Huddersfield had become a "considerable town," chiefly because of the manufacture of woolen kersies, which was aided by good local water; and toward the end of the same century, trade was increased by two events—the opening of navigation on the Calder in 1780 and the completion of the cloth hall or piece hall, built and given to the town by Sir John Ramsden in 1784. Originally erected as a clothiers' emporium, it was demolished in 1930 and partly re-erected at Ravensknowle park, Dalton.

The town is almost entirely modern, with great warehouses and business premises, built principally of gray gritstone. The market hall, on the site of the old Shambles, dates from 1878. The parish church of St. Peter was rebuilt in 1836–37 and occupies a site which has carried a church since the 11th century. There are a public library and art gallery, and a local history museum in Ravensknowle. The technical college, affiliated to the University of Leeds in 1905, started as a small society in 1841. The Huddersfield Choral society, the Glee and Madrigal society and the Association football team are well known. Huddersfield is the chief seat of the West Riding woolen and worsted industry, and rayon and cotton as well as wool yarns are made. Dyeing and textile machinery making are two of the many industries auxiliary to wool, and there are iron foundries and engineering works.

The town was incorporated in 1868 and created a county borough in 1888. It was made a parliamentary borough in 1832 and returns two members. Water supply and public transport undertakings are owned by the borough corporation.

HUDLESTON, JOHN (1608–1698), English Roman Catholic priest and Benedictine monk, one of those who helped King Charles II after the battle of Worcester, reconciled the king to the Roman Catholic Church on his deathbed. He was born at Farington Hall in Lancashire on April 15, 1608, and educated at Great Blencow in Cumberland, at St. Omer and at the English college in Rome. In 1651 he was living at Moseley in Staffordshire as chaplain to the Whitgrave family; there, during the night of Sunday, Sept. 7, King Charles was brought in disguise. Two days later soldiers came to search the house, and the king and Hudleston were shut away in the priest's hiding hole; however, the troops were persuaded to leave without a search. After the Restoration Hudleston became chaplain to the queen. On Feb. 5, 1685, between 7:00 and 8:00 P.M., the duke of York brought Hudleston to the dying king. Hudleston heard his confession and gave him absolution, extreme unction and the viaticum. He left an account of the scene in his own words, *A Brief Account of . . . the Happy Death of Our Late Sovereign* (1688). Hudleston died in 1698 and was buried on Sept. 13 in the churchyard of St. Mary le Strand.

See T. Blount, *Boscobel* (1660). (J. D. A.)

HUDSON, GEORGE (1800–1871), English railway financier, who by 1844 controlled more than a thousand miles of railway, was born in York in March 1800. He rose from apprenticeship in the drapery business to partnership in the firm and, on receiving a £30,000 bequest in 1827, invested it in North Midland railway shares. He helped to secure the passage of an act of parliament to raise capital for the York and North Midland railway and was subsequently appointed chairman of that company. In that year the mania for railway speculation was at its height, and no man was more courted than the "railway king." Deputy lieutenant for Durham and thrice lord mayor of York, he was returned as a Conservative member of parliament for Sunderland in 1845. He was suddenly ruined by the disclosure of the Eastern Counties railway frauds, losing influence and fortune at a single stroke. The rest of his life was spent mainly in litigations and attempts to operate financially abroad. He died in London on Dec. 14, 1871.

See R. S. Lambert, *The Railway King* (1934). (W. H. D.)

HUDSON, HENRY (d. 1611), English navigator and explorer, made four voyages seeking a short route to China by way of the Arctic ocean. His first voyage was made for the Muscovy company in 1607. Sailing to east Greenland, he traced the boundary of sea ice eastward to Spitsbergen, reaching a previously unknown portion of the coast in approximately 80° N. lat. On the homeward voyage he discovered an island in about lat. 71° which he named Hudson's Tutches, now called Jan Mayen (*q.v.*). His reports led to the establishment of the English whale fisheries at Spitsbergen.

On April 22, 1608, the Muscovy company dispatched Hudson to seek a northeast passage to China between Spitsbergen and Novaya Zemlya. He scoured Barents sea, vainly seeking a passage. Before docking at Gravesend on Aug. 26, Hudson's mind had already turned to a search for a northwest passage.

Later that year Hudson was invited to Amsterdam to consider undertaking explorations for the Dutch. With a Dutch and English crew, Hudson sailed from the island of Texel, North Holland, in the "Half Moon" on April 6, 1609, for his third exploration. By May 5 he was in Barents sea, encountering ice off Novaya Zemlya. Some of his men becoming mutinous, he offered to go either to Lumley inlet or to seek a passage through Virginia in about 40° N. lat. The latter plan was adopted, and on May 14 Hudson set his face toward the Chesapeake. On Sept. 3 he entered New York harbour. After ascending the river which bears his name some 150 mi. to the vicinity of the present Albany, parleying with the Indians, surveying the country and trying the stream above tidewater, he concluded that this channel did not lead to China. On Oct. 4 the "Half Moon" left for the Texel and on Nov. 7 arrived at Dartmouth, where she was detained by the English govern-

ment. Hudson and the other Englishmen aboard were commanded henceforth to serve their own country. The voyage exploded the myth that near 40° N. lat. only a narrow isthmus, like the isthmus of Panama, separated the Atlantic and Pacific oceans.

A new company was formed to support Hudson in another attempt on the northwest passage, the principal promoters being Sir Thomas Smythe, Sir Dudley Digges and John Wolstenholme. Hudson determined to carry out his old plan of searching for a passage up Davis strait. Sailing from London in the ship "Discovery" (55 tons) on April 17, 1610, Hudson entered the strait which bears his name about mid-June. He reached Hudson bay on Aug. 3 and spent three months examining the eastern shore of the bay. On Nov. 1 the "Discovery" went into winter quarters in the southwest corner of James bay, being frozen in a few days later. After the ship broke out of the ice in the spring, Hudson was accused of unjust distribution of rations. A young protégé of Hudson's, Henry Greene, incited part of the crew against him. Hudson, his young son and seven others were put in a small boat on June 22, 1611, and set adrift. Robert Bylot was elected master. During the voyage home Greene and several others were killed in a fight with the Eskimos. A portion of the remnant that reached England, in September, were later brought to trial, but were adjudged not guilty. Nothing was ever heard of the deserted men. An expedition sent out the next year failed to find them. The remains of a structure found in 1631–32 may have been built by Hudson's party.

The three great geographical landmarks which keep Hudson's memory alive—Hudson bay, strait and river—had repeatedly been visited and even drawn on charts before he set out on his voyages; but he carried his discoveries beyond the limits of his predecessors. The fisheries of Spitsbergen and the fur industry of the Hudson bay region were the immediate fruits of his labours.

See also ARCTIC, THE.

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HUDSON, WILLIAM HENRY (1841–1922), British writer and naturalist, described himself as "a field naturalist who takes all life for his field . . . an observer of everything he sees," and in his novels and essays shows both observation and enjoyment of all aspects of nature, to which he gives almost visionary significance by the imaginative power of his descriptions.

Born near Buenos Aires, Arg., on Aug. 4, 1841, of American parents, he spent his childhood—lovingly recalled in *Far Away and Long Ago* (1918)—on the pampas, but illness and wide reading developed tendencies to solitariness and introspection and Darwin's *Origin of Species* made a deep impact. After his parents' death, he led a wandering life. Little is known of this period or of his early years in England, where he settled in 1869 (although not naturalized until 1900). Poverty and ill-health may have occasioned his marriage in 1876 to a woman much older than himself. He and his wife lived precariously on the proceeds of two boarding-houses, until she inherited a house in Bayswater where Hudson spent the rest of his life, and where he died on Aug. 18, 1922.

His early books, romances with a South American setting, weak in characterization but imbued with a brooding sense of nature's power, sometimes symbolized by the pampas, sometimes by the South American forest, attracted little attention. The first, *The Purple Land*, 2 volumes (1885), was followed by several long short stories, collected in 1902. "El Ombú," the title story, is one of his best, containing scenes of horrifying intensity. His last romance, *Green Mansions* (1904), is the strange love story of Rima, half-bird and half-human. She is the best-known of his characters, and is the subject of the statue by Jacob Epstein in the bird sanctuary erected in Hudson's memory in Hyde park, London, in 1925.

The romances secured Hudson the friendship of Joseph Conrad, Ford Madox Ford, Edward Garnett, George Gissing and others. His books on ornithology (*Argentine Ornithology*, 1888–99; *British Birds*, 1895; etc.) brought recognition from Sir Edward Grey, who procured him a civil list pension in 1901. Fame came with his books on the English countryside—*Afoot in England* (1909), *A Shepherd's Life* (1910), *Dead Man's Plack* (1920), *A Traveller in Little Things* (1921) and *A Hind in Richmond Park* (1922). These, by their detailed, imaginative descriptions, conveyed, in usually sensitive prose, the sensations of one who accepted nature and in some sense entered into it, and did much to foster the "back to nature" movement of the 1920s and 1930s.

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HUDSON BAY, a large gulf or inland sea in northeastern Canada, is an extension of the Atlantic ocean separating Baffin Island from mainland Canada. In this broad sense it includes Hudson bay proper, James bay, Foxe channel, Foxe basin, Hudson strait and Ungava bay. Its area is about 480,000 sq.mi. (Hudson bay proper, 250,000 sq.mi.). The length of the mainland coast line alone exceeds 4,400 mi. Islands, including Baffin itself and island groups—Foxe basin, Southampton, Hudson strait, Belcher and James bay—increase this total by at least 70%. It is bordered by Quebec on the east and by Ontario, Manitoba and the Northwest Territories on the west and south, its islands comprising a part of the latter.

Most of Hudson bay proper has depths of between 120 and 600 ft., increasing to 846 ft. in a submarine valley extending from about 61° N. to 88° W. toward Hudson strait. The strait itself is mostly 600–1,200 ft. deep, though a depth of 2,886 ft. occurs at the eastern end. Ungava bay and Foxe channel are generally shallower than 420 ft.; Foxe basin and James bay, shallower than 180 ft.

The waters of Hudson bay are cold, being chiefly of Arctic origin; they have low salinity values because of dilution by numerous tributary rivers. Having been funneled southeastward through Fury and Hecla strait, the Arctic sea water develops major counterclockwise circulations in Foxe basin and in Hudson bay proper, finally discharging eastward along the south side of Hudson strait. Minor counterclockwise circulations also prevail in James and Ungava bays. Hudson strait's north shore is dominated by an inflow of mild, saline water from the Labrador sea, which, however, recurves southwards and eastwards to join the main Hudson bay outflow.

Most of the Hudson bay system, which is situated between 65° and 95° W. and 52° and 70° N., is covered with floating ice from January until May. In Hudson bay proper there is usually a strip of fast ice along the shore, separated from a vast central ice mass by a strip of open water. The central mass is relatively thin, smooth and unbroken. Beginning late in May, melting and disintegration spread northward from James bay, and by mid-September Hudson bay proper is entirely free of ice. In Foxe basin and Foxe channel open leads may occur anywhere during wintertime; the ice is much older, thicker and rougher than in Hudson bay proper. This northern ice is slow to melt in summer: large masses of it persist in the eastern part of Foxe basin; other masses float through Foxe channel to western Hudson strait, where their progress is impeded by Nottingham, Mill and Salisbury islands. Usually no serious ice jam develops there, but navigation of the bottleneck is liable to be difficult in cool years. The main part of Hudson strait is never completely ice-covered because of the frequency of winter storms; by late summer it is usually ice-free.

Hummocky or, locally, hilly rocks of the Canadian shield form the coast around the greater part of Hudson bay, but limestone plains occur on the south coast, on Southampton, Coats and Mansel islands and around Foxe basin. The whole region lies north of the tree line, except for southern James bay. Spruce, balsam and poplar grow to a fair size as far as the northern limit of James bay. Caribou, musk ox and other animals are found in large numbers, and there is an abundance of feathered game—ducks, geese, loons and ptarmigan; hunting and fishing form the chief occupation of the Indians and Eskimos who live in scattered bands near the shore. The bay abounds with fish, of which the chief are cod and salmon. Whales were formerly pursued by American whalers, whose destructive methods greatly depleted the supply.

Completion of a railway from Saskatchewan to Churchill in 1931

led to the development of a shipping route through Hudson strait to Europe (the first shipment being made in 1931), for the distance from Edmonton to Liverpool via Churchill is almost 1,000 mi. less than via Montreal. Despite this advantage the Hudson route long suffered from high insurance rates, chiefly because accurate ice distribution and forecast data were lacking. By the second half of the 20th century, however, Churchill was handling 50–60 cargo vessels a year, exporting 18,000,000–20,000,000 bu. of wheat, and importing manufactured goods.

Another railway, to Moosonee at the head of James bay, was completed in 1932. Other economic developments include those at Rankin inlet (nickel mining), Richmond gulf (iron and lead mining), Wakeham bay (nickel mining), Coral harbour (airfield) and Hopes Advance bay (iron mining and concentrating). Settlements providing trading centres for Indian and Eskimo trappers exist at Fort Chimo, Port Harrison, Chesterfield Inlet, Igloolik and many other places.

Hudson strait may have been discovered by the Cabots as early as 1498, but no deep westward penetration was achieved until 1610, when Henry Hudson traced the Canadian mainland coast from Ungava bay to James bay. Two years later Sir Thomas Button mapped the west coast of Hudson bay proper. In 1631 Captain Thomas James traced much of the south coast, and Luke Foxe discovered Foxe channel. The west coast of Foxe basin was not mapped till 1821–23 by Sir William Parry; Prince Charles, Air Force and Foley islands, near the east coast, were not charted until 1948.

See also RUPERT'S LAND; HUDSON'S BAY COMPANY.

(H. R. TN.)

HUDSON RIVER, situated entirely within the state of New York, originates in several small, postglacial lakes in Essex county near Mt. Marcy, the highest point in the state. For about 108 mi. it pursues a winding course, flowing generally southeast to Corinth in Saratoga county and then northeast to Hudson Falls at the northern end of what is called the Hudson valley. From there it flows without significant gradient almost directly south for nearly 200 mi. to the Battery at the head of New York's Upper bay. As it descends from the Archean (Pre-Cambrian) Adirondack province to the younger Hudson-Champlain trough it drains an area of 13,370 sq.mi. For 150 mi. from its mouth, the Hudson is a drowned valley and as such is an arm of the sea. Tides are felt as far north as the federal dam at Troy, where the mean tidal range is 4.7 ft., with a maximum record after freshets of 33.4 ft. In width, the Hudson ranges from $\frac{3}{4}$ mi. at its mouth to 3 mi. at Haverstraw bay (between Harmon in Westchester county and Haverstraw in Rockland county), with the section to the south of this, called Tappan Zee, almost attaining this width. Upstream of Haverstraw bay to the head of navigation at Waterford, it narrows unevenly from about 1 mi. to a few hundred feet. Along its final 17 mi., where it is called North river, it forms part of the eastern boundary of New Jersey. Total river length is 306 mi.

Navigation and Commerce.—The most important tributary of the Hudson is the Mohawk, which enters at Waterford, north of Troy. Together these constitute one of the world's major waterways—a passage of such shallow gradient that it has long been the principal route through the Appalachian barrier. Improvement of the Hudson began in 1797, at first by the state, then jointly with the federal government and, since 1892, by the latter alone. Canalization of the Mohawk proceeded simultaneously. The controlling depth of the Hudson is 27 ft. at Albany and 14 ft. from Albany to the mouth of the Mohawk, a distance of about 155 mi. This is sufficient for deepwater navigation to Albany and for through tugbarge traffic to the Great Lakes via the canalized Mohawk and the New York state barge canal. The lower river is open year-round; and to Albany the navigation season is 12 months for ocean-going ships and 8 months for barges. Principal items in the tonnage of river-borne commerce are sand, gravel and crushed rock; petroleum and its products; coal and lignite. Passenger service has dwindled to a few excursion boats, largely because of the efficiency of parallel transportation, both highway and rail, including the New York state thruway, which follows the Hudson-Mohawk depression to Buffalo.

The addition of bridges also has led to the abandonment of ferries in many places. Important bridges south of Albany are the Rip van Winkle (1935) at Catskill; the Kingston-Rhinecliff (1957); the Mid-Hudson (1930) at Poughkeepsie; the Bear Mountain (1924) near Peekskill; the Tappan Zee (1956) at Tarrytown; and the George Washington (1931) at New York city. Vehicular and railway tunnels under the river also connect New York city with northern New Jersey.

Although the Hudson valley is famous for its scenery and is used mainly for dairying, fruitgrowing, recreation and travel, industry and commerce are noteworthy north of the New York metropolitan area in such cities as Nyack, Tarrytown, Haverstraw, Ossining, Peekskill, Newburgh, Beacon, Poughkeepsie, Kingston, Saugerties, Catskill, Hudson, Albany, Troy, Cohoes and Glens Falls.

History.—The Florentine navigator Giovanni da Verrazano sailed a short distance up the Hudson in 1524, but the river rightly bears the name of Henry Hudson, who explored it in 1609. Dutch settlement of the valley began in 1629, but for over 200 years tenants were denied title to the land under an aristocratic patroon system, which created along the river a series of large and elegant estates. The region possessed a serene scenic beauty that formed a background to the stories of Washington Irving and inspired the Hudson River school of art and architecture.

In the American Revolution the Hudson was a strategic waterway and was the site of many historic events; including the decisive victory over Burgoyne at Saratoga and the naval battle of Tappan Zee, during which an enormous chain was stretched across the river between Gee's point and Constitution Island to prevent the passage of British ships. Benedict Arnold, while military commander of the forts in this locality, planned to surrender them to the British. He made his escape from his quarters on the east bank near the site of the village of Garrison to a British ship anchored in the river below. Washington made his headquarters at Newburgh in 1782 and later disbanded the continental armies from there.

During the 19th century the Hudson traffic flourished, particularly after the opening of three canals—the Erie, the Delaware and Hudson and the Champlain—that linked New York city with the Great Lakes and with the Delaware and lower St. Lawrence valleys. The waterway was thus a key factor in the growth of New York city. (*See* also ERIE CANAL.) Practical American steam navigation was begun on the Hudson by Robert Fulton in 1807, and the river rapidly gained in importance as a highway for passengers and goods. Its main towns owed their early prosperity to the whaling trade, but later they became home ports for interocean merchant fleets. Local industries other than whale-processing included brickmaking, leather fabricating, lumbering, fishing, ice storage and quarrying.

Many of the Hudson river estates have become schools or institutions, and the colourful paddle wheelers and sailing ships are things of the past; but the magnificence of Hudson valley scenery, especially in its lower portion, remains one of the great natural attractions of North America.

See also references under "Hudson River" in the Index volume.

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HUDSON'S BAY COMPANY, a corporation consisting of "the Governor and Company of Adventurers of England trading into Hudson's Bay" incorporated on May 2, 1670, to seek the northwest passage, occupy the lands adjacent to Hudson bay, and carry on any commerce with those lands that might prove profitable. In fact only the fur trade throve, and that trade was the principal object in view when the company was formed. But the company was a band of proprietors such as those who had colonized North and South Carolina a few years before, and had the shores of Hudson bay been habitable, the company might have established English colonies there. As things turned out, the company's lordship of the soil had little significance until the 19th century, and it was a fur trade company during its first two centuries of existence. After 1870 it turned increasingly to retail merchandising.

BY COURTESY OF THE GOVERNOR AND COMMITTEE OF THE HUDSON'S BAY COMPANY

FACSIMILE OF A PORTION OF THE FIRST SHEET OF THE CHARTER GRANTED MAY 2, 1670, BY KING CHARLES II TO "THE GOVERNOR AND COMPANY OF ADVENTURERS OF ENGLAND TRAOING INTO HUDSON'S BAY." THE FIVE-PAGE CHARTER GAVE POWER TO THE COMPANY TO RULE WITHIN ITS TERRITORY ACCORDING TO ENGLISH LAW

The company was founded at the suggestion of two French fur traders, Médard Chouart, sieur des Groseilliers, and Pierre Radisson, who urged that Hudson bay was a better route of approach to the fur areas of central North America than was the St. Lawrence river. The early voyages were profitable, and posts were founded in James bay and at the mouth of the Hayes river, near the Nelson estuary, on the west shore of Hudson bay. However, the French traders of Canada opposed the English company strongly from 1682, and the French actually held most of the posts in the bay from 1686 to 1714. The company did manage to begin a post at the mouth of the Churchill river in 1688, and to send Henry Kelsey inland to the Saskatchewan river and the Canadian prairies in 1690 and 1691.

The company survived the losses inflicted by the French and all its posts were restored by the treaty of Utrecht in 1713. The fur trade was resumed, but efforts to find reputed copper mines on the Arctic coast failed. The great Prince of Wales's fort at Churchill was begun in 1731 as defense against future French attack. But in 1732 the French under Pierre Gaultier de Varennes, sieur de la Vérendrye, entered the Red river basin from Canada and by 1740 had reached the Saskatchewan. The competition forced the company to send inland men such as Anthony Henday, to persuade the Indians to continue to come down to the bay.

After the cession of New France in 1763, English traders appeared in the northwest and by 1779 had formed the North West company of Montreal. The Hudson's Bay company was forced to build posts inland, of which the first was Cumberland House in 1774, near the lower Saskatchewan river. Prolonged competition became fierce after 1810 when the Hudson's Bay company reorganized its methods of trading in order to enter the Athabasca country, where furs were most abundant, and to found, by Lord Selkirk's agency, the colony of Assiniboia on the Red river to prove its title to the soil (*see* RED RIVER SETTLEMENT). The ensuing "fur traders war" was stopped when the British government brought about a union of the companies in 1821 under the name and charter of the Hudson's Bay company. The new company was given an exclusive licence to trade for 21 years (revived for the same term in 1838) in Rupert's Land and as well in the northwest territory beyond Rupert's Land and on the Pacific slope.

In the late 1840s the monopoly was challenged by the native people of the Red River territory, and in the late 1850s by newcomers from Canada. Canada also revived the old French claim to the northwest. At the same time a rapidly developing trade between St. Paul, Minn., and the Red River territory, and the gold rush on the Fraser river in 1856 threatened to draw the Hudson's Bay company's territories into the United States. The company had already responded to the loss of the southern part of the disputed Oregon territory in 1846 by building Ft. Victoria on Vancouver Island, which was made a colony under a company governor in 1849. In 1858 a crown colony of British Columbia was set up, Vancouver Island was made a crown colony also, and the Pacific slope ceased to be governed by the company. But the British government did not think a crown colony could be set up at Red River. The licence was not renewed in 1859, and more and more free traders entered the fur trade. Canada continued to claim the territory and the Hudson's Bay company territories were transferred to the dominion in 1869–70, after the confederation.

By the terms of transfer the company received £300,000 from Canada, blocks of territory around its posts, and title to one-twentieth of the "fertile belt," or habitable portion of western Canada, with mineral rights on all these lands. In all, slightly over 7,000,000 ac. of land were granted to the company as its portion of the fertile belt.

After the transfer the company became a merely commercial corporation. The fur trade in the north, merchandising in the growing cities of western Canada, and the sale of its lands as the prairies were settled were its chief concerns. The development of the petroleum industry in western Canada after 1947 added greatly to the wealth of the company by reason of its mineral rights. While it remained one of the chief business firms of Canada, the company was governed wholly from England until in 1931 a Canadian committee was set up with executive authority in Canada, but responsible to the governor and committee in England.

See also references under "Hudson's Bay Company" in the Index volume.

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HUE, a town of Vietnam in the northernmost part of South Vietnam (Republic of Vietnam), is situated on the delta of the Hue river, about 9 mi. from the South China sea and accessible only by shallow-draft vessels. Its population (1962 est., 103,367) has increased nearly sixfold since 1936 and was swollen by refugees from North Vietnam after the partition of Vietnam in 1954 (*see* VIETNAM). The Hue delta is complexly channeled and embanked to control and make use of the river water which is erratic and violent in flow after debouching from the western Annamite mountains. The danger of flash spates is greater because of past deforestation for firewood and timber. Warm and moist enough to permit three rice crops a year, Hue has an annual rainfall of 116 in., with the maximum fall from September to January. It is subject to late summer typhoons.

The town was for several centuries the royal capital of Annam, a result of the wealth of its intensively farmed surroundings and of its position beside the trade seaways of the South China sea.

Hue still has its great walls, marking the former threat from the pirate-infested sea, and the modern town retains a defensive function since it is near the border with North Vietnam. Its history is seen in the palaces and tombs scattered in the town, royal relics strongly influenced by Chinese patterns and symbols, a reminder of the prolonged association with imperial China, which sent viceroys, legates and traders to reside there, who treated Hue as though it were what it still resembles—a town of south China. There is a 17th-century Buddhist shrine, a temple to Confucius, and the Temple of Heaven, the chief Annamese building. During the period of French dominion, Hue was linked overland by a modern highway and railway to Saigon and to Hanoi, the chief seats of the former French administration to which Hue has steadily lost ground as a commercial centre. (E. H. G. D.)

HUE AND CRY, a phrase employed in English law to signify the old common-law process of pursuing a criminal with horn and voice. It was the duty of any person aggrieved, or discovering a felony, to raise the hue and cry, and his neighbours were bound to turn out with him and assist in the discovery of the offender. All those joining in the pursuit were justified in arresting the person pursued, even though it turned out that he was innocent. If he still had about him the signs of his guilt, and he resisted, he could be cut down; while, if he submitted to capture, his fate was decided. Proof was not required of a culprit's guilt, but merely that he had been taken red-handed by hue and cry. The various statutes relating to hue and cry were repealed in 1827. *See* also ENGLISH LAW: *The Norman Age;* HARO (CLAMEUR DE).

HUEHUETENANGO, a city and capital of the department of the same name in western Guatemala on the Mexican border. Area of the department 2,857 sq.mi. Pop. (1960 est.) 280,988. Most of the population is Maya Indian, whose subsistence farms grow wheat, maize (corn), beans and potatoes. On the high Alta de Cuchamatanes the land is used for the pasture of sheep.

The city of HUEHUETENANGO, 80 mi. N.W. of Guatemala City, altitude 6,200 ft., pop. (1957 est.) 7,858, is one of the larger commercial centres for the Maya settlements, trading in pottery, leather goods and woolen textiles. The Inter-American highway passes through the city. The name means "Place of the Ancients," and nearby are ruins of an ancient Indian centre called Zaculeu. (P. E. J.)

HUELVA, a Spanish city, capital of a province of the same name forming the border with Portugal and constituting the westernmost part of Andalusia. Area of province 3,894 sq.mi. Pop.: province (1960) 399,934; capital (1960) 74,384 (mun.).

The city is built on the western shore of a triangular peninsula formed by the estuaries of the Odiel and Tinto, which meet below the town. It was originally a Carthaginian trading station, and afterward a Roman colony (Onuba). The colossal statue of Columbus (112 ft. high) was erected in 1892 to commemorate the fourth centenary of his voyage which began and ended in the nearby village of Palos de la Frontera. Columbus resided in the neighbouring Franciscan monastery of Santa María la Rábida (now a summer university) after his original plans for the voyage had been rejected by King John II of Portugal in 1484. The present town is modern in appearance, and owes its prosperity to a transit trade in copper and other ores, for which it is the port of shipment. When the famous Ríotinto copper mines were for the first time properly exploited (*see* below), it progressed rapidly in size and wealth. Besides exporting ores, Huelva is the headquarters of the sardine, tunny and bonito fisheries, and of a trade in grain, grapes, olives and cork. The bulk of the imports, which consist chiefly of coal, iron and steel and machinery, ordinarily comes from Great Britain. There are railway links with Seville, Zafra and Ayamonte. Industrial railways link the ore deposits with the port. Main roads run to Badajoz and Seville. Franco's Nationalist forces captured Huelva early in the civil war of 1936–39.

HUELVA PROVINCE has a contrasting topography of flat lowland plain and high mountain ranges. Geologically, it is one of the oldest parts of Spain. The Sierra de Aracena is the principal mountain zone. The Campina or lowland is remarkably flat. The coast is low, sandy, inhospitable and infertile, with the river estuaries surrounded by marshes. These rivers are the Guadiana, which forms the frontier with Portugal, the lower (navigable) reaches of the Guadalquivir, and the Odiel and the Tinto, the main rivers of the province, which join up to form the ria at Huelva city.

Dry farming (cereals) predominates and supports half the population. Cultivation of cotton, olives and fruit trees is also important. The mineral deposits have been exploited since prehistoric times. Particularly famous are the Ríotinto copper mines, which were exploited by a British company from 1873 until 1954, when they were acquired by the Spanish government. The mines at Tharsis remain under British control. The tunny fishing industry supports more than 70 preserving and salting factories.

Important cities in the province include Ayamonte (13,298), Lepe (10,106), Cartaya (13,225), Palos de la Frontera (2,571), Valverde del Camino (10,904) and Isla-Cristina (12,506). (M. B. F.)

HUESCA, a city, and capital of the province of the same name, is situated in the northeast of Spain, 208 mi. N.E. of Madrid. Pop. (1960) 24,377 (mun.). It lies in the region known as La Hoya de Huesca, at a height of 1,546 ft. above sea level, dominated by the Sierra de Guara to the north, and watered by the Flumen river. Buildings include the church of San Pedro el Viejo, begun *c.* 1134 and completed in the 13th century, one of the oldest in Spain and the burial place of the kings Ramiro II and Alfonso I, "the Battler," of Aragon; it has a Romanesque hexagonal tower and cloister (the latter 12th century, restored 19th); the town hall, in the former convent of St. Francis (pre-13th century, but much changed by restoration); Huesca cathedral, begun in the 13th century on the site of a pagan temple and of a later mosque and completed in 1515; and the episcopal palace, built in the Mudéjar style (perhaps the only example in Upper Aragon). The Colegio Mayor e Imperial de Santiago, founded by the emperor Charles V in 1534, houses the provincial museum of fine arts and the provincial archives. The Alcazar Real, the ancient palace of the kings of Aragon and former fortress of the Muslim walls, was reconstructed in 1845 to hold the Sertoria university and later given to the institute of intermediate education. The church of San Miguel was founded in 1110 by Alfonso I; near it is the only tower still extant of the 99 which existed for the defense of the city, together with remains of the walls. Of interest are the municipal archives (in the town hall) and those of the cathedral. The cathedral museum contains some remarkable Romanesque paintings. Huesca has rail and road links with Saragossa and Lérida and northward via Jaca and Puerto de Somport (a border pass, altitude 5,878 ft.) to Pau, France. There is little industry apart from local handicrafts and two agricultural machinery factories.

Huesca (Osca) was settled in Iberian times, and under the Romans gave support successively to Sertorius and to Julius Caesar, who awarded the town the title "Urbs victrix Osca." It became an important Roman mint. Later it fell to the Visigoths and then to the Moors. In the 11th century Sancho Ramírez, the second king of the small kingdom of Aragon, tried to reconquer the town. His son, Pedro I, took it in 1096, and it soon became the political and military centre of Aragon. The Sertoria university was founded in 1354 by Pedro IV and closed in the 19th century. In 1837 the battle of Huesca took place between the supporters of Isabella and the Carlists (*qq.v.*). In the civil war of 1936–39 the town took the side of the Nationalists and was besieged for 22 months. (X.)

HUESCA PROVINCE includes the highest point in the Pyrenees, the Pico de Aneto (11,168 ft.), flanked by precipitous ridges of sedimentary rocks, mainly limestone, with steep-sided valleys. Pop. (1960) 233,543. Area 6,050 sq.mi. It is bordered east by Lérida, south and west by Saragossa and Navarre and north by the French *départements* of Basses-Pyrénées, Hautes-Pyrénées and Haute-Garonne. The relief diversifies the climate; above 3,000 ft. rainfall is 40–50 in. and winter snowfall considerable. There is alpine vegetation above 8,000 ft. giving way at lower altitudes to fir and pine, important in Spanish timber production, then to beech, chestnut and oak. This isolated, sparsely settled Sobrarbe region is one of transhumant pastoralists. The Ordesa National park near Monte Perdido (11,007 ft.) has magnificent mountain scenery and woodland; it is reached by road from Barbastro. The sierras

and valleys of the Pyrenean foothills are succeeded by the upper terraces of the Ebro valley. One-third of the population of the province lives in the productive agricultural belt between the Cinca valley and La Hoya. The Ebro trough, floored with level-bedded recent and Tertiary deposits, displays marked contrasts. The arid steppe and saline soil of Los Monegros has widely spaced pastoral villages; the huertas, notably La Noguera in the southeast, have well-populated villages producing olives, sugar beet, grain and vegetables by extensive irrigation from the Ebro and tributaries. The chief towns are Huesca, Jaca, and Barbastro. The rainfall is limited (12–20 in.) and summers are hot (Huesca 25° C. [77° F.] in August). Monzón and Sabiñánigo have chemical and metallurgical industries, and hydroelectricity for the Barcelona grid, mainly from the Cinca river system, is significant. Communications are poor and roads over the Pyrenees may be closed by snow between November and May. (Ri. L.)

HUET (Huetius), **PIERRE DANIEL** (1630–1721), French scholar, antiquary, scientist and bishop, was born in Caen on Feb. 8, 1630. A brilliant pupil at the local Jesuit college and later in the faculty of law of the local university, he showed from an early age the marks of a scholar. His acquaintance with the learned Protestant Samuel Bochart enabled him in 1652 to visit Sweden, and thus to see the famous queen Christina, the aurora borealis, Tycho Brahe's observatory near Copenhagen and the classical scholar Claude Saumaise in Leiden. His discovery in the Swedish royal library of some fragments of Origen's commentary on St. Matthew led to an edition of Origen (1668), but also to a dispute with Bochart, who accused him of corrupting the text. Although living in Caen ("the peaceful centre of my studies") he was constantly in Paris, and in touch with its men of science, notably with André de Graindorge, with whom he carried on a lengthy correspondence. He became known to Jean Chapelain and his circle, including Madeleine de Scudéry, Mme de la Fayette, and presumably also Gilles Boileau and Charles Perrault. But these literary associations were less important than his scientific work, done chiefly in Caen, where he induced the local academy to consider experiments and discussions of natural science. His own investigations covered astronomy, anatomy, mathematics and philosophy. His enthusiasm made Caen into a focus of scientific activity at a time when the tendency to concentrate scholarly meetings in Paris was not only strong but officially encouraged.

From 1670 Huet assisted Bossuet in the task of tutor to the dauphin, which provoked him to supervise (with Mme Dacier) a long series of Delphin classics, editions of ancient authors, each accompanied by a Latin commentary. He took holy orders in 1676 and received from the king the gift of the abbey of Aulnay, where he loved to reside and after which one of his scientific works took its title: *Questiones Alnetanae* (1690). He was bishop of Avranches for ten years (1689–99) and then retired to the abbey of Fontenay near Caen. His biblical studies drew him to Paris, where he died on Jan. 26, 1721.

A diffuse writer, he has not the mastery over his materials of a Pascal, but his impressive range of interests can be seen in *Huetiana* (1722). His mastery of ancient tongues, including Hebrew, was remarkable even in an age of scholars; his knowledge of local antiquities was such that he is still revered as historian of his native city. He was a great novel reader, confessed to an early and passionate taste for the *Astrée* of Honoré d'Urfé and wrote a treatise on the origins of fiction (1670). His other main books were *Demonstratio evangelica* (1679); *Histoire du commerce des anciens* (1716; Eng. trans. 1717); *De la situation du paradis terrestre* (1691; Eng. trans. 1694); *Censura philosophiae Cartesianae* (1689) and an autobiographical work (1718; Eng. trans. 1810). His part in the renewal of scientific method and inquiry was modest but real. His interests put him in the world of Pierre Bayle, and the polemic that followed the posthumous publication of his *Traité philosophique de la faiblesse de l'esprit humain* (1722; Eng. trans. 1725) showed that he was meeting the problems of the skeptics of the age of enlightenment.

See L. Tolmer, *P-D. Huet, humaniste, physicien* (1949); Harcourt Brown, *Scientific Organizations in Seventeenth Century France* (1934). (W. G. Me.)

HUFUF, AL (Hofuf), a town and former capital of Hasa (Eastern Province), Saudi Arabia, lies 70 mi. S.W. of Dhahran and 180 mi. E.N.E. of Riyadh. Pop. (1960 est.) 100,000. It has a broad market street, partly colonnaded, and was formerly a centre of commercial activity. Its medieval castle of Kut belongs to the Karmatian period (10th century) and there is the early 19th-century domed mosque of Ibrahim Pasha (*q.v.*). The Ithmaniya oil fields lie southwest. Mubarraz (north) is a major oasis. Al Hufuf is connected by rail with Dammam and Riyadh. It has an airport of moderate capacity. Al Hufuf became the headquarters of the Turkish administration in 1871, when the Turks seized eastern Arabia while its rulers (the house of Sa'ud) were engaged in civil war. In 1913 Al Hufuf was captured by Abdul-'Aziz ibn Sa'ud. It was replaced in 1953 as provincial capital by Dammam (*q.v.*). *See* also Arabia; *The Wahhabi Movement;* Hasa. (H. St. J. B. P.; X.)

HÜGEL, BARON FRIEDRICH VON (1852–1925), Roman Catholic philosopher and theologian, precursor of the realist revival in philosophy and of the theological study of religious feeling. The son of Karl von Hügel (1795–1870), Austrian diplomat and explorer, and his Scottish wife, he was born on May 5, 1852, at Florence. In 1867 the family moved to England. Hügel's interest in religious problems began during a spiritual crisis in Vienna, 1870, where he had to give up his law studies through ill health. In 1873 he married Lady Mary Herbert, a daughter of Sidney Herbert (Lord Herbert of Lea), and settled in London where he lived until his death on Jan. 27, 1925.

Hügel combined deepest faith in the Roman Catholic Church and a rare holiness of life with tolerant views which won him friends among distinguished thinkers of all denominations. His influence was great outside his own church, for instance upon Evelyn Underhill and the Lutheran theologian Friedrich Heiler. When the modernist crisis broke out in the early 20th century his close contacts with the leaders, especially A. Loisy and G. Tyrrell, led him to be classed with those who undermined the church. In fact, he fully accepted the papacy, but thought the methods of church government suffered from overcentralization, which he hoped to counteract by the healthy interplay of energy between head and members. His correspondence and writings, including a study of St. Catherine of Genoa and essays on religious philosophy, make clear his disapproval of revolt and his rejection of the modernist theory of belief. He wrote the article on the Gospel of St. John for the 11th edition of *Encyclopædia Britannica* (reprinted in several later editions).

See M. Nédoncelle, *Baron Friedrich von Hügel* (1937); M. de la Bédoyère, *The Life of Baron von Hügel* (1951). (Pe. Gn.)

HUGGINS, SIR WILLIAM (1824–1910), English astronomer who revolutionized observational astronomy by applying the spectroscopic method to the determination of the chemical constitution of stars and by his use of photography in stellar spectroscopy. He was born in London on Feb. 7, 1824, and was educated at the City of London school and under private tuition. He built a private observatory at Tulse Hill, London, in 1856 and began to apply G. R. Kirchhoff's discoveries in spectrum analysis to astronomy; this work was independent of nearly contemporary researches by L. M. Rutherfurd in the U.S. His results on the chemical constitution of the stars, obtained in collaboration with W. A. Miller, were presented to the Royal society in 1863 in a note on the "Lines of the Spectra of some of the fixed stars." In 1864 Huggins discovered the gaseous nature of the so-called "unresolved" nebulae, previously considered to be aggregates of stars too remote to be resolved by existing instruments. On May 18, 1866, in the first spectroscopic examination of a nova, he observed, superimposed on a solar-type spectrum, a number of bright hydrogen lines, suggesting that the outburst was accompanied by the emission of a shell of gas at a temperature higher than that of the star's surface. In 1868 he proved incandescent carbon vapours to be the main source of cometary light and in the same year applied Doppler's principle to the detection and measurement of stellar velocities in the line of sight. Huggins was made knight commander of the Order of the Bath in 1897, was an original member of the Order of Merit (1902) and president of the Royal

society from 1900 to 1905. His *Atlas of Representative Stellar Spectra*, prepared conjointly with Lady Huggins (who actively co-operated in her husband's work), was published in 1899.

Huggins died in London on May 12, 1910.

See *The Scientific Papers of Sir William Huggins* (1909).

(O. J. E.)

HUGH, SAINT, OF LINCOLN. There are two saints named Hugh associated with Lincoln.

HUGH (*c.* 1140–1200), bishop of Lincoln, was born at Avalon, Dauphiné (now in the *département* of Isère), France. At the age of eight he was placed by his father, William, seigneur of Avalon, in the care of the canons regular of Villard-Bonnot nearby. Both father and son became canons, but, after the death of William, Hugh joined, *c.* 1165, the monks of La Grande Chartreuse, then recently founded. He was ordained priest as a Carthusian and *c.* 1170 was made procurator of the house. In 1179 or 1180 King Henry II of England, who had heard of his reputation for energy and tact, made him prior of the Carthusian house at Witham in Somerset, a royal foundation. The king took a keen interest in Hugh's excellent work and in 1186 procured his election to the see of Lincoln. Both as prior and as bishop Hugh consistently resisted any infringement of his rights, even by the king. Though himself an ascetic, he was noted for his kindliness to children, to the poor, to lepers and to Jews. With his residence at Stow, near Lincoln, are associated the legends of his tame swan (and a swan is generally his emblem). In 1200 Hugh revisited La Grande Chartreuse when in France to promote peace between King John of England and King Philip Augustus of France. On his return journey he fell ill and died in London on Nov. 16, 1200, after sunset (his feast day being thus Nov. 17, according to the medieval reckoning). He was buried in his cathedral on Nov. 24, and canonized in 1220.

HUGH (1245–1255), known as "little St. Hugh," was an alleged victim of Jewish anti-Christian activities. He is frequently mentioned in ballads and also by Chaucer and Marlowe. His feast day is Aug. 27.

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HUGH THE GREAT (d. 956), duke of the Franks and count of Paris, was the son of King Robert I (*q.v.*) and the father of Hugh Capet (*q.v.*). He held extensive territory between the Seine and Loire rivers, which had belonged to his family since the mid-9th century. His prestige was increased by his marriages, first (926) with Eadhild, sister of the Anglo-Saxon king Aethelstan, and second (937) with Hedwig, sister of the emperor Otto I. He was also lay abbot of St. Martin de Tours, of Marmoutier, of St. Germain d'Auxerre and of Morienval. Formidable rivalries, however, prevented him from claiming the throne on his father's death in 923; and on the death of Rudolph (Raoul) I in 936 he favoured a Carolingian restoration and helped to set Louis IV d'Outremer, son of Charles the Simple, on the throne.

Disappointed in a plan to use Louis as a puppet, Hugh formed a coalition against him, styling himself, from 937, "duke of the Franks by the grace of God." He obtained the emperor Otto's support and in 940 captured Reims, where he installed Hugh, the young son of Herbert of Vermandois, as archbishop; but in 942 he had to submit to Louis, who had purchased Otto's support by the cession of Lorraine. He then tried to play the king and the rebellious Normans off against one another, and in 945 the king, captured by the Normans, came into his power. In exchange for his liberty, Louis was forced to cede to Hugh the stronghold of Laon, commanding the approaches to the major Carolingian domains.

Within the next three years, however, Louis IV recovered Reims; the uncanonical position of Hugh's protégé as archbishop there was censured by ecclesiastical councils; and Hugh himself was excommunicated for rebellion. Then Louis recaptured Laon (949) and Hugh formally submitted (950). He was then given a vague authority in Aquitaine. Unable to oppose the accession of Louis's son Lothair to the French throne (954), Hugh concentrated on securing the succession to Burgundy for his family. He achieved this, but died almost immediately afterward, on June 16 or 17, 956, leaving three young sons.

See P. Lauer (ed.), *Les Annales de Flodoard* (1905). (J. DE.)

HUGH OF ST. CHER (A SANCTO CARO OR A SANCTO THEODORICO) (*c.* 1200–1264), French cardinal best known for his work in correcting and indexing the Latin version of the Bible, was born about 1200 at St. Cher, near Vienne, and was lecturer at Paris university when he became a Dominican in 1226. He was twice provincial of his order in France, 1227–30 and 1236–44, and, having become master of theology in Paris in 1230, was vicar-general in 1240–41. Several popes entrusted him with missions abroad. He was made a cardinal in 1244 and played an important part in the Council of Lyons, 1245. He died at Orvieto, March 3, 1264.

Hugh helped to revise the Carmelite rule in 1247. In 1255 he was charged with the examination of the *Introductorius* of Gherardino del Borgo San Donnino to Joachim of Fiore's *Evangelium aeternum*, and in 1256 with the examination of William de St. Amour's *De periculis novissimorum temporum;* both were condemned. From 1256 to 1263 he directed the first revision or *Correctorium* of the Vulgate begun in 1236 by the Dominicans, which attracted vigorous criticism from Roger Bacon; this *Correctorium*, after several revisions, formed the basis of the celebrated *Correctorium Sorbonicum*. He started the first concordance of the Latin bible, generally known as *Concordantiae Sancti Jacobi*, from the name of the Dominican house in Paris, and wrote numerous *Postillae* or commentaries on the Bible.

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HUGH OF ST. VICTOR (1096–1141), scholastic theologian and philosopher, who began the tradition of mysticism that made the school of St. Victor famous throughout the 12th century, was born of noble parentage, probably at Hartingam in Saxony. After spending some time in the monastery of Hamersleben, near Halberstadt, where he took the habit of the Augustinian canons, he went to Paris to continue his studies at the abbey of St. Victor. He began his lectures there in 1125 and was in charge of the school from 1133 until his death.

Hugh wrote a number of mystical treatises, in which he shows himself strongly influenced by the teaching of St. Augustine. He describes the three stages in the ascent of the soul to God: *cogitatio*, by which the eye of the soul becomes accustomed to see God in the creation of the world; *meditatio*, which results in the soul's discovering God in itself; and *contemplatio*, through which the soul gains a supernatural intuition of God.

Hugh made an important contribution to the development of natural theology by basing his arguments for the existence of God upon both external and internal experience. He also added a teleological proof which took its start from the facts of experience. His chief work on dogmatic theology, the *De sacramentis Christianae fidei*, anticipates the *summae* of the 13th century.

Unlike some of his contemporaries, Hugh did not despise secular learning: "Learn everything," he said, "and you will see afterward that nothing is useless." Thus he was able to make use of Abelard's dialectical methods without incurring the charge of being unorthodox. His *Didascalion* was a kind of encyclopaedia of all the known sciences, which he divided into four groups: the theoretical, the practical, the mechanical and the logical sciences. In regard to universals, he was a moderate realist and ably supported his theory of knowledge through his sound grasp of psychology. He interpreted the doctrine of matter and form by utilizing the concept of the atomic structure of matter, which he had adopted from William of Conches.

Hugh was a prolific writer. In addition to the works already mentioned, he wrote commentaries on the Scriptures, interpreting them in an allegorical and mystical sense, and a commentary on

the *Celestial Hierarchy* of the Pseudo-Dionysius the Areopagite, which he based upon the Latin translation of Johannes Scotus Erigena. The edition of his work by the canons of St. Victor (1648) was reprinted by J. P. Migne, *Patrologia Latina,* vol. 175–177 (1854).

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HUGH CAPET (*c.* 938–996), king of France from 987 to 996, from whose nickname (Lat. *capa,* cope or cape) the Capetian dynasty was named, was the eldest son of Hugh the Great (*q.v.*). On his father's death (956) he became duke of the Franks and inherited vast estates in the region of Paris and Orléans, extending in some places south of the Loire river. He thus became one of the most powerful vassals in the kingdom and a serious danger to the Carolingian ruler. He married Adelaide of Aquitaine (970), but his efforts to extend his influence toward the southwest were not successful. Hugh gave his support to the Carolingian king Lothair when the latter tried to wrest Lorraine from the emperor Otto II (978); but Otto made a counterinvasion of France (979) and for a while besieged Hugh's city of Paris. Disappointed when Otto and Lothair made peace at Margut-sur-Chiers (980), Hugh visited Rome, where he probably intrigued with Otto against Lothair (981).

In collaboration with Adalberon, archbishop of Reims, Hugh continued to oppose Lothair (d. 986) and his successor Louis V; and on Louis V's death (May 987) Adalberon and his secretary, the scholar Gerbert (afterward Pope Silvester II), declared the crown to be elective rather than hereditary, persuading the nobles to chose Hugh as king instead of the Carolingian claimant, Charles, duke of Lower Lorraine. Hugh was proclaimed king in June and crowned at Noyon by Adalberon on July 3, 987.

Despite the possession of the royal domain (Paris, Étampes, Orléans, Compiègne, Reims and Laon), the position of the new king was not strong. He had to reckon with many belligerent vassals, even buying their allegiance by enfeoffing them with territory, such as the county of Melun which he gave to his supporter Bouchard of Vendôme. The perennial strife between Eudes I of Blois and Fulk Nerra of Anjou also caused him uneasiness; ultimately (996) he gave his support to Fulk. But Hugh's main danger came from his rival Charles of Lower Lorraine, who took Laon from him (May 988) with the aid of Arnulf, an illegitimate son of King Lothair. Hugh tried to suborn Arnulf by causing him to be elected archbishop of Reims on the death of Adalberon (989); but Arnulf defected almost immediately (Sept. 989) and surrendered Reims to Charles. A reverse of fortune occurred in March 991 when, by the trickery of another Adalberon, bishop of Laon, Charles fell into Hugh's hands—to die in prison a year or so later. Hugh persuaded an episcopal council at St. Basle to declare Arnulf deposed (991) and Gerbert was elected in his place. This, however, involved Hugh in a serious dispute with the pope, John XV.

The course of history has invested Hugh's reign with a greater significance than its immediate achievements warrant, for from his time the Capetian dynasty ruled France in direct line of descent for more than 300 years. Very soon after his own election he arranged the election and coronation (Dec. 987) of his son Robert. Thus, on Hugh's death, Robert succeeded without undue difficulty. This practice of crowning the heir during the father's lifetime, continued by the Capetians until the time of Louis VII, undoubtedly contributed to their success in the face of many obstacles. Hugh Capet died in Paris on Oct. 24, 996.

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HUGH DU PUISET (*c.* 1125–1195), a wealthy and powerful bishop of Durham, who built the Galilee chapel in Durham cathedral and rebuilt Durham castle, was the son of Hugh III, lord of Le Puiset, near Chartres, and Agnes of Blois, sister of King Stephen of England. Hugh's rapid advancement in the English church was due to the patronage of his uncle Henry (*q.v.*) of Blois, bishop of Winchester. Archdeacon of Winchester by 1139, Hugh became, *c.* 1143, treasurer of York and archdeacon of the East Riding. During Stephen's reign, ecclesiastical politics in northern England were dominated by rivalry between the Blois and Angevin factions. Through Blois influence, Hugh was elected bishop of Durham in Jan. 1153, but Archbishop Murdac of York disallowed the election. Hugh appealed to Rome in person, and was consecrated by the pope in Dec. 1153, thus being the last member of the Blois party to gain a position of power before the accession of the Angevin Henry II. The quarrel between Henry and Thomas Becket hardly affected Hugh and in the rebellion of 1173–74 he was neutral almost to the point of supporting the king of Scotland, who tried to profit by Henry's difficulties. For this, Hugh was fined about £1,300 and temporarily lost his castles.

In 1189 Hugh bought the earldom of Northumberland for life from Richard I, who wished to raise money for his crusade, and he was also appointed justiciar. But after the king's departure on crusade William Longchamp (*q.v.*) first deprived him of this office and then kept him at Howden under house arrest. Hugh attended the council of Oct. 1191, which brought about Longchamp's fall, and was active in the north on Richard's behalf from 1193 till he met the king on his return, in March 1194. In these years he had opposed the king's brother John for political reasons and the king's half brother Geoffrey Plantagenet, archbishop of York, in support of Durham's unjustifiable claim to be independent of York. He died at Howden on March 3, 1195.

See G. V. Scammell, *Hugh du Puiset, Bishop of Durham* (1956). (G. W. S. B.)

HUGHES, CHARLES EVANS (1862–1948), U.S. jurist and statesman who narrowly missed election to the presidency of the United States; twice a member of the United States supreme court, he led that tribunal as chief justice through its greatest crisis in the first half of the 20th century.

Hughes was born at Glens Falls, N.Y., on April 11, 1862, the only son of the Rev. David Charles Hughes and Mary Catherine Connelly Hughes. He was educated at Madison (now Colgate) university, Hamilton, N.Y. (1876–78), and at Brown university, Providence, R.I., where he was graduated (B.A.) in 1881. After teaching for a year at Delhi, N.Y., and studying law in his spare time, he entered Columbia law school in 1882. Two years later he was graduated with an LL.B. degree and a three-year prize fellowship. Passing the bar examination with a mark of 99½, he began his practice in New York city. For two years (1891–93) he served as professor of law at Cornell university, Ithaca, N.Y., and then resumed his practice in New York city.

Early Career.—Hughes's work as counsel for the Stevens committee investigating the gas and electric lighting industries of New York in 1905 first brought him public recognition. His success in that venture resulted in his employment by the Armstrong legislative committee to investigate the corruption in which many New York life insurance companies had become involved. Though his methods were fair, his conscientious digging brought sensational disclosures which led to extensive life insurance reforms and to his nomination for the governorship of New York by the Republican party acting under the influence of Pres. Theodore Roosevelt. After a turbulent campaign Hughes won by 57,897 votes over William Randolph Hearst. He was re-elected in 1908. By appealing to the people over the heads of the party bosses, he succeeded in establishing two of the first public service commissions in the country. His administration was also notable for its progressive labour and welfare legislation, its administrative reforms, and for enforcement of the constitutional prohibition of race-track gambling.

Associate Justice and Presidential Candidate.—Pres. William Howard Taft named Hughes associate justice of the U.S. supreme court in 1910, and he soon emerged as an eminent judge, especially in the fields of civil rights and railway rate regulation. In 1912 he flatly refused to be a candidate for the presidency; in

1916 he again repudiated all work in his behalf, but, with Europe at war and the Republican party split between William H. Taft and Theodore Roosevelt, he was drafted by the Republican national convention and immediately resigned from the court. Though he campaigned vigorously as candidate of both the Progressive and the Republican parties, he lost by 277 to 254 electoral votes to Pres. Woodrow Wilson, who was widely credited with having kept the United States out of the war in Europe. When the country was drawn into World War I in the early months of Wilson's second term, Hughes offered his services to the president and became chairman of the draft appeals board of New York city in 1917 and special assistant to the U.S. attorney general to investigate the sluggish aircraft industry in 1918. Between his official assignments, he again practised law in New York.

Secretary of State.—Hughes put aside suggestions that he become a presidential candidate again in 1920, partly because of the death of his daughter Helen. When Pres. Warren G. Harding was inaugurated on March 4, 1921, however, Hughes became secretary of state. His behind-the-scenes struggle to take the United States into the League of Nations, without art. x of its covenant, was blocked by the "Irreconcilables" in the senate. Unable to save any part of the treaty of Versailles, he negotiated a separate peace with Germany. In a spirited contest with Japan, he insisted on keeping the mandated islands of the Pacific open to international inspection.

Hughes was the chief planner of the Washington arms conference of 1921–22. His dramatic speech proposing a formula to end the naval race, with drastic reductions in the capital ships of the United States, Britain and Japan, was applauded throughout the world and adopted with little change. Likewise he succeeded in breaking up the Anglo-Japanese alliance and substituting for it a four-power pact designed to keep the peace in the Pacific. Among the seven treaties which the conference produced were also a nine-power pact guaranteeing the integrity of China and a settlement of the Shantung controversy between Japan and China. (*See* WASHINGTON CONFERENCE.)

Secretary Hughes continued the Wilson policy of refusing to recognize the Communist government of the U.S.S.R., but he applied steady pressure on Japan to end the postwar occupation of Siberia and Sakhalin. In Latin America his policy was one of removing causes of friction and of "liquidating imperialism." His patience and fairness brought about settlement of several boundary disputes between Latin-American countries and contributed greatly to the ultimate settlement of the Tacna-Arica controversy between Chile and Peru. Alarmed by mounting economic chaos in Europe, he tried to induce France to agree to an expert investigation of Germany's capacity to pay reparations. The French repeatedly refused, and the situation worsened. Finally he made his suggestion publicly in a speech at New Haven, Conn., in Dec. 1922, and after much pulling and hauling this led to the scaling down of reparations through the Dawes plan. (*See* REPARATIONS.)

Hughes's efforts to take the United States into the world court were no more successful than his fight for the League had been. Because he was a moderate internationalist at a time of extreme isolationism, some of his favourite projects were thwarted. After his retirement in the 1940s, however, Secretary of State Cordell Hull secretly consulted him in regard to international organization to keep the peace and some of his ideas found expression in the charter of the United Nations. His policies as secretary of state made a substantial impact on the course of international events; he pursued his principles of justice and peace with remarkable skill.

When Hughes returned to the bar on March 4, 1925, he was acknowledged to be the country's leading attorney. Yet he found time for extensive public service. In 1925–26 he headed the New York state reorganization commission, which strengthened the powers of the governor, created an executive budget system and consolidated nearly 180 bureaus and agencies into 18 departments. In 1928 he went to Havana, Cuba, as chairman of the U.S. delegation to the sixth Pan-American conference. His dramatic speech in defense of the U.S. occupation of Nicaragua convinced the delegates that the U.S. had no aggressive intent. A year later he again represented the U.S. at the Pan-American Conference on Arbitration and Conciliation. In the same year he served as a judge of the Permanent Court of International Justice at The Hague.

Chief Justice.—Hughes let it be known that he would not accept nomination for the presidency in 1928 because he was too old, but two years later (Feb. 3, 1930) he did accept nomination to the chief justiceship of the United States at the age of 67. The nomination was confirmed only after a spirited fight in the senate. Sen. George W. Norris and others had been seeking an opportunity to denounce some of the court's conservative opinions and to embarrass Pres. Herbert Hoover, who made the appointment. They unleashed all their fury against Hughes, but to no avail. He was confirmed by a vote of 52 to 26.

On the bench Hughes confounded his critics by a series of liberal opinions further buttressing civil rights against encroachment by the states. He also took a broad view of the power of congress to regulate interstate commerce and thus control the national economy. Though he held to the concept of a "marching" constitution, he believed that the court was obligated to hold invalid statutes for which no constitutional backing could be found.

In the dark years of the great depression of the 1930s the court ruled that congress had exceeded its powers in passing several recovery measures sponsored by Pres. Franklin D. Roosevelt. The National Recovery administration, the Agricultural Adjustment administration and the Guffey Coal act went down. The court also upset the New York minimum wage law, thus curbing state as well as national power. Its extreme conservatism brought frequent dissents from Hughes and other justices. However, it upheld the more carefully devised New Deal statutes.

In 1937 Roosevelt asked congress to give him authority to name six new members of the court if the justices over 70 did not retire. A letter from Hughes to the senate judiciary committee riddled the president's contention that this would enhance the court's efficiency. It is sometimes said that the court further contributed to defeat Roosevelt's "court-packing" bill by upholding the Wagner Labor Relations act and the Social Security acts and by changing its mind on state minimum wage laws. But Hughes always insisted that the bill had no effect on the court's rulings and that the later New Deal laws were upheld because they had been enacted with greater care. His skilful defense of the court's work and the restraint of his opinions were powerful factors in the final defeat of the bill. In 1941 he retired and on Aug. 27, 1948, he died at Cape Cod, Mass., at the age of 86.

Hughes delivered numerous addresses subsequently reproduced in pamphlet form. In addition, he published *Addresses and Papers* (1908); *Public Papers of C. E. Hughes, Governor, 1907–1910* (1910); *Conditions of Progress in Democratic Government*, Yale lectures (1910); *Addresses 1906–16* (1916); *Foreign Relations* (1924); *The Pathway of Peace* (1925); *The Supreme Court of the United States: Its Foundations, Methods and Achievements* (1928); and *Pan American Peace Plans* (1929).

See M. J. Pusey, *Charles Evans Hughes*, authorized biography, 2 vol. (1951). (M. J. PY.)

HUGHES, DAVID EDWARD (1831–1900), Anglo-U.S. inventor, remembered for important contributions to telephony and telegraphy, was born on May 16, 1831, in London, but the earlier part of his life was spent in the United States, to which his parents emigrated when he was about seven years old. In 1850 he became professor of music at the college of Bardstown, Kentucky, and soon afterward teacher of natural philosophy at the same place; he resigned this post in 1854. In 1855 he took out a patent in the United States for his type-printing telegraph instrument (*see* TELEGRAPH: *Printing Telegraphs*). Its success was immediate and in 1857 Hughes took it to Europe. In the succeeding ten years it came into extensive use throughout Europe, gaining for its inventor numerous honours and prizes. Hughes's microphone (*q.v.*) was the forerunner of the various forms of carbon transmitter later in general use. He is also known for his invention of the induction balance and for contributions to the theory of magnetism. He died in London on Jan. 22, 1900.

HUGHES, HUGH PRICE (1847–1902), prominent British Wesleyan Methodist minister, journalist and founder of the *Meth-*

odist Times (1885), was born at Carmarthen, Wales, on Feb. 8, 1847, and educated at University college, London, and the Wesleyan Theological college, Richmond. After holding various pastorships he became superintendent of the West London mission in 1887. Advocating his own mixture of evangelical Christianity and political liberalism, he worked for the reform of social problems and supported many plans to adapt the Wesleyan Church to the rapidly changing conditions of the late 19th century. In 1896 he was the first president of the National Free Church council, which he had done much to create, bringing his own denomination closer to other Free churches. In 1892–95 he shared in the Grindelwald conversations between Free churchmen and Anglicans. Politically he acted as the Nonconformist conscience, and his most influential political act was to declare against Charles Stewart Parnell after the famous divorce case in 1890. He also took a prominent part in the Education acts controversy. Originally a Gladstonian liberal, he later became an imperialist, and his support of the South African War cost him much influence in Nonconformity. He died in London on Nov. 17, 1902.

See the life by his daughter, D. Price Hughes (1904). (J. H. S. K.)

HUGHES, JOHN (1797–1864), U.S. Roman Catholic prelate, fourth bishop and first archbishop of New York, was born in Annaloghan, County Tyrone, Ire., June 24, 1797. He followed his father to the United States, studied at Mount St. Mary's College, Emmitsburg, Md., and was ordained a priest in 1826. After serving in several Philadelphia parishes, he became bishop coadjutor to Bishop John Dubois of New York (1838), bishop of the see (1842) and archbishop (1850). He vigorously opposed and defeated proponents of the lay trustee system in the management of church property, argued for state support of parochial schools, publicly defended his faith against attacks of Protestant clergymen and the Nativist and Know-Nothing agitations of 1844 and 1854, fought the radical Irish press established in New York by political exiles, and denounced the movement to settle Irish immigrants on western land rather than in urban centres. During the Civil War he ardently supported the Union, visited Europe as President Lincoln's personal agent in a successful effort to counteract pro-Southern feeling in France, Rome and Ireland, and helped to end the critical draft riots in New York (1863). Such activities made him an international figure as well as the foremost Catholic prelate in the U.S. In ecclesiastical administration he vastly expanded Catholic churches and institutions, founded St. John's college (now Fordham university), and was a leader in the establishment of St. Joseph's Provincial seminary, Troy, N.Y., and of the North American college in Rome. He died in New York on Jan. 3, 1864.

See J. R. G. Hassard, *Life of the Most Rev. John Hughes* (1866). (J. A. Rs.)

HUGHES, SIR SAM (1853–1921), Canadian minister of militia and defense during World War I, was born at Darlington, Upper Canada (Ont.), on Jan. 8, 1853. Educated at the Toronto Normal school and the University of Toronto, he was a schoolteacher until 1885. He was then, until 1897, editor and proprietor of the *Lindsay Warder*, and in 1892 he was elected as a Conservative to represent North Victoria in the Canadian house of commons. He remained a member of the house continuously until his death in 1921. Early in life Hughes joined the Canadian militia, and in 1897 he rose to command the 45th regiment. He served in various capacities in the South African War in 1899–1900, and in 1902 he was promoted to the rank of colonel. In parliament he came to be considered a leading authority on militia matters, and when the government of Robert (later Sir Robert) Borden was formed in 1911, he was made minister of militia and defense. As such he was largely responsible for the organization in 1914 of the first Canadian contingent to serve in World War I. In 1915 he was promoted to the rank of major general and later to that of lieutenant general. In 1916 his disagreements with Borden brought about his resignation from the cabinet. Hughes was created knight commander of the order of the Bath in 1915. He died at Lindsay, Ont., on Aug. 24, 1921. (W. S. Wa.)

HUGHES, THOMAS (1822–1896), English novelist, author of *Tom Brown's School Days*, was born at Uffington, Berkshire, on Oct. 20, 1822. He was educated at Rugby school from 1834 to 1842. His love for the great Rugby headmaster Thomas Arnold and his delight in boyish high spirits are admirably captured in his greatest book—*Tom Brown's School Days*—published in 1857. Its success—it ran into nearly 50 editions by 1890—did much to create a new ideal of the public-school product, to popularize the doctrine of "muscular Christianity" and to distort the true picture of Arnold's work and ideals.

From 1842 to 1845 Hughes was at Oriel college, Oxford, and *Tom Brown at Oxford* (1861) gives a vivid picture of life there at that time. He then studied law, being called to the bar in 1848. His admiration for J. F. D. Maurice (*q.v.*) led him to join the Christian Socialists and, in 1854, to become a founder member of the Working Men's college, of which he was principal from 1872 to 1883. His simple, earnest approach to religion and his robust patriotism show plainly in his tracts *A Layman's Faith* (1868) and *The Manliness of Christ* (1879). A Liberal member of parliament from 1865 to 1874, he became queen's counsel in 1869 and a county court judge in 1882. In 1870 he visited the United States, and in 1879 he made an unsuccessful attempt to found a co-operative settlement in Tennessee, involving himself in heavy financial loss. He died at Brighton on March 22, 1896.

See E. C. Mack and W. H. G. Armytage, *Thomas Hughes* (1953). (D. H. N.)

HUGHES, WILLIAM MORRIS (1862–1952), Australian statesman, prime minister from 1915 to 1923, was born of Welsh stock in London. He was educated at St. Stephen's school, Westminster, and became a student teacher before emigrating to Australia in 1884. He later claimed to have spent the following months roaming the Queensland outback in typical pioneer fashion. From 1886 he lived in Sydney, soon becoming interested in trade union affairs and labour politics. Fruits of his energy in these fields were the organization of the Sydney stevedores, with whose federation he long remained associated, and his election to the New South Wales legislature (1894). He helped organize the early Labor party, and was one of its few leaders who warmly supported federation of the Australian colonies.

In 1901 Hughes became a member of the first federal house of representatives. He served in Labor cabinets under J. C. Watson (1904) and Andrew Fisher (1908, 1910–13, 1914–15), helping establish a national system of defense and such left-liberal policies as a system of judicial arbitration in industrial disputes. As an administrator, a parliamentarian and a publicist, Hughes soon showed that he possessed political genius superior to that of his leaders, and Fisher's retirement in Oct. 1915 inevitably meant his succession to the premiership.

During the next few years Hughes established himself as a figure of world standing. He was a war leader comparable to David Lloyd George and Winston Churchill. In Australia he brought the war effort to a very high pitch of efficiency; when visiting Great Britain in 1916 he contributed to rallying that nation, and so the empire, to the task of winning the struggle. At the Versailles peace conference he asserted Australia's interests (especially in the Pacific, as against Japan) very strongly; he scorned Pres. Woodrow Wilson's idealism, and personal clashes between the two resulted.

Meanwhile Hughes's political position inside Australia had weakened. From 1916 he was convinced that the government must enforce conscription to maintain Australian armies in Europe. The majority of the Labor party disagreed and consequently expelled the leader and a few others (Nov. 1916); this minority then joined with anti-Labor forces to form the Nationalist party, as head of which Hughes remained prime minister until Feb. 1923. But he was never quite happy with his new allies, and they were suspicious of Hughes's continuing sympathy for positive, even quasi-socialistic government. This bitterness finally grew strong enough to force his deposition.

For the rest of his long life Hughes remained in parliament, waiting for the fortune of politics to favour him once more. He helped bring about the fall of S. M. Bruce in 1929 and R. G. Menzies in 1941; served in the cabinet from 1934 to 1941 (except for three months in 1935–36 when J. A. Lyons dismissed him for

outspoken criticism of Australia's lack of defense preparations); and even led the United Australia (ex-Nationalist) party in 1941–43. Probably he had hoped that John Curtin's Labor ministry, which entered office in Oct. 1941, would offer him a post, but no such development occurred. He died in Canberra on Oct. 28, 1952.

Hughes's name will ever remain famous. As "Billy" or "the little Digger" he achieved a charismatic force unknown to any other Australian politician. He perfectly expressed the temper of the Labor movement and of nationalist feeling in crucial years of their development. But the qualities which make a nationalist spokesman and a powerful war leader are not wholly attractive. Hughes was autocratic, ill-tempered, egocentric and avid for power. He was too nearly superhuman to possess much humanity. Among his published works were *The Price of Peace* (1934) and *Policies and Potentates* (1950).

See also AUSTRALIA, COMMONWEALTH OF: *History*.

See W. Farmer Whyte, *William Morris Hughes* (1957). (O. M. R.)

HUGO, VICTOR MARIE (1802–1885), French poet and novelist who, because of the immense range and vigour of his works, is counted among the great figures of world literature. Born at Besançon, on Feb. 26, 1802, he was the third son of Joseph Léopold Sigisbert Hugo, a professional soldier who was a major at the time of his marriage (to Sophie Françoise Trébuchet) and was later promoted general. The paternal family was of Nancy, the maternal of Nantes; the former consisted of farmers and artisans, the latter of seamen and lawyers. Victor claimed that he came of "a stock both Breton and Lorrain," but it was Paris, where he went to live with his mother when he was two, that he called "the birth-place of his soul."

Early Years (1802–1830).—Hugo's childhood was coloured by his father's constant traveling with the imperial army and by the disagreements which soon alienated his parents from one another. His mother's royalism, a development perhaps subsequent to marriage, and his father's loyalty to successive governments—the Convention, the Empire, the Restoration—reflected their deeper incompatibility. It was a chaotic time for Victor, continually uprooted from Paris to set out for Elba or Naples or Madrid, yet always returning to Paris, usually with his mother alone. Such an existence at least fed his mind on contemporary history even if it did not provide a settled, religious upbringing; yet somehow his intellectual education did achieve a solid basis, especially in Latin literature, and his private reading, though without order, was omnivorous. A few clear images from this period stayed in his mind: of Spain especially, and of the garden of the Feuillantines in the Latin Quarter—a paradise, long since disappeared, which seemed to hold all the poetry of childhood. The fall of the Empire gave him from 1815 to 1818 a time of uninterrupted study at the Pension Cordier and the *lycée* Louis-le-Grand, after which he matriculated at the law faculty at Paris where his studies seem to have been purposeless and irregular. Memories of his life as a poor student inspired the figure of Marius in *Les Misérables*.

Indeed from 1816 at least he had conceived other ambitions; he was already filling notebooks with verses that he later called "bêtises que je faisais avant ma naissance" ("nonsense I perpetrated before my birth"): translations—particularly from Virgil—two tragedies, a play, elegies. Encouraged by his mother and excited by the dazzling example of Chateaubriand, he founded a review, the *Conservateur littéraire* (1819–21), in which his own articles on Lamartine and André Chénier stand out. His mother died in 1821 and, a year later, he married a childhood friend, Adèle Foucher, to whom he wrote some charming love letters, the *Lettres à la Fiancée* (1820–22; published posthumously). They had five children, four of whom survived: Léopold (d. 1823), Léopoldine (1824–43), Charles (1826–71), François Victor (1828–73) and Adèle (1830–1915). In the same year as his marriage, 1822, he published his first book of poems, *Odes et poésies diverses*, which earned him a pension from Louis XVIII. His triumphant literary career, which now seems inevitable, did not begin with a success equal to that of Lamartine's, whose first book, *Méditations poétiques*, had come out the year before, but behind Hugo's care for classical form and his political inspiration it is possible to recognize a personal voice and his own particular vein of fantasy. Fantasy had become fashionable and Hugo developed his gift for it in his first published novel, *Han d'Islande* (1823), which in 1825 appeared in an English translation with illustrations by George Cruikshank. Charles Nodier, a journalist and himself author of novels of fantasy, was enthusiastic about this *"roman noir"* and drew Hugo into the group of friends, all devotees of romanticism, which met regularly at the Bibliothèque de l'Arsenal where he was curator. Hugo continued to frequent this literary circle, called the Cénacle, though he sometimes professed indifference to the theoretical distinctions it debated. He shared also in launching a new review of moderate tendencies, the *Muse Française* (1823–24), to which he contributed essays on Lamennais, Vigny, Byron and Scott. In 1824 he published *Nouvelles Odes* and followed it with an exotic romance, *Bug-Jargal* (1826), developed from a short story written in 1819. In 1826 he published *Odes et ballades*, an enlarged edition of his previously printed verse, further augmented and republished in 1828. The latest of these poems were brilliant variations on the fashionable modes of mirth and terror; they possessed the youthful vigour which was also a characteristic of *Les Orientales* (1829).

Cromwell, published in 1827 between these two collections of poems, was an essay in verse-drama. The subject, with its near contemporary overtones, was that of a national leader risen from the people, but the play's reputation rested largely on the long, elaborate preface in which Hugo proposed a doctrine of romanticism that for all its intellectual moderation was extremely provocative. He demanded a verse-drama in which the contradictions of human existence would be resolved by the inclusion of both tragic and comic elements in a single play. Such a type of drama, abandoning the formal rules of classical tragedy for the freedom and truth to be found in Shakespeare, would provide a vantage point from which to view history and men. *Cromwell* itself, though immensely long and almost impossible to stage, was written in verse of great force and originality, as in the charming fantasy of the "Chanson du Fou" (or "Jester's Song").

"Au soleil couchant
Toi qui vas cherchant
Fortune,
Prends garde de choir;
La terre, le soir,
Est brune . . ."

Amy Robsart (1828), a prose adaptation for the stage of Scott's *Kenilworth*, was a failure, but *Les Orientales*, with its echoes of the Greek War of Independence, was an instant success. Hugo here displayed such technical mastery that some critics, Sainte-Beuve among them, regarded the book as nothing more than "a splendid throne raised to the honour of pure art"—a judgment in which the modern reader can share. Yet it can also be remarked that the poet, exalting freedom in verse which vibrates with ardent and brilliant imagery, is gradually shedding the legitimist royalism of his youth. It may be noted too that "Le Feu du Ciel," a visionary poem, forecasts those he was to write 25 years later. This fusion of the contemporary with the apocalyptic is a particular mark of Hugo's genius.

Success (1830–1851).—The defense of freedom and the cult of an idealized Napoleon in such poems as the ode "À la Colonne" and "Lui" brought Hugo into touch with the liberal group of writers on the newspaper *Le Globe*, and his move toward liberalism was strengthened by Charles X's restrictions on the liberty of the press as well as by the censor's prohibiting the stage performance of his play *Marion de Lorme* (1829), in which one of the characters was Louis XIII. He immediately retorted with *Hernani*, the first performance of which on Feb. 25, 1830, gained him victory in a literary battle (*see* FRENCH LITERATURE: *The Revolution and the 19th Century*). In this play he extolled the romantic hero already sketched in the character of Didier in *Marion de Lorme:* the noble outlaw at war with society, dedicated to a passionate love and driven on by inexorable fate. The actual impact of the play owed less to the plot than to the sound and beat of the verse, softened only in the elegiac passages spoken by Hernani and Doña Sol. The triumph of *Hernani* was due to the student audi-

ence, for it was a homage from a youth to youth.

Hugo had derived his early renown from his plays; wider fame was brought to him by his novel *Notre-Dame de Paris* (1831; frequently titled *The Hunchback of Notre Dame* in English translations). Its mysterious theme touched the public consciousness more deeply than had that of his previous novel, *Le Dernier Jour d'un condamné* (1829), a generous humanitarian protest against the death penalty, renewed later in *Claude Gueux* (1834). *Notre-Dame de Paris* condemned a society which, in the persons of Frollo the archdeacon and Phoebus the soldier, heaped misery on the hunchback Quasimodo and the gypsy Esmeralda. While this novel was being written Louis Philippe, a constitutional king, had been brought to power by the students and the liberal bourgeois in the three days of the July Revolution. Hugo composed a poem in their honour: *Dicté après Juillet 1830;* it was a forerunner of much political verse.

Four books of poems came from Hugo in the period of the July monarchy: *Les Feuilles d'automne* (1831), intimate and personal in inspiration; *Les Chants du crépuscule* (1835), overtly political; *Les Voix intérieures* (1837), at once personal and philosophical in tone; *Les Rayons et les ombres* (1840), in which the poet, renewing these different themes, indulged his gift for colour and picturesque detail. Poems echo each other from book to book: "Pente de la rêverie" (1831), in which he surrenders himself to the movement of universal history, finds its complement in "Puits de l'Inde" (1837); a short elegy such as "À Virgile" is answered by the great love poem "Tristesse d'Olympio," in which he confronts the passage of time and the advent of old age; and the sketches of children in poems such as "À des oiseaux envolés" are enlarged in the pathetic and more elaborate composition of "Oceano Nox." Hugo was not content to express personal emotions; he wanted to be the "écho sonore" of his time and thus to fulfill the poet's function as he saw it. Political and philosophical problems were integrated with the religious and social disquiet of the period; one poem evoked the misery of the workers, another praised the efficacy of prayer. He addressed many poems to the glory of Napoleon though he shared with his contemporaries the reversion to republican ideals. Independent of party and church, he restated the problems of his century and the great human questions always asked by man, and he spoke with a warmhearted eloquence and reasonableness that moved men's souls. Such was his influence that he even gained an admirer at court: the young duchess of Orleans, whose protection he enjoyed after 1837.

So intense was Hugo's creative activity during these years that, having at last achieved the stage production of *Marion de Lorme* in 1831, he continued to pour out plays. There were two motives for this: he needed a platform for his political and social ideas, and he wished to write parts for a young and beautiful actress, Juliette Drouet, with whom he had begun a liaison in 1833. Juliette had little talent and, perhaps persuaded by her lover, soon renounced the stage in order to devote herself exclusively to him, becoming the discreet and faithful companion she was to remain throughout her life (she died in 1883). The first of these plays was another verse-drama: *Le Roi s'amuse* (1832), and this too was banned; it was used by Verdi as the libretto of *Rigoletto*. Three prose plays followed: *Lucrèce Borgia* and *Marie Tudor* (1833); *Angelo tyran de Padoue* (1835); and a play in verse, *Ruy Blas* (1838). The historical and geographical diversity of these plays, apparent also in the poems of *La Légende des Siècles* (3 series; 1859, 1877 and 1883), is very striking. This was emphasized by Hugo himself when he came to classify his works on a basis of epochs and countries; Germany, he realized, was absent and he filled the gap by writing *Le Rhin* (1842) and *Les Burgraves* (1843), the latter a vivid theatrical extravaganza. *Ruy Blas* and *Le Rhin* stand out among these works. Indeed *Le Rhin* (together with *Choses Vues*, a posthumous collection of notes and observations on people and contemporary events) is the most effective initiation into Hugo's mind; this book of travel is composed of letters written during a series of journeys in the Rhine valley (1839–40) and is a workshop of the "picturesque"—a style that achieved its most accomplished dramatic application in *Ruy Blas*. But there is more to this play than its romantic theme of a low-born poet's passionate love of a queen or the light relief of the farcical Don César; the whole piece is animated by the democratic faith and the ideals of reform for which the hero is the author's spokesman. The failure of *Les Burgraves* interrupted Hugo's career as a dramatist; exile (1851–70; *see* below) and preoccupation with other tasks discouraged him from writing for the stage, though from time to time he composed those plays, giving rein to his fantasy, which make up the posthumous volume *Théâtre en Liberté* (1886).

Hugo's literary achievement was recognized in 1841 by his election, after three unsuccessful attempts, to the Académie Française, and by his nomination in 1845 to the chamber of peers. From this time he almost ceased to publish, partly because of the demands of society and political life but also as a result of personal loss; his daughter Léopoldine, recently married, was accidentally drowned with her husband in the Seine at Villequier on Sept. 4, 1843. He was traveling with Juliette Drouet when it happened and learned the news from a paper picked up in a *café*. His intense grief found some mitigation in poems which later appeared in *Les Contemplations*, a volume which he divided into "Autrefois" and "Aujourd'hui" as marking the moment of his daughter's death. He found relief above all in working on a new novel, which should, at one and the same time, achieve popularity in the manner of Eugène Sue (*q.v.*) and also affirm a greater faith in humanity. (The novel became *Les Misérables*, published in 1862 after work on it had been set aside for a time and then resumed.) Other distractions were a liaison with the wife of an artist, Léonie Biard, herself a writer, and, because of his close friendship with Louis Philippe and his daughter-in-law the duchess of Orleans, an assiduous attendance at court festivities. It seemed as if he wished to forget his personal sorrows and the menace of social unrest, but in fact his writings both in verse and prose reflect his troubled mind and it was in his grief that his genius matured.

His political intuition was confirmed when the revolution of Feb. 1848 was seen to be less political than social in its aims as compared with that of 1830. Hugo's plan to form a regency under the duchess of Orleans was unsuccessful and he entered the political arena of the Second Republic first as a deputy for Paris in the Constituent Assembly and then, later, in the Legislative Assembly, where he upheld his ideals of education for all and the well-being of the people. Such aspirations and his loyalty to the name of Bonaparte led him to support the candidature of Prince Louis Napoleon for the presidency in 1849. The more the president evolved toward an authoritarianism of the right, however, the more Hugo moved toward the assembly's left. When the *coup d'état* of Dec. 2, 1851, took place he made one attempt at resistance and then fled to Brussels.

Exile (1851–1870).—His exile was to last until the return of liberty and the reconstitution of the republic on Sept. 4, 1870. Enforced at the beginning, exile later became a voluntary gesture, and, after the amnesty of 1859, an act of pride. He remained in Brussels for a year until, foreseeing expulsion, he took refuge on British territory. He first established himself on Jersey, where he occupied Marine Terrace, St. Hélier (1852–55). When he was expelled from there he bought Hauteville house, as he called it, at St. Peter Port on the neighbouring island of Guernsey.

Immersed in politics as he was, he devoted the first writings of his exile to satire and recent history: *Napoléon-le-Petit* (1852) and *Histoire d'un Crime* (not published until 1877). His return to poetry was an explosion of wrath: *Les Châtiments* (1853). The composition of these poems liberated him from his few remaining classical prejudices into the full mastery of his poetic powers. During this exile of nearly 20 years all the intimations of his earlier works achieved definitive expressions. It was during this period that he produced the most extensive part of all his writings and the most original—one of the most astounding creative feats in literary history. It was accomplished in virtual solitude—his only companion, except for his family and the ever faithful Juliette, the restless sea. *Les Châtiments* ranks with D'Aubigné's *Les Tragiques* and André Chénier's *Iambes* as the most powerful of satirical works in the French language. All his future verse profited from this release of his imagination; the tone of this collection of poems some-

times attains the pure lyricism of "Stella," sometimes the epic quality of "L'Expiation" and "La Caravane." The inspiration behind *Les Châtiments,* with its undertone of national and personal frustration, was borne out by a feeling sustained and developed in all his subsequent work, however flawed by the repetitions and weaknesses which were its inevitable accompaniment.

Despite all the satisfaction he derived from his political poetry, Hugo began to weary of its limitations; turning back to the unpublished poems of 1840–50 he set to work on a volume of "pure poetry," *Les Contemplations* (1856). In the meantime, however, he had become obsessed with the preternatural, or the *surréel,* as he called it: table-turning, dreams, insomnia, knockings and other such phenomena were recorded in the private notebooks, later housed in the Bibliothèque Nationale. This was not without influence on his work but it remains true, nevertheless, that *Les Contemplations* contains the purest of his poetry—the most moving because the memory of his dead child is at the centre of the book, the most disquieting also because it transmits the haunted world of a thinker with whom we must come to terms. Lines of great confidence and simplicity such as:

> Demain, dès l'aube, à l'heure où blanchit la campagne,
> Je partirai. Vois-tu, je sais que tu m'attends . . .

alternate with the stern grandeur of:

> Nous rampons, oiseaux pris sous le filet de l'être . . .

or

> Un affreux soleil noir d'où rayonne la nuit . . .

while in poems such as "Pleurs dans la nuit" and "La Bouche d' ombre," from which these last two lines are quoted, we enter the region where a tormented mind struggles between doubt and faith in its lonely search for meaning and significance.

This apocalyptic approach to reality dominated the poet's inspiration; it was the source of those epic or metaphysical poems for which there has been growing admiration among modern readers: *La Fin de Satan* and *Dieu*—poems of vast scope, the first a tapestry of resplendent visions, the second tense with urgent debate, both of them confrontations of the problem of evil. Written between 1854 and 1860, constantly revised, they were not published until after his death because his publisher preferred the epics based on history and legend: the "Petites epopées" of *La Légende des siècles* (first series, 1859). These, which for Hugo himself formed a single poem with the metaphysical epics, are the summit of his art; they display all his spiritual power without sacrificing his exuberant capacity to tell a story. Hugo's personal mythology of the human struggle between good and evil lies behind each of the legends: Eve's motherhood is exalted in "Le Sacre de la femme," mankind liberating itself from all religions in order to attain divine truth is the theme of "Le Satyre," and "Plein Ciel" proclaims, through utopian prediction of men's conquest of the air, the poet's conviction of indefinite progress toward the final unity of science with moral consciousness. Hugo was a prophet of the modern world at a moment when his century was foundering in religious disbelief.

Yet he was prudent enough not to overtax his readers' comprehension. After the publication of three long books of poetry he turned to prose—though not before relaxing in the delightful *Chansons des rues et des bois* (written 1859; publ. 1865)—and took up his abandoned novel *Les Misérables.* Its extraordinary success with readers of every type when it was published in 1862 brought him instant popularity in his own country, and its speedy translation into many languages won him fame abroad. The plot is that of a detective story, but it is also the epic of the people of Paris. Its author claimed it as a "religious" work and indeed by means of its characters, sometimes a little larger than life yet always vital and engaging, and by its re-creation of the swarming Parisian underworld, the main theme of man's ceaseless combat with evil does clearly emerge while the whole gives a faithful picture of the ebb and flow of life. Hugo relives his youth in this vast novel and the ordinary reader can still be moved by its author's search for justice; even the more critical can admire the novel's complex structure, in spite of lengthy digressions in the narrative.

The translation of Shakespeare's works undertaken by his son François Victor was nearing its end. Hugo had promised to write a preface. It became an essay, *William Shakespeare,* published for the tercentenary (1864), in which he elaborated his theory of the poetic imagination as divided between light and darkness, joy and grief. The experience of the great dramatist, he believed, confirmed his own. In this essay, probably unique of its kind, Hugo developed a hierarchy of human genius—Job, St. Paul, Dante, Cervantes, Shakespeare—which went beyond the customary classifications, and there is little doubt that he saw himself in these ranks. There is much to explore in this little-known work. Two novels also showed this tendency toward the grandiose: *Les Travailleurs de la mer* (1866), dedicated to the island of Guernsey and its sailors' battles with the sea, and *L'Homme qui rit* (1869), a curious baroque novel about the English people's fight against feudalism in the 17th century. His last novel, *Quatrevingt-treize* (1874), planned at the same period but finally written in Guernsey in 1873, portrayed, but with less complexity than the previous works, human justice and charity against the background of the French Revolution. These were not the only works of his exile; on his return to France he left behind many manuscripts which were to be published later.

The Last Years (1870–85).—The defeat of France in the Franco-German War and the proclamation of the third republic brought Hugo, faithful to his vow, back to Paris. He agreed to play his part in public affairs as a deputy in the national assembly (1871) but resigned the following month. Though he was belligerent for his old ideals he no longer possessed the same energies. The trials of recent years had aged him, and there were more to come: in 1863 his daughter Adèle had eloped to America whence, in 1872, she returned insane; in 1868 he had lost his wife, a profound sadness to him after their many years together; in 1871 his son Charles died, in 1873 François Victor. Increasingly detached from life around him, the poet of *L'Année Terrible* (1872) had become a national hero. He went on with his task, his gaze fixed on the horizons closing in. He had his grandchildren, Georges and Jeanne, for whom he wrote the genial verse of *L'Art d'être grand-père* (1877). The episode of the commune, which met with his disapproval, found him once more at Brussels and he was again expelled for giving shelter to the defeated rebels; after a temporary refuge in Luxembourg he returned to Paris, where he was elected senator. During 1873–74 he was in Guernsey for the writing of *Quatrevingt-treize* and the preparation of his remaining works for publication. In 1878 he was stricken by cerebral congestion, but he lived on for some years in the Avenue d'Eylau, renamed Avenue Victor Hugo on his 80th birthday. Two years after the death of Juliette, his faithful companion, he died, crowned with glory, on May 22, 1885. He was given a national funeral, lay in state under the Arc de Triomphe, and was buried in the Panthéon, having been taken there in a poor man's hearse as he had wished.

During these last years the works planned in exile as well as occasional writings maintained a continuous flow of publications. Among them were a collection of his political speeches: *Actes et paroles* (1875–76); additions to *La Légende des siècles* (new series, 1877, and complementary series, 1883; the poems of the three series were rearranged according to the historical order in the definitive edition, 1883); satiric and didactic verse: *Le Pape* (1878), *La Pitié suprême* (1879), *L'Âne* (1880), *Religions et Religion* (1880); a collection of poems exemplifying the four trends of his poetry during the last 40 years: *Les Quatre Vents de l'esprit* (1881); a new verse-play, *Torquemada* (1882). The two great apocalyptic poems, *La Fin de Satan* and *Dieu,* achieved posthumous publication in 1886 and 1891, as did *Toute la lyre* (1888) and *Les Années funestes* (1898). The two volumes of *Choses Vues,* a masterpiece of descriptive writing, followed (1887–1900), together with the delightful travel books, *Alpes et Pyrénées* (1890) and *France et Belgique* (1892). A last volume of miscellaneous prose and poetry, *Océan,* appeared in 1942.

Reputation.—Such an enormous output is unique in French literature. A comparison with Balzac is deceptive in spite of the vast scope of the *Comédie Humaine;* Balzac had neither Hugo's diversity of talent nor did he benefit from the longevity and enforced solitude of which Hugo made such conscientious use—it is said that he used to write each morning 100 lines of verse or 20

pages of prose. "The most powerful mind of the romantic movement," as he was described in 1830, laureate and peer of France in 1845, he went on to assume the role of an outlawed sage who, with the easy consciousness of authority, put down his insights and prophetic visions in great prose and verse, becoming at last the genial grandfather of popular portraiture and the national poet who gave his name to a street in every town in France.

This instinctive recognition of Hugo as a great poet at the time of his death was followed by a period of critical neglect. A few of his poems were remembered and *Les Misérables* continued to be widely read; his poetic art was prized by the few, and the generosity of his ideas and the warmth of their expression still moved the public mind. What François Mauriac has called "the heroism of banality" made him a poet of the common man because he knew how to write with simplicity and power of common joys and sorrows. There was another side to this people's poet—what Paul Claudel called his "panic contemplation" of the universe, the numinous fear that penetrates the sombre poems of the 6th book of *Les Contemplations*, *La Fin de Satan* and *Dieu*. He knew, as Baudelaire wrote of him, how to evoke the ambience of mystery. Moreover, his knowledge of the resources of French verse and his technical virtuosity in metre and rhyme rescued French poetry from the sterility of the 18th century. The poets who succeeded him—Baudelaire, Rimbaud, Claudel, Apollinaire—are indebted to his vast poetic experience.

André Gide, when asked whom he considered the greatest French poet, replied "Victor Hugo, hélas"; he subsequently explained that if it was a regrettable fact at least it was a fact. The time has come to replace this ambiguous verdict by that of another poet, Léon Paul Fargue: "Victor Hugo, un poète d'avenir," which might be translated as "a poet who has time on his side." Poet of the real and the surreal, Hugo must be accepted whole. As with other outsize figures of genius, his full stature will be discerned only when all his work has been assimilated and understood.

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HUGUENOTS, the name given, about the middle of the 16th century, to the Protestants in France. Some historians attribute the origin of the name to the assemblies of the Protestants of Tours, which took place at night in a tower haunted, it was said, by a spirit called King Hugo. It appears, more simply, to come from the word *aignos*, derived from the German *Eidgenossen* (confederates bound together by oath), used to describe, between 1520 and 1524, the patriots of Geneva hostile to the duke of Savoy.

Reform Movement in France, to 1559.—The French Reformation has often been regarded as an offshoot of Lutheranism. Yet as early as 1512 Jacques Lefèvre d'Étaples wrote his *Sancti Pauli Epistolae xiv . . . cum commentariis*, which has been interpreted as embodying the cardinal doctrine of the Reformation, justification by faith; and in 1523 his French translation of the New Testament appeared. The movement for reform spread quickly in France, especially in places which had suffered economic depression and among those who had grievances against the established order of government. The first of its martyrs to be burned at the stake in Paris was Jean Vallière (Aug. 1523); other martyrs were Jacques Pouet (Pavanes), a priest from the diocese of Meaux (1526), and Louis de Berquin (1529). Despite persecution, however, the movement progressed; but measures against it were redoubled after the "affair of the Placards" (Oct. 1534), when posters attacking the Mass were found on walls throughout Paris and even on the door of Francis I's bedroom at Amboise. Thereafter the number of refugees from persecution increased. Many went to Strasbourg, then a free city of the Holy Roman empire, where Martin Bucer had organized a Reformed church.

The most famous of these exiles was John Calvin, who left for Basel in the autumn of 1534. At Basel he is thought to have written his *Christianae religionis institutio*, which was prefaced by a letter to Francis I pleading the cause of the Reformers in France. In 1538 Calvin visited Strasbourg on Bucer's invitation and organized the French community there. The first Huguenot community in French territory, that of Meaux, was founded in 1546 on the model of the Strasbourg community.

Persecution, however, became more rigorous. The Vaudois of Cabrières and Mérindol had been massacred in 1545 by the orders of Jean de Maynier, baron d'Oppède, lieutenant general of Provence; and at Paris a special court in the *parlement*, the so-called *chambre ardente*, was created for the suppression of heretics (1547). The Huguenot church in Paris was founded about 1555, and in spite of persecution the Reformers increased in numbers. In 1558, at Poitiers, it was decided that all the Protestant churches in France should formulate by common accord a confession of faith and an ecclesiastical discipline; and the church at Paris was commissioned to summon the first synod, which was attended by 72 deputies representing all the provinces of the kingdom (May 1559). The synod of Paris derived its inspiration from the constitution introduced by Calvin at Geneva (subsequently the model for all Presbyterian churches). Ecclesiastical authority resides ultimately in the people, for the faithful select the elders who are charged with the general supervision of the church and the choice of pastors; churches are independent units but have common interests, and their unity must be maintained by an authority capable of protecting them. The association of several neighbouring churches was to be a local council, or *colloque;* over the *colloques* stood the provincial synod, on which each church was equally represented by lay delegates and pastors; and supreme authority resided in the national synod, composed of representatives, lay and ecclesiastic, elected by the provincial synods.

Wars of Religion.—The synod of 1559 was the beginning of a remarkable increase in the Reform movement. At that synod 15 churches were represented; two years later, in 1561, the number was 2,150—an increase which carried the struggle into the arena of national politics.

The Huguenot conspiracy of Amboise, formed with the object of kidnaping King Francis II (March 1560), resulted in the death of all the plotters except Louis I de Bourbon, prince de Condé; but the Reformers had become so powerful that Gaspard de Coligny (*q.v.*), their most famous leader, protested in their name at the assembly of notables at Fontainebleau (Aug. 1560) against all violation of the liberty of conscience. For a moment, at the colloquy of Poissy (Sept.–Oct. 1561), at which Roman Catholic and Protestant divines were assembled together, it seemed as though a *modus vivendi* would be established. The attempt failed, but the edict of Jan. 1562 assured the right of holding public worship outside the towns to the Huguenots—or adherents of the *Religion Prétendue Réformée* ("so-called Reformed Religion") as they were officially designated by the Catholics. This, however, was merely the prelude to civil war, which started after a number of Huguenots assembled for worship in a barn at Vassy had been massacred by soldiers of the Guises. It was then that Condé declared there was no hope but in God and arms, and, with the Huguenot leaders, signed at Orléans (April 12, 1562) the manifesto in which they stated that as loyal subjects they were driven to take up arms for liberty of conscience on behalf of the persecuted saints. Thus began a period of confusion and violence which lasted until almost the end of the century (*see* FRANCE: *History*).

After two abortive attempts at a settlement (1563 and 1568), the Huguenots were in 1569 defeated at Jarnac, where Condé was captured and killed. But the queen of Navarre, Condé's sister-in-law Jeanne d'Albret, renewed the courage of the vanquished by presenting to them her son, the future Henry IV of France; and Coligny, whose heroic courage rose with adversity, collected the

remnants of the Protestant army and moved on Paris. The peace of St. Germain followed, on Aug. 8, 1570. Held with great solemnity at La Rochelle in 1571, the seventh national synod of the Protestants sanctioned the declaration of faith of 1559 and drew up a standard text of it.

For a moment it seemed reasonable to hope that the war was over. Coligny, always conciliating, returned to court, where his influence grew; and Henry of Navarre was to marry Margaret, sister of Charles IX of France. On the night of Aug. 24, 1572, however, after a council at which Catherine de Médicis, Charles IX, the duc d'Anjou (later Henry III of France) and the Guises were present, there occurred the massacre of St. Bartholomew's day (*q.v.*), in which Coligny and all the leading Huguenots in Paris were slain. The Paris massacre was repeated throughout France, and the Protestants were slain in thousands. The survivors resolved upon a desperate resistance, and a Huguenot political party was formed at Milhaud, near Nîmes, in 1573. Especially prominent was Philippe de Mornay (*q.v.*), known as Duplessis-Mornay.

While it is a mistake to suppose that the majority of Huguenots wished to abolish the institution of monarchy, their religious organization did encourage political separatism. According to the historian J. A. de Thou, the Huguenot organization had a president, called the protector of the churches, and its own laws dealing with civil government, justice, war, commerce and finance. The Huguenots at first hoped that the crown of France would pass to a Huguenot; when that became obviously impossible, they fought for full religious and civil liberty within the state. Their political views are expressed in François Hotman's *Franco-Gallia* (1573) and in the *Vindiciae contra tyrannos* (1579), attributed to Hubert Languet. These works postulate government by consent of the governed and the right to rebel against insupportable tyranny.

War was resumed after the massacre of St. Bartholomew's day and continued, with short-lived intermissions, throughout the reign of the unpopular Henry III, who succeeded Charles IX in 1574. Henry III's hesitations encouraged the formation of the powerful Holy League (*see* LEAGUE, HOLY) against the Huguenots, and after the assassination of Henry III in 1589 his successor, Henry IV, could only pacify the kingdom by abjuring Protestantism (July 1593) and thus depriving the League of its pretext for resisting him. The Huguenots after 40 years of strife obtained by their constancy the promulgation of the Edict of Nantes (*q.v.;* April 1598), the charter of their religious and political freedom.

17th Century.—Under Louis XIII civil war broke out again between the king and the Huguenots in 1620, when the Huguenots, led by Henri, duc de Rohan, took up arms to resist the enforcement of a royal edict restoring to the Catholics ecclesiastical property in Navarre and Béarn which the Huguenots had been holding since the previous reign. Though the royal army had to raise its siege of Montauban (Aug.–Nov. 1621), the peace of Montpellier (Oct. 1622) left to the Huguenots only La Rochelle and Montauban of all the strongholds that they had been granted under the Edict of Nantes. They rebelled again in 1625–26, but were treated lightly because of English mediation; but in 1627 the Huguenots of La Rochelle abetted the English attack on the Île de Ré. The cardinal de Richelieu then resolved to carry out his plan for putting an end to their political power in France. La Rochelle, besieged from Oct. 1627, made a heroic resistance but fell on Oct. 28, 1628. In the following months the Huguenot forces in southern France were defeated; and on June 28, 1629, the peace of Alais was signed, whereby the Huguenots retained their freedom of conscience but lost all their military advantages.

No longer a political entity, the Huguenots showed themselves loyal subjects of the French king. Their remaining rights under the Edict of Nantes were confirmed by a royal declaration of July 8, 1643, on behalf of the infant Louis XIV. The Catholic clergy, however, had always resented the edict, and all their efforts were directed to obtaining its revocation. As long as Cardinal Mazarin was alive the complaints of the clergy were almost always in vain, but when Louis XIV began his personal rule a change of policy ensued. The Edict of Nantes, which was part of the law of the land, might seem to defy all attacks, but the clergy found means to circumvent its effect by demanding that it be observed with literal accuracy, disregarding the changes which had been produced in France since its promulgation. The clergy in 1661 successfully demanded that commissioners should be sent to the provinces to report infractions of the edict, and thus began a judicial war which was to last for more than 20 years. All Huguenot churches built since the Edict of Nantes were condemned to be demolished; all privileges not explicitly granted in the actual text of the edict were suppressed; and a multitude of proclamations, edicts and declarations were issued attacking the Huguenots in their family life, in their civil freedom, in their property rights and in their liberty of conscience. In spite of all the suffering which this rigorous legislation inflicted, the Huguenots did not cease to resist; and as early as 1681, to compel them to accept the "king's religion," the system of *dragonnades* was devised. This meant the deliberate quartering of dragoons or other soldiers in Huguenot households, with tacit licence to maltreat their hosts. There followed the forcible conversion of thousands of Protestants. Large Huguenot communities, like those at Nîmes and at Montauban, were forced to abjure *en masse*. It was then that Louis XIV declared that "the best of the larger part of our subjects, who formerly held the so-called Reformed Religion, have embraced the Catholic Religion, and therefore the Edict of Nantes has become unnecessary." On Oct. 18, 1685, he pronounced its revocation. Thus was committed one of the most flagrant political and religious blunders in the history of France, which in the course of a few years lost more than 400,000 of its inhabitants. Many emigrated to England, to Prussia, to Holland or to America and became very useful citizens of their adopted countries.

18th Century.—As a result of the persecution the guerrilla warfare of the Camisards (*q.v.*) broke out in 1702 in the Cévennes, only to end in the defeat of the insurgents (*see* also CAVALIER, JEAN). The Huguenots seemed to be finally conquered. On March 8, 1715, Louis XIV announced that he had put an end to all exercise of the Protestant religion; but in that very year, on Aug. 21, while the king was dying at Versailles, there assembled together at the gates of Nîmes, under the presidency of Antoine Court (*q.v.*), the "Restorer of Protestantism," then only 20 years of age, a conference devoted to the re-establishment of the church. This was the first "synod of the Desert." By 1750 ten provinces had been reorganized and were holding synods, consistories and colloquies regularly.

As in the 18th century advanced public opinion began to revolt from the persecution of the Huguenots, which from 1745 to 1754 had been revived with exceptional violence in Dauphiné, the Cévennes and Languedoc. The torture of Jean Calas (*q.v.*), condemned on a false charge of having killed his son because he desired to become a Catholic (1762), caused general indignation, of which Voltaire became the eloquent mouthpiece. Thanks to the courageous efforts of the pastor Paul Rabaut (*q.v.*) and to those of Malesherbes and Lafayette, an edict of Nov. 1787, in spite of fierce opposition by the clergy, restored in part the civil rights of the Huguenots; *e.g.*, by recognizing the validity of their marriages. In Dec. 1789 the National Assembly affirmed the liberty of religion and granted Protestants admission to all offices and professions.

19th and 20th Centuries.—By the law of 18 Germinal year X (April 1802), under Napoleon Bonaparte's consulate, the French Protestant Church was established as an organ of the state, under controls which naturally curtailed its freedom of action. By this time, however, as a result of constant persecution and the vicissitudes of the Revolution, it was much reduced in numbers from what it had been at the beginning of the 17th century. An official census of 1806 rated the number of pastors at 210 and the churches at 99; in Paris there was only one church and one pastor. The Protestants moreover had no faculty of theology, no schools and no orphanages. The work of rebuilding the community lay ahead.

At the fall of Napoleon (1815) the reaction of the "White Terror" once more exposed the Protestants to outrage, in particular in the south of France, for instance at Nîmes. Again a number fled from persecution to foreign countries. Order having been restored, attention was then focused on religious questions, and the period was marked by a notable revival. An intense mysticism

inspired the preaching of Adolphe Monod (*q.v.*) at Montauban and at Lyons and the success of Félix Neff in the Hautes-Alpes (1823–27). On all sides churches were built and schools opened. During that period were founded the great religious societies: Société Biblique (1819), Société pour l'Encouragement de l'Instruction Primaire (1829), Société des Traités (1821), Société des Missions (1822). On the other hand, the old union of the Reformed churches ceased to exist after the revolution of July 1848. A schism occurred first in 1848, because of the refusal of the synod to draw up a profession of faith. The comte Agénor de Gasparin and the pastor Frédéric Monod seceded and in 1849 founded the Union des Églises Évangéliques Libres de France, separated from the state, of which Edmond de Pressensé was to become the most famous pastor. Under the second empire (1852–70) the divisions between the orthodox and the liberal thinkers were accentuated. The former declared their strict loyalty to the confessions of faith formulated by the synods; the latter, giving a large place to individual liberty of conscience, were particularly hostile to any declaration or obligatory confession of faith. A new separation followed on the reassembly of the national synod, authorized in 1872 by the government of the third republic. The old Huguenot church was thus separated into two parts, having no other link than that of the *loi des cultes* of 1802, and each possessing its own peculiar organization.

The law of Dec. 9, 1905, which separated the church from the state, was accepted by the great majority of Protestants as a legitimate consequence of the principles of the Reformation, and its application caused no difficulty with the state. Obliged to renounce all state subsidies, the Protestant churches now had to provide for themselves. They had the right to take subscriptions from their members, to make collections in churches and houses for expenses and to exact payment for religious ceremonies, even in the form of endowment. The property they had hitherto controlled was transferred to the so-called *associations cultuelles,* civil bodies which the faithful were invited to form.

Four major Reformed groups emerged after the separation of church and state: the Union des Églises Réformées Évangéliques, orthodox in tendency and originally the largest of the four; the Union Nationale des Églises Réformées, liberal in outlook and comprising at the moment of its foundation (1907) about 100 regional unions; the Églises Évangéliques Libres, founded on the principle of an obligatory confession of faith; and the Église Wesleyenne, usually called Méthodiste. The Jarnac group, so named from the town where it held its meetings, did not succeed in its purpose of reunifying the Protestant church and soon joined the Union Nationale des Églises Réformées.

Envisaged by a Methodist synod as early as 1904 and adumbrated in the first general assembly of French Protestantism in 1909, the Fédération Protestante de France came into effective existence after World War I. This succeeded in maintaining in a large measure the moral and spiritual union of the Reformed church as a whole. Its council and its general assemblies have the duty of discussing periodically the major questions of common interest to all French Protestants.

The restoration of Alsace-Lorraine to France involved the inclusion of the Lutheran and Reformed churches of that territory in the main body of French Protestants, increasing the membership to nearly 1,000,000. These churches are established and supported by the French state, in accordance with the regime existing before the Franco-German War of 1870–71, after which Alsace-Lorraine was annexed by Germany. Divided into seven *inspections,* the Lutheran Church of Alsace, by far the larger, is directed by a chief consistory, of which the permanent organization, the directory of Strasbourg, is composed mainly of nominees of the state.

Though the diversity of its churches has never impaired its vitality and though its divisions are often the result of beneficial differences of opinion, French Protestantism does not despair of restoring its old unity. Journées du Christ (founded 1927), a fusionist group from the valley of the Drôme in southeastern France, persuaded the national synods of the four Reformed groups to enter into negotiations in 1933 and to vote a common declaration of faith in 1936. After the reunion of a constituent assembly a new organization, the Reformed Church of France, regrouped the majority of the Protestant communities in 1938. The churches of Alsace-Lorraine did not join, because of their special status; and theological differences and problems of ecclesiastical discipline kept out the majority of the Églises Évangéliques Libres, the Églises Méthodistes of the Gard *département* and the "independent" Églises Évangéliques, hostile alike to the centralization of the new church and to any union between orthodox and liberal. *See* also references under "Huguenots" in the Index volume.

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(F. P.; L. MA.)

HUGUET, JAIME (*c.* 1415–1492), Spanish painter, the last important master of Catalan Gothic painting, was established in Barcelona in 1448. With the aid of assistants he produced many large composite altarpieces. The most important surviving examples are the retable of SS. Abdon and Sennen (Tarrasa), the retable made for the constable of Portugal (S. Agueda, Barcelona) and that of St. Augustine in the Barcelona museum, where many other productions of his workshop are to be seen. His style, reflecting French, Italian and Flemish influences, is distinguished by a combination of highly individualized heads and a purely decorative treatment of costume and background, ornamented with patterned and embossed gold. He had many followers.

See C. R. Post, *A History of Spanish Painting,* vol. vii, part i (1938).

(E. Hs.)

HUHEHOT (formerly KUEI-SUI, KWEIHWA, KUKU KHOTO), former capital of Suiyüan province, China; since 1954 capital of the Inner Mongolian Autonomous Region. The city lies at the northeastern end of the Kuei-sui plain, a fertile irrigated basin of the Hei river on the eastern shoulder of the Yellow river bend, and south of a break in the 4,500-ft.-high Yin-Shan scarp of the Mongolian plateau. In the 11th century the city became a frontier mart, where Chinese tea and manufactures were exchanged for Mongolian horses, skins and wool. Huhehot (meaning "blue city") was more Mongol than Chinese and prior to 1664 housed the Mongolian dalai lama. Increased Chinese control eventually resulted in the erection of an administrative city one mile northeast of the old Mongol settlement, an influx of Chinese farmers in 1928, the completion of the Peking-Suiyüan railway to Pao-t'ou, 90 mi. W., and increased manufacture of local wares, such as rugs,

clothing and leather goods. Since 1954, under the city's status of regional capital, industry has grown and plants have been built for making brick and tile, farm tools, woolen textiles, and sugar from sugar beets. It is the location of the Inner Mongolian Medical college and has six secondary technical schools. The city is 90 mi. W. of Chi-ning, connecting point for the railway to Ulan Bator, a location that is advantageous to its flourishing as a supply centre for the rapidly growing Chi-ning and of the new heavy industry centre, Pao-t'ou. Pop. (1953) 148,400. (TE. H.)

HUICHOL. This Indian tribe of the inaccessible Sierra Madre mountains of northern Jalisco and Nayarit is notable in modern Mexico for the degree to which its members have preserved their aboriginal speech (a Uto-Aztecan language), religion (especially the peyote cult) and customs (corn-beans-squash agriculture, selection of political officials by dreaming, curing of illness by shamans, etc.). They are closely related in language and culture to the neighbouring Cora. The Huichols number somewhat more, and the Cora somewhat fewer, than 3,000.

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HUÍLA, a southern district of the Portuguese overseas province of Angola, in western Africa, had a population (1960) of 592,-451. Area 72,907 sq.mi. Northward the district rises to about 5,000 ft. toward the Bié plateau and in the west the mountain chain exceeds 6,500 ft. around Sá da Bandeira. Huila is drained southward chiefly by the Cunene river and its affluents. Its agricultural wealth decreases from north to south. The northern part produces much wheat, maize (corn) and fruits, but the district depends chiefly on stock raising (more than 750,000 head of cattle). Fruit- and meat-preserving industries, and a meat-freezing works with an annual capacity of 30,000 carcasses, have been established.

The capital is Sá de Bandeira, about 100 mi. E. of the port of Moçâmedes; pop. (1955) 13,867 including 8,258 Europeans. Sá de Bandeira, strikingly Portuguese in style, is the only town in Angola with a white majority. Its chief buildings are the Diogo Cão secondary school, named for Diogo Cam (Cão), the discoverer of Angola; the cathedral; the commerce hall; and the industrial school. It is linked with the coast by the Moçâmedes railway, which east of Sá da Bandeira forks eastward to Artur de Paiva and southeast to Chibemba. Other important centres are Caconda, Quilengues, Pereira de Eça and Roçadas. At Humpata are zootechnical and agricultural stations and at Tchivinguiro an agricultural school. (A. A. G. P.)

HUILA, a department in the south central part of the republic of Colombia, drained by the upper reaches of the Magdalena river. Pop. (1961 est.) 368,730; area 7,656 sq.mi. Created in 1905 from Tolima, it is named for the snow-capped Nevado del Huila (17,844 ft.) in the central cordillera, which dominates much of the landscape. Since the colonial period this part of the upper Magdalena valley has been primarily a stock-raising area, but with the improvement of irrigation facilities, agriculture (especially cotton) became increasingly important. The capital, Neiva, is the terminus of a railroad that links it to Bogotá, Girardot and Ibagué. The San Agustín archaeological zone, with its mysterious giant stone figures, lies in the southernmost part of the department. The impressive Cuevas de los Guácharos (caves of the oilbirds) are 12 mi. S. of Pitalito, east of San Agustín. (Js. J. P.)

HUI TSUNG (1082–1135), Chinese emperor of the Sung dynasty, was famous for his calligraphy and his exquisitely composed paintings. Paintings by court academicians, greatly advanced by his patronage, eventually gave rise to a new school, outstanding in art history. Politically, his reign (1101–25) was fatal to the Northern Sung dynasty. A brief attempt to reunify the bureaucracy failed to resolve the bitter factional strife between the conservatives in opposition and the postreformers who claimed to follow the new policies which had originated with the great reformer Wang An-shih. Probably disillusioned with state affairs, Hui Tsung sought comfort and pleasure in promoting Taoism (*q.v.*) at the court, in arts, in amorous affairs and in enjoying a new extravagant palace garden. His requisition of colourful stones, precious plants and exotic pets caused great hardship among the people. The administration was for many years left to Ts'ai Chin. With the persecution of the conservatives, the bureaucracy became submissive; with manipulation and corrupt practices, it became abusive. Favourite eunuchs also gained unprecedented power, including military command. The victory over the Liao in north China brought about by the alliance with the Chin Tatars from Manchuria was entirely illusory, for the Chin turned out to be the real menace. In mounting crisis, Hui Tsung abdicated in favour of his son, Ch'in Tsung. In 1127 the Chin invaders ended the Northern Sung dynasty, and both emperors suffered captivity and exile in the north under miserable conditions till their deaths. *See* also CHINESE PAINTING: *History: Sung Dynasty*; SUNG. (J. T. C. L.)

HUITZILOPOCHTLI, an ancient Mexican god ("hummingbird on the left [south]"), was one of four Toltec gods considered brothers and called the Tezcatlipocas. Each was connected with a people, a direction and a colour. Tradition varies, but according to the most acceptable sources Tezcatlipoca the Red (more commonly called Xipe) was god of the Tlacochcalca people and of the East; Tezcatlipoca the Black (or simply Tezcatlipoca) was god of the Huitznahua-Acolhua people and of the North; Tezcatlipoca the White (Quetzalcoatl) was god of the Colhua and of the West; and Tezcatlipoca the Blue (Huitzilopochtli, the youngest of the brothers) was god of the Mexitin or Mexica, and of the South. All four figures appear historically as tribal leaders and mythologically as gods, in contrast with the typical vegetation deities like Tlaloc who are never conceived of as human. All four are said to have participated in creation. In the historical struggle in Tula, the Toltec capital, Huitzilopochtli is reported to have sided with Xipe and Tezcatlipoca against Quetzalcoatl. In either case, as a god or a tribal leader, Huitzilopochtli played a minor role.

Like his people, Huitzilopochtli is of double (Toltec-Aztec) origin. Children were sacrificed to him as a Toltec god, which, in Mexican thinking, endows him with the character of a rain-bringer; as deity of an Aztec vassal tribe of fishermen he was a god of the lake shore and was still so grouped at the coming of the Spaniards. But long before that, through a transformation which is little known as yet (since it took place during the hundred-odd years when the Mexica slowly moved from Aztlan to the Valley of Mexico, associating with one people after the other), the humble fishing tribe became a boisterous and aggressive group, and the original water-god became god of the rising sun, to be nourished by sacrifice of human hearts. Water brought from a place called Hummingbird Water continued to play a decisive part in his principal rite, and his temple was joined to that of Tlaloc, the old god of rain; but in keeping with his now predominating solar character his blue colour was interpreted as representing the sky.

This startling change probably came about gradually; but the decisive step may have been taken while the Mexica were at Coatepec near Tula. There Huitzilopochtli died (in the form of his human representative who had led the people from their homeland), and was reborn in a fashion typical of solar myths. This evolution was completed when, after the founding of Mexico City, the Aztecs embarked as conquerors, sacrifices to Huitzilopochtli became holocausts, and he increasingly took the character of a deity of war. (P. KI.)

HUIZINGA, JOHAN (1872–1945), Dutch historian who gained international recognition with his book *Herfsttij der middeleeuwen* (1919; Eng. trans., *The Waning of the Middle Ages*, 1924). He was born on Dec. 7, 1872, at Groningen and was educated at the universities of Groningen and Leipzig. After teaching history in Haarlem and lecturing in Indian literature at Amsterdam he became professor of history first at Groningen university (1905–15) and then at Leiden university until 1942 when he was held as a hostage by the Nazis. He remained under open arrest until his death at De Steeg (near Arnhem) on Feb. 1, 1945.

His first works dealt with Indian literature and culture but he established his reputation with *The Waning of the Middle Ages* which examines life and thought in France and Holland of the 14th and 15th centuries. Its lively and well-modulated style renders the work literature as well as history, a merit also to be claimed for *Erasmus* (1924; Eng. trans., 1924), a sympathetic study of the

central intellectual figure of the following age. Huizinga's other chief works are *In de schaduwen van Morgen* (1935; Eng. trans., *In the Shadow of Tomorrow*, 1936), "a diagnosis of the spiritual distemper of our time"; and *Homo Ludens* (1938; Eng. trans., 1949), a study of the play element in culture.

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HU-K'OU (HUKOW), a town in northern Kiangsi province, China, on the south bank of the Yangtze river, 20 mi. E.N.E. of Chiu-chiang (*q.v.*). Hu-k'ou, whose name means "lake mouth," is situated on a short canal that provides an outlet from the P'o-yang Hu (lake) to the Yangtze. In the days when Chinese waterways played a dominant role in inland transportation, Hu-k'ou was a major transportation hub and transshipment centre. Shallow-draft lake junks transferred their goods to or from the larger ocean-going vessels that plied the middle and lower course of the Yangtze. With the coming of the railroad era to China, Hu-k'ou began to decline. Its functions were largely taken over by the rising commercial centre of Chiu-chiang, linked by a railroad with Nan-ch'ang, the provincial capital of Kiangsi. (T. SD.)

HULAGU (*c.* 1217–1265), son of Tului Khan, grandson of Genghis Khan, is best known for having sacked Baghdad. Deputed by Mangu, his brother, the fourth great khan of the Mongols, to subdue Islamic lands, Hulagu crossed the Oxus (Amu-Darya) river in Jan. 1256. He reduced Isma'ili fortresses in north and east Iran, notably Alamut, thus extirpating the Assassins (*q.v.*), and in Jan. 1258, having routed the Abbasid caliph's army, he seized Baghdad. Al-Musta'sim, the last caliph at Baghdad, was executed by being kicked to death. Continuing west, Hulagu was opposed by an Egyptian army which destroyed one of his forces outside Damascus in 1260, thus halting his progress despite his (perhaps tentative) alliance with the Franks. His Christian wife, Dokuz Khatun, encouraged him in a magnanimous attitude toward Christians. His original commission was for a prolonged raid, consolidating Mongol power in the former eastern caliphate and extending it to the eastern Mediterranean, Asia Minor and the Persian gulf. Thus control would be gained over greater lengths of important trade routes. It had been expected that he would return to Mongolia, but he settled in Azerbaijan (northwest Iran), founding the Il-khanid dynasty there. An observatory was erected at Maragheh and a treasury at Shahu on Lake Urmia. There Hulagu died on Feb. 8, 1265, and was buried with the last performance in Iran of the Mongol funeral rite of the slaughter of beautiful maidens. Hulagu did not totally destroy Baghdad; certain buildings were retained for use by his administrative officers. Reconstruction after the havoc of earlier Mongol invasions in Iran was begun in his time. As il-khan (*q.v.*; tribal khan), Hulagu ruled as vassal of the great khan, who, in succession to Mangu, was a third brother, Kublai Khan (*q.v.*). (P. W. A.)

HULDA, an obscure mythological figure of central Germany. Like Berchta (*q.v.*) in the south of the country, she leads a band of spirits combining beneficent and evil qualities. (K. C. K.)

HULL, CLARK LEONARD (1884–1952), U.S. psychologist, the most influential theoretical psychologist of the period 1930–50, was born near Akron, N.Y., on May 24, 1884. Poliomyelitis interrupted his education in mining engineering, and studies at the University of Michigan (A.B., 1913) directed him to psychology. His doctoral dissertation (University of Wisconsin, 1918) pioneered the experimental analysis of concept formation. He remained at Wisconsin until called in 1929 to the Sterling professorship of psychology at Yale university. He died there on May 10, 1952.

By 1930 Hull had produced two research programs that resulted in the classical books *Aptitude Testing* (1928) and *Hypnosis and Suggestibility* (1933). His influence, however, resulted largely from many articles and two books (*Principles of Behavior* [1943] and *A Behavior System* [1952]), in which he developed an explicit, quantitative theory of simple and complex forms of learning and behaviour. His theory proved to be remarkably suggestive of, and responsive to, experimental data.

Hull's autobiography appears in *History of Psychology in Autobiography*, vol. iv (1952), and evaluations of him may be found in *American Journal of Psychology*, vol. lxv (1952) and *Psychological Review*, vol. lix (1952). (A. W. MN.)

HULL, CORDELL (1871–1955), U.S. congressman, secretary of state (1933–44) and winner of the Nobel peace prize in 1945. Hull was born in a log cabin in Overton (now Pickett) county, Tenn., on Oct. 2, 1871. He graduated from Cumberland university law school, Lebanon, Tenn., in 1891 and was admitted to the Tennessee bar the same year. He was elected to the Tennessee house of representatives in 1893, served as a captain of volunteers in the Spanish-American War and was a judge in the 5th judicial district from 1903 to 1907. He served in the U.S. house of representatives continuously from 1907 to 1921 and again from 1923 to 1931. In 1931 he was elected to the U.S. senate. As a congressman Hull was active in support of the income tax act of 1913 and the inheritance tax act of 1916. During the presidency of Woodrow Wilson he came to believe that lowering tariffs and removing other trade barriers would help to ensure world peace. He favoured the League of Nations and believed that rejection of the league by the United States was a major cause of the disintegration of world peace in the 1930s.

When Pres. Franklin D. Roosevelt took office in 1933 he appointed Hull as his secretary of state. At the outset of his tenure Hull headed the U.S. delegation to the London Economic conference of 1933, a largely futile meeting. In 1934 he sponsored the Reciprocal Trade Agreements act, which allowed the president to lower the tariff by as much as 50% of any existing schedule, providing that foreign nations would make similar reductions in schedules in which the U.S. had an interest. During the 1930s Hull did much to improve American relations with Latin America and to implement the "good neighbour" policy. He attended Pan-American conferences at Montevideo, Urug. (1933), and Buenos Aires, Arg. (1936), and a special foreign ministers' conference at Havana, Cuba (1940). In the early years of his secretaryship he assured the Latin-American nations that the United States would not intervene in their affairs; he later sponsored a united front of the American republics against aggression. As U.S. relations worsened with Germany and Japan, Hull took a strong moral position against those who threatened the peace of the world. In the crucial negotiations with Japan in the autumn of 1941 he stood firm for the rights of China. In a final note of Nov. 26, 1941, he invited Japan to abandon its military conquests in China, sending this note on the same day that, unknown to him, Japan's carrier fleet sailed to attack Pearl Harbor. During the war Hull championed the formation of a United Nations organization, and President Roosevelt later described him as the "father of the United Nations." He participated in the Moscow conference of foreign ministers in 1943, at which time Marshal Stalin promised to enter the Pacific war after the defeat of Germany. Tired and in poor health, Hull resigned after the Nov. 1944 presidential election, having served nearly 12 years as secretary of state, longer than any of his predecessors. He was awarded the 1945 Nobel peace prize for his part in organizing the United Nations. He died at Bethesda, Md., July 23, 1955.

See *The Memoirs of Cordell Hull* (1948); Harold B. Hinton, *Cordell Hull* (1942).

HULL, ISAAC (1773–1843), commodore in the U.S. navy, whose claim to fame came from his exploits in the War of 1812, was born at Derby, Conn., on March 9, 1773. Going to sea at 14 as a cabin boy on a coaster, he was master of a ship at 19. In 1796–97 he was twice captured by French privateers in the West Indies. He was commissioned fourth lieutenant of the frigate "Constitution" on March 9, 1798. In the naval war with France he distinguished himself by cutting out the French privateer "Sandwich" in the harbour of Puerto Plata, Santo Domingo. Commanding the brig "Argus" during the Tripolitan War, he gave naval support to William Eaton, U.S. navy agent for the Barbary regencies, in the capture of Derna. Hull was promoted to captain April 23, 1806, and became commander of the "Constitution" on June 17, 1810. After taking U.S. minister Joel Barlow to France and delivering $28,000 in specie to Holland, he returned a few months before hostilities began between the U.S. and England.

Theodore Roosevelt regarded Hull's actions in the War of 1812 as placing him "above any single ship captain of the war." Encountering a British squadron in July 1812, off Egg Harbor, N.J., in a dead calm, Hull escaped after three days and nights in one of the most remarkable chases in naval history. On Aug. 19 the "Constitution" met the British frigate "Guerrière." In fewer than 30 minutes of close and violent action the British ship was dismasted and at Hull's mercy. Considered the most important single victory in U.S. naval annals, the defeat of the "Guerrière" united the nation behind the war effort and destroyed the legend of British naval invincibility. In this fight the "Constitution" won the name of "Old Ironsides." Relieved of his command at his own request, Hull commanded harbour defenses at New York city. Hull was one of the first three members of the board of naval commissioners and was commandant at navy yards at Portsmouth, N.H., Boston, Mass., and Washington, D.C. He was commodore of the U.S. squadron in the Pacific (1824–27) and Mediterranean (1839–41). He died at Philadelphia, Pa., on Feb. 13, 1843.

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HULL, a city and railway junction of the province of Quebec, Can., located on the north bank of the Ottawa river, opposite Ottawa, Ont., is the county seat of Hull county and chief administrative and business centre in southwest Quebec. Pop. (1961) 56,929; 90% French in origin. Abundant hydroelectric power and timber resources support large pulp, paper and match factories; other industries include portland cement, meat packing, foundries, clothing and furniture. A large government printing plant has been established there.

Samuel de Champlain described the site in 1613. The community began as a lumber settlement. The first settler (1800) was Philemon Wright from Massachusetts, who named it after Hull, Eng., from which his parents had emigrated. It was incorporated as a city in 1875. (GN. C. M.)

HULL (officially KINGSTON UPON HULL), a city and county of a city, municipal, parliamentary and county borough and seaport in the East Riding of Yorkshire, Eng., lies at the junction of the river Hull with the Humber, 22 mi. from the open sea and 38 mi. S.E. of York by road. Standing on level ground, approximately 8 ft. above sea level, the city extends to the foot of the Yorkshire wolds on the west, the eastern boundary runs through the Plain of Holderness and there is frontage to the Humber of 7 mi. Pop. (1961) 303,268.

The older portion which was walled in the 14th century is completely enclosed by the river Hull on the east, the Humber on the south, and on the west and north by docks and the Queen's gardens (the site of the city's first enclosed dock). Rapid development in the 19th century produced congested areas outside the line of the old walls, and many narrow streets were cleared about 1900 to provide for new main shopping streets, the city hall (a fine concert hall) and a large area for Queen Victoria square, which forms the hub of the main radial road system. This area suffered severe damage during World War II and has been substantially rebuilt. Holy Trinity church is one of the largest English parish churches with Decorated style transepts and choir and Perpendicular nave. The choir is an unusually early example of the use of brick in English ecclesiastical architecture. The church of St. Mary, in Lowgate, was founded in the 14th century. Among the principal buildings are the Guildhall and law courts in Lowgate and Alfred Gelder street (1915), and the dock offices (1871) near the spot where once stood the Beverley gate which was closed against Charles I in 1642. The ancient grammar school was re-endowed in 1485. Among its students was said to be Andrew Marvell, the poet, who represented the town in parliament from 1659 until his death in 1678. Another student was William Wilberforce (1759–1833), the slave emancipator, who is commemorated by a column and statue at the east end of the Queen's gardens, and by a museum in the house of his birth in High street. The house is a fine example of Elizabethan domestic architecture and has been preserved as a museum of the slave trade and local antiquities. The Mortimer museum of prehistoric archaeology is housed in the old Corn exchange, High street, and contains the collection of Bronze Age remains from the burial mounds of east Yorkshire, together with material of the Stone Age, Iron Age, Roman and Saxon periods found in the region. A collection of vehicles forms the Transport museum in the same building. The Maritime museum in Pickering park contains ship models, pictures and objects relating to the whaling industry, in which Hull was a pioneer. The Ferens Art gallery houses the city's permanent collection which consists mainly of contemporary British art. The works of John Ward of Hull (1798–1849), recording types of shipping on the Humber and whaling in the arctic, form the nucleus of an extensive collection of marine paintings. An important acquisition in 1963 was Frans Hals's "Portrait of a Lady," the most valuable single purchase made by an English municipal art gallery. There are four established parks, numerous playing fields and two municipal golf courses, and a total of 1,150 ac. has been allotted for public open space, including provision for three parks associated with new residential areas.

Kingston upon Hull is the educational centre for the East Riding of Yorkshire. The university college, opened in 1929, was raised by royal charter to full university status in 1954. Further and secondary education is provided at the college of technology, colleges of art and crafts and of commerce, the old grammar school (in extensive new buildings), Hymers college (a modern direct grant public school), Trinity House Navigation school (founded 1787), the Nautical college and many other schools.

The Port.—From medieval times until the last quarter of the 18th century the river Hull at its confluence with the Humber formed the port, and this old harbour remains in active use. Rapidly growing trade brought demands from the government of the day to relieve the congestion of shipping, and a dock, later known as Queen's dock, was opened in 1778 on the site of the old walls and moat which had been granted by the crown for the purpose. Princes, Humber and Railway docks followed and by 1846 the chain of docks round the old town was complete. Victoria dock (1850), east of the river Hull, is now the centre of the timber importing trade, second only to London among U.K. ports. To the westward, Albert and William Wright docks and the Riverside quay are concerned with the Scandinavian and near-continental trades, and St. Andrew's dock is wholly devoted to the fishing industry. The Riverside quay, rebuilt in 1959 after total loss through war damage, provides for continental perishable traffic and passenger services. A further extension eastward was Alexandra dock (1885) of 53 ac., accommodating deep-sea vessels sailing to and from all parts of the world. The King George dock, having a water area of 55 ac., was opened in 1914. Equipment includes modern quay cranes, pneumatic grain elevators, a 60,000-ton grain silo, large transit sheds and open berths for bulk traffic such as timber, ores and building materials. Five graving docks provide facilities for an extensive ship-repairing industry.

The first oil jetty was built at Saltend in 1914 and other jetties were added in 1928 and 1960. Thirty-six feet of water is available at mean low water springs to accommodate tankers up to 27,500 tons dead weight serving the ocean oil depots which have tankage capacity of over 150,000,000 gal. of petroleum. The Hull dock undertaking is owned by the British Transport Docks board.

Hull, as the third port in the United Kingdom, serves the heavy industrial areas of Yorkshire, Lincolnshire and the midlands by road, rail and inland waterways. The principal trades are softwood from Scandinavia, the U.S.S.R. and Canada, and hardwood, grain, oilseeds, foodstuffs, fruit, wool, ores, petroleum, chemicals and manufactures from various parts of the world. There are passenger services with the principal European ports and a ferry serves the Lincolnshire shore of the Humber. Exports include coal, coke and patent fuels; machinery; automobiles and tractors; iron and steel manufactures; and textiles. Hull is the largest fishing port in the United Kingdom, its fishing fleet landing annually more than one-quarter of Britain's fish.

Industries.—The facilities of the port for the import of raw material and the export of finished products, and its central location on the east coast convenient for transport to the industrial

areas of the north and midlands, have led to a wide range of industries being established. Products include abrasives, acetic acid, aircraft, alcohol (industrial) and its derivatives, beer, cattle food, cement, chemicals, cocoa, cocoa butter and confectionery, containers (wood, metal, card and plastic), electric lamps, engineering equipment (marine, hydraulic, chemical, transmission and general), excavators, fish products, flour, household requisites, oils (edible, technical, medicinal), paint and colours, pharmaceutical products, radiators, sacks (jute and multiwall paper), sanitary pottery, sawmilling and wood products, solvents and plasticizers, starch, surgical dressings, leather, typewriters and vinyl acetate. Shipbuilding is also carried on. The borough corporation owns and operates the telephone service which is the only municipal telephone undertaking in the United Kingdom and operates independently of the post office system.

History.—There was a trading settlement known as Wyke upon Hull from at least as early as 1160. It was acquired from the abbots of Meaux by Edward I who renamed the town Kingston upon Hull. He granted the first municipal charter in 1299, established a royal mint and confirmed the port's export privileges. The right to elect a mayor and market rights were granted in 1331 by Edward III, the first mayor being Sir William de la Pole, a merchant, whose son Michael became the first earl of Suffolk and lord chancellor of England. The 1440 charter of Henry VI incorporated the mayor and burgesses, created the town a county and empowered the burgesses to elect a sheriff. The corporation was authorized to construct water works by charter of Henry VI in 1447. Henry VIII visited Hull in 1541 and ordered a castle and other defenses to be built. During the Civil War, although the majority of the inhabitants were said to be royalist, Kingston upon Hull was garrisoned by parliament and the first overt act against the king was the refusal of admission to the town by the governor, Sir John Hotham. The town withstood two sieges with some ease as supplies and reinforcements were brought in by water, the royalist forces never gaining command of the Humber. The first embarkation of the Pilgrim Fathers took place from the Humber and it was in Hull that the exiles secured the vessel in which they sailed from Immingham Creek for Holland in 1609, some years before they returned to Plymouth to join the "Mayflower." A charter, commonly called the governing charter, was granted in 1661. Hull attained county borough status in 1888. The title of "city" was bestowed on the town in 1897 and since 1914 the chief citizen has been styled "lord mayor." (J. H. W. G.)

HULL HOUSE, one of the first social settlements in North America, was founded in Chicago, Ill., in 1889 when Jane Addams (*q.v.*) and Ellen Gates Starr rented the old abandoned residence at 800 S. Halsted street that had been built by Charles G. Hull in 1856. Twelve large buildings were added from year to year until Hull House covered half of a city block and operated a playground across the street and a large camp in the country.

Miss Addams, after college, had traveled extensively in Europe, studying the traditions, history and lives of people in many countries, always seeking a way of life in which she could put her theories and convictions about human and social welfare into action. After visiting Toynbee hall (*q.v.*), a pioneer settlement founded by Canon S. A. Barnett in east London, and finding there a group of university undergraduate residents sharing companionship, intelligent interests and absorbed devotion "in a world of things as they are," she and Miss Starr decided to establish such a settlement in a comparable district in Chicago.

"The first days there," Miss Addams recalled, "laid the simple human foundations which are certainly essential for continuous living among the poor—first, genuine preference for residence in an industrial quarter to any other part of a city because it is interesting and makes the human appeal; second, the conviction—in the words of Canon Barnett—that the things which make men alike are finer and better than the things which keep them apart and that these basic likenesses, if they are properly accentuated, easily transcend the less essential differences of race, language, creed and tradition." (Jane Addams, *Twenty Years at Hull House,* The MacMillan Company, New York, N.Y., 1910.)

Many volunteers, both men and women, soon joined them as residents of Hull House but continued in their own professions, as lawyers, artists, musicians, teachers, social workers and businessmen. They were devoted not only to helping their neighbours in their humble and tragic personal problems but to developing in Hull House opportunities for education, art, music, recreation and companionship for the young and the old.

The settlement became a great laboratory for the study of challenging problems of poverty, labour, education, government, legislation, suffrage, civil rights and war and peace. Visitors from all over the world, including leaders in government, science, education and labour, and social welfare, brought world recognition to Hull House.

The Hull-House Maps and Papers (1895) by its residents, the 12 books of Jane Addams, and the publications of distinguished residents, including Alice Hamilton, Florence Kelly, Julia Lathrop, Jessie F. Binford and others, portray vividly the way of life at the settlement, which contributed greatly to advances in individual, community and social welfare. Interest in Hull House was stimulated in 1960, when the 100th anniversary of the birth of Jane Addams was commemorated.

In Jan. 1961 plans to clear the area for a University of Illinois campus were announced by the city. Legal protests by a Harrison-Halsted community group organized to preserve Hull House and the neighbourhood were unsuccessful. The trustees of Hull House sold its 14 buildings and adopted plans for decentralized operations in other parts of the city. Although most of the buildings were demolished, the original Hull mansion and the adjoining dining hall were spared. *See* also SOCIAL SETTLEMENTS. (J. F. BI.)

HULLS, JONATHAN (1699–1758), English inventor who produced what is believed to be the earliest representation still extant (it was drawn with considerable technical detail) of a steam-driven paddle boat, was born near Campden, Gloucestershire, in 1699. In 1736 he obtained a patent for a machine to carry "ships and vessels out of and into any harbour, port, or river against wind and tide or in a calm." This steam tugboat was further described and illustrated in a pamphlet published in 1737.

It was to have a paddle wheel at the stern, driven by a Newcomen atmospheric engine, with vertical steam cylinder (*see* STEAM). To obtain continuous rotation of the paddle wheel, Hulls proposed the use of ratchet wheels, driven by ropes from the piston. Neither the patent nor the pamphlet attracted much attention at the time of their publication, and Hulls never obtained a practical trial for his scheme. He retired disheartened to London, where he died in 1758.

See Jonathan Hulls, *Description and Draught of a New-Invented Machine for Carrying Vessels or Ships Out of or Into any Harbour, Port, or River Against Wind and Tide or in a Calm* (1737); H. P. Spratt, *The Birth of the Steamboat* (1959). (H. P. St.)

HULME, THOMAS ERNEST (1883–1917), English philosopher and poet, one of the founders of the Imagist movement, was born at Endon, Staffordshire, on Sept. 16, 1883. He was educated at Newcastle-under-Lyme grammar school, and went up to St. John's college, Cambridge, but was sent down for rowdyism in 1904. Thereafter he lived mainly in London, translating the works of Henri Bergson and Albert Sorel, and, with Ezra Pound and F. S. Flint, instigating the Imagist movement (*see* IMAGISM). Five of his poems were published in the *New Age* (Jan. 1912), and reprinted at the end of Pound's *Ripostes*. During World War I, Hulme defended militarism against the pacifism of Bertrand Russell (*q.v.*). He was killed in action on Sept. 28, 1917.

T. E. Hulme (as he is always called) published little in his lifetime, but sprang into fame in 1924, when his friend, Herbert (later Sir Herbert) Read, assembled some of his notes and fragmentary essays under the title *Speculations*. As an art critic, he praised the "geometrical" abstractions of Picasso; as a thinker, he demanded discipline; as a poet, he expressed himself in clear-cut images. His hatred of romantic optimism, his view of man as limited and absurd, his theology, which emphasized the doctrine of original sin, and his advocacy of a "hard, dry" kind of art and poetry foreshadowed the disillusionment of many writers of the 1920s, who hailed him as a great thinker. Later, it was realized that he was less original than had been thought, and that where

he was original, he came close to fascism. He remains, however, a forceful and provocative writer.

See M. Roberts, *T. E. Hulme* (1938); A. R. Jones, *The Life and Opinions of T. E. Hulme* (1960). (G. S. F.)

HULWAN (HILWAN; HELWAN), a health resort in Giza governorate, Egypt, 20 mi. S. of Cairo by road, stands 3 mi. E. of the Nile at an elevation of 187 ft. above the river, commanding an excellent view of the pyramids on the left bank. Pop. (1957) 50,831. The dry equable climate benefits invalids and supplements strong sulfur and alkaline springs at a temperature of 33° C. (91° F.). A thermal establishment was opened in 1900, hotels were built and the town was developed as a spa. An astronomical and meteorological observatory lies 1 mi. N. Hulwan is a dormitory town for Cairo, with which it is linked by electric railway. Industries include cement manufacture, textile printing and dyeing and a small iron and steel plant beside the Nile at Al Tibin.

(A. B. M.)

HUMACAO, a town and municipality in the eastern part of Puerto Rico, 28 mi. E. of San Juan. Urban pop. (1960) 8,005; municipal, 33,381. Located at the end of a valley which opens to the sea 6 mi. E., Humacao has a delightful climate. The town, which was founded in 1790, is connected by excellent highways with Fajardo, Caguas and San Juan. Sugar is grown in the surrounding rural area and many small farms in the nearby foothills produce a variety of tropical fruits. The Ryder Memorial hospital is located there. The local government was successful in encouraging the establishment of several industries in the town.

(T. G. Ms.)

HUMANE SOCIETIES were originally societies founded for the relief of human suffering. The earliest society to bear the name "humane" was the Royal Humane society, founded, on the model of an earlier society in Amsterdam, Neth., in 1774 "for the relief of persons apparently drowned"; other humane societies with the same objects were established in places as far apart as Philadelphia, Pa., and St. Petersburg, Russia (*see* LIFEBOAT AND LIFE-SAVING: *Historical Background*).

However, the term "humane," as popularly used, no longer refers to the object of charity but describes the benevolent and kindly attitude which prompts the charitable action. Thus "humane society" has come to mean one which affords protection to the helpless, chiefly children and animals.

The earliest act in Britain protecting children from cruel treatment was that of 1884, after which the National Society for the Prevention of Cruelty to Children was organized. The Royal Scottish Society for the Prevention of Cruelty to Children was organized in the same year, and similar societies were founded in other countries.

Protection for animals started with the 1822 act promoted by Richard Martin, a member of parliament, which prohibited the improper treatment of cattle. The English Society for the Prevention of Cruelty to Animals was organized in 1824 to make this law operative, and in 1840 it acquired the prefix "royal." Through its agency brutal sports as well as other types of cruelty were prohibited or abated. Meanwhile, an act of 1835 afforded some protection to all domestic animals. The Cruelty to Animals acts of 1849 and 1854 laid down basic rules against cruelty on which all later legislation was based. A further act was passed in 1876 to regulate vivisection. In 1900 the Wild Animals in Captivity Protection act was passed. (X.)

United States.—After its establishment in Britain the movement for animal protection spread rapidly, and societies were organized in all parts of Europe and other countries. In 1866 the American Society for the Prevention of Cruelty to Animals, the first society of its kind in the United States, was founded in New York by Henry Bergh (1811–88). New York's laws for the prevention of cruelty to animals were the first in the United States and were based on English law. In 1868 and 1869 anticruelty societies were organized in Massachusetts, Pennsylvania, New Jersey, California, Illinois and Minnesota. Laws similar to those of New York were enacted in these states, and since then legislation has spread until there is not a state or territory without some statutory provision for animal protection.

Organized activity to prevent cruelty to children grew out of the same wave of humane sentiment and activity. There were no laws in existence for the prevention of cruelty to children and the common law gave no protection except in extraordinary cases. In 1874 in New York the Mary Ellen case, in which the laws for the prevention of cruelty to animals were used to rescue a nine-year-old girl who had been brutally beaten by her foster mother, directed attention to the necessity for appropriate legislation. Soon afterward steps were taken by Elbridge T. Gerry, counsel for the American Society for the Prevention of Cruelty to Animals, to have laws enacted in New York for the protection of children from cruelty. After the enactment of these laws in 1875, the New York Society for the Prevention of Cruelty to Children was organized to rescue children from vicious and immoral surroundings and to prosecute offenders, to prevent the employment of children for mendicant purposes or in theatrical performances and to provide for the enforcement of laws for the protection of minors from abuse. Similar laws were passed and societies organized in other states on the New York model. The Juvenile Court act in Illinois in 1899 was the first relating to children who are or who may become dependent, neglected or delinquent, defining these terms and providing for treatment, control, maintenance, adoption and guardianship of such children. The juvenile court movement developed rapidly and has succeeded in many jurisdictions in securing systems which remove children's problems from the ordinary processes of the law. (*See* CHILDREN'S COURT.)

From 1870 to 1877 the Illinois society had rescued so many children from conditions of cruelty and neglect, in addition to its animal work, that it decided to change its name to the Illinois Humane society, the first in the world to take the name "humane" to indicate the dual work of prevention of cruelty to children and animals. Other societies later adopted the same usage. In 1877 the leading U.S. societies met at Cleveland, O., and organized the International Humane society to deal with the maltreatment of animals being transported. In 1878 the name was changed to the American Humane association. Its headquarters are in Denver, Colo. An organization with similar aims, the Humane Society of the United States, was founded in 1954 with headquarters in Washington, D.C. In 1959, after several years of planning by a joint committee of the American Humane association and the Royal society, the International Society for the Protection of Animals was formed to provide facilities for affiliation of animal welfare societies and interested individuals throughout the world.

Local humane soceties function autonomously for the most part, engaging in publicity and education and activities to ensure that anticruelty laws are adequately enforced. Sometimes the local society has a semiofficial status, receiving some public funds and being responsible for carrying out anticruelty activities like animal rescue and poundkeeping. Many humane organizations are affiliated with the American Humane association, which publishes the *National Humane Review* and functions as a centre for publicity, education, co-ordination and lobbying and furnishes assistance to local societies and authorities. There is a schism in the humane movement over vivisection. The American Humane association works to eliminate abuse of animals used in scientific experimentation, while the National Antivivisection society and its affiliates attempt to secure the prohibition of experimental use of animals. *See* ANIMAL EXPERIMENTATION; ANIMALS, LAWS CONCERNING; CHILDREN, LAWS CONCERNING.

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(G. A. H. S.; G. M. Jo.)

HUMANISM, the attitude of mind which attaches primary importance to man and to his faculties, affairs, temporal aspirations and well-being (from Latin *humanus*, "human"; *cf. homo*, "man," *homines*, "mankind"), often regarded as the characteristic attitude of the Renaissance (*q.v.*) in western Europe. The Greek and Roman classical writers regularly distinguished the human, or humane, on the one hand from the bestial and on the other from

the divine; but in making the latter contrast they usually stressed some pathetic aspect of the human, such as mortality or fallibility. Medieval Christianity, however, suggested that man's life on earth was significant only in so far as it affected his soul's expectation of God's mercy after death, and it was against this belittling of his natural condition that the humanists of the Renaissance asserted the intrinsic value of man's life before death and the greatness of his potentialities. As ecclesiastical influence waned, the protest of humanism was turned against secular orthodoxies that subordinated man to the abstract concepts of political or biological theory.

In the 20th century some new senses were given to the word humanism. F. C. S. Schiller (1864–1937) took it as the special name of his own version of pragmatism (*q.v.*), maintaining that all philosophic understanding stems from human activity and reaffirming Protagoras' contention that "Man is the measure" against what he called the "intellectualist" philosophies, whether represented by Plato, by Hume or by the idealists of his own time. The "new humanism" of Irving Babbitt (*q.v.*) was very different, being a reaction in favour of classical order against romanticism and naturalism, not only in their literary but also in their wider aspects. *See* also references under "Humanism" in the Index volume.

HUMANITIES, a group of educational disciplines distinguished in content and method from the physical and biological sciences and, if less decisively, from the social sciences. The group includes language and literature in each of their principal examples (ancient and modern), the fine arts other than literature, philosophy, at least in its more traditional divisions, and, to a less clearly defined extent, history, where the boundary between the social sciences and the humanities is most debatable. These are the core of the humanities and are sometimes organized as a school or division in the modern university.

The humanities are studies which centre attention on the life of man. But this does not by itself serve to distinguish them from biology, a natural science, if it directs its attention to man; or from politics, a social science (for man, as Aristotle said, is a political animal); or even from religion (for man, as Edmund Burke added, is a religious animal). It is true, however, that as early as William Caxton (1422–91), humanity was distinguished from divinity, as the one dealt with man on the merely human level (or in the order of nature), and the other embraced the whole scheme of revealed religion (or the order of grace); and this distinction remains significant. Though the humanities stand committed to no particular philosophy or creed, they assume the possibility of distinguishing with some sharpness between man and the rest of nature, and between the human and the supernatural. These two facts, taken in conjunction, mean that at different times or by different schools the humanities may be brought into some relation with naturalism (as in the more pagan forms of Renaissance and subsequent humanism) or with religion (as in the Christian humanists of the same and succeeding periods). Cicero's use of the term *humanitas* leads to the question of meaning in another way. In its most general sense *humanitas* signified for him the qualities, feelings and inclinations proper to mankind and was from the first not descriptive only, but normative in function. From the general it developed two special senses. It came to connote humane feelings and the conduct toward others which they dictated: gentleness, consideration, good manners—in a word, much that was to be incorporated in the ideal of the gentleman and to become, thereby, the second aim of a liberal education as formulated by John Henry Newman (*q.v.*) in *Idea of a University* (1852). *Humanitas* also came to connote intellectual cultivation and the training that produced it, or (in the language of Newman) the process and primary end of liberal education. Since, for Cicero, education reached its goal in the production of the orator, the principal acquisition and instrument of training was literature in a wide sense, and the outcome of intellectual culture was weight, precision and effectiveness of utterance. *Humanitas* was coupled with literature or study or came to stand for them, in such phrases as *literae humanitatis* and *in omni recto studio atque humanitate versari* ("to be versed in all true study and humanity"). No wonder *inhumanitas* was for Cicero a synonym for *barbaria*. For the humanists of the Renaissance, humanity, partly through the direct influence of Cicero, retained these connotations; and since for them, as for him, Greek and Latin literature was the great source of knowledge, wisdom and eloquence, the humanities meant the languages and literatures of ancient Greece and Rome (literature including of course philosophy, history and oratory, as well as belles-lettres)—the meaning preserved in such phrases as *literae humaniores* (Oxford) and professor of humanity (*i.e.*, Latin) at Edinburgh. All the meanings discussed here have left their mark on the term humanities as applied to the group of disciplines listed at the outset. The extension and differentiation of studies and the emergence of new methods, since the 17th century, have also had their influence.

In European universities language has ceased to mean Greek, Latin and the ancient languages of the near east; it has come to include the modern languages, with (as is natural) special attention to the mother tongue of the student, and has extended its territory to take in the Slavic and the far-eastern language groups. The historical and comparative study of languages and general linguistics have approximated in their aims and methods natural science and, further, have discovered common ground with such social sciences as psychology, anthropology and sociology. But in another department, the study of language continues to be treated not as science merely, but as the art of expression; and here the tradition of the humanities and the emphasis on a normative function clearly persist. The cumbersome framework of ancient rhetoric has been largely abandoned (to be replaced by new techniques), but something of the underlying belief survives that effective expression depends on a trained and cultivated intellect and sensibility and is their ultimate sign and seal.

Literature.—Literature, which is still, as all the more conservative definitions suggest, the core of the humanities, has kept pace with the extension of the field in language since added languages have given access to additional literatures of greater or less value; and here, too, new methods of study and new affinities with other disciplines have been discovered and applied. But it is remarkable how many of the essential methods of literary study were already foreshadowed in the *De Ratione Studii* of Erasmus in the 16th century. And indeed the traditional pattern set by the study of the classics has continued to exercise its pervasive influence: in the wide definition of literature centring on, but extending beyond, belles-lettres (as in Matthew Arnold's "Literature and Science"); in the concentration upon major authors and acknowledged masterpieces so that, in one view, what extension meant was to add Dante to Virgil, Milton to Homer, Racine to Sophocles, Gibbon to Thucydides, Bacon to Aristotle, Burke to Cicero; and in the connection, fairly steadily maintained, of literature and language—sometimes reduced to the dry analysis of the grammarian but capable of being reinvigorated, as often in contemporary criticism. The training ground in literature as such has increasingly shifted from the classics to modern literature, and especially to whichever is for the student the literature of his mother tongue; with this last (which of course betokens some decline in linguistic studies, despite the extension of their range and methods) may be associated courses in ancient and modern foreign literature in translation. Such courses while sacrificing the connection with language do at least bear witness to the centrality of literature itself, as also does that other experiment of basing a liberal education, in whole or in part, on a systematic study of "great books" of literature in its widest extent, including the classics of philosophy, history, politics and even theology and science. Literature thus conceived (that is, as requiring only that it shall be addressed to the general reader and shall manifest a certain significance of content and distinction of expression) becomes a great meeting place of subject matters.

In its stricter definition as belles-lettres, literature long provided the principal or only representative of the aesthetic in liberal education. There has been added the academic (*i.e.*, the critical and historical) study of the fine arts, and especially of painting and music. The latecomers have immensely strengthened the humanities on the aesthetic side, have supplemented and reinforced the study of literature and have been able in measure to apply some methods of which literature has been the proving ground.

Philosophy and History.—The two remaining divisions of the humanities, philosophy and history, possess their own appropriate subject matters but are unique in also providing distinctive methods which can be applied to other subjects. For a century and a half, historical method has increasingly dominated all branches of humanistic study and research, though, especially in literary criticism, there is some reaction against it based on an avowed desire to contemplate the work in itself and therefore in isolation. One may question how effective and lasting this reaction can prove, since so many of the materials of humanistic study belong to the past and demand their historical settings and explanations. Historical method has, of course, been applied outside the humanities and especially in the social sciences where history, because its special subject matter has so often been political, holds also an important place. But history in other of its departments has close affinities with the humanities: historical biography may be regarded as a form of literature, historiography as part of the theory of literature and indeed of knowledge, and the philosophy of history, from Hegel to Arnold Toynbee, as a branch of philosophy.

In the subdivision of subjects and distinction of disciplines, philosophy has lost psychology to the social (or perhaps, rather, to the natural) sciences and has come to share the theory of government with political science and the history of ideas with literature; but a large and vastly important territory remains its undisputed possession, including metaphysics, ethics and the history of philosophy in general. Moreover, philosophy has manifold contracts with other disciplines. Like history it includes, as well as a subject matter, a method applicable to a wide range of subjects which it can thus, in a sense, appropriate. Commanding as it does the theory of knowledge in general, it deals on the theoretic level with aesthetics and the kind of knowledge involved in the arts and also with logic and the kind of knowledge involved in the sciences and social sciences.

Finally, philosophy, and it alone, is equipped to synthetize, still on the theoretic level, data supplied by all the other departments of the humanities and by the sciences and the social sciences as well. There is in the modern university a need, more often recognized than adequately met, for giving to the nonspecialist some insight into the philosophy and history of science, and such a course of instruction evidently requires the techniques of both philosophy and history or, in other words, the co-operation of the humanities, since its real subject would be the bearings of science on the life and thought of man.

Well into the 19th century the humanities, still mainly represented by Greek and Latin, constituted with mathematics the staple of liberal education. The 19th century, which witnessed a great expansion of and within the humanistic disciplines, also witnessed the inevitable loss of their monopoly before the advance of the sciences and social sciences. These disciplines have indeed brought within the scheme of formal education knowledge essential to an understanding of the world we live in and useful for various practical ends; but (as Matthew Arnold observed in "Literature and Science") science is apt to content itself with the steady accumulation of knowledge, while the humanities have failed unless, in addition, they bring some accession of wisdom, some recognizable cultivation of intellect, imagination and sensibility, and some preparation for what the Greeks called the good life. This conception of the humanities and their role is true to the tradition from Cicero onward; but it sometimes invites misapprehension.

There has been a widespread feeling in the 20th century that the retreat of the humanities in education may have gone too far and fresh demands have been made upon them. Schemes of "general education" in some U.S. universities have apportioned time and effort between the humanities, the sciences and the social sciences as distinctive areas and forms of knowledge. In these schemes there has been perhaps a tacit assumption, little supported by the tradition of the humanities, that their concern is wholly with man as an individual and not at all with man as a social being. Nor do their varied subject matters easily lend themselves to an effort of united presentation, under what is in effect a new academic subject, designated "Humanities." Though not without its possible uses in general education, this effort is also a departure from the tradition of the humanities and carries some threat to the integrity of the separate subjects.

The gravest danger in the demands made upon the humanities, and the opportunities opening before them, lies in the possible misapprehension regarding their role, hinted above, and what that role entails. This misapprehension, in a word, is to suppose that the humanities can reach their end by indoctrination concealed as intellectual discipline. If the humanities are indeed normative, if they mold the mind and sensibility of the student and bring an accession of wisdom, it is by virtue of their subject matter, of the ideas which they present or evoke and the experiences to which they give him entry; and these ideas and experiences achieve their full effect only as they are examined critically, evaluated, and by the student made his own. *See* also EDUCATION, HISTORY OF; HIGHER EDUCATION; UNIVERSITIES. (A. S. P. W.)

HUMAN NATURE. Man has a nature, widespread and persistent, that is obviously characteristic of his kind and notably different from the natures of other living things. Yet there is no generally acceptable account including all principal aspects of this nature as one whole. The nature of man is familiar, impressively unique and almost indescribable. Common experience meets it daily; every considered system of thought or action declares or implies some view of it; none of the scholarly or scientific disciplines presents it in terms of all that common sense recognizes in it.

Different meanings have been attached to the phrase "human nature." Most commonly it refers to an original, inborn nature characteristic of all men or of this particular man or these particular men. So understood, "human nature" is man's special form of that which is biologically inherited in any and all species. It is, of course, an abstraction or inference, for very early it combines with "environment," and from the effects of experience becomes something else. This original, inborn, never directly observed nature has been variously conceived: as composed of distinguishable dispositions to specific behaviour (reflex and instinct); as powers or faculties of the mind; as something greatly or even infinitely plastic, or empty and formless.

Of those who see man's inborn nature in this last way, some have come to identify "human natures"—now plural—with the particular unique manifestations of mankind in local groups; each traditional group, or culture, has its own human nature, and no nature true of all peoples in this view can be asserted.

Similar to this conception in its identification of "human nature" with what is acquired through experience is that conception which, in contrast to the foregoing, asserts the reality of an acquired nature that is widespread or even universal. "Human nature" is then taken to be a resultant of man's characteristic experiences in any and all societies so far. Everywhere he lives and has lived in groups with similar basic necessities and activities, has known intimate and personal relationships, has recognized differences between people close to him and of his own kind, and other people farther away and of another kind. And so on. Those who so think of man's nature attempt to describe the states of mind and feeling that underlie the great local differences and that are everywhere similar.

Of these three principal ways of conceiving man's nature—as defined or vague inborn potentiality or necessity; as knowable only in its locally developed special forms; as a nature universally acquired or developed and common to all—various combinations can and have been made. For example, the Freudian view of man combines the first and third.

The view adopted as to what man is, essentially and generally, is connected with the thinker's moral judgments and with his position as to the possibilities and the methods of action and reform. He who strongly believes in the power of education or of learning or of conditioned response conceives of original nature as very modifiable. He who takes a pessimistic view as to the elimination of such man-caused evils as war and crime is likely to think of these mischiefs as rooted in particularities of an unalterable inborn nature.

In the everyday experience of the ordinary person the nature of

man presents itself as states of mind and feeling, and as characteristic action, in or by the people he meets and deals with. He comes to know human nature through the persons he knows, their characters and conduct. Behind what they do he comes to recognize qualities that often do not surprise him: they are what he comes to expect of other human beings and not of cows or horses. People are proud, sensitive, eager for recognition or admiration, often ambitious, hopeful or despondent, selfish or capable of sacrifice of self. They take satisfaction in their achievements, sometimes feel guilt or shame, have within them a something called a conscience, are loyal or disloyal. The common-sense view of human nature sees it not as innate and inferable from certain behaviour, but as present, however originating, in the conduct of grown people all the time. This is that kind of human nature from which Walt Whitman turned away when he said he would live with the animals because

> They do not sweat and whine about their condition;
> They do not lie awake at night and weep for their sins;
> They do not make me sick discussing their duty to God;
> Not one is dissatisfied—not one is demented with the mania of owning things;
> Not one kneels to another, nor to his kind that lived thousands of years ago. . . .

This is the common conception of human nature that has given rise to ideas—however differently defined—of the inhuman and the superhuman. It implies a probable range of conduct that is "just what you expect" of people; conduct beyond that range is held to violate or exceed the normal expectancy.

These common attributions of man's nature as human are variously made so as to include or exclude some people but not others. More remote and exotic peoples may be denied full inclusion: they are "really not quite human." On the whole, persons who have experience and acquaintance with man's nature as seen in customs and institutions very unlike their own tend to recognize in such alien peoples a humanity common with their own. On the whole, in the course of history, the popular category "human beings" has widened, including more and more people, and recognizing local variants as nevertheless only variants of common humanity.

This view of man's nature is that which is developed and deepened through experience with persons and their conduct. The acquaintance and understanding are gained in part through imaginative works of the mind: biography, letters, novels, drama. Literature is the great storehouse from which to draw experience of the human. It provides a variety and scope that direct experience cannot. In meeting human beings in literature the reader encounters that same question as to the local and special, and the widespread or universal, about which the systematic thinker, disciplined in a science or in philosophy, feels he must consider. Do the people presented in the Greek tragedies have the same human nature as those shown us by Shakespeare? In reading *War and Peace* and *The Tale of Genji* we seem to see a human nature that is both different and the same. Though such impressions as to the universality and the variability of humanity do not submit to the procedures of a behavioural science, for those who think about them they seem to deepen and refine opinions, however imperfectly definable, as to the nature of man.

The fragmentation of knowledge as it touches on the subject "man" appears to have gone very far. This has often been remarked: "We have discarded eternal man and cut mutable man into pieces to be enquired into by different sciences, each of which claims autonomy. The pieces fit into one another less and less. A relatively immutable remnant, called human nature, is left to the care of a biology that speaks the language of physics and chemistry. In this language the animal we call Man is meaningless to himself." (Kurt Riezler, *Man: Mutable and Immutable*, p. vii, Henry Regnery Company, Chicago, 1951.) For the most part *Britannica's* articles present knowledge as it has got itself organized in science, scholarship and the arts. The formal disciplines—and here the scientific disciplines are especially in mind—have come to deal with those aspects of man's nature which lend themselves to organized method and more or less precise formulation. The subject matter "man" is not presented to the reader in any one article that would presume to say all that is important about that topic, but in many and separated articles relating to man, most of which approach the topic from the point of view of some specialized discipline.

For the biological side of man's nature, *see* MAN, EVOLUTION OF; LIFE, ORIGIN OF; ANATOMY (ARTICLES ON); ECOLOGY, HUMAN; and PHYSIOLOGY (ARTICLES ON). For a discussion of concepts of culture, *see* CIVILIZATION AND CULTURE; also, articles on individual cultures, such as ANDEAN CIVILIZATION; and sections on cultural history in the articles cited in HISTORY (ARTICLES ON). *See* also ARCHAEOLOGY (ARTICLES ON); ANTHROPOLOGY (ARTICLES ON); PHILOSOPHY (ARTICLES ON); PSYCHOLOGY (ARTICLES ON); and RELIGION (ARTICLES ON).

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HUMAN RIGHTS. One of the main purposes of every legal system is to protect the individual against oppression. Ordinarily the rights of individuals are protected on the local level; in federations there is, in addition, federal machinery for their protection. In some cases, if no protection can be found domestically, recourse may be had to appropriate international institutions.

History.—The first international rules and procedures for the protection of human rights were developed in order to protect foreigners against abuse by local authorities. Many international tribunals and claims commissions throughout the 19th century established certain minimum standards for all nations to follow in the treatment of aliens. If a citizen of one nation suffers an injury because of a violation of one of these standards by the government or an official of another nation, the violating nation has a duty to pay reparation to the alien's nation.

A series of treaties concluded after World War I imposed upon several European countries special obligations for the protection of racial, religious and national minorities, and authorized the League of Nations to supervise the execution of these obligations. (*See* MINORITIES.)

While international law does not usually deal with relations between a country and its citizens, this rule ceases to apply when a nation's treatment of its population violates the dictates of humanity and justice or shocks the conscience of mankind. Thus, in the course of the 19th century, trade in African slaves came to be generally condemned and following the massacre of minorities in the middle east various remedial measures were taken by western nations. It was, however, the ruthless tyranny of the Nazi regime and the wholesale slaughter by the Germans of minorities and inhabitants of occupied territories that brought about a widespread insistence that human rights must be internationally protected.

Charter of the United Nations.—At the San Francisco conference of 1945, many delegations urged the inclusion of provisions concerning human rights in the charter of the United Nations; some proposed even that a detailed declaration of essential human rights be appended to the charter. While the latter proposal was sidetracked on the ground that such a declaration required careful drafting and there was no time for it at the conference, the charter did contain seven specific references to human rights.

The preamble to the charter reaffirms faith in "fundamental human rights," and art. 1 lists among the purposes of the United Nations: "To achieve international cooperation . . . in promoting and encouraging respect for human rights and for the fundamental freedoms for all without distinction as to race, sex, language or religion"; similar provisions are contained in the additional statements of purposes in art. 55 and 76 of the charter, which deal, respectively, with economic and social co-operation and trusteeship. The general assembly was empowered to initiate studies and make recommendations for the purpose of "assisting in the realization" of these rights and freedoms; and the Economic and Social council was authorized to make recommendations for the purpose of "promoting respect for, and observance of" these rights and freedoms and to set up a special commission "for the promo-

tion of human rights" (art. 13, 62 and 68).

Finally, all members pledged themselves "to take joint and separate action in cooperation with the organization for the achievement" of "universal respect for, and observance of, human rights and fundamental freedoms for all without distinction as to race, sex, language or religion" (art. 55 and 56).

It may be noted that none of these provisions defined in precise terms the meaning of the phrase "human rights and fundamental freedoms," and that the task of the United Nations was limited to "promoting" and "encouraging" respect for, and observance of, these rights and freedoms. Consequently, it was argued that these provisions did not create any definite obligations and that the United Nations might not enforce them until they had been properly defined by supplementary instruments. It became important therefore to prepare such a definition immediately, and the United Nations Commission on Human Rights was entrusted with the preparation of two separate instruments: a declaration of general principles and a treaty containing binding obligations (the so-called Covenant on Human Rights).

Universal Declaration of Human Rights.—The declaration completed by the commission in June 1948 was adopted, after a few changes, by the general assembly at its Paris session on Dec. 10, 1948, by unanimous vote (the six members of the Soviet bloc and Saudi Arabia and the Union of South Africa abstained). The declaration was proclaimed by the assembly as "a common standard of achievement for all peoples and all nations, to the end that every individual and every organ of society, keeping this Declaration constantly in mind, shall strive by teaching and education to promote respect for these rights and freedoms and by progressive measures, national and international, to secure their universal and effective recognition and observance."

The declaration contained general definitions not only of those principal civil and political rights recognized in democratic constitutions, but also of several so-called economic, social and cultural rights. To the first group belong such rights as: life, liberty and the security of person; freedom from arbitrary arrest, detention or exile; right to a fair and public hearing by an independent and impartial tribunal; freedom of thought, conscience and religion; and freedom of peaceful assembly and association. Among the new items in the declaration were: right to social security; right to work; right to education; right to participate in the cultural life of the community; and right to enjoy the arts and to share in scientific advancement and its benefits.

Effect of the Charter and the Declaration.—The effect of the declaration is not entirely clear. On the one hand Charles Malik of Lebanon, one of its chief draftsmen, stated that the principles embodied in the declaration represent "what my government pledged itself to promote, achieve and observe" when it signed the charter, and that "the declaration continued and in a way supplemented the charter, and could not therefore be considered a mere resolution." (United Nations, *These Rights and Freedoms*, p. 15 (1950); General Assembly, *Official Records of the Third Session*, pt. ii, "General Committee," p. 32.) On the other hand, another of its authors, Mrs. Franklin D. Roosevelt (United States), expressed the view that the declaration "is not a treaty; it is not an international agreement. It is not and does not purport to be a statement of law or of legal obligation." The middle view would seem to be that the declaration, though not a binding instrument itself, makes more precise the obligations previously contracted in the charter.

Whether the charter itself has any binding force within the nations which are members of the United Nations, and whether its effect was strengthened by the adoption of the declaration, were also disputed points. In *Sei Fujii* v. *California* (38 Cal. 2d 718, 242 p.2d 617, 1952), the supreme court of California held that the charter and the declaration were not self-executing and that they could not therefore invalidate the California Alien Land law which forbade the acquisition of land by aliens. (The court held the law invalid, however, on other grounds.)

On the other hand, the general assembly considered that the charter obliged members to "promote" human rights and condemned those who violated such rights. It held, for instance, that certain legislative acts of the Union of South Africa were "contrary to the charter and the Universal Declaration of Human Rights" (resolution 719 [viii] of 1953); and that measures taken by the Soviet Union to prevent Russian wives of citizens of other nationalities from leaving the union with their husbands were "not in conformity with the charter" (resolution 285 [iii] of 1949).

Covenants on Human Rights.—To ensure further the enforcement of national obligations with respect to human rights, the UN general assembly requested the Commission on Human Rights to prepare in treaty form two covenants, one dealing with civil and political rights and the other with economic, social and cultural rights. While the primary purpose of both covenants was to spell out in great detail the rights outlined in the declaration, they were intended also to provide more effective enforcement. For instance, nations accepting the covenant on civil and political rights would be obliged to adopt such legislative measures as might be necessary to give effect to the rights recognized in that covenant; and to ensure that any person whose rights were violated should have an effective remedy and that the competent authorities should enforce such remedies when granted. On the other hand, a party to the covenant on economic, social and cultural rights would be bound only to take steps to the maximum of its available resources, with a view to achieving progressively the full realization of the rights recognized in that covenant. Many difficulties were encountered in the drafting of the two covenants.

Protection of Human Rights in Europe.—Enforcement of human rights does not depend solely on the United Nations. Under the auspices of the Council of Europe, for instance, the nations of western Europe put into force the European Convention on Human Rights of Nov. 4, 1950 (together with a supplementary protocol of March 20, 1952). A European court of human rights was established in 1959 to enforce this convention, and individuals were allowed to bring complaints in the form of petitions to a European commission of human rights. Effective measures were thus provided for direct international protection of human rights.

See also CIVIL LIBERTIES.

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(L. B. SN.)

HUMAN SACRIFICE is the offering of the life of a human being to a deity. This article describes the incidence of human sacrifice; for a fuller discussion of sacrificial motives and their implications *see* SACRIFICE.

Human sacrifice has been most widely adopted by agricultural rather than by the less highly developed hunting or pastoral peoples. In particular, sacral kings (considered to embody gods of vegetation) were sacrificed when their vigour declined in order to prevent reciprocal effects on soil fertility; or sometimes a substitute was assigned divine status for a period of time and then put to death.

Africa.—Human sacrifice has been widely, if rather sporadically adopted mainly in connection with fertility ritual and the cult of the dead. For example, at the festival of new yams in September among the Ashanti about 100 victims, usually criminals reserved for the purpose, were sacrificed as a first-fruit offering. The chiefs also killed slaves and placed their heads in the hole out of which the new yams were taken. In Nyasaland and Uganda, where human sacrifice was connected with ancestor worship, some of the slaves of the deceased were buried alive with him, or they were killed and laid beneath him in his grave. The Dahomey (*q.v.*) made especially elaborate sacrifices at the death of a king. (*See* also HEAD-HUNTING.)

America.—In Mexico the belief that the sun needed human nourishment led to sacrifices in which about 20,000 victims perished annually in the Aztec and Nahua calendrical maize ritual in the 14th century A.D. (*see* AZTEC). In Peru a modified form of the rite occurred, and the Incas confined holocausts to the accession of a ruler (*see* ANDEAN CIVILIZATION). In North America human sacrifice was sporadic among the Skidi Pawnee, the Natchez, the

Iroquois and the Huron and in the Pueblo region; as late as 1838 the body of a Pawnee girl was cut to pieces and taken to fertilize the newly sown crops.

Ancient Egypt, Mesopotamia and Palestine.—The slaying of prisoners of war was a common custom. Classical writings suggest that in Egypt human sacrifice also was not unknown—a suggestion confirmed by excavations, for instance of a 1st-dynasty burial at Abydos where numerous servants had been interred with the rest of a princess' funerary equipment in order to provide her with a retinue in the next life. In Mesopotamia the only similar examples are the Sumerian royal tombs at Ur (*c.* 3000 B.C.). The Babylonians and Assyrians held a negative attitude to life after death, which necessarily discouraged human sacrifice at funerals, but it probably occurred at other times; an Assyrian document of the 7th century B.C. refers to the burning of children reminiscent of the Hebrew sacrifices to Moloch (*q.v.*) before the reforms of Josiah in the same century (II Kings xxiii, 10). Excavations, for example in Gezer and elsewhere, reveal that the Canaanites frequently sacrificed children at the foundation of important buildings, and the Israelites apparently adopted this practice under their influence (I Kings xvi, 31–34). Human sacrifices were offered in return for victory by the Israelites (*cf.* the vow of Jephthah in Judg. xi, 30 ff.) as well as by their enemies (II Kings iii, 27). The story of Isaac, based on a legend of a sanctuary where rams had been substituted for human victims, is part of the prophetic *midrash* of the 8th century B.C. and confirms that such sacrifices were once thought acceptable to Yahweh.

Iran, India and the Far East.—In the 6th century B.C., Zoroaster opposed all sacrifice but it is possible that even human sacrifice later recurred among his followers. According to the *Yajurveda*, it was practised in Vedic India and continued spasmodically among the Hindus, especially the followers of Kali (*q.v.*), until the 19th century. Thus, until the custom was abandoned under British rule, a male child was sacrificed to Kali every Friday evening at a shrine dedicated to the goddess in the Shivaite temple at Tanjore. In Japan human sacrifice to natural deities and at burials seems to have been abandoned in the early middle ages; in ancient China the king's retinue was commonly buried with him and such interments continued intermittently until the 17th century.

Greece and Rome.—Human sacrifice was not condoned in classical Greece; *e.g.*, Aeschylus in the *Agamemnon* condemns the sacrifice of Iphigenia. Some rites, however, may have originally required human victims, for instance that in which the Maenads of Thrace and Phrygia killed and devoured a bull, or goat, which was believed to be an incarnation of the god Zagreus (Dionysus); and when calamity threatened human sacrifice may still have occurred—Plutarch records that in 480 B.C. three prisoners were put to death before the battle of Salamis (*Themistocles*, 13). Similarly Roman writers considered the practice a repulsive one, and the infrequent instances of it probably resulted from Etruscan or other foreign influences. Among the rites that are sometimes supposed to have derived from human sacrifices are the *ver sacrum*, in which the total progeny of one spring were dedicated to Mars at times of national peril, the animals being sacrificed and the children banished (Strabo, *Geographica* v, 250), and the annual Argei (*q.v.*) rite, in which straw puppets commonly thought to represent elderly citizens were thrown into the Tiber (Ovid, *Fasti* v, 621 ff.).

Ritual Murder.—A belief that human sacrifice was practised by unofficial and esoteric cults persisted in the Roman empire. In the 2nd century A.D. Christians were charged with consuming sacrificial victims at nocturnal feasts, and the Montanists were similarly accused. From the 12th century onward it was maintained that the Jews sacrificed Christian children at the Passover. In 1144 a young boy, William of Norwich, was said to have been crucified and, in spite of the lack of evidence, the story spread and marked the beginning of a long series of anti-Semitic persecutions throughout Europe. In the next century little St. Hugh of Lincoln was said to be a victim. Even in the 19th century 42 cases of ritual murder are listed. In 1911 the Russian government prosecuted a Jew, Mendel Beilis, and although he was eventually acquitted the legend revived sporadically in eastern Europe and Poland and, under Nazi influence, in Germany and Czechoslovakia.

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(E. O. J.)

HUMAYUN (1508–1556), second Mogul ruler in India, was born at Kabul on March 6, 1508, and succeeded to the Indian conquests of his father Babur (*q.v.*) in 1530. Humayun inherited the hope rather than the fact of empire as the Afghans and Rajputs were merely chastened but not reconciled to Mogul supremacy by their defeats at Panipat, Khanua and the Gogra. Bahadur Shah of Gujarat encouraged by Afghan—and Mogul—emigrés challenged the Moguls in Rajasthan, and although Humayun occupied Gujarat in 1535, the danger from Gujarat only ended with Bahadur's death in 1537. Meanwhile the Sur Afghan, Sher Shah, had so consolidated his power in Bihar and Bengal that he was able to defeat Humayun at Chausa in 1539 and Kannauj in 1540 and expel him from India. The Safawid Shah Tahmasp gave Humayun asylum and provided him with troops wherewith to capture Kandahar in 1545. From his unfriendly brother Kamran, Humayun captured Kabul finally in 1550 and by Jan. 1555 was able to re-enter Hindustan and defeat the Sur forces at Sirhind in June 1555. Delhi was occupied in July. On Jan. 27, 1556, Humayun was fatally injured by falling (probably under the influence of opium) down the roof staircase of his library in Delhi.

Humayun, indolent and volatile, followed his father's traditions of cultured knight-errantry, better at leading loyal retainers from adventure to adventure in politically uncharted territory than at consolidating an empire. He was a poet and a patron of the sciences and of painting. His tomb at Delhi is one of the finest Mogul monuments. He was succeeded by his son Akbar (*q.v.*).

See Ishwari Prasad, *The Life and Times of Humāyūn* (1955).

(P. H.)

HUMBER, an estuary on the east coast of England, outlet of the Ouse and Trent, separates the counties of Yorkshire and Lincolnshire, which are linked by ferry at Hull (Kingston upon Hull). For 18 mi. it flows east by north reproducing the course of an earlier consequent stream which followed the general geological dip, and cuts between the chalk Yorkshire and Lincolnshire wolds along a line of faulting and folding. The gap thus formed, 1½ mi. wide, was the site for the bridge authorized by act of parliament, 1959. A channel in the chalk buried beneath the glacial deposits of Holderness continues eastward, but below Hull the estuary turns 85° into a southeasterly course of 19 mi. which originated, with the river Hull, as a meltwater stream along the ice fronts and moraines of Holderness. Seven miles of docks and quays at Hull, which first developed on the haven provided by the river Hull, line the outside of the bend which guides a deep channel inshore. A slighter reverse curve downstream swings it across to Immingham dock. It then remains midstream, making Grimsby, 6 mi. lower, less accessible to large vessels. The Humber Conservancy board surveys, charts and marks the channels and banks. A 22-ft. dredged channel extends to Goole on the Ouse. The estuary, draining 9,550 sq.mi., is ¾ mi. wide at its head, 2 mi. at Hull, and 7 mi. near the mouth where, on Spurn head (*q.v.*), a dune-capped sand and shingle spit 3½ mi. long, there is a lighthouse, a lifeboat station and a bird observatory. Spring-tide ranges are 18½ ft. at Spurn, 22 ft. at Hull. There is heavy sedimentation from the muddy water on to tidal flats, some of which have been made a wild-fowl refuge, others have been reclaimed, especially Sunk Island.

(G. DE BO.)

HUMBERT I (It. UMBERTO) (1844–1900), king of Italy from 1878, the son of Victor Emmanuel II (*q.v.*) and Adelaide, archduchess of Austria, was born at Turin in Piedmont, capital of the kingdom of Sardinia, on March 14, 1844. He had some education

in constitutional law from the celebrated jurist P. S. Mancini, but for the most part he received the usual severe and rigid military education of his house. All his life he was first and foremost a soldier. Ignorant and untutored in all matters of culture, his early training left him predisposed toward the authoritarian and imperialist policy of a minister such as Francesco Crispi. Entering the army on March 14, 1858, as a captain, he was present at Solferino in 1859 and commanded a division at Custozza in 1866 (*see* ITALIAN INDEPENDENCE, WARS OF). In April 1868 he married his cousin Margherita Teresa Giovanna, princess of Savoy, so carrying one stage further the unwise tendency of his family toward intermarriage. On Nov. 11, 1869, Margherita gave birth to Victor Emmanuel, prince of Naples, afterward Victor Emmanuel III of Italy.

Ascending the throne on the death of his father (Jan. 9, 1878), Humbert adopted the style "Humbert I of Italy" instead of Humbert IV (*i.e.*, of the house of Savoy, as Victor Emmanuel II had preferred to remain). The same sensible policy of making the monarchy more Roman and less Piedmontese led him to go against his father's wishes and bury him at Rome in the Pantheon and not in the royal mausoleum of Superga. He himself always spoke with a strong Piedmontese accent, and indeed preferred to use not Italian but his own northern dialect, but he did much more than his parents to visit other areas of Italy and come in contact with other classes than the narrow court aristocracy; for a time he even lived in Naples, and there his son was born. Just after his accession, on entering Naples (Nov. 17, 1878), he was attacked by a fanatic named G. Passanante. The king warded off the blow with his sabre, but Benedetto Cairoli, the prime minister, in attempting to defend him, was severely wounded.

Compared with the reigns of his grandfather, Charles Albert, and of his father, Victor Emmanuel, the reign of Humbert was tranquil, at least in its early years. Despite his father's great popularity—to which the less colourful Humbert could never aspire—there was a strong antimonarchical opposition which was inherited by the new king. On the left were the republicans and near-republicans who derived from Mazzini and Garibaldi; on the right were the clericals who were completely unreconciled to the Italian capture of Rome and the papal states in 1870. Humbert maintained a firm attitude toward the Vatican and repeatedly asserted Italy's right to permanent possession of the Holy City. He and Queen Margherita did their best, with moderate success, to set up a sociable court life in Rome such as had been lacking in the previous reign, and so to win over Catholic society to the new order. Margherita was a strong and ambitious personality, indeed the only uncontestably regal character in modern Italian history. Although much neglected by her husband, she had a strong influence over him, and used this influence to make the monarchy a powerful ally in politics of the conservative right.

The royal prerogative was allowed special play in foreign policy and in the appointment of a foreign minister. Humbert approved Italy's alliance with Austria-Hungary and Germany, and in repeated visits to Vienna and Berlin consolidated the pact. He also refused to let his governments reduce the money spent on armaments. Latterly he tried to override parliament in his choice of premiers and became associated with a harsh policy of ruling by martial law. At one point the premiership and five ministries were in the hands of generals or admirals who had a sworn allegiance to the king personally. This was met by a dangerous upsurge of republicanism, and on July 29, 1900, Humbert was assassinated at Monza by the anarchist G. Bresci. (D. M. SH.)

HUMBERT II (UMBERTO) (1904–), king of Italy for 35 days in 1946, was born at the Racconigi castle, near Turin, on Sept. 15, 1904, the only son of King Victor Emmanuel III and Queen Elena. As prince of Piedmont he was privately educated, passed through the Royal Military academy in Turin and was a colonel at 26. On Jan. 8, 1930, he married, in Rome, Princess Marie José, daughter of King Albert I of the Belgians. She bore him four children: Maria Pia (1934), Victor Emmanuel (1937), Maria Gabriella (1940) and Maria Isabella (1943). Shortly before World War II Humbert was serving as general inspector of infantry. He was promoted to the rank of army general in Jan. 1941 and made marshal of the Italian empire on Mussolini's recommendation in Oct. 1942. His father appointed him lieutenant general of the realm on June 5, 1944, and abdicated in his favour on May 9, 1946. On June 2, 1946, however, the Italian people voted in favour of a republic (by 12,717,923 against 10,719,284 votes); and on June 14 King Humbert II flew to Lisbon to join his family. He took residence at Cascais under the style of Conte di Sarre.

HUMBLEBEE: *see* BUMBLEBEE.

HUMBLE PETITION AND ADVICE. This was a constitution devised by the second parliament of the English Protectorate (1656) to replace the Instrument of Government (*q.v.*). It was inspired by resentment at the rule of the major generals and marked a further return toward the ancient constitution. In its original form (March 1657) it offered the title of king to the protector, Oliver Cromwell, but this he refused after much hesitation. In its final form, with the modifications introduced by the Additional Petition and Advice (June 1657), it left him the title of lord protector, with power to name his successor. It vested authority in the protector, a privy council and a parliament of two houses, and gave the government an annual revenue of £1,300,000 of which £1,000,000 was assigned to the upkeep of the army and navy. Parliament was to meet at least once in every three years. Those who had abetted the rebellion in Ireland, who professed the Roman Catholic religion or who had fought against parliament and had not afterward given good testimony of their affection to the commonwealth were excluded from sitting in either house and from voting in the elections for the commons. No one elected to the commons was to be excluded except by a decision of the house itself. The "other house" was to consist of from 40 to 70 members nominated by the protector. The 21 members of the privy council were to be approved by both houses of parliament, whose approval was also required for the dismissal of a councilor and for appointments to most of the great offices of state. The control of the standing forces by land and sea was shared between the protector and parliament or, when parliament was not sitting, between protector and council; and the treasury was to account to parliament for the £1,000,000 allotted to these forces. The revenue of £1,300,000 per annum was not to be altered, nor were any other taxes to be raised, without consent of parliament. Finally, protector and parliament were to agree upon and "recommend" to the people a confession of faith "according to the rule and warrant of the scriptures"; but religious toleration was promised to all, with the serious qualification "that this liberty be not extended to Popery or Prelacy or to the countenancing such who publish . . . blasphemies or practise or hold forth licentiousness or profaneness under the profession of Christ." (R. B. WM.)

HUMBOLDT, (FRIEDRICH HEINRICH) ALEXANDER, BARON VON (1769–1859), German naturalist and traveler, the first exponent of the classical period of physical geography and biogeography and best known for his work on the oceanic current off the west coast of South America which was named after him. Born in Berlin on Sept. 14, 1769, he was the son of a Prussian nobleman and younger brother of the philologist Wilhelm von Humboldt (*q.v.*). After the death of his father in 1779 he was educated privately, before attending the University of Göttingen and the Mining academy of Freiburg. A journey along the Rhine, through the Netherlands to England and Paris with Georg Forster, the companion of Cook on his second voyage and an ardent republican, strengthened his liberal, humanitarian idealism and wakened his romantic inclination to the tropics.

In his first essay (*Mineralogical Observations on Basaltic Rocks*, 1790) he upheld the Neptunian theory. His researches into the subterranean vegetation of the mines of Freiburg (*Florae Friburgensis Specimen*, 1793) led him to the assumption of a vital power and to a contribution to Schiller's periodical, *Die Horen*, a philosophical allegory entitled *Die Lebenskraft, oder der rhodische Genius* (1795). Meanwhile, he had been appointed assessor of mines and, subsequently, director of mines in the Prussian principality of Bayreuth (Franconia), where he occupied himself with research (he discovered the local magnetic declination of rocks), technical inventions and social reform (he founded a school of mines and improved the miners' conditions), and where he was

entrusted with his first diplomatic mission. During 1792–97 he traveled to the salt-mining regions of Bavaria, Austria and Galicia, and to Vienna, northern Italy and Switzerland, and became acquainted with A. Volta, R. P. Pictet and H. B. de Saussure, the promoter of scientific alpinism (deriving from De Saussure's work on Mont Blanc).

Following upon L. Galvani's discovery of muscular irritability, Humboldt carried out extensive experiments upon himself, recording the results in his *Versuche über die gereizte Muskel-und Nervenfaser* (1797), in which he set out his ideas in the form of practical chemistry rather than as speculative ideas.

In 1794 Humboldt had been admitted to the Weimar coterie and thereafter discussed with many of the participants the fundamental problems of science and natural philosophy, his own basic assumptions turning toward empiricism.

After the death of his mother in 1796 he was able to travel extensively. From Paris he left for Marseilles with Aimé Bonpland, the botanist, hoping to join Napoleon in Egypt, but they eventually went to Madrid, where the unexpected patronage of the prime minister, Mariano de Urquijo, determined them to make Spanish America the scene of their explorations.

In 1799 they sailed in the "Pizarro" from La Coruña, stopped for six days at Tenerife for the ascent of the peak, and landed at Cumaná. There, on the night of Nov. 11–12, Humboldt observed a meteor shower which forms the starting point of modern knowledge of the periodicity of the phenomenon. He proceeded thence to Caracas, and in 1800 he left with Bonpland to explore the course of the Orinoco. In four months he discovered 1,725 mi. of wild and uninhabited country, confirmed the existence of a link between the drainage of the Orinoco and the Amazon and studied plant and animal life of the savannas and rain forests. In Nov. 1800 the two friends set sail for Cuba, and after a stay of several months regained the mainland at Cartagena.

After a long and troublesome journey along the Cordilleras from Colombia to Peru, with stops in Bogotá and Quito for intensive work, an ascent of Chimborazo to an elevation of 18,893 ft. (the world record for ascent for the next 36 years) and a detour to the sources of the Amazon, they reached Lima. At Callao Humboldt measured the temperatures of the ocean current off the west coast of South America which came to bear his name. During this expedition he also observed the transit of Mercury and made investigations into the properties of guano, which he sent to Europe for chemical analysis, leading ultimately to the export of guano to Europe. After a year in Mexico and a short visit to the United States, they returned to Europe in 1804.

After a short trip to Italy with J. Gay-Lussac and C. L. von Buch, where they investigated Vesuvius, and a sojourn of $2\frac{1}{2}$ years in Berlin, where in 1807 Humboldt wrote his *Ansichten der Natur*, he settled in Paris (1808) in order to secure the scientific co-operation required for the arrangement of the material he had collected on his travels. This colossal task occupied him and many collaborators for 21 years, and even then remained incomplete. With the exception of Napoleon Bonaparte, he was the most famous man in Europe. Academies, both native and foreign, were eager to enroll him among their members. Frederick William III of Prussia gave him a court sinecure. He refused the appointment of Prussian minister of public instruction in 1810. In 1814 he accompanied the allied sovereigns to London, and in the following years the king of Prussia to different congresses and visits to European countries.

By 1794 Humboldt had in mind a *Physique du monde*, comprising all forms of life and their relations to physical conditions. With his researches in the mountain regions of tropical America he had laid the foundation of physical geography and geophysics. He used scientific instruments for a continuous survey in orography, meteorology and earth magnetism, studied plant life in its environmental conditions and collected about 60,000 specimens, among them thousands of new species and genera.

Much of his influence on science must come from his graphic records of his work. By his delineation (1817) of isothermal lines, he suggested the idea and devised the means of comparing the climatic conditions of various countries. He first investigated the rate of decrease in mean temperature with increase of elevation above sea level, and afforded, by his inquiries into the origin of tropical storms, the earliest clue to the detection of the more complicated law governing atmospheric disturbances in higher latitudes; while his *Essoi sur la géographie des plantes* (part v of his main work the *Voyage* [*see* below]) was based on the then novel idea of studying the distribution of organic life as affected by varying physical conditions. The *Ideen zu einer Physiognomik der Gewächse* (1806) was the beginning of the concept of post-Darwinian biogeography.

Humboldt's discovery of the decrease in intensity of the earth's magnetic force from the poles to the equator was communicated to the Paris institute (1804). His services to geology were based on his study of the volcanoes of the new world. He showed that they fell naturally in linear groups, presumably corresponding with vast subterranean fissures, and by his demonstration of the igneous formation of rocks eradicated many errors in thought. He formed extensive theories on magmatism, volcanicity, seismology and tectonics.

In Paris Humboldt collaborated closely, and on a friendly basis, with many famous scientists, and he enjoyed the spirited social life of the *salons*. When at last he had spent his considerable fortune—partly in travel, partly in editing his 30-vol. *Voyage de Humboldt et Bonpland* (1805–34; sometimes cited by the title of part i, *Voyage aux régions équinoxiales du nouveau continent*)—a summons from his king and the offer of the salaried post of chamberlain induced him, regretfully, to move to his birthplace in 1827.

During 1827–29 he was at the height of his powers. The idea of the *Kosmos*, which should convey not only a graphic description but an imaginative conception of the physical world, had first taken shape in public lectures in 1827–28, visited by members of all sections of society. He became active in scientific societies, opened the Berlin meeting of the Gesellschaft der Naturforscher und Ärzte (1828) with a celebrated oration, and was a founder member of the Gesellschaft für Erdkunde zu Berlin (1828). In 1829 he accepted an invitation from the tsar of Russia to go to central Asia; together with G. Rose and C. G. Ehrenberg he journeyed, in 25 weeks, from St. Petersburg to the Chinese border by way of the Urals and the Altai and back by the Caspian sea. The most important results were the completion of meteorological data for the isothermal world map, a theory of the orographic configuration of the central Asiatic mountain systems and tablelands, and the discovery of diamonds in the gold mines of the Urals.

His appeal to the Russian government in 1829 led to the establishment of a line of magnetic and meteorological stations across northern Asia; while his letter to the duke of Sussex, then (1836) president of the Royal society, secured for the undertaking the wide basis of the British dominions, thus forerunning the modern scientific co-operation between the nations of the world.

After 1830 Humboldt was partly plunged into abstruse researches, partly in demand at court and frequently sent on diplomatic missions to the court of Louis Philippe, with whom he always maintained cordial personal relations. His influence on educational and scientific affairs was important: he was the guardian angel of all scientists and artists. But the social position of the "court-democrat, who carried the golden key of a chamberlain on the belt with the ideals of 1789 in his heart" was not easy. He never ceased to rail against bigotry without religion, aestheticism without culture and philosophy without common sense. In a period when all sciences tended toward specialization, Humboldt followed his path to universalism, working on his *Kosmos*. The first two volumes were published in 1845 and 1847, the third and fourth between 1850 and 1858, and for the fifth, which appeared posthumously in 1862, he did not put down his pen until his 90th year, a few weeks before his death. The supreme and abiding value of his work consists in its faithful reflection of the mind of a great man.

His interests in the economic and world political problems of his epoch are reflected in two regional monographs: *Essai politique sur le royaume de la Nouvelle Espagne* (part iii of the *Voyage*, 1811) and *Essai politique sur l'île de Cuba* (1826). In these

works he analyzed for the first time on the basis of detailed statistics the economic structure of both countries, then Spanish colonies—Mexico, the richest mining country of that time under the colonial-mercantile administration, and Cuba, a growing plantation colony, shadowed by inhuman slavery, which he detested and opposed frankly, giving practical hints for its gradual abolition. The influence he exerted on the young Simón Bolívar in Paris gave him a high reputation in Latin America as promoter of the liberation from colonialism.

Humboldt died on May 6, 1859, and received a state funeral. He was a great representative of the scientific culture of Germany, and a man of considerable energy and self-control, but he was also endowed with a touch of French spirituality and sociability.

Humboldt's works also include: *Nova Genera et species plantarum*, 7 vol. (1815–25), with Bonpland and C. S. Kunth, part vi of the *Voyage; Recueil d'Observations Astronomiques* with J. Oltmanns, part iv of the *Voyage; Fragments de géologie et de climatologie asiatiques*, 2 vol. (1831); *Asie centrale*, 3 vol. (1843); *Briefe an Varnhagen von Ense* (1860); *Correspondance scientifique et littéraire*, 2 vol. (1865–69).

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HUMBOLDT, WILHELM VON, Baron (1767–1835), German philologist, diplomat and man of letters, who was the first to state clearly that the character and structure of a language express the inner life and knowledge of its speakers and that languages differ from one another in the same way and to the same extent as those who use them. He was born at Potsdam on June 22, 1767, the elder brother of Alexander von Humboldt. After studying at Berlin, Göttingen and Jena, in the last of which places he formed a close and lifelong friendship with Schiller, he married Karoline von Dacheröden, and in 1802 was appointed by the Prussian government first resident and then minister plenipotentiary at Rome. While there he published a poem entitled *Rom*. His critical essay on Johann Wolfgang von Goethe's *Hermann und Dorothea*, published in 1799, had already placed him in the first rank of authorities on aesthetics, and, together with his family connections, had much to do with his appointment at Rome. In the years 1795 and 1797 he had brought out translations of several of the odes of Pindar, which were also held in high esteem. On quitting his post at Rome he was made councillor of state and minister of public instruction. (*See* Education, History of: *Germany*.) He soon, however, retired to his estate at Tegel, near Berlin, but was recalled and sent as ambassador to Vienna in 1812.

In 1813, as Prussian plenipotentiary at the congress of Prague, he was instrumental in inducing Austria to unite with Prussia and Russia against France; in 1815 he was one of the signatories of the capitulation of Paris, and drafted the treaty between Prussia and Saxony, by which Prussian territory was largely increased. In 1816 he was at Frankfurt, but was summoned to London in the midst of his work, and in 1818 had to attend the congress at Aix-la-Chapelle. The reactionary policy of the Prussian government made him resign his office of privy councillor and give up political life in 1819; and from that time forward he devoted himself solely to literature and study.

In 1816 he had published a translation of the *Agamemnon* of Aeschylus, and in 1817 corrections and additions to J. Adelung's *Mithridates*, that famous collection of specimens of the various languages and dialects of the world. Among these additions that on the Basque language is the longest and most important. Basque having for some time specially attracted his attention. Wilhelm von Humboldt introduced Basque to the notice of European philologists, and made a scientific study of it possible. He visited the Basque country itself, the result of his visit being the valuable "Researches Into the Early Inhabitants of Spain by the Help of the Basque Language" (*Prüfung der Untersuchungen über die Urbewohner Hispaniens vermittelst der vaskischen Sprache*, 1821). Another work on what has sometimes been termed the metaphysics of language was published in 1828 under the title of *Über den Dualis*.

The great work of his life, on the ancient Kawi language of Java, was interrupted by his death on April 8, 1835. The imperfect fragment was edited by his brother and J. Buschmann in 1836, and contains the introduction on "The Heterogeneity of Language and Its Influence on the Intellectual Development of Mankind," which was afterward edited and defended against H. Steinthal's criticisms by A. Pott (2 vol., 1876). This essay has been called the textbook of the philosophy of speech. Other linguistic publications of Humboldt, which had appeared in the *Transactions* of the Berlin Academy, the *Journal* of the Royal Asiatic society or elsewhere, were republished by his brother in a seven volume edition (1841–52). These volumes also contain poems, essays on aesthetic subjects and other creations of his prolific mind.

Many volumes of Humboldt's interesting correspondence with his contemporaries have been published, among them: with Schiller (1830), new ed. by A. Leitzmann (1889); with Goethe, ed. by F. Bratranek (1876); with J. R. Forster, ed. by Forster (1889); with F. H. Jacobi, ed. by A. Leitzmann (1892); with A. W. von Schlegel, ed. by A. Leitzmann (1908); with Karoline von Humboldt, ed. by A. von Sydow, 3 vol. (1906–09); and a selection of letters to various correspondents, ed. by K. Sell (1924). A new edition of his *Gesammelte Werke*, 7 vol. (1841–52) was prepared for the Prussian Academy, 15 vol. (1903–18).

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HUME, ALEXANDER (*c.* 1560–1609), Scottish poet, one of the "last of the makaris," or native Scottish poets, of the 16th century. He was the second son of Patrick Hume of Polwarth, Berwickshire. He probably studied at St. Andrews university, spent some years in France and, after practising law in Edinburgh and trying his fortune at court, was finally ordained, becoming minister of Logie, near Stirling, in 1597. He remained there until his death, Dec. 4, 1609. He wrote a few religious tracts and published his meagre collection of poems, *Hymnes, or Sacred Songs*, "written in rude Scottish," in 1599. Although he is remembered chiefly by one poem, the evocatively descriptive "Of the Day Estivall," his autobiographical "Epistle to Maister Gilbert Mont-Crief" is an interesting early example of the genre.

See Poems of Alexander Hume, ed. by A. Lawson for the Scottish Text Society (1902), which also contains his prose tracts; R. M. Fergusson, *Alexander Hume . . . and His Intimates* (1899). (E. G. M.)

HUME, ALLAN OCTAVIAN (1829–1912), English ornithologist, Indian administrator and one of the leading spirits in the foundation of the Indian national congress (Congress party), the son of Joseph Hume, was born on June 6, 1829. After an education at Haileybury college and the University of London, he joined the Indian civil service in 1849 and had a distinguished career, mainly in the northwestern provinces, until his retirement in 1882. During this period he produced several works on ornithology, including *The Game Birds of India, Burmah and Ceylon* (1879–81) written with Col. G. E. Marshall. He later presented his collection of birds to the British museum. Hume was attached to the central government of India from 1870 to 1879 as secretary in the revenue and agriculture department, but his political views and outspokenness created difficulties and he returned to provincial administration.

On his retirement he threw himself into political activities which aimed at giving Indians more democratic, representational government, and he was one of the chief founders of the Indian national congress which first met in Dec. 1885. By the time Hume left India in 1894 he was no longer able to control the movement in which radical ideas were gaining force. Hume returned to England and died at Norwood, in south London, on July 31, 1912.

See Sir William Wedderburn, *Allan Octavian Hume, C. B.: Father of the Indian National Congress* (1913).

HUME, DAVID (1711–1776), British philosopher, historian, economist and essayist, who conceived of philosophy as the inductive science of human nature. He was the younger son of Joseph

Hume, the modestly circumstanced laird of Ninewells, a small estate adjoining the village of Chirnside, about nine miles distant on the Scottish side from Berwick-upon-Tweed. The family seems to have had some remote connection with the earls of Home. David's mother, Catherine, daughter of Sir David Falconer, president of the Scottish court of session, was in Edinburgh when he was born, on May 7 (new style; April 26, old style), 1711. In his third year his father died. He entered Edinburgh university when he was about 12 years old and left it at 14 or 15, as was then usual. Pressed a little later to study law (in the family tradition on both sides), he found it distasteful, read voraciously in the wider sphere of letters and, through this intensity and the excitement of intellectual discovery, had a nervous breakdown in 1729 from which it took him a few years to recover.

In 1734, after trying his hand in a merchant's office in Bristol, he took the turning point of his life, retiring to France for three years. Most of this time he spent at La Flèche in Maine, studying and composing *A Treatise of Human Nature*. Returning to England in 1737, he set about publishing the *Treatise* (books i and ii, 2 vol., 1739; book iii, 1740). The negligent reception of this, his first and very ambitious work, depressed him, but his next venture, *Essays, Moral and Political*, 2 vol. (1741–42), won some success. Perhaps encouraged by this, he became a candidate for the chair of moral philosophy at Edinburgh in 1744. Objectors alleged heresy and even atheism, pointing to the *Treatise* for evidence. Unsuccessful, he left the city, where he had been living since 1740, and began a period of wandering: a sorry year near St. Albans as tutor to the mad marquess of Annandale (1745–46); a few months as secretary to Gen. James Sinclair (d. 1762) throughout an abortive expedition to Brittany (1746); a little tarrying in London and at Ninewells; and then some further months with General Sinclair on an embassy to the courts of Vienna and Turin (1748–49). He was earning the money that he needed to get leisure for his studies. Some fruits of these studies had already appeared before the end of his travels: namely, a further *Three Essays Moral and Political* (1748) and *Philosophical Essays Concerning Human Understanding* (1748), the latter a rewriting of book i of the *Treatise* (with the addition of his notorious essay "Of Miracles") and better known as *An Enquiry Concerning Human Understanding*, the title that Hume gave to it in a revision of 1758. The *Enquiry Concerning the Principles of Morals* (1751) was a rewriting of book iii of the *Treatise*.

A settled spell followed (1751–63), spent in Edinburgh, with two breaks in London. It opened with an attempt to get him appointed as successor to Adam Smith (later to be his close friend) in the chair of logic at Glasgow. The rumour of atheism prevailed again. In 1752, however, he was made keeper of the Advocates' library at Edinburgh. There, "master of 30,000 volumes," he could indulge a desire of some years to turn to historical writing. His *History of England*, extending from Caesar's invasion to 1688, came out in six quarto volumes between 1754 and 1762, preceded by *Political Discourses* (1752). His recent writings had begun to make him known, but these two brought him fame, abroad as well as at home: there were two French translations of the *Discourses* as early as 1754; and of the *History* a French version was begun in 1760 and a German in 1762. In this period he also produced *Four Dissertations* (1757), which he regarded as a trifle, although it included a rewriting of book ii of the *Treatise* (completing his purged restatement of this work) and an able study of "the natural history of religion." In 1762 James Boswell called Hume "the greatest writer in Britain," and Rome paid him the attention of putting all his writings on the *Index* in 1761.

The most colourful episode of his life ensued: in 1763 he left England to become secretary to the British embassy in Paris under the earl of Hertford. The society of Paris accepted him, despite his ungainly figure and gauche manner. He was honoured as eminent in breadth of learning, in acuteness of thought and in elegance of pen, and taken to heart for his simple goodness and cheerfulness. The salons threw open their doors to him, and he was even given a distinguished reception at court. For four months in 1765 he acted as chargé d'affaires at the embassy. When he returned to London at the beginning of 1766 (to become a year later undersecretary of state there) he brought Jean Jacques Rousseau with him and found him a refuge from persecution in a country house at Wootton in Staffordshire. This pathetic genius, under one of his delusions, suspected a plot, took secret flight back to France and spread a report of Hume's bad faith (*see* ROUSSEAU, JEAN JACQUES). Hume was partly stung and partly persuaded into publishing the relevant correspondence between them with a connecting narrative (*A Concise and Genuine Account of the Dispute Between Mr. Hume and M. Rousseau*, 1766).

In 1769, somewhat tired of public life and of England too, he established a residence (he never married) in his beloved Edinburgh again, deeply enjoying the company, at once intellectual and convivial, of friends old and new and revising the text of his writings. He issued five further editions of his *History* between 1762 and 1773 (there was also a Dublin one, perhaps without his leave) and eight editions of his collected writings (omitting the *Treatise*, *History* and ephemera) under the title *Essays and Treatises* between 1753 and 1772, besides preparing the final edition of this collection, which appeared posthumously (1777), and *Dialogues Concerning Natural Religion*, held back under pressure from friends and not published until 1779. His curiously detached autobiography, *The Life of David Hume, written by Himself* (1777; the title is his own) is dated April 18, 1776. After a long illness he died in his Edinburgh house on Aug. 25, 1776, and was buried on Calton hill. Adam Smith, his literary executor, added to the *Life* a letter that concludes with his judgment on his friend as "approaching as nearly to the idea of a perfectly wise and virtuous man as perhaps the nature of human frailty will permit." His distinguished friends, with ministers of religion among them, certainly admired and loved him, and there were younger men indebted either to his influence or to his pocket. The mob had heard only that he was an atheist and simply wondered how such an ogre would manage his dying. How he did, Boswell, who visited him in his last illness, has told us.

Place in History.—That Hume was one of the major figures of his century can hardly be doubted. So his contemporaries thought, and his achievement, as seen in historical perspective, confirms that judgment, though with a shift of emphasis. Some hints of the reasons for the assessment may be given under four heads:

As a Writer.—Hume's style was praised in his lifetime and has often been praised since; but not so much in the 20th century. It seems in retrospect to be little, if anything, more than the style of his day at a high level of competence. It lacks individuality and the pulse of variety and power. Hume's quill never becomes a wing, nor does it ever plunge into depths; and the pathetic was beyond him, for he was always proudly on guard against his emotions. The touch is light, except on slight subjects, where it is rather heavy. Yet in his philosophical works—those later than the *Treatise*—he gives an unsought pleasure. Here his detachment, levelness (all on one plane), smoothness and daylight clearness are proper merits. It is as one of the best writers of scientific prose in English that he stands in the history of style.

As a Historian.—Library catalogues still list Hume as "Hume, David, the Historian." Between his death and 1894 there were at least 50 editions of his *History;* and an abridgment, *The Student's Hume* (1859; often reprinted), remained in common use for 50 years. Though now outdated, its generations of readers entitle the *History* to be regarded as an event of cultural importance. Moreover, in its own day it was an innovation, soaring high above its very few predecessors. It was fuller and set a higher standard of impartiality. It saw in the nation the mental interests of the educated citizens as well as the deeds of kings and statesmen, as may be seen, for instance, in the pages on literature and science at the end of ch. iii under the Commonwealth and at the end of ch. ii under James II. It was unprecedentedly readable, in structure as well as in phrasing, persons and events being woven into causal patterns that furnished a narrative with the goals and resting points of recurrent climaxes. That was to be the plan and march of future history books for the general reader. No one, however, would place Hume near to Gibbon.

As an Economist.—Hume steps forward as an economist in the *Political Discourses* incorporated in *Essays and Treatises* as part

ii of *Essays Moral, Political and Literary*. How far he influenced his friend Adam Smith, 12 years his junior, remains uncertain: they have broadly similar principles and both have the excellent habit of illustrating and supporting these from history. How far he was original is also uncertain: George Berkeley's *Querist* (1735–37) and some of the private correspondence of the period leave the impression that there was more economic sense alive than the histories of economic thought suggest. Still, in the eliciting of general principles, in sense of evidence and in lucidity of exposition, Hume wrote ahead of his day, though, unlike Smith, whose *Wealth of Nations* he just lived to see, he did not work out a system. His level of insight can be gathered from his main contentions: that wealth consists not of money but of commodities; that the amount of money in circulation should be kept related to the amount of goods in the market (two points made by Berkeley); that a low rate of interest is a symptom not of superabundance of money but of booming trade; that no nation can go on exporting only for bullion; that each nation has special advantages of raw materials, climate and skill, so that a free interchange of products (with some exceptions) is mutually beneficial; and that poor nations impoverish the rest just because they do not produce enough to be able to take much part in that exchange. He welcomed advance beyond an agricultural to an industrial economy as a precondition of any but the barer forms of civilization.

As a Philosopher.—This is the essential Hume, for even outside his philosophy all his serious work is either the seed or the fruit of his conception of philosophy as the inductive science of human nature, as well as of his philosophical conclusion that man is more a creature of sensitive and practical sentiment than of reason. It is also the Hume that has been most vigorously alive since his physical death. On the continent of Europe he is seen as one of the few classical philosophers of Great Britain, with only Francis Bacon and John Locke for company. For some Germans his title to fame is that by putting the problem of causal inference devastatingly he stung Immanuel Kant into creating the "critical" philosophy. He was one of the factors that led Auguste Comte to positivism. In Great Britain he has been and remains the symbol of a cause, of a type of philosophy that must be either exalted or disgraced. The Scottish school, from its beginning in his lifetime under Thomas Reid until Thomas Brown, recoiled from his skeptical treatment of belief in causality and in a material world, and the British Hegelian idealists attacked his empiricism and naturalism generally. His positive influence is instanced in Jeremy Bentham, confessedly moved to utilitarianism by book iii of the *Treatise*, and more extensively in J. S. Mill. By the middle of the 20th century he was again on his pedestal, regarded by the antimetaphysicians in England as one of the few philosophers of the past still worth reading.

PHILOSOPHY

Theory of Knowledge.—Hume's conclusion is that no *theory* of reality is possible. His way to this conclusion is in both the *Treatise* (book i) and the *Enquiry Concerning Human Understanding*. The custom of expositors is to follow the former, on the true ground that it is more thorough and on the questionable supposition that the latter is merely a popular version of the former. Hume himself at the end of his life vehemently repudiated the *Treatise* as juvenile, avowing that only his later writings presented his considered views. A brief summary can only follow the clearer lines of the *Enquiry*.

The basis is a twofold classification of objects of awareness, both classifications being derived from Locke and the second sharpened by Leibniz. In the first place, all such objects are either "impressions," ultimate data of sensation or of internal consciousness, or "ideas," derived from the data by compounding, transposing, augmenting or diminishing. That is to say, we do not create any ideas. From this Hume, again with Locke, infers a theory of meaning: a word that does not stand directly for an impression has meaning only if it brings before the mind an object that can be gathered from an impression by one of the mental processes mentioned. In this short way he dismisses the terms of metaphysics: all talk of a realm beyond experience has no content. Secondly, all objects of awareness are either "relations of ideas" or "matters of fact." Ideas can be held before the mind simply as meanings, and their logical relations to one another can then be detected by rational inspection. The idea of a plane triangle, for example, entails the equality of its internal angles to two right angles, and the idea of motion entails the ideas of space and time, irrespective of whether there really are such things as triangles and motions. Only on this level of mere meanings, Hume asserts, is there room for demonstrative knowledge, which (unlike Locke) he arbitrarily restricts to ideas of quantity; *i.e.*, to mathematics. Matters of fact, on the other hand, objects believed to exist, come before us merely as they are, revealing no logical relations; their properties and connections have to be accepted as they are given. That primroses are yellow, that lead is heavy and that fire burns things are facts, each shut up in itself, logically barren. Each, so far as reason is concerned, could be different: the contradictory of every matter of fact is conceivable. Therefore, any demonstrative science of fact is impossible—as Locke had said, with less crispness and less relish.

From this unoriginal basis Hume takes his own way, developing his distinctive doctrine about causality, singled out because of its importance both in natural science and in practical thinking. The idea of causality is alleged to be of a necessary connection among matters of fact. From what impression, then, is it derived? But no logically necessary relation is discoverable among matters of fact. What, then, is the nature of causal inference? The two questions are obviously intertwined.

On the first question, Hume concurs with the occasionalists, with Locke and with Berkeley in observing no causal relation among the data of the "external" senses; in his own terms, the idea of causality has no impressional source there. Locke had found this internally, in the experience of willing: here we are directly aware of putting forth power, necessitating the next event. Hume disagrees: causal power is nowhere observed, for when we regard any events as causally connected, all that we do and can observe is that they frequently and uniformly go together. Now in this sort of togetherness it is a fact that the impression or idea of the one event brings with it the idea of the other. A habitual association is set up in the mind; and as in other forms of habit, so in this one, the working of the association is felt as compulsion. This *feeling*, Hume concludes, is the only discoverable impressional source of the idea of causality; in other words, when we assert, however carefully (as in natural science), a causal connection between any two objects, the sole experience or evidenced necessitation is not in them but in the habituated mind.

The second question has already been partly answered: causal inference is not rational detection but a habit-determined movement from one object to another. But there is a residual question, namely, the movement also of belief. When we see a glass fall, we not only think of its breaking but expect and believe this, or, starting from an effect, when we see the ground to be generally wet, besides thinking of rain we believe that there has been rain. Hume claims that he was the first to investigate the nature of belief. He uses this term in the narrowed sense of belief in matter of fact, in anything as existing. Belief is not, he notes, part of the content of ideas, since if it were it would be itself an idea and could then be joined at will to any other idea. He describes it as a sort of liveliness or vividness possessed by some of the immediate objects of awareness, originally by impressions and the simple memory-images of these. How does it come to belong to certain ideas? By association. Now this is the essence of causal inference: we pass from an impression to an idea regularly associated with it. Hume confidently asserts that in the process the aspect of liveliness proper to the impression infects the idea. He is almost thinking by analogy with the communication of motion by impetus. It is an odd theory that makes belief consist in a vividness of what is thought of instead of an attitude of the thinker (one consequence of it should be that "existing" means being believed) but, taken with his view of it as transferable by association, it enables him to formulate a theory of probability.

Transferred belief varies in strength with the frequency and regularity of the association. The degrees of probability are the degrees of transferred belief.

What Hume was doing falls within what we would now call the psychology of cognition: he has been trying to describe how the mind works in acquiring what passes for knowledge, or, more particularly, how it derives ideas from impressions and infers from given facts to ideas believed also to be facts. He claimed to have shown that there can be no knowledge of anything beyond experience; that reason can work only with bare meanings, not with facts, or, in other words, cannot infer anything from any facts, since no particular causal law, nor the general law of causality (that every event has a cause), nor the law of uniformity (that every cause always has the same effect) has a shred of logic in it; that causality can be known only as a feeling attending frequent and regular association; and that causal inference is merely such association. What he has not claimed to prove is that the propositions (1) that events themselves are causally related and (2) that they will be related in the future in the same ways as they were in the past are false. He firmly believed both these propositions and insisted that everybody else does, will continue to do and must do in order to survive. They are natural beliefs, inextinguishable propensities (here Hume slips back into taking belief as an attitude) of our nature, madness apart. What he has claimed to prove is that they are not got and cannot be illuminated either by empirical observation or by reason whether intuitive or inferential. Reflection shows that there is no evidence for them and shows also both that we are bound to believe them and that it is sensible or sane to do so. This is Hume's skepticism: it is an affirmation of that tension, a denial not of belief but of evidence. Some of our knowledge of what exists is merely given, the rest of it is not logically inferred, yet it is believed and deserves to be believed. He was fond of saying that we should be grateful to nature for giving us the knowledge we need through "a species of instinct or mechanical power" (association) instead of leaving us to so narrow a faculty as reason.

In the *Treatise* (book i) the arguings of the *Enquiry* had proceeded with divagations and applications which do indeed exhibit Hume's flair for seeing problems and his acuteness in following them out (making it a fertile textbook for students) but leave the reader wondering where Hume stands. The *Treatise* is badly constructed, in parts over-subtle, confusing because of ambiguity in important terms (especially "reason") and marred by willful extravagance of statement and rather theatrical personal avowals. His mature condemnation of it was only severe, not misplaced. Since, however, that single book i has been more read in academic circles than any other of his writings, a summary must be given of its treatment of some topics that are omitted from, or merely hinted at, in the *Enquiry*. First, on the relation of the impressions of the "external" senses to reality, Hume, convinced by the current doctrine that such impressions are all within the sensing mind, rejects as fruitless all attempts to argue from them to continuing material things outside the mind: the sensations are our ultimates; and the theories that pretend to justify our belief in an external world are incoherent and unverifiable, whereas the belief itself is indispensable for practice and in fact ineradicable. Secondly, he continues Berkeley's polemic against the possibility of abstract ideas and general entities and (at much length) against the infinite divisibility of space and time. Thirdly, the idea of substance, as something underlying, producing and holding together all the observable properties of a thing, is discarded. Locke had exposed the extreme thinness of the idea of material substance; Berkeley had dismissed it as empty; Hume dismissed along with it the idea of mental substance. As for a self, if there is one it should be observable, but nothing is observable except particular and momentary impressions and ideas. A mind is known only as a "bundle" of punctual experiences; we suppose it to be a unity because of the felt smoothness of the transitions which imagination effects from point to point. In an appendix published a year later (at the end of book iii) Hume frankly condemns as one-sided his treatment of the problem of the self, summarizes the opposite side as equally cogent and claims the right of a skeptic to leave the matter there. He never returned to it in print. Once more he finds critical reflection at variance with itself. Surprisingly, in book ii, on the "passions," he openly uses the idea of a self; and in book iii he seems to take it for granted.

Theory of Morals.—When Hume passes from the study of knowing to the study of living, another character seems to come into play. He is still whittling down the pretensions of reason, but no longer enjoying the business of displaying reason as divided against itself. He writes as a man having the same engagements as his fellows, anxious both to elucidate and to defend them. The subject occupies book iii of the *Treatise*, more than half of the space being given to justice. The substance of the book was re-expressed in a more balanced form in the *Enquiry Concerning the Principles of Morals*. If we take his confession about this two years later, "I have a partiality for that work," and his judgment at the end of his life, "Of all my writings incomparably the best," along with many other indications in his *History*, essays and letters, we may well suspect that he regarded himself chiefly as a moralist.

The total evidence strongly suggests that the traditional view of his character (a detached scoffer, everywhere a skeptic) and of his ruling purpose (desire for literary fame) is deeply wrong. The priority of his moral interest has been shown by N. K. Smith to provide an illuminating clue to some of the glaring inconsistencies within the *Treatise* as a whole.

In ethics Francis Hutcheson is Hume's general guide, behind whom stands the 3rd earl of Shaftesbury, and the impress of Joseph Butler is evident; but he achieves, as in his theory of knowledge, a striking originality. He keeps to his rule of studying what human nature can be observed to be. Defining morality as those qualities that are approved (1) in whomsoever they happen to be and (2) by virtually everybody, he sets himself to discover the broadest grounds of the approvals. He finds them, as he found the grounds of belief, in "feelings," not in "knowings." No single *summum bonum* or single faculty of moral reason or sense, or single moral propulsion, emerges, but four types of human merit and four corresponding "moral sentiments." Qualities are valued either for their utility or for their agreeableness, in each case either to their owners or to others.

Utility or usefulness means the fitness or natural tendency of anything to serve an end, if the end is regarded as good. Hume takes special pains to prove that justice—still taken in Locke's sense as the honouring of property rights—owes its merit entirely to its "public utility"; *i.e.*, to its being conducive to the weal of society. It might be rhetorically, but is not scientifically ultimate: it is not to be set among the original biases which Hume is trying to track down as the general sources of behaviour and judgment. It cannot be original because property is not; because it would be unrequired if nature's bounty were so great that everybody could take what he pleased without robbing anybody else; and because it would be impossible if the weal of society were not itself desired or admired as an end. It has an external condition (the distinction of property) and an internal condition (esteem for the public good), and when these are present it arises so naturally that it is not to be classified as merely conventional. Within our nature, then, the irreducible source is concern for the good of others, of which justice is an impersonal and institutionalized form and benevolence a freer form, operating among individuals and over a sphere wider than property. This regard for others, according to Hume, accounts for the greater part of morality. He was continuing the reaction of Shaftesbury, Butler and Hutcheson against the egoism of Hobbes. Altruism is not analyzable into a covert care for oneself.

A second group of esteemed qualities is characterized by usefulness to those who have them; *e.g.*, diligence and frugality. Our approval of them cannot be attributed to self-love, since we approve them in others even when we ourselves are not beneficiaries—another stream from the spring of concern for others. True, some of them, for example honesty and truthfulness, are praised for their usefulness to others as well as to those who have them. The doubleness here of the ground for esteem is a general fact of

experience, not to be argued away with a theoretical preconception that one of the grounds must be collapsible into the other: we do like a man to be industrious for his own sake. In this group Hume includes such goods as advantages of birth, wealth and figure (handsomeness), expostulating that the distinction of virtues and what he calls "talents" is merely verbal. If he is wrong here, it is because his starting point, the qualities that we admire, is too wide for ethics.

Further, Hume records, there are some qualities, such as cheerfulness and courage, which we approve because they are felt as pleasant by their owners, again whether these be ourselves or others. Like the preceding type, this third one also benefits others, but our esteem is irrespective of this fact. Benevolence is an instance: Hume says that our chief reason for regarding it as good is its utility to others, but that we do as well find it intrinsically attractive. However, their tendency to benefit others leads Hume to refer the first and third types to a common source, which he calls "a sentiment of humanity," linking with this "social sympathy."

The fourth type consists of qualities, for instance, modesty and good manners, which are approved, whether in ourselves or in others, simply because they are agreeable or attractive to others. Of this type, Hume remarks, nothing more can be said than that it "must be trusted entirely to the sure but blind testimony of taste and sentiment, and must be considered as a part of ethics left by nature to baffle all the pride of philosophy, and make her sensible of her narrow boundaries and slender acquisitions."

Hume is clearly not a utilitarian in the Benthamite sense. His system is more nearly eudaemonism—the happiness of others (without any such formula as "the greatest happiness of the greatest number") *and* the happiness of self. Like Butler, he contends that these two do not conflict. His emphasis is on altruism: of the four moral sentiments which he claims to find by inductive classification, he traces the first three to a sentiment for and a sympathy with our fellows. It is our nature, he maintains, to laugh with the laughing and to grieve with the grieved and to seek the good of others as well as our own. It is also our nature to find certain human qualities intrinsically good, and this takes him beyond eudaemonism. How is this nature to be accounted for? It cannot be, is his reply, since any attempt would take us into the vacuum of metaphysics.

See also references under "Hume, David" in the Index volume.

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HUME, JOSEPH (1777–1855), British radical, responsible for a number of social reforms, was born on Jan. 22, 1777, at Montrose, Scot. After completing his course of medical study at Edinburgh university, he sailed in 1797 for India, where he made a fortune. In 1812 he purchased a seat in parliament for Weymouth and voted as a Tory. When upon the dissolution of parliament the patron refused to return him he brought an action and recovered part of his money. Six years elapsed before Hume again entered the house, and during that interval he adopted the doctrines of James Mill and the philosophical radicals. In 1818, soon after his marriage with Miss Burnley, the daughter of an East India director, Hume was returned to parliament as member for the Border burghs. He was afterward successively elected for Middlesex (1830), Kilkenny (1837) and for the Montrose burghs (1842). Hume became the self-elected guardian of the public purse, by challenging and bringing to a direct vote every single item of public expenditure. It was he who caused the word "retrenchment" to be added to the radical program "peace and reform." He was a believer in free trade, fought the combination laws, and was largely responsible, though a backbencher, for repeal of the laws prohibiting the export of machinery and of the act preventing workmen from going abroad. He constantly protested against flogging in the army, the impressment of sailors and imprisonment for debt. He took up the question of lighthouses and harbours; in the former he secured greater efficiency, in the latter he prevented useless expenditure. He died on Feb. 20, 1855.
(A. BRI.)

HUME, TOBIAS (? –1645?), English viol player and composer, was at one time an officer in the army. He published two books: *The First Part of Ayres* (1605), containing 116 pieces for the viol and 6 songs, and *Captaine Humes Poeticall Musicke* (1607), containing 18 instrumental pieces and 4 songs. In 1642 he presented a petition to the house of lords offering his services in the Irish war. He was at that time a poor brother of the Charter house and was suffering from a severe mental disorder. He is best known for the song "Fain Would I Change That Note."
(D. PO.)

HUMFREY, PELHAM (1647–1674), English composer and lutenist. In 1660 Humfrey became one of the first choristers of the restored Chapel Royal under Capt. Henry Cooke and when still a boy showed his skill in composition. At the age of 17 he was sent by Charles II to Italy and France to continue his studies and, while abroad, was appointed royal lutenist and gentleman of the Chapel. On his return to England in 1667 he received further court appointments and succeeded Cooke as master of the children, one of his pupils being the young Henry Purcell. He also became Composer in Ordinary for the Violins to His Majesty and had many sacred and secular works performed at court. He died at Windsor on July 14, 1674, aged 27, and was buried in Westminster abbey.

Humfrey produced many fine works, principally anthems. He wrote odes for the king's birthday and some theatre music, including songs for plays by William Wycherley and John Dryden and incidental music for *The Tempest*. Many of his songs appear in the numerous collections published by John Playford. (B. P.)

HUMIDITY, ATMOSPHERIC. The atmosphere is made up of a number of gases, of which water vapour is in many respects the most important. This importance arises from the fact that water vapour is the only constituent of air whose state changes at the temperatures encountered in the atmosphere. Water substance occurs as a vapour (invisible), as a liquid (fog, cloud and rain droplets) and as a solid (ice crystals, hail and snowflakes). The subject of atmospheric humidity deals only with water in its vapour state.

There is an upper limit to the amount of water vapour which a given space can contain, this upper limit depending only on the temperature of the vapour. At low temperatures the amount is small; at high temperatures it is large. The presence of other gases does not appreciably affect this relationship. When a given space contains the maximum amount of water vapour, the vapour is said to be saturated; air containing saturated vapour is also loosely but commonly referred to as saturated. From the foregoing, it follows that the amount of water vapour present near the earth's surface is nearly always greater than that in the cooler upper air; similarly, near the surface, the amount is greater in equatorial than in polar regions. The proportion of water vapour in air is small but variable; it ranges from a very small fraction of 1% to nearly 3%. The processes by which water substance

changes from one state to another, and the influence of the variability of the concentration of water vapour in the atmosphere, form the subject matter of many studies of weather phenomena.

There are several ways of expressing the water vapour content of air:

1. The relative humidity gives the amount of water vapour present in a volume of air as a percentage of the maximum possible amount in that volume at the same temperature. For example, a relative humidity of 25% means that one-quarter of the maximum amount is present; one of 100% indicates that the air is saturated. The relative humidity depends on the temperature as well as on the vapour content, falling as the former rises, and vice versa.

2. The absolute humidity specifies the mass of water vapour in unit volume of air. It also changes with the temperature.

3. The humidity mixing ratio is the mass of water vapour per unit mass of the dry components of the air.

4. The specific humidity is the mass of water vapour per unit mass of air.

The difference between the numerical values of the humidity mixing ratio and the specific humidity of any mass of air is slight, and for most purposes the two are used interchangeably. These two quantities are especially useful in weather analysis, for they do not change with temperature but only when water vapour is added to or removed from the air, as by evaporation or condensation, or by mixing with moister or drier air.

Related to these measures of moisture content are the dew point and the wet-bulb temperature. The dew point is the temperature at which condensation commences when air is cooled at constant pressure and constant vapour content. The wet-bulb temperature may be defined as the lowest temperature to which air can be cooled by evaporating water into it, the air itself supplying the heat necessary for the process. The former quantity is useful because it remains constant as long as water vapour is neither added to nor removed from the air, and the latter because it does not change when evaporation or condensation occurs in the air. The dew point is always lower than the wet-bulb temperature except when the air is saturated, in which case the two coincide with the existing air temperature.

Both of these quantities find numerous applications in aeronautical meteorology, especially in cloud and fog forecasting. The dew point is useful for forecasting the height of the base of certain types of clouds. For example, the height of the base of the cumulus (woolpack) clouds which often develop during a summer afternoon may be predicted approximately from the formula

$$\text{height of base (in feet)} = 220(T\text{-}T_d)$$

where T is the temperature and T_d the dew point of the air near the surface, both in degrees Fahrenheit (or, height of base, in metres $= 120[\mathrm{T\text{-}T_d}]$, in °C.). For example, if it is expected that the spread between the two temperatures will be 10° F. during the afternoon, a cloud base height of 2,200 ft. would be forecast. The heights of the bases of some other types of low clouds may be predicted in the same way. The wet-bulb temperature aloft is especially useful for studying the vertical stability of the atmosphere, which governs the formation and vertical extent of a number of types of clouds.

The determination of the humidity of the atmosphere is known as hygrometry. The first hygrometer, invented by Leonardo da Vinci about 1500, was based on the principle that certain substances, known as hygroscopic, have an affinity for water vapour and absorb it readily. With Leonardo's hygrometer the humidity was measured by weighing a ball of wool, which absorbed varying amounts of water vapour, large when the atmospheric humidity was high and small when it was low. Other instruments were later devised, depending on various principles. Horace Bénédict de Saussure, in 1783, described a hygrometer which utilized a human hair, freed from grease. The hair lengthened with increasing humidity and shortened with decreasing humidity. In 1802, C. W. Boeckmann made measurements of humidity by comparing the readings of two thermometers, one with its bulb dry and the other wet. The lower the humidity relative to that for saturation, the greater was the spread between the two temperatures. Improving on a technique suggested earlier (1822) by Johann Wolfgang Döbereiner, Henri Victor Regnault in 1845 measured the dew point. A highly polished silver cylinder was cooled until dew formed on it and the temperature of the cylinder noted when this happened, thus giving the dew point. Refinements of these basic methods were made later.

Hygrometers may be divided into five types, according to the basic principles employed:

1. The evaporation method. The wet- and dry-bulb instrument, known as a psychrometer, is essentially the same as Boeckmann's hygrometer, described above. In one type the wet bulb is covered with muslin, which is kept moist by a wick extending to a vessel containing water. A steady flow of air past the wet bulb is necessary for accurate measurements. The sling psychrometer consists of two thermometers in a frame, with muslin covering the bulb of one. The latter is dipped in water and the assembly then whirled vigorously. The relative humidity corresponding to the wet- and dry-bulb temperatures is found from tables.

2. The condensation method. The dew-point hygrometer is based on Regnault's instrument. A thermometer is set up with its bulb in the polished silver cylinder, which contains ether. Air is bubbled through the ether, which cools by evaporation. The temperature at which water vapour starts to condense on the outside of the cylinder, as read by the thermometer, is the dew point. Comparison with the air temperature from another thermometer gives, with the aid of tables, the relative humidity. Through the use of a photoelectric cell sensitive to dew formed on the reflecting surface, it is possible to balance the temperature at the dew point through direct or induction heating, and thus provide a recording dew-point hygrometer.

3. The hygroscopic method. The dimensions of certain substances, known as hygroscopic, vary with the relative humidity. Human hair has this property, increasing in length by about 2½% as the relative humidity rises from 0% to 100%. In the hair hygrometer, the relative humidity is obtained directly as a function of the length of the hair. Many household hygrometers are of this type. Sometimes the outside membrane of the large intestine of an ox (goldbeater's skin) is found more satisfactory than a hair. The chief disadvantage of hygrometers of this type is the slowness of their response in changing humidity at very low temperatures.

4. The chemical method. With the chemical hygrometer, a given quantity of air is exposed to a drying agent which absorbs the water vapour present; the humidity of the air is obtained by comparing the weight of the drier after absorption has occurred with that before, or by a similar means. The weighing method is the most accurate known but is not suitable for routine meteorological observations.

5. The electrical method. The electrical resistance of certain substances varies with the amount of moisture absorbed by them; lithium chloride is one of these. In one type of electrical hygrometer, measurement of the resistance of a film of lithium chloride permits the evaluation of the relative humidity. This instrument is used mainly for studies of the upper air.

An instrument which records the humidity is called a hygrograph. Most hygrographs depend on the hygroscopic principle, for the variations in the length of a hair are readily magnified and recorded on a revolving drum.

One of the factors governing human comfort is the relative humidity of the air, for it, in part, determines the rate at which perspiration evaporates, with its resultant cooling effect. No single optimum humidity can be given, for the moisture content of the air must be considered in conjunction with its temperature and movement. It is possible, with air conditioning of buildings, to control indoor conditions for maximum health and efficiency. Estimates of the best conditions vary for different countries. Thus in Great Britain an indoor temperature of 18° C. (65° F.) with a relative humidity of 50% to 60% is considered ideal, whereas in the United States and Canada a temperature of 22° C. (72° F.) with a relative humidity from 40% to 60% is preferred. Air conditioning is also of great importance in many industrial plants. To take one example only, printing establishments find

humidity control in pressrooms and paper storage rooms helpful, for the properties and dimensions of paper vary with the relative humidity of the air. Most papers are handled with a minimum of trouble when the relative humidity is between 40% and 50%.

See also references under "Humidity, Atmospheric" in the Index volume.

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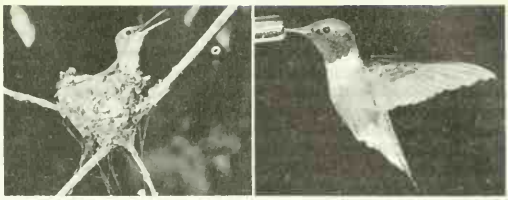
HUMITE, a group of four related minerals consisting of basic magnesium fluosilicates; chondrodite, clinohumite, humite and norbergite. The four minerals are strikingly similar in appearance and are best distinguished by their optics and X-ray powder diffraction patterns. They are honey-yellow to brown or red in colour and have a vitreous to resinous lustre; hardness 6–6.5; specific gravity 3.1–3.2. The name humite, after Sir Abraham Hume (1749–1839), was given in 1813 to the small and brilliant honey-yellow crystals found in the blocks of crystalline limestone ejected from Monte Somma, Vesuvius; all but norbergite have since been recognized at this locality. Chondrodite (from the Greek word for a grain) was a name early in use for granular forms of these minerals found embedded in crystalline limestones in Sweden, Finland and at several places in New York and New Jersey. Large hyacinth-red crystals of all four species are associated with magnetite in the Tilly Foster iron mine at Brewster, N.Y.

The minerals have the formulas: norbergite, $Mg(F,OH)_2.Mg_2SiO_4$; chondrodite, $Mg(F,OH)_2.2Mg_2SiO_4$; humite, $Mg(F,OH)_2.3Mg_2SiO_4$; and clinohumite, $Mg(F,OH)_2.4Mg_2SiO_4$. Norbergite and humite are orthorhombic, the others monoclinic in crystallization. The lengths of the vertical axes are in the ratio 3:5:7:9, and this is also the ratio of the number of magnesium atoms present in each of the four minerals. Such a relation between the crystallographic constants and the chemical composition is known as a morphotropic relation. Structurally, the minerals consist of interleaved layers of the olivine (Mg_2SiO_4) structure and of brucite, $Mg(OH)_2$. The stacking sequence of these layers determines the compositional and crystallographic relations observed. (CL. F.)

HUMMEL, JOHANN NEPOMUK (1778–1837), properly JOHAN NEPOMUKA HUMMEL, Austrian composer, pianist and conductor, was born Nov. 14, 1778, at Pressburg (Bratislava). The son of Joseph Hummel, director of the imperial school of military music at Pressburg, he studied music at an early age with Mozart, at whose house in Vienna he lived for two years. Later, accompanied by his father, he toured northern Europe as an infant prodigy pianist, giving recitals in Germany, Holland and England. He stayed in London for one year, studying there with M. Clementi. Returning to Vienna in 1793, he continued his studies with J. G. Albrechtsberger, Haydn and A. Salieri. He was for some years *Kapellmeister* to the Esterházy family, a post previously held by Haydn. After meeting with further success as a traveling virtuoso pianist and conductor, he settled in Weimar in 1819 as conductor to the court, a position he held until his death there on Oct. 17, 1837. Hummel's most important compositions are his works for pianoforte. His concertos, trios, sonatas and rondos are the music of a composer with a distinctive, elegant style and of a most competent pianist who foreshadowed a great deal of later developments in pianoforte technique. The texture of his music, however, is more in accordance with the light action of the pianoforte of his day than with that of the modern instrument. Among Hummel's pupils were A. Henselt and F. Hiller.

HUMMINGBIRD, any of about 320 species of the smallest of all birds, confined to the Americas and constituting the family Trochilidae, usually placed with the swift (*q.v.*) family (Apodidae) in the order Apodiformes. Hummingbirds range from Alaska to Tierra del Fuego and from lowlands up to the snow line at 16,000 ft. in Ecuador, but the centre of abundance in species is in the northern Andes. They are famous for the rainbow colours and delicate shades of the brilliant iridescent plumage of the males, which may also have striking crests, neck tufts and remarkably elongate spatulate tail feathers. Like the swifts they have short legs and small feet, narrow wings and long primary feathers. The



(LEFT) WILLIS PETERSON, (RIGHT) DONALD S. HEINTZELMAN FROM NATIONAL AUDUBON SOCIETY

(LEFT) FEMALE BLACK-CHINNED HUMMINGBIRD (ARCHILOCHUS ALEXANDRI) ON NEST; (RIGHT) MALE RUBY-THROATED HUMMINGBIRD (A. COLUBRIS) AT FEEDER

extreme development of the breastbone and keel is associated with the very rapid wingbeat, so fast as to appear a blur in smaller species, in which it may be as much as 90 or more beats per second. The bill is slender, usually straight, from one-third inch to five inches long; it may be curved in a third of a circle, as in the sickle-billed hummingbird (*Eutoxeres aquila*), ranging from Costa Rica to Ecuador. The specialized tubular tongue probes flowers for tiny insects and nectar as the bird hovers in mid-air.

A hummingbird can easily move backward in flight to remove its bill from a flower and dart away in humming flight. The voice is weak; the cries, chippering and unmusical. The nest is a solidly built little cup of vegetable down held together with plant fibres and spider webs, and in some species decorated with bits of lichens; often less than one inch across the opening, it usually contains two tiny, elliptical white eggs. The female is pugnacious in protecting the eggs and young; the male normally takes no part in family affairs. Hummingbirds seem to be partial to red, and may be attracted to feeders containing honey or sugar water, especially if red spots mark where food is available. They are sometimes confused with sphinx moths, which also hover at flowers, but chiefly at dusk. In captivity some specimens have lived up to six years.

The smallest bird in the world is the bee hummingbird (*Mellisuga helenae*) of Cuba, with a body two inches long and weighing less than two grams; its nest cavity measures three-fourths of an inch across and the eggs are three-tenths of an inch long. The largest hummingbird is *Patagona gigas*, eight inches long, of the Andes. The ruby-throated hummingbird (*Archilochus colubris*) is the only one in eastern North America, the allied black-chinned (*A. alexandri*) ranging the southwest to Texas and British Columbia. The former sometimes migrates across the Gulf of Mexico in a single flight.

See C. H. Greenewalt, *Hummingbirds* (1960). (DR. A.)

HUMORESQUE, the title of a musical composition, common in the 19th century, usually genial and sometimes whimsical in mood. Well-known examples are the "Humoreske," Opus 20, for piano by Schumann in which there are many contrasting moods, and the "Eight Humoresques," Opus 101, for piano, by Dvorak (of which the seventh exists in numerous arrangements). Other composers who have used the title for piano pieces are Stephen Heller, Grieg and Max Reger. Humperdinck wrote a *Humoreske* for orchestra. The name does not imply any structural peculiarity.

HUMOUR began its interesting career as a Latin word *humor*, meaning "moisture." In a more specialized sense "humour" meant the fluids of the body; this sense survives in part in medical usage. In the ancient physiology still current in the middle ages and later the four cardinal humours of the body were blood, phlegm, choler (yellow bile) and melancholy (black bile); the variant mixtures of these humours in different men determined their "complexions" or "temperaments," their physical and mental qualities, their dispositions: the ideal man had the ideally proportioned mixture of the four; a predominance of one produced a man who was sanguine (Latin *sanguis*, "blood"), phlegmatic, choleric or melancholic. Each of these complexions had specific characteristics so that the words carried much weight that they have since lost: the choleric man, for example, was not only quick to anger but yellow-faced, lean, hairy, proud, ambitious, revengeful and shrewd. Some knowledge of the four humours is helpful in read-

ing Chaucer and Shakespeare and their contemporaries.

Renaissance Theory.—By further extension and specialization, humour in the 16th century came to denote usually an unbalanced mental condition, a mood, or unreasonable caprice, or a fixed folly or vice. As such, humour was a fit subject for the writer of comedy, whose traditional function, in Renaissance theory, was the correction of irrational or immoral conduct. The great exponent of the comedy of humours was Ben Jonson, who took for his own a word already popular and, as Jonson saw it, absurdly abused: all sorts of fools and knaves proudly insisted upon their personal humours. Jonson, at the beginning of *Every Man Out of His Humour*, distinguished two kinds of humour, in the sense in which the word is applied to disposition. One is true humour, in which one peculiar quality actually possesses a man, body and soul. But there is also an adopted humour, in which a man goes out of his way to appear singular by affecting certain modes of clothing, speech and social habits. This ridiculous pride in singularity Jonson scourges without mercy. Affected humours change with the years, with the fashions; they are manners, so that Jonson comes to speak of "recent humours . . . or manners of men that [go] along with the times"; his 17th-century successors continued to find new humours, new kinds of offensive conduct, that offered material for the satiric comedy of manners.

18th and 19th Centuries.—By the end of the 17th century the English had come to be rather proud of the excellence of their comedy, claiming that it was superior to that of the ancients and of the modern French because of its humour; that is, its greater copiousness in comic characters. Moreover, they began to claim that this richness of the comic stage derived from the richness of their national life, which abounded in men of varied humours. England had long been known as the home of individualists, peculiar men, even madmen, so that when young Hamlet put his antic disposition on he was packed off to England where it would not be noticed. In that sense England had always had its "humorists" (its odd types, men with a humour). It was, however, Sir William Temple in "Of Poetry" (1690) who was the first to try to account for English eminence in humour—he claimed that the word itself was peculiar to the English language—by finding its causes: the native plenty of the soil, the ease of government and the uncertainty of the climate. These forces, he said, produce a nation of extremists and this has disadvantages, but wealth, liberty and varied weather produce a brilliant crop: health, courage, beauty, genius, goodness of nature and, among all these, humour "because every Man follows his own, and takes a Pleasure, perhaps a Pride, to shew it." When humour was seen in this light, not as an affected manner but as a natural, national expression, a distinct compliment to a race of rich and free men, its future was assured. William Congreve in "Concerning Humour in Comedy" (1695) confirmed Temple's observations on the English and analyzed closely the distinction between affectation and true humour. Temple's account was widely popular and the English variety of humours became one of the great commonplaces of the English heritage. The entire matter was regarded with much complacency. As one writer in 1725 said, "The pleasing Medley of Characters and Humours particular to *Old England*, make up together a very fine Scene; and the general Face of Peace and Prosperity that covers all, will well enough excuse a warm *Englishman* in thinking it the finest Country in the World." Another writer of 1777 summarized the history of "true humour" in a few words: "At length Commerce, and her companion Freedom, ushered into the world their genuine offspring, True Humour. To these she owed her birth; and when they expire, it will require no great sagacity to prophesy that she will follow her parents to the same grave." This was the humour of a national tradition complex in origin and expression, but one that may be described in outline as empirical, liberal and expansive, scientific, democratic and commercial, one that emphasized variety and the individual rather than conformity and the class. It was the Whig tradition of the Glorious Revolution of 1688, which made Englishmen proudly self-conscious of their liberties and wealth; and it was a legacy inherited and then independently cultivated by Americans. The continuing vitality of the tradition from which "True Humour" sprang can be seen in the 19th century, at its best, in John Stuart Mill's insistence that free scope should be given to varieties of character, that eccentricity in a society is proportional to genius, originality, mental vigour and moral courage. The major critic of its defects was Matthew Arnold, who saw its degeneration into the mere rawness of "Doing as One Likes." It drew its inspiration neither from the witty aristocracy nor the baseborn knaves and fools; it was distinctly "middle class": "the Courtier crys out for *Wit*," according to George Farquhar's analysis of the public taste (1702), "the Citizen for *Humour*."

Humour and Wit.—Wit was a form of intellectual quickness, raillery and repartee, likely to be an upper-class manner of discourse, likely to be dangerous, as are all sharp weapons that can cut good and bad alike; wit was associated with the aggressive, sexual Restoration rakes, who, in the eyes of good citizens, had used ridicule against religion and marriage and all moral and social decency. Wit was inferior, furthermore, as a literary form because it was primarily cleverness and thus without passion or heart; in comedy, therefore, it offered no cause for the action of characters; on the contrary, it was regarded as too often obliterating the distinctions between characters because some authors in their overflowing desire to display their wit tended to put their witticisms into the mouths of inappropriate characters. Congreve became the standard example of the excessively witty writer. But Congreve himself had declared that the manner of the wit should be adapted to the humour; that is, humour as a manner peculiar to one man was bound up necessarily in individual character and feeling and thus determined action and speech (including such wit as might be appropriate). Humour, then, unlike wit, was not the flash of an isolated sentence whose force was largely independent of the speaker or the time or place, but gathered its strength from a wide context, the previous life of the character, the relationships among a number of human beings in a complex specific dramatic situation. Humour was therefore more "natural," a growth of time, a freer and less restrained expression of character than wit. Wit, like any impersonal mental skill, required books, learning, art; humour was a more universal gift. Wit surprised the mind, but humour was more delightful and appealed to the heart as well. To the more "polite" critics of the 18th century, where wit was more designed, concerted, regular and artificial, humour was more wild, loose, extravagant and fantastical, not consistent with true politeness; if humour was more diverting than wit it was only as a buffoon is more diverting than a gentleman: this was the account given by Adam Smith in 1755. Humour was therefore considered by some to be "low," but the prevalent tendency was to vindicate it: if humour is not found in the well-bred it is because they have learned to repress their feelings and adapt their manners to a rigid mold of decorum; among the lower orders, by passions and humour, nature appears in all its charming, unsophisticated diversities.

The development of the concept of humour was thus closely linked to the development of the concept of nature; humour flourished not in a nature that was a set of ideal or general norms or types in which individual variants were aberrations, but in a nature in which luxuriant variation and plenitude of forms were necessary and desirable, a "picturesque" nature in which irregularity and roughness of outline, the unusual and unexpected, even the grotesque, were admired and treasured.

By the mid-18th century humour was no longer an abnormality and a fit subject for the satirist but rather a whimsical oddity or foible, amusing and innocent. But more than that, unlike wit, which was often severe, bitter and satirical, humour very frequently exhibited generous, benevolent sentiments of heart which, though exerted in an odd manner, it was said, justly commanded our fondness and love. Benevolence, in one of its forms, giving free rein to inner impulse and trusting that spontaneous expression of personal feeling was good for both the individual and society, even if it seemed excessive or foolish or ludicrous by cool-headed standards, had a near relationship with humour. Certain free, jocund and liberal oddities and foibles might result from a generous flow of spirits and warm uncalculating benevolence, but these were amiable, even estimable failings. Humour might even be a guise to hide tender feelings.

18th-Century Humorists.—The 18th century was prolific in the creation of kindhearted "humorists," most notably Joseph Addison and Sir Richard Steele's Sir Roger de Coverley, Henry Fielding's Parson Adams, Oliver Goldsmith's Vicar of Wakefield and Laurence Sterne's Uncle Toby. The history of comic writing was reshaped so that though it may seem obvious to us that amiable humour has always existed, that Shakespeare and Cervantes and the humorous characters they created, for example, were greater than anything produced by later ages, if such is the case it is because we have inherited the 18th-century interpretations of those earlier authors. Falstaff and Don Quixote, though always highly admired as comic creations, were regarded as butts of ridicule, the one an amorous, lying, gluttonous buffoon, the other a lunatic designed to satirize chivalric romances, until well along into the 18th century; then Falstaff became a lovable, harmless rogue; Don Quixote became an enthusiastic philanthropist: even when his too ardent feelings betray him into ridiculous excesses and we are tempted to laugh at him, it is impossible to withhold our love and pity.

Thus humour, by the end of the 18th century and the beginning of the 19th, in its most exquisite moments was found to have an intimacy with sympathy and pathos. The inevitable distresses of a high-minded innocent like Don Quixote brought a tear to the eye even as the smile was upon the lip. Humour was the expression of a human nature that was, within itself and in its social and cosmic relations, a strange mixture, at once sublime and ridiculous. Humour was an essential resource of the sensitive and melancholy, a relief from and defense against the sadness of life that always weighs most heavily on those of keenest sensibilities. Sterne, with his unpredictable mingling of mirth and sentiment, laughter and tears, writing, as he claimed, against the "spleen," was tremendously popular and influential. The spleen was a nervous, depressive disorder that affected especially the finest tempers; it made men "humorists" and it made humour a necessary therapeutic. The English as a nation were notable for their spleen and their humour; the two were inseparable.

19th-Century German Humour.—Though the English had declared their monopoly of humour, other nations were not always prepared to acknowledge the claim. In the 19th century the Germans in particular became determined and solemn philosophers about humour. Jean Paul Richter, who was much influenced by English humour, especially Sterne's, and whose ideas on humour, in turn, were influential on Samuel Coleridge, Thomas De Quincey and Thomas Carlyle, developed in his *Vorschule der Ästhetik* (1804) a theory of humour as the romantic form of the comic; in his highly complex exposition, the observer of a humorous situation must subjectively identify himself with the object of his laughter and thereby the object of his laughter is himself as well, indeed all humanity, of which both he and the object are a part. Humour destroys not the individual but the finite in its contrast with the infinite. In this universality humour finds no individual fools but only foolishness in a foolish world and is therefore tenderly tolerant. But when humour measures and connects with this little world the infinite one, there arises a laughter wherein there is still a pain of greatness, Richter says. Nor is it difficult to find later theories of humour with loftier pyramids of complexity.

Modern Humour.—In the 19th century humour was established as the highest and richest form of the comic. As such the word came also to be employed as a general term, as it usually is today, to denote anything comic, or anything that makes us laugh. By obvious extension of meaning a "humorist" is now someone consciously skilled in comic artistry, not, as the word was normally used until the 19th century, an unconscious subject of comedy himself. "Humour" is applied also to the ability to perceive or appreciate the comic. When qualified, of course, the word is used of a large variety of special areas of the comic. The word, therefore, now has little specific meaning except what it still may retain from its history in the 18th and 19th centuries, when it reached its apotheosis.

At its worst the idea of humour that developed in that period is a pudding of meaningless grotesquerie and gratuitous emotionalism. At its best it preserved a fine and difficult balance and a comprehensive conception of man and nature. It caught the enthusiasm of man's aspiring goodness and checked it with an eye for the incongruities of his concomitant weaknesses. At its best it did not identify innocence with the whole of nature or the complete virtue of man; innocence is also ludicrously short of fulfilling human capabilities. It measured reality, not as the satirist tends, by an ideal against which reality is terribly wanting, nor did it, in the manner of the sentimentalist, deny the gap of the real and the ideal. It accepted the difference with a liberal tolerance, or, unlike both satirist and sentimentalist, it found the ideal in the varied fullness of the real in all its imperfections. Its strength can be seen in the manner in which it prepared an enormous audience for the early Dickens; its weakness can be seen in the unwillingness of that audience to let Dickens get beyond *Pickwick Papers*.

In the 20th century humour no longer enjoys an unquestioned pre-eminence in the hierarchy of the comic. For one thing, increased historical study of the comic has led to the rejection of 18th- and 19th-century interpretations of earlier authors and to the understanding of modes of the comic that antedate the later idea of humour. The interest of many critics has turned also to questions of formal structural analysis, in which the emotions of the audience, essential in humour, are subordinated. And it is certainly true that one characteristic of the 20th century is an astringency (cynicism to those who do not like it, tough-mindedness to those who do) that questions sharply the liberal assumptions on which the 18th- and 19th-century idea of humour was based, regarding them as undisciplined both in intellect and emotion. It is noteworthy that those critics who tend to regard the 18th and 19th centuries as unfortunate errors in the history of literature have revived "wit," using it once again in a 17th-century sense to denote the hard, bright quality of that fine fusion of intelligence and feeling found in the greatest poetry. (S. M. T.)

Related Articles.—There are in *Britannica* a number of articles related to humour in its broadest sense, as anything comic, or anything that makes one laugh. For the psychological aspects of laughter *see* EMOTION. In the performing arts, *see* THEATRE and COMEDY and articles referred to in those articles. Literary genres which lend themselves to humour in this sense include parody, burlesque and satire (*qq.v.*). A particular form of verbal humour is the pun (*q.v.*); *see* also FIGURES OF SPEECH. Verse forms that are usually funny are the limerick and the clerihew (*qq.v.*); *see* also LIGHT VERSE. Caricature is related to satire and the modern cartoon is pictorial comedy; *see* CARICATURE AND CARTOON.

HUMPERDINCK, ENGELBERT (1854–1921), German composer known for his children's opera *Hänsel und Gretel*. Born at Sieburg, Sept. 1, 1854, he studied under Ferdinand Hiller at Cologne and Franz Lachner and Joseph Rheinberger at Munich. In 1879 a Mendelssohn scholarship enabled him to go to Italy, where he met Wagner who invited him to assist in the production of *Parsifal* at Bayreuth. He taught at the Barcelona conservatory (1885–87) and at Frankfurt (1890–96) where he was also music critic of the *Frankfurter Zeitung*. Early works were the choral ballads, *Die Wallfahrt nach Kevelaar* (1878), *Das Glück von Edenhall* (1879) and the *Humoreske* (1880) for orchestra. *Hänsel und Gretel*, conducted by Richard Strauss, was produced at Weimar on Dec. 23, 1893. The libretto, by the composer's sister Adelheid Wette, was based on the folk tale made familiar by the brothers Grimm. In this work Humperdinck showed an understanding of a child's mind and a subtle sense of poetry, notably in the atmosphere of the woodland scene at twilight and in the realistic effects in the episode of the broken milk jug. The Wagnerian harmonies, often of simple tunes, and the resourceful orchestration maintain the musical interest on a high level.

Between 1895 and 1919 Humperdinck produced six further operas, including *Dornröschen* (Frankfurt, 1902) and *Königskinder* (New York, 1910) but none of them, nor the pantomime *The Miracle* (London, 1911), achieved much success. He also wrote incidental music for plays by Aristophanes, Shakespeare and Maeterlinck, a *Moorish Rhapsody* for orchestra (1898), a string quartet, piano works and songs. He died at Neustrelitz, Sept. 27, 1921.

HUMPHREY, DORIS (1895–1958), U.S. dancer and choreographer, a significant figure in the development of the American modern dance, was born in Oak Park, Ill., on Oct. 17, 1895. She studied dancing in Chicago before entering the Denishawn school in Los Angeles in 1917. A year later she joined the Denishawn company. As one of its leading dancers she toured the United States, visited London in 1922 and studied oriental dancing under native teachers during a tour of the east in 1925–26. Her first group choreography was *Sonata Trágica*, created in 1925.

Leaving Denishawn in 1928, she evolved her own philosophy of the dance and developed the independent technique, based upon principles of fall and recovery, balance and unbalance, on which her later work was based. With Charles Weidman she formed the Humphrey-Weidman school and company, which was active until 1944. In such works as *Water Study*, *Life of the Bee* and *The Shakers*, she tested her theories of movement and soon won recognition as the foremost modern dance choreographer of the time. Further works included *New Dance*, *Song of the West* and *Inquest*, in which she made her final appearance on the stage (1944).

From 1946 until her death in New York city on Dec. 29, 1958, she was artistic director and principal choreographer of the José Limón company. For Limón, who had been one of her pupils, she created such works as *Day on Earth*, *Lament for Ignacio Sánchez Mejías* and *Ruins and Visions*.

See Walter Terry, "Doris Humphrey," ch. ix, *The Dance in America* (1956). (Ln. Me.)

HUMPHREY, HUBERT HORATIO (1911–), U.S. vice-president who, while assistant senate majority leader in 1964, led the Democratic administration's forces in a successful fight to pass the most sweeping civil rights law since the Reconstruction period. Born in Wallace, S.D., on May 27, 1911, Humphrey attended the Denver (Colo.) College of Pharmacy (1932–33) and, after working as a pharmacist, studied at the universities of Minnesota (B.A., 1939) and Louisiana (M.A., 1940). From then until he became mayor of Minneapolis, Minn., in 1945, he taught political science, served in several federal administrative posts, became an instructor with the army air forces, worked as a radio news commentator and was Minnesota campaign manager for Pres. Franklin D. Roosevelt in 1944. During this period he also was instrumental in merging the Democratic and Farmer-Labor parties in Minnesota. He was elected to the U.S. senate in 1948 and twice re-elected, becoming assistant majority leader in 1961 after an unsuccessful bid for the 1960 Democratic presidential nomination. An outspoken liberal, though perhaps more moderate than when he began his senate career, Humphrey was chosen to steer the 1964 civil rights bill through the senate. With strong bipartisan support, he was able to marshal enough votes to end a three-month filibuster by opponents of the bill and to ensure its passage. At the 1964 Democratic national convention Humphrey was nominated for vice-president. In the November elections the ticket, headed by Pres. Lyndon B. Johnson, was elected.

HUMPHREY, LAURENCE (*c.* 1527–1590), Puritan reformer famous for his part in the vestiarian controversy, writer, president of Magdalen college, Oxford, and dean successively of Gloucester and Winchester, was born at Newport Pagnell, Buckinghamshire. Elected a fellow of Magdalen college in 1548, he was a pupil of the reformer Peter Martyr. On Mary's accession he obtained leave of absence from his college to study abroad. He lived at Zürich, Basel and for a short time Geneva, making the acquaintance of the leading Swiss reformers, whose theological views he adopted. He returned to England at the accession of Elizabeth I, was appointed regius professor of divinity at Oxford in 1560, and recommended for election as president of Magdalen. The fellows declined to elect so pronounced a reformer, but they yielded in 1561, and Humphrey gradually converted the college into a Puritan stronghold. In 1564 he and his friend Thomas Sampson, dean of Christ Church, were summoned before Archbishop Matthew Parker for refusing to wear the prescribed ecclesiastical vestments; a prolonged controversy broke out, involving Heinrich Bullinger and other continental theologians, as well as many of the leading English clergy. In spite of Bullinger's advice, Humphrey refused to conform and Parker wished to deprive him. He escaped by going into temporary retirement. In 1566 he preached at Paul's Cross without the vestments. In that year, when Elizabeth visited Oxford, he wore only his doctor's gown and habit, and was jokingly complimented by the queen. Gradually his attitude moderated. By 1571, when he became dean of Gloucester and vice-chancellor of Oxford, Humphrey had ceased to play any part in the vestiarian controversy, and some years later he actually served on a commission to enforce Parker's "Advertisements" of 1566, a pronouncement on ritual matters that, among other things, commanded the use of the surplice. In 1580 he was appointed dean of Winchester. He died on Feb. 1, 1590. Of Humphrey's writings, the more important are *De religionis conservatione et reformatione vera* (1559), discussing the religious and political situation in England, and a *Life* of John Jewel, bishop of Salisbury, in Latin (1573).

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HUMPHRY, OZIAS (1742–1810), English miniature painter, was born at Honiton and educated at the grammar school of that town. Attracted by the gallery of casts opened by the duke of Richmond, Humphry came to London and studied at Shipley's school; and later he left for Bath, where he lodged with Thomas Linley and became a great friend of his beautiful daughter, afterward the wife of Richard Brinsley Sheridan. In 1766 he was in London warmly encouraged by Sir Joshua Reynolds, who was always interested in Devonshire painters. He was a great friend of the painter George Romney, with whom in 1773 he went to Italy, staying, on his way to Dover, at Knole, where the duke of Dorset gave him many commissions. In 1785 he went to India, visiting the native courts, painting a large number of miniatures and making many beautiful sketches. His sight failed him in 1797, and he died in Hampstead in 1810. (G. C. W.)

HUMUS is organic matter that has undergone partial decomposition. It is brown to black in colour and imparts these colours to peat bogs and to many surface soils. Complex chemically, its compounds are known only in part. In addition to the nonliving organic material, to which the term "humus" is usually applied, soils contain great numbers of bacteria and other microorganisms that form humus from added organic materials and that serve to gradually decompose humus itself. Humus contains some of the phosphorus and sulfur and almost all the nitrogen of soils. It is important principally because during decomposition the nitrogen is gradually changed to simple forms that can be used by plants. Humus is valuable also because it increases the water absorption and improves the workability of soils. *See* Soil: *Component Parts of Soils;* Geochemistry: *Bioliths.*

See C. A. Black, *Soil-Plant Relationships* (1957). (C. A. Bk.)

HUNALD (8th century A.D.), duke of Aquitaine from 735 to 745, was the son and successor of Eudes (*q.v.*), whose struggle against the Carolingian mayors of the palace of Austrasia he resumed. Charles Martel had to lead an expedition into Aquitaine in 736 to obtain his oath of fidelity, and this did not deter Hunald from further intrigues and efforts to maintain his country's autonomy. After Charles Martel's death (741) the brothers Pepin the Short and Carloman launched a campaign against Hunald as early as 742. But they soon had to turn their attention to the eastern frontier, whereupon Hunald seized the opportunity to send raids northward over the Loire river (742–744). At last, however, in 745, the Carolingians made him abdicate in favour of Waifer (his brother or his son?). Hunald then withdrew to a monastery on the Île de Ré, but probably took service later with the Lombards and may have been killed during their attack on Rome in 756. In that case, the Hunald who seized power in Aquitaine *c.* 768 but was driven to take refuge in Gascony by Charlemagne's campaign of 769 and was handed over to the Franks by the Gascon duke Lupus must have been a different person (perhaps a son of Waifer?), though some historians identify him with the earlier duke.

Bibliography.—Continuators of Fredegarius in the *Monumenta Germaniae historica*, series *Scriptores rerum merovingicarum*, vol. ii (1883); F. Bladé, "La Fin du premier duché d'Aquitaine," *Annales de la Faculté*

des Lettres de Bordeaux (1892); L. Halphen, *Charlemagne et l'empire carolingien* (1947). (J. De.)

HUNAN (Hu-nan Sheng), an important rice-producing province of China south of the central part of the Yangtze river (*q.v.*), bounded in the south by the Nan Ling mountains. Area 81,274 sq.mi., pop. (1957 est.) 36,220,000. The province mostly comprises the drainage area of Tungting lake (Tung-t'ing Hu). Except for the plain around the lake in the northeast and strips of river alluviums which narrow as the land rises in the south and west, much of the province consists of rough uplands of sandstone, limestone and granite. The largest river is the Hsiang Chiang (Siang Kiang) whose course is followed by the railroad from Hankow to Canton. At Heng-yang (*q.v.*) this railroad continues alongside a tributary stream almost due south, while a branch rail line runs over the Nan Ling mountains to Kuei-lin in Kwangsi province. River steamboats up to 500 tons can reach Ch'ang-sha (*q.v.*) on the Hsiang Chiang and during flood periods may reach Heng-yang. Rainfall ranges from 50 in. in the north to 58 in. in the south.

Rice is the leading field crop and, in the south, a growing season of up to 330 days permits two plantings on the same field each year. In the Tung-t'ing basin to the north the growing season is limited to about 300 days. Other field crops cultivated are rapeseed, broad beans, wheat, peas, barley and glutinous rice. Industrial crops include cotton, ramie, tung-oil nut, tea (especially the Anhwa variety grown principally on the uplands), silk and tobacco. Oranges, tangerines, grapefruit and pears are important fruits. Large quantities of sweet potatoes are grown. There is some lumber production (pine, bamboo, fir) in the uplands.

Hunan is one of the leading mineral reservoirs of China, particularly in nonferrous metals. There are widespread coal deposits but only a few are economically significant. Hunan produces about 90% of China's antimony supplies. The province also accounts for about 10% of China's tungsten, 65% of its mercury, 90% of its manganese and much of the lead, zinc, gold, silver and sulfur. Although Hunan's population is overwhelmingly rural, a large number of industries have developed, including metal refining, dyes and fertilizer, glass, electric light bulbs, paper, silk gauze, matches, soap and cigarettes. A hydroelectric plant was started on the Tzu Shui (river) in the late 1950s. Ch'ang-sha, the provincial capital (pop. [1957 est.] 703,000), is a market for rice, tea, lumber, ramie and metals as well as the major industrial centre and the site of Hunan university. Hsiang-t'an (*q.v.*) is an important industrial centre 20 mi. S.S.W. of Ch'ang-sha.

In the 1950s non-Chinese tribespeople in the western hill lands numbered about 400,000, of which about 320,000 were Miao and 51,000 were Yi (formerly Lolo); the rest comprised smaller ethnic groups. Under the Communists these tribespeoples were organized into national autonomous regions or districts.

The name Hu-nan means "south of the lake," referring to Tung-t'ing Hu. Before the Chinese migrated southward, this region was inhabited by the ancestors of the Miao and Thai (T'ai) tribes. In the time of Confucius (6th century B.C.) it was part of the Ch'u kingdom. At the beginning of the Han dynasty (206 B.C.) it was in the Ch'ang-sha kingdom. During the T'ang dynasty (618–906) it formed a division of the Chiang-nan provinces; during the Sung dynasty (960–1279) part of the Ch'ing-hu provinces. The Mongols formed part of Hu-kuang from it and this name was continued during the Ming dynasty (1368–1644). In 1665 under the Manchus, Hu-kuang was split, and one of the sections eventually became Hunan province. Strategically, the Hsiang Chiang valley has been important since the early Chinese moved south through Hunan to settle the Hsi Chiang (*q.v.*) drainage across the Nan Ling. The revolutionary Nationalist armies drove through Hunan northward from their Canton base to defeat the war lords in 1926–27. It was in this area that the Japanese were stopped in three campaigns during the Chinese-Japanese war (1894–95). In World War II the province was invaded by the Japanese who captured Ch'ang-sha in June 1944. Communist chief Mao Tse-tung started his peasants' associations in Hunan, Jan. 1927, and together with Chu Teh led various uprisings in 1928. However, the Nationalist forces drove Mao and his supporters into the Nan Ling hills from which they made their Long March to the west and north, finally ending at Yenan (Fu-shih) in Shensi province, not to return until 1949. (H. J. Ws.)

HUNDRED, a unit in English local government intermediate between the village and the shire, which survived into the 19th century. In Yorkshire, Lincolnshire, Nottinghamshire, Derbyshire, Rutland and Leicestershire, however, these units were usually called wapentakes (*q.v.*) and in the four northern counties of Northumberland, Durham, Cumberland and Westmorland known as wards. The hundred first appears thus named in the laws of Edmund I (939–946). In an anonymous Ordinance of the Hundred issued earlier than 975, rules which have every appearance of antiquity show that the hundred was then a long-established institution. The long association of hundreds or groups of hundreds with individual royal manors suggests that its origin probably lies in the division of primitive tribal districts into hundreds of hides (*q.v.*) for the purpose of collecting food rents for the king's support. Occasionally a group of medieval hundreds seems to go back to one of these early divisions. The "seven hundreds of Cookham and Bray" in Berkshire may well represent the *provincia* of Sonning mentioned in the 7th century.

In the 10th century, and probably long before, the hundred had a court in which private disputes as well as criminal business were settled by customary law. The ordinance shows that in the 10th century the court of the hundred was of prime importance, particularly in relation to cattle thefts, that it met once a month, could impose and collect fines, could adjudge the triple ordeal and that an official called the hundredman was a central figure in its organization. The court still met once a month in Henry I's reign (1100–35) and, by the king's order, in the traditional meeting place unless he summoned it to sit elsewhere. An ordinance of 1234 declared that the court had met in Henry II's reign once a fortnight, but that in the future it should meet once in three weeks. Henry II, by the assize of Clarendon (1166), established that a grand jury of 12 lawful men from every hundred and 4 from every village should report crimes in the shire court and before royal judges. The early records of royal courts of justice show men and women taking their wrongs in the first instance to the hundred court.

Hundred courts generally met in the open air, often in a site embanked to give some protection to the suitors sitting in a square "within the four benches" of the court. Since everyone knew when and where the court should meet there was no need of special summons. As the hundred court became less important, suit to it often became attached to the tenure of specific land and the attendance of all men dwelling within the hundred was not expected. The suitors were the judges in the ordinary sessions, but in two specially full meetings after Easter and Michaelmas, when the sheriff made his "tourn" through the hundred courts to take the view of frankpledge (*q.v.*), he was the judge. Even before the Norman conquest important landholders had begun to get control of hundred courts, and after 1066 this process was rapidly accelerated (*see* Court Leet). The hundred rolls compiled as a result of inquiries into local affairs ordered by Edward I in 1274 reveal that by the latter part of the 13th century more than half the hundreds were in private hands. But the hundred as a geographical term long preserved an artificial existence as a unit for the administration of the new statutory powers created in the 16th and 17th centuries.

After the Norman conquest the hundred was made responsible for the murdrum due for the unexplained death of a Norman (*see* English Law: *The Norman Age*). By the Statute of Winchester (1285) the hundred was made responsible for robbery if the offender were not produced and the civil liabilities of the hundred for crimes committed within its borders were thereafter constantly increased by statute. Many of these statutes were repealed in 1827, leaving to the hundred only the responsibility for damage done by rioters, which was transferred to the county or borough ratepayers by the Riot (Damages) act of 1886. The memory of the hundred faded and county atlases no longer included as a matter of course the boundaries of the old hundreds.

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(D. M. S.)

HUNDRED DAYS, the name commonly given to the period between March 20, 1815, the date on which Napoleon arrived in Paris after his return from Elba, and June 28, 1815, the date of the second restoration of Louis XVIII. The phrase *Cent Jours* was first used by the prefect of the Seine, the comte Gilbert de Chabrol-Volvic, in his speech welcoming the king. *See* FRANCE: *History;* NAPOLEON I; WATERLOO CAMPAIGN, *1815.*

HUNDRED YEARS' WAR, the name usually given by historians, not quite accurately, to the long struggle between France and England which, interrupted by two treaties and by numerous truces, continued intermittently from 1337 to 1453. The confiscation (May 24, 1337) of the English-held duchy of Guienne by the French king Philip VI is generally accepted as marking its outbreak. This confiscation, however, had been preceded by others and was but one episode in a series of disputes which had long exacerbated relations between the two countries.

In the first half of the 14th century France was without doubt the richest, largest and most populous kingdom of western Christendom; it had, moreover, derived immense prestige from the fame and exploits of its monarchs, especially of Louis IX (Saint Louis), and it had grown powerful through the loyal service given by its administrators and officials. But England was the best organized and most closely integrated western state and the most likely to rival France, since the Holy Roman empire was paralyzed by deep divisions. In these circumstances serious conflict between the two countries was perhaps inevitable, but its extreme bitterness and long duration are more surprising. The length of the conflict can be explained, however, by the fact that a basic struggle for supremacy was exacerbated by complicated problems such as that of the English territorial possessions in France and the disputed succession to the French throne; it was also prolonged by bitter litigation, commercial rivalry and greed for plunder.

REMOTE AND PROXIMATE CAUSES

Problem of the English Lands in France.—The complicated political relationship existing between France and England in the first half of the 14th century derived ultimately from the position of William the Conqueror (d. 1087), the first sovereign ruler of England who also held fiefs on the continent of Europe as a vassal of the French king. The natural alarm caused to the Capetian kings by their overmighty vassals the dukes of Normandy who were also kings of England was greatly increased when Henry Plantagenet, already duke of Normandy (1150) and count of Anjou (1151), became not only duke of Aquitaine in 1152, by right of his wife Eleanor of Aquitaine, recently divorced from Louis VII of France, but also king of England, as Henry II, in 1154. A long conflict inevitably ensued, in which the French kings steadily reduced and weakened the Angevin empire. This struggle, which could well be termed the "First Hundred Years' War," was ended by the treaty of Paris between Henry III of England and Louis IX of France, which was finally ratified in Dec. 1259. By this treaty Henry III was to retain the duchy of Guienne (*q.v.*; a much-reduced vestige of Aquitaine, with Gascony), doing homage for it to the French king, but had to resign his claim to Normandy, Anjou, Poitou and most of the other lands of Henry II's original empire, which the English had in any case already lost. In return Louis pledged himself in due course to hand over to the English certain territory which protected the border of Guienne; *i.e.,* lower Saintonge, Agenais and some lands in Quercy. This treaty stood a fair chance of being respected by two rulers such as Henry and Louis, who admired each other and were closely related (they had married sisters); but it posed many problems for the future. It had been agreed, for instance, that the lands in Saintonge, Agenais and Quercy, which were held at the time of the treaty by Louis IX's brother Alphonse, count of Poitiers and Toulouse, should go to the English at his death, if he had no heir. When Alphonse died without issue in 1271, the new king of France, Philip III, tried to evade the agreement, and the question was not settled until Edward I of England received the lands in Agenais by the treaty of Amiens (1279) and those in Saintonge by the treaty of Paris (1286). Edward surrendered his treaty rights to the Quercy lands. By the treaty of Amiens, moreover, Philip acknowledged the rights of Edward's consort, Eleanor of Castile, to the countship of Ponthieu.

Meanwhile the French kings' suzerainty over Guienne gave their officials an excuse for frequent intervention in the duchy's affairs. The result was that French royal seneschals and their subordinates encouraged malcontents in the duchy to appeal against their duke to the French king and to the *parlement* of Paris. Such appeals strained relations between the French and English courts on more than one occasion; and the homage which had to be done again wherever a new ruler ascended either throne was given only grudgingly.

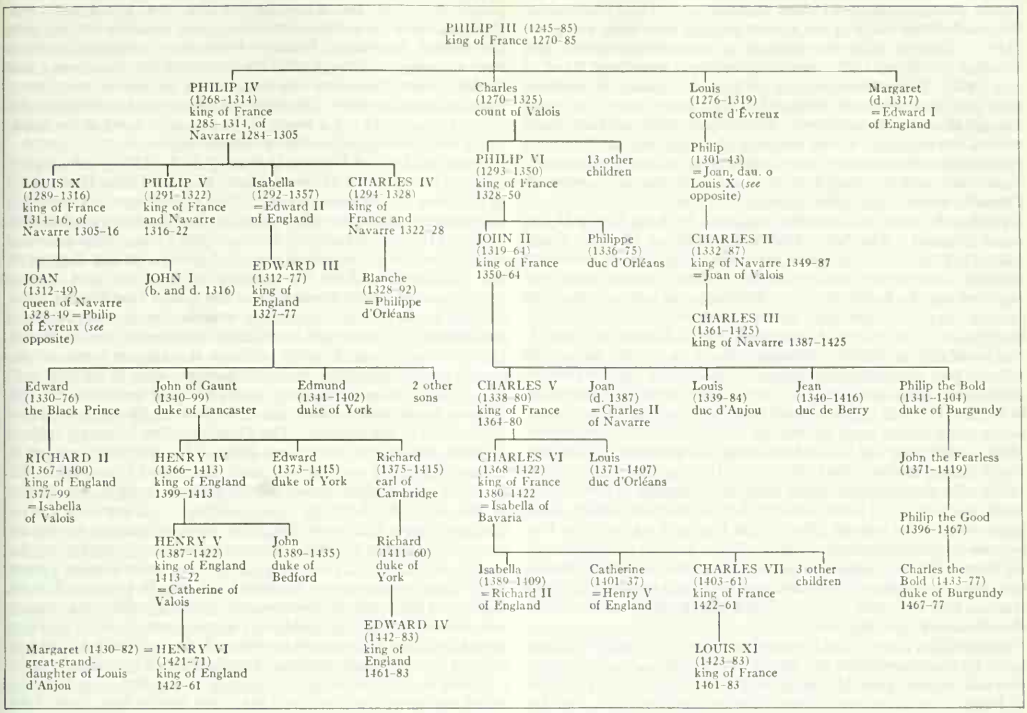
The first serious crisis after the conclusion of the treaty of Paris came in 1293 when ships from England and Bayonne were engaged in a series of skirmishes with a Norman fleet. Demanding compensation, Philip IV of France announced the confiscation of Guienne (May 19, 1294). By 1296, as a result of the successful campaigns there of his brother Charles, count of Valois, and his cousin Robert II of Artois, Philip had become the effective master of almost the whole duchy; but Edward I then allied himself in 1297 with Guy of Dampierre, count of Flanders, another rebellious vassal of France. A truce (Oct. 1297), confirmed a year later through the arbitration of Pope Boniface VIII, ended this phase of hostilities.

Shortly after his succession to the English throne Edward II did homage for his French lands to Philip IV in 1308. But Edward was reluctant to repeat the ceremony on the accessions of Philip's three sons Louis X (1314), Philip V (1316) and Charles IV (1322). Louis X died before Edward profferred homage; Philip V did not receive it until 1320; and Edward's delay in paying homage to Charles IV, combined with the destruction (Nov. 1323) by the Gascons of the newly built French fortress at Saint Sardos in Agenais, led the French king to declare Guienne forfeit (July 1324). The duchy was overrun again (1324–25) by the forces of Charles of Valois. Even so, both sides had intermittently been seeking a solution to this troublesome problem. Edward II and Philip V had tried to solve it by the nomination of seneschals or governors for Guienne who were acceptable to them both, and the appointment of the Genoese Antonio Pessagno and later of Amaury de Craon to this post had proved successful for a time. A similar expedient was adopted by the appointment (1325) of Henri de Sully, who held the office of butler in the French royal household and was a friend of Edward II. In the same year Edward renounced the duchy in favour of his son, the future Edward III. But this solution, which avoided the awkwardness of requiring one king to do homage to another, proved unfortunately of short duration, since the new duke of Guienne returned almost immediately to England (Sept. 1326) to dethrone his father (1327).

Problem of the French Succession.—A fresh complication was introduced when Charles IV died on Feb. 1, 1328, leaving no male heir. Since there existed at that time no definite rule about the succession to the French crown in such circumstances, it was left to an assembly of magnates to decide who ought to be the new king. The two principal claimants were Edward III of England, who derived his claim through his mother, Isabella, sister of Charles IV, and Philip, count of Valois, son of Philip IV's brother Charles (*see* table).

The assembly decided in favour of the count of Valois, who became king as Philip VI. Edward III protested vigorously, threatening to defend his rights by every possible means; but after his rival had defeated some Flemish rebels at the battle of Cassel (Aug. 1328) he withdrew his claim and did simple homage for Guienne at Amiens in June 1329. But Philip required liege homage and was, moreover, determined not to restore certain lands for which Edward asked; war nearly broke out and Edward was ultimately obliged to renew his homage, in private, on the French king's terms (March–April 1331). Anglo-French relations remained cordial for more than two years, but from 1334 onward, encouraged by Robert III of Artois (grandson of Philip IV's cousin), who quarreled with Philip and took refuge in England, Edward seems to

The Capetian Succession in the Hundred Years' War



have regretted his weakness, seeking to recover the Gascon lands lost to Charles IV and demanding an end of the alliance between France and Scotland. He intrigued against Philip in the Low Countries and in Germany, while Philip, for his part, organized a small expedition to help the Scots (1336) and formed an alliance with Castile (Dec. 1336). Both parties were preparing for war; Philip declared Guienne confiscate on May 24, 1337, and in October, Edward began to declare that the kingdom of France was rightfully his and sent a formal challenge to his opponent.

FROM THE OUTBREAK OF WAR TO THE PEACE OF BRÉTIGNY, 1337–60

Hostilities in the Hundred Years' War began at sea, with battles between privateers. Edward III did not disembark on the continent until 1338. He settled at Antwerp and made an alliance (1340) with Jacob van Artevelde (*q.v.*), a citizen of Ghent who had become the leader of the Flemish towns; these, in their anxiety to ensure the continued supply of English wool for their textile industries, had rebelled against the count, Louis of Nevers, who supported Philip (*see* FLANDERS, COUNTY OF). Edward also won the support of several rulers in the Low Countries, such as his brother-in-law William II, count of Hainaut, and John III, duke of Brabant. He also made an alliance (1338) with the emperor Louis IV the Bavarian. He besieged Cambrai in 1339; and, on Oct. 22 of that year, a French and an English army came within a few miles of each other at Buironfosse, without however daring to join battle. A similar encounter occurred near Bouvines in 1340, after an English army supported by Flemish militia had failed to take Tournai. Meanwhile at sea Edward's ships defeated the French fleet, supported by Castilian and Genoese squadrons, in the battle of Sluys (*q.v.*) on June 24, 1340, thus making it possible for him to move troops and provisions to the continent. After this victory the truce of Esplechin (Sept. 25, 1340), brought about by the mediation of Philip VI's sister, Margaret countess of Hainaut, and of Pope Benedict XII, temporarily suspended hostilities.

The scene of operations shifted in 1341 to Brittany, where, after the death of Duke John III in April, the help of the French and English kings was invoked respectively by Charles of Blois and by John of Montfort (d. 1345), rival claimants for the succession. The troops of both kings invaded the duchy and their armies were confronting each other near Vannes by Dec. 1342 when the legates of the new pope, Clement VI, intervened and managed to negotiate the truce of Malestroit (Jan. 19, 1343).

At this stage neither king was anxious to press the conflict to the issue of a decisive battle; each hoped to achieve his purpose by other means. They embarked on an intensive war of propaganda, Edward trying to enlist French support for his claims by means of proclamations nailed on church doors, and Philip cleverly exploiting to his own advantage all the traditions of the French kingship and losing no opportunity of stressing his claim to be the lawful successor of his Capetian ancestors. Edward's propaganda and promises were partly successful in fomenting rebellions in the west of France (1343 and 1344); these, however, Philip crushed with severity. Edward resumed the offensive in 1345, this time in Guienne, since the murder of Jacob van Artevelde (July 1345) made it no longer easy for the English to use Flanders as a base for operations. Henry of Grosmont, earl of Derby (d. 1361), defeated the French under Bertrand de l'Isle-Jourdain at Auberoche (Oct. 1345) and took La Réole; in 1346 he repelled at Aiguillon an army led by John duke of Normandy, Philip's eldest son.

Crécy Campaign and Its Aftermath (1346–54).—Meanwhile Edward III himself landed in the Cotentin (July 1346), penetrated into Normandy, took Caen and marched on Paris. Without attempting to take the capital he crossed the Seine river by the bridge at Poissy and set out toward Picardy and his fief of Ponthieu.

Philip pursued him, catching up near Crécy in Ponthieu and immediately giving battle (*see* CRÉCY, BATTLE OF). The French army was crushed and many of the highest nobility were slain (Aug. 26, 1346). Edward made no attempt to exploit his victory and marched straight to Calais, which he besieged from Sept. 1346 to Aug. 1347. Under the leadership of Jean de Vienne, the garrison there put up a stubborn defense but was finally forced to yield through shortage of provisions. Then followed the celebrated episode of the surrender of the burghers of Calais who, at Edward's order, gave themselves up, wearing only their shirts and with ropes round their necks. Their lives were saved by the intercession of Edward's queen, Philippa of Hainaut.

During the siege of Calais the Scots, led by King David II, invaded England. They were beaten, however, at Neville's Cross (Oct. 17, 1346) and David was captured. The English were also fortunate in Brittany, where Charles of Blois was defeated and captured near La Roche-Derrien. In France the political situation became very confused after Crécy; there were changes in the king's council, and John of Normandy lost influence for a while. The possibility of Philip's adopting Edward as his heir instead of John, as part of a peace plan devised by the papacy and St. Bridget of Sweden, came to nothing. During these years the incidence of the Black Death (*q.v.*) and the financial straits of both governments combined to bring the war to a standstill; the truce signed (Sept. 1347) after the fall of Calais was twice renewed (1348 and 1349) during the last years of Philip VI's reign and again (Sept. 1351) after the accession of the duke of Normandy to the French crown as John II. John considered it his duty to bring about peace even at the cost of allowing the English king to enjoy free possession of his continental fiefs without having to do homage for them. But this suggestion so outraged public opinion in France that John was unable to conclude peace on such terms at the conferences held at Guines (July 1353 and March 1354). Edward III then refused to prolong the truce.

The political situation in France at this time was further complicated by the intervention of Charles II the Bad, king of Navarre, who had married John II's daughter Joan in 1352. As a grandson of Louis X on his mother's side, Charles could maintain that his claim to the Capetian inheritance was better than Edward III's and that he was accordingly entitled to profit from any concessions that John II might be willing to make. After a first dispute with his father-in-law had apparently been settled by the treaties of Mantes (1354) and Valognes (1355), Charles quarreled with him again, in collusion with the English. John II had him arrested (April 1356), but Charles II's brother Philip then assumed leadership of the Navarrese faction and managed to retain possession of the extensive lands in Normandy, which John had ceded to Charles.

Poitiers Campaign (1356).—Hostilities between French and English broke out again in 1355. Edward the Black Prince, eldest son of Edward III, landed at Bordeaux in September and ravaged Languedoc as far as Narbonne; in October another English army marched into Artois and confronted John's army at Amiens. No engagement took place, however. The Black Prince left Bordeaux again in July 1356, marching north as far as the Loire river. To meet this threat John left Normandy, where he had been engaged in reducing Navarrese strongholds. Having crossed the Loire, he met the Anglo-Gascon army at Maupertuis near Poitiers (*q.v.*), attacked its strongly entrenched position, suffered an overwhelming defeat and was taken prisoner (Sept. 19, 1356). He was conveyed by slow stages to Bordeaux, where he was held until his transfer to England (April–May 1357).

Negotiations During John II's Captivity (to 1360).—While he was in Bordeaux, the French king concluded a two-year truce with his captors and began to discuss peace terms on a basis of abandoning Aquitaine in full sovereignty to Edward. Meanwhile a difficult situation had arisen in Paris, where a group of reformers, among them Jean de Craon, Robert Le Coq and Étienne Marcel (*q.v.*), the provost of the merchants, had become members of the council and were not disposed blindly to endorse the decisions of their captive ruler. The estates also seemed to prefer a continuance of war to dismemberment of the kingdom. Moreover, Charles the Bad was allowed to escape from imprisonment (Nov. 1357).

The estates hoped that Charles would quell the numerous companies of English and Navarrese soldiers who, left without employment since the truce of Bordeaux, were ravaging and pillaging the western districts of France. However, Charles preferred to treat with them. Though officially hostilities between France and England were suspended, the devastation became at this period more serious than ever. Disorder and misery were much increased by the Jacquerie (*q.v.*), a revolt of the peasants, north of the Seine, which was brutally repressed by the nobility.

After the death of Étienne Marcel (July 31, 1358), the dauphin Charles, son of John II, was able to re-enter Paris, from which he had been forced some months earlier to withdraw. King John, following up the peace talks begun at Bordeaux, concluded with Edward III the first treaty of London (Jan. 1358). This provided for the cession of the old duchy of Aquitaine to the English in full sovereignty and for the payment of 4,000,000 gold *écus* as John's ransom, while Edward in return would abandon his claim to the French crown. But delays in collecting and paying early instalments of the ransom invalidated this treaty, and in March 1359 Edward imposed on his prisoner the harsher terms of the second treaty of London, by which hostages were to be held until part of the ransom was paid, and additional territory, the old Angevin lands lying between the Loire and the Channel, were also to be ceded to the English. The French estates, however, refused to ratify this second treaty, and Edward III landed once more at Calais (Oct. 1359) and marched across Artois and Champagne. He failed to take Reims, however, and instead ravaged the district of Beauce. At Brétigny (*see* BRÉTIGNY, TREATY OF), near Chartres, peace talks were held with the dauphin, and agreement was reached (May 8, 1360) on terms subsequently ratified by the treaties of Calais (July–October 1360). By these treaties France ceded the whole of the old Aquitaine and also, in northern France, Calais and Guines in full sovereignty to the English; the ransom was reduced to 3,000,000 gold *écus*, for payment of which hostages were taken, but John was to be released after a first instalment of 600,000 *écus* had been received; and the French king was to make a formal resignation of all sovereignty and jurisdiction over the ceded territories by Nov. 30, 1361. Set free in Oct. 1360, John went back to an exhausted and divided France, where a strenuous effort was still required against the rapacious military companies. In July 1362 Edward III transferred his principality of Aquitaine to his son Edward the Black Prince.

FROM THE PEACE OF BRÉTIGNY TO THE ACCESSION OF HENRY V, 1360–1413

Charles the Bad, who had made peace with the dauphin at Pontoise (Aug. 1359), now rebelled anew (1364). He was defeated at Cocherel, on the banks of the Eure river (May 16, 1364), by Bertrand du Guesclin (*q.v.*), a Breton captain to whom the French had entrusted the operation. By that time, however, John II, who had returned to London because one of his hostages had defaulted, was already dead (April 1364), and the dauphin had succeeded him as Charles V. The new king proceeded with the task of reducing disorder and misery in France. The defeat and death of Charles of Blois at the battle of Auray (Sept. 29, 1364) brought to an end the war in Brittany, and by the treaty of Guérande (*q.v.*), in April 1365, John of Montfort's son was recognized as Duke John IV. The cessation of hostilities with the English gave the French the opportunity temporarily to divert their resources from military activity to reconstruction.

Yet public opinion in France was unwilling to accept a permanent division of the country. The renunciation clause of the treaty of Calais had never been carried out by John II, who had not completed the transfer of the territory by Nov. 1361; thus Charles V was within his rights in accepting (June 30, 1368) an appeal against their duke from the Gascon nobles. Edward III held that this acceptance constituted a breach of the treaty and hostilities were renewed. Edward's son John of Gaunt, duke of Lancaster, disembarked at Calais (1369) and led a *chevauchée*, or cavalry raid, into French territory; Sir Robert Knollys advanced toward the Île-de-France but the new constable of France, Bertrand du Guesclin, destroyed part of his army at Pontvallain (Dec. 1370).

The Castilian navy, in alliance with the French, defeated an English fleet off La Rochelle (1372), and John of Gaunt conducted a more ambitious *chevauchée* (1373), across France from Calais to Bordeaux. In the intervals between these expeditions, the French king's younger brother, Louis I of Anjou, and Du Guesclin were carrying out, partly by warfare but mainly by diplomacy and by bribing local lords, a patient reconquest of the territories ceded in 1360.

A truce was effected at Bruges in 1375, which lasted until 1377. The Black Prince died on June 8, 1376, and when King Edward III died (June 21, 1377) his heir, the Black Prince's son Richard II, was only ten years old. The war dragged on in a desultory fashion, and Charles V found himself once again the target of the ambitious designs of Charles the Bad and of John of Montfort. Thus when Charles V and Du Guesclin died in 1380 the English had still not been completely driven out of France.

Richard II and Charles VI.—For the next few years both the English and the French thrones were occupied by children, Richard II and Charles V's son Charles VI. England was divided and weakened by the peasants' revolt of 1381 and by the political and constitutional struggles between Richard and his opponents; there was no surplus energy for active campaigning in France. In France, on the other hand, Charles VI's uncles were too busy jostling for power and dividing the spoils to complete the expulsion of the English. The most serious source of dispute between the two countries was now the problem of Flanders. Henry Despenser, bishop of Norwich, led an expedition (nominally a crusade against the Avignon papacy) to Dunkerque and Ypres (1383), but it proved a complete fiasco (*see* DESPENSER); and after the death without male heirs (Jan. 1384) of the count of Flanders, Louis of Male, Flanders came into the possession of his son-in-law Philip the Bold, duke of Burgundy, the French king's uncle. The French made considerable preparations to invade England between 1385 and 1387, but for reasons not known the project was eventually abandoned. Shortly after this the acquisition of political power by groups in both countries who favoured peace led to the inauguration of truce talks.

In France the princes had been ousted (1388) from control of the royal council in favour of the "Marmousets," who represented its traditional membership as in Charles V's time; and in England the magnate group known as the "Appellants" had achieved temporary ascendancy. Discussions began (Nov. 1388) in the small town of Leulinghen in Picardy, and a three-year truce was signed on June 18, 1389; the English were to evacuate certain places, such as Brest and Cherbourg, and agreed that Richard II should do homage for Aquitaine, thus ignoring the terms of the treaty of Calais. But the conclusion of a firm peace was prevented by disputes over the duchy's boundaries. However, at this point Richard II rid himself of the tutelage of the Appellants and entered into direct negotiation with Charles VI. As he was now a widower, he asked for the hand of Charles's daughter Isabella, and a marriage by proxy took place in Paris on March 9, 1396. At the same time the kings agreed that the truce of Leulinghen, already previously renewed, should be extended for 28 years. Subsequently the two kings met (Oct. 1396) between Calais and Ardres; this encounter was the occasion both for magnificent festivities and keen diplomatic bargaining. Though it proved impossible then to conclude a final peace treaty, the two kingdoms seemed at any rate to be developing a relationship perhaps sufficiently cordial for the remaining problems ultimately to be settled.

Henry IV, the Armagnacs and the Burgundians.—Unfortunately few of his subjects shared Richard II's desire for peace. The nobility and the knights had acquired a taste for profitable *chevauchées* through France, while the rest of the population had absorbed the war propaganda issued in Edward III's reign and regarded the French as responsible for all their ills. In any case it was not long before sharp opposition to Richard II again developed; and when John of Gaunt's heir Henry Bolingbroke, earl of Derby, returned from banishment in June 1399 to wrest his inheritance from Richard, all the discontented rallied round him. Richard was deposed and imprisoned (he died in prison in Feb. 1400) and Bolingbroke proclaimed king of England as Henry IV in his stead. Though Henry legitimately sought to discredit the claims of Edward I's descendants to the English crown, he did not scruple to adopt Edward III's claim to the French and decisively reversed the pacific policy of his predecessor.

Henry's primary task, however, was the consolidation of his power in England, and he allowed Richard's widow, Isabella, to return to France (Aug. 1400), though he kept her jewelry. Since the French king was only intermittently sane, his brother Louis, duc d'Orléans, presided over the royal council. Louis tried to make trouble for Henry of England by renewing the traditional support given by France to Scotland and by supporting the rebellion of the Welsh leader Owen Glendower; and, profiting from Henry's preoccupations, he began the reconquest of Aquitaine. In 1405 the constable of France, Charles d'Albret, took many towns in Saintonge and Périgord, while Jean II, comte d'Armagnac, threatened Bordeaux. But in 1406 the French suffered two reverses: Orléans failed to take Blaye on the Gironde river, while John the Fearless, duke of Burgundy, was repulsed before Calais.

These reverses in the French fortunes were due primarily to the rivalry which had arisen between the duc d'Orléans and John the Fearless and which was seriously dividing France. Orléans was anxious to attack the English positions with energy and dispatch; John the Fearless, on the other hand, seemed inclined to seek a settlement with Henry IV. Charles VI was not sane for sufficiently long intervals to impose his will on his quarrelsome kinsmen, so had to leave many decisions to his consort, Isabella of Bavaria. The personal rivalry of the two princes culminated in the assassination of the duc d'Orléans (Nov. 1407) at the instigation of John the Fearless, but this murder set off a bitter civil war in which France was divided between the Burgundian faction and the Armagnac, the latter taking its name from Bernard VII, comte d'Armagnac, leader of the movement to avenge the murder. Under these circumstances, both sides in the civil war in turn sounded Henry IV in an attempt to obtain his assistance. Henry gave a little help to John the Fearless in 1411, by sending through Calais a small contingent which relieved Paris from siege by other princes of the house of Valois. The Armagnacs sought Henry's help in 1412, offering him the restitution of Aquitaine; but Henry died in March 1413. In 1413 likewise the Burgundians in Paris issued the series of reforms known as the "Ordonnance Cabochienne" after Simon Caboche (*q.v.*), the Paris butcher and demagogic leader; but this was promptly annulled by their opponents.

FROM THE ACCESSION OF HENRY V TO THE SIEGE OF ORLÉANS, 1413–28

From the moment of his accession, it was clear that the new English king Henry V intended to act decisively on the continent. Conversations with the emissaries of Charles VI proved fruitless because of the intransigence of Henry's demands, and he embarked his troops on Aug. 10, 1415, landing at Le Chef-de-Caux on the estuary of the Seine. He took Harfleur (Sept. 14), moved toward Picardy and awaited the arrival of the French army at Agincourt in Artois, where, on Oct. 25, 1415, he utterly routed it (*see* AGINCOURT, BATTLE OF). But he failed to follow up his advantage, retiring thereafter to Calais, whence he took ship for England. Though in no way strategically decisive, this victory won for Henry V the alliance of the German king Sigismund, who in Aug. 1416 recognized his claim to the title and attributes of king of France. John the Fearless was equally impressed and, at an interview with Henry at Calais, offered not only alliance but homage.

Henry V did not return to France until 1417, and then it was to effect the methodical subjugation of Normandy town by town and district by district: Caen, Alençon and Evreux successively opened their gates to him. Meanwhile, Isabella of Bavaria, who had been for a while imprisoned by the Armagnacs, and John the Fearless joined forces at Troyes in Nov. 1417 and there set up a rival government to that of Isabella's own son, the dauphin Charles. After a Parisian revolt (May 1418), as a result of which the dauphin retired to Berry, John the Fearless was able to enter the capital; but he and Isabella could oppose Henry V no more effectively than could the Armagnacs, and Henry seized Rouen (Jan. 1419), the Pays de Caux and the Vexin. John the Fearless now

became so alarmed at the English progress that he made overtures of peace to the Armagnacs and the dauphin; but John himself was assassinated, on the bridge of Montereau, by the dauphin's emissary (Sept. 10, 1419). Thereupon his heir, Philip the Good, wishing to avenge him, allied himself (Dec. 1419) with Henry V against the dauphin. By the treaty of Troyes (May 21, 1420), concluded between Queen Isabella and Philip the Good, both acting for Charles VI, and King Henry, the dauphin was disinherited in favour of Henry V, who was, on June 2, 1420, to marry Catherine, one of Charles VI's daughters. This arrangement was intended to set up a dual monarchy, based on a personal union of the French and English crowns, under which, however, each of the kingdoms would retain its separate institutions and character. The dual monarchy was never achieved. In practice, France fell into three parts, controlled respectively by Henry V, by the duke of Burgundy and by the dauphin. Henry's authority was firm enough in Normandy and in Guienne and was acknowledged in Paris and in the surrounding *bailliages;* but Philip the Good retained considerable power in fact in the Paris area and was naturally supreme in Burgundy; and from his court at Bourges or at Poitiers the dauphin ruled over central France and Languedoc. The frontiers between these rival territories were never clearly delineated, being constantly altered by intermittent warfare; and allegiances did not necessarily follow the boundaries.

When the treaty of Troyes had been signed Henry V set about capturing the Armagnac fortresses which menaced his conquests. He seized Melun (1420) and his subordinates overran Maine and Perche. After a visit to England (January–July 1421), he returned to rout the army with which the dauphin was marching toward Paris. Subsequently he took Meaux and Compiègne (May and June 1422), but died on Aug. 31, 1422. Thereafter the French territories of his infant successor Henry VI were governed by Henry V's brother John, duke of Bedford. Charles VI died seven weeks after his son-in-law, on Oct. 22, 1422; his long reign, which had begun auspiciously, ended in disorder and shame.

The dauphin immediately proclaimed himself king as Charles VII. The next few years saw a series of ineffective and tortuous diplomatic negotiations, conducted severally between Bedford, Burgundy, John V of Brittany and Charles VII, whose policy was much influenced by his mother-in-law, Yolande of Aragon. An understanding which might have changed the civil war into a war against the English was nearly achieved between Burgundy and Charles at the time (March 1425) when Arthur of Richmond became constable of France, but nothing came of the *rapprochement,* and in 1427 Bedford's army invaded the Loire valley. Bedford decided in 1428 to besiege Orléans, which could provide a good base for an attack on Charles VII's stronghold south of the Loire. The siege began in Oct. 1428, all attempts to relieve the city failed, and by the beginning of 1429 its surrender seemed imminent.

EXPULSION OF THE ENGLISH, 1428–53

Joan of Arc.—The siege of Orléans proved the turning point of the war, the event which enabled Joan of Arc to fulfill her mission and save France (*see* JOAN, SAINT). A peasant girl from Domrémy in the borderland between Champagne and Lorraine, she managed to persuade Robert de Baudricourt, Charles VII's captain at Vaucouleurs, to send her to Charles's court at Chinon. She gained the confidence of the king and his advisers and went with a small force to try to relieve Orléans. A few days after their arrival the English raised the siege. The psychological effect of this was considerable. The morale of the French army soared, and in June 1429 the constable Richmond defeated the English in the battle of Patay (*q.v.*). Charles, persuaded by Joan, then went to Reims for his coronation; the city made no show of resistance and opened its gates to him. Once crowned and anointed (July 18, 1429), his position as legitimate king was unassailable and the terms of the treaty of Troyes became of no significance. Laon, Soissons and Compiègne now acknowledged his sovereignty, but his attempt on Paris (Sept. 8) was repulsed.

After several other expeditions Joan entered Compiègne (1430) in order to strengthen its defense against Philip the Good, who had just renewed (March 1430) his alliance with the duke of Bedford. During a sortie she fell into the hands of the Burgundians (May 23). She was sold to the English, imprisoned at Rouen, tried before an ecclesiastical tribunal according to the procedure of the Holy Office and adjudged a heretic. Though she signed a recantation, she quickly revoked it and was burned to death at Rouen on May 30, 1431.

Treaty of Arras (1435) and Truce of Tours (1444).—Joan's death in no way checked the French recovery which she had inaugurated. Seeing which way the wind was now blowing, Philip the Good opened negotiations (1432) with Charles VII. The treaty of Arras, which they signed on Sept. 20, 1435, terminated the civil war, and Paris submitted to Charles on April 13, 1436.

Bedford died in Sept. 1435 and was replaced as Henry VI's lieutenant general and governor of France and Normandy by Richard, duke of York (from 1436 to 1437 and from 1440 to 1447), and by Richard Beauchamp, earl of Warwick (from 1437 to 1439). Military operations continued sporadically for several years, in Bordelais and on the borders of Normandy. Charles VII was faced with the immense task of restoring order to his kingdom, and in France no less than in England royal authority was severely weakened by faction within the royal councils. General exhaustion on both sides of the Channel created an atmosphere favourable to negotiation, and after Henry VI had sent William de la Pole, earl of Suffolk, to France a first local truce was signed in April 1444. More comprehensive talks were then begun at Tours; and when it proved impossible to agree on terms for a final treaty it was decided to sign a renewable truce at Tours (May 28, 1444) and to strengthen it by the marriage (April 1445) of Henry VI with Margaret of Anjou, niece of the French king's consort Mary of Anjou. This truce legalized the status quo, the English retaining Maine, Bordelais, the Pas de Calais and most of Normandy.

Reconquest of Maine and Normandy.—The need to renew the truce and the prospect of attaining a firm peace treaty encouraged the exchange of diplomatic envoys. Jean Jouvenel, archbishop of Reims, crossed to England in July 1445 to discuss a proposed meeting between the two kings; he obtained a promise that Henry VI would give up Maine to his father-in-law, René of Anjou. But the English were slow in honouring this promise, and not until Charles VII's army had surrounded it was Le Mans surrendered (1448).

No longer respecting the truce, the French took several towns from the English. With assistance from Francis I of Brittany, they began the reconquest of Normandy, and Charles VII made a solemn entry into Rouen, the capital, on Nov. 20, 1449. The following spring a small English army landed at Cherbourg, recovered several fortresses in the Cotentin, but was then defeated in the battle of Formigny (*q.v.*) on April 15, 1450. The French subsequently took Caen and brought the whole of Normandy under their control. The English reverses had considerable domestic repercussions; they were partly the cause of Suffolk's fall from power (1450) and led to the revolt of Jack Cade (*q.v.*) and to the increase of Yorkist influence in opposition to the Lancastrian dynasty.

Conquest of Guienne (1453) and Treaty of Picquigny (1475).—Charles VII and his advisers took advantage of the confused political situation in England to attack what remained of English-held Guienne. There, however, they encountered a population which, unlike that of Normandy, had a long tradition of loyalty to the English crown. The campaign, begun in 1449, continued into 1450 with the capture of Bergerac (Oct. 1450) and of Bazas. Jean, comte de Dunois, began to encircle Bordeaux (1451), taking most of the towns on which its strategic defense depended. Bordeaux capitulated in June and Bayonne in Aug. 1451. But the people of Bordelais were in no way resigned to the ending of English rule; when the veteran general John Talbot, earl of Shrewsbury, landed an army on the Gironde estuary (Oct. 1452), they rose against the French and Shrewsbury was able to make a triumphant entry into Bordeaux. Charles VII waited long enough to raise a considerable army, which then marched into Guienne in the early months of 1453. The English suffered a severe defeat in the battle of Castillon (*q.v.*), near Libourne, on July 17; and Bordeaux, once more besieged, finally capitulated on Oct. 19, 1453. This time

English rule in Aquitaine was really at an end.

Peace, however, seemed no nearer, for even if the English had lost all their continental possessions except Calais and the countship of Guines, they would in no way admit defeat, mainly because neither of the contending Yorkist and Beaufort factions dared incur the odium of treating with the French. On the other hand, Charles VII was prevented from attacking Calais or the English coast by the uncertain attitude of Philip of Burgundy. After Charles VII's death (1461), his son and successor Louis XI managed to make the truce of St. Omer (1463) with the Yorkist king of England Edward IV; it was renewed, after some difficulties, in 1466 and again in 1471. But after 1474 Edward IV allied with his brother-in-law Charles the Bold, duke of Burgundy, and prepared for a fresh invasion of France. In 1475 a powerful English army landed at Calais; French and English forces faced each other across the Somme river, but neither side dared to cross and join battle. Edward IV and Louis XI then met at Picquigny (Aug. 29, 1475) and decided upon a seven years' truce, agreeing in future to settle their differences by negotiation rather than by force of arms. Edward was to withdraw from France, receiving in compensation a payment of 75,000 gold *écus* and an annual payment of 50,000 while both kings lived. This truce, seemingly fragile, survived various stresses and can be held to mark the end of the Hundred Years' War. No peace treaty was ever signed, Calais was retained by the English until 1553 and English kings continued to bear the title king of France until 1801.

SIGNIFICANCE OF THE WAR

The Hundred Years' War, begun on the pretext of an English claim to the French throne, was later renewed and perpetuated in an attempt to establish in reality Henry V's grandiose conception of a dual monarchy by which the English king should rule two kingdoms on either side of the Channel. It demonstrated, however, that English authority could not become effective in a hostile France; nor, on the other hand, were the French strong enough to make the English kings recognize the utter folly and impracticability of their pretensions. In fact, during the 14th and 15th centuries, behind the façade of claims and counterclaims, behind the battles and political maneuvers, two nations were being forged whose natural development and juxtaposition were bound to lead to warfare.

The initial claim to the French throne can be explained only by Edward III's strong ties with France and by a feeling for his Capetian ancestry as strong as his manifest pride in his English kingdom. By the 15th century, however, this feeling was virtually dead in the Lancastrian and Yorkist kings who challenged Charles VII and Louis XI. But during the previous three or four generations the English had acquired a taste for profitable expeditions to the continent, from which they always hoped to return laden with spoil and with prisoners for ransom, so that France was ravaged and wasted as it had been when the Vikings and Northmen raided the Carolingian empire. Apparently unable to remedy this state of affairs, the French sought instead to alleviate their sufferings by reforming the monarchy—a reform which took effect, after the Paris revolution of 1356–58, in the reigns of John II and of Charles V. But the weakening of the monarchy by the minority and the insanity of Charles VI left the greed of the princes and of favourite ministers unbridled and the country a prey to extortion. Public disgust at these abuses was expressed more and more frequently, with ever-increasing violence but with less and less effect.

Ultimately the fact that the malcontents compromised themselves by adhering to the English and to the Burgundians gave the French monarchy the chance of asserting itself, and the royal power that emerged was not only freed from former constitutional restraints but also capable of settling definitively, to its own advantage, the perennial problem of the English continental fiefs.

The 14th and 15th centuries marked, both in France and in England, a prolonged struggle for power between the crown, the nobility and various reforming elements. Similarities in political and constitutional development and the common experience of social upheaval might well have resulted in alliances between parallel parties on either side of the Channel. But, as it happened, when one group was in the ascendant in France, the other was frequently ruling in England, so that, far from bringing the two countries closer together, their similar experiences divided them more bitterly. National consciousness, born and nurtured in the long struggle, grew in the end so strong that any project of union—even a merely personal union of the crowns as envisaged by Henry V—was doomed to failure. The most obvious result of the Hundred Years' War was to make both France and England determined to avoid the revival of such a struggle, in which both sides had squandered their manpower and resources, utterly without profit. In both countries rulers and populace alike avidly turned their energies to other projects.

See ENGLISH HISTORY; FRANCE: *History; see* also references under "Hundred Years' War" in the Index volume.

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(R. Cs.)

HUNEDOARA, a town in Rumania and the administrative centre of Hunedoara *regiunea* (administrative and economic region), is situated east of the Poiana Ruscă mountains. Pop. (1956) 37,370. The citadel, west of the town, was completed in 1452. Hunedoara is a major iron and steel centre. First established in 1884, it processed iron ore from the Ghelar mines. Modernized and expanded after World War II, the plants include blast furnaces, steel foundries, rolling mills, a coke and chemical works, an iron ore sintering plant and an oxygen and talc factory; they yield 70% of Rumania's pig iron output. The Victoria Calan works east of Hunedoara also processes pig iron, and a new town has been built for the workers.

HUNEDOARA REGIUNEA lies southeast of Transylvania on the Mures river. Area, 4,247 sq.mi. Pop. (1956) 576,339. It has six districts and the main towns are: Deva (16,897), the administrative centre; Hunedoara; Alba Iulia (14,543) a cultural centre; Lupeni (21,279); and Petrila (20,191), Petroşeni (23,144) and Vulcan (14,869), mining centres. Besides coal there are silver and gold ores, copper-bearing pyrites and mercury. There is mechanical engineering, paper and pulp manufacture, and leatherwork, footwear, textile, timber and food processing industries. Petroşeni has a mining institute. Agriculture occupies nearly one-half of the total area; wheat, maize (corn), rye, vegetables and vines are grown and cattle are raised.

HUNEKER, JAMES GIBBONS (1860–1921), U.S. critic, whose perceptive comments and brilliant style won him a wide audience in both Europe and the United States, was born in Philadelphia, Jan. 31, 1860, and studied the piano in Philadelphia, Paris and New York. He taught piano at the National Conservatory of Music, New York city, 1886–98, and was musical and dramatic critic for the *New York Recorder* and *Morning Advertiser*.

He joined the *New York Sun* in 1900, the *Times* in 1918 and the *World* in 1919. A man of great versatility, he frequently wrote on art and literature as well as music and drama. His published works include: *Chopin: the Man and His Music* (1900); *Overtones: a Book of Temperaments* (1904); *Iconoclasts: a Book of Dramatists* (1905); *Franz Liszt: a Study* (1911); *Egoists: a Book of Supermen* (1909); and *Ivory Apes and Peacocks* (1915). He died in Brooklyn, N.Y., Feb. 9, 1921.

BIBLIOGRAPHY.—Autobiographical material may be found in *Old Fogy* (1913) and *Steeplejack* (1920). *See* also the two collections, *Letters* (1922) and *Intimate Letters* (1924), ed. by Josephine Huneker; Benjamin de Casseres, *James Gibbons Huneker* (1925).

HUNGARIAN LANGUAGE. Hungarian (self-designation MAGYAR) is spoken by about 12,000,000 persons, mainly in the central Danube valley, in Hungary, in Czechoslovakia, in Rumania and in Yugoslavia, and by scattered groups elsewhere (close to 500,000 in the United States).

History.—Hungarian belongs to the Uralic language family which includes the Finno-Ugrian and the Samoyed branches. (*See* FINNO-UGRIC LANGUAGES.) Closest kin to Hungarian are the two other Ugric languages, Vogul and Ostyak, now spoken in western Siberia. From Uralic, Hungarian inherited about 250 basic words, and the Uralic portion still makes up more than three-fourths of the morphemes in a running text. Up to the conquest of present-day Hungary at the end of the 9th century A.D., the vocabulary of Hungarian was greatly affected by old Iranian (metallurgical expressions), by Turkic (cattle breeding and agriculture) and to a minor extent by Ossetian and Caucasian. After the conquest the major influences came from Slavonic, Latin and German. The earliest occurrence of Hungarian words is in Arabic (8th-century), Greek (10th-century) and Latin (10th-century) texts; the first connected text, a funeral sermon, dates from the end of the 12th century. A major development of Hungarian took place around the turn of the 18th and 19th centuries, when in a quarter of a century 10,000 new words were introduced through neologistic formations, all in accordance with existing patterns which left the structure of the language unchanged. Dialectal differentiation is not very great.

Script.—During the 1st millennium after Christ, while they inhabited the steppes, the Hungarians acquired a script, related to the Old Turkic runes which, though not extensively used, survived until after the middle ages. The current Hungarian script was introduced in the 11th century by western Christianity and its orthography stabilized by the 16th century with the introduction of printing. The alphabet includes single letters and digraphs. The spelling is consistently phonetic, except that minor variations at morphological boundaries are not indicated and that remnants of historical spelling occur in family names. Of the vowels, the accentuated letters are pronounced long, the others short; thus *e* as in "bed," *á* as in "father." Of the consonants, *p*, *t* and *k* are unaspirated, *b*, *d* and *g* voiced; *y* (except at the end of family names where it stands for *i*) indicates palatal articulation, *ny* as in French *champagne*; *s* is pronounced as in "she," *sz* as in "six," *z* as in "zero," *zs* as in "rouge," *cs* as in "arch," *c* as in German *zehn*. Long consonants are written double (the first component only in case of the digraphs, in hyphenation both components: *össze* ["together"] but *ösz-sze*).

Phonology.—The vowels include back vowels: *a á o ó u ú*, front rounded vowels: *ö ő ü ű*, and front unrounded vowels: *e é i í* (with many speakers differentiating two *e* phonemes). The consonants comprehend: stops; nasals; fricatives; affricates; and liquids; *l* (clear) and *r* (trilled). The occurrence of vowels in words is governed by vowel harmony: back vowels do not occur together with front rounded vowels. Consonant clusters are simple; initially in general no clusters occur. Stress is always on the first vowel of the word.

There is a distinction between falling intonation indicating assertion, and interrogative intonation which is rising if the utterance is not longer than two syllables and rising to the prefinal syllable and then falling if the utterance is longer.

Grammar.—The grammatical structure is transparent, and the categories clearly marked. The main morphological process is suffixation, by which words of considerable length can be produced; *e.g.*, *verethetnélek* "I might cause thee to be beaten" (*ver* "beat," *-et* "cause," *-het* "may," *-né* [conditional], *-lek* "I thee"); *tanítványaimtól* "from my pupils" (*tanít* "teach," *-vány* [nominal derivative], *-ai* [plural], *-m* "my," *-tól* "from"). Prefixes are rare, *legszebb* "most beautiful" from *szebb* "more beautiful." Suffixes often have two alternants, one with a front and one with a back vowel, which are added to stems with corresponding vowels (*cf.* vowel harmony), *Berlinben* "in Berlin," *Stockholmban* "in Stockholm." (This difference is sometimes employed for lexical purposes, *kever* "stir lightly," *kawar* "stir heavily," or in demonstratives, *ez* "this," *az* "that," *ide* "hither," *oda* "thither.")

Noun inflection indicates number, possessivity (reference to person and number, *emberem* "my man"), and case (there are about 25 cases, most of them indicating locality and direction, such as inessive "within"; other nonspatial relations, such as causal "for the sake of"). The cases are supplemented by postpositional constructions which do not show accommodation to the vowels of the head word, *emberben* "in man," *házban* "in the house," but *ember mellett* "besides the man," *ház mellett* "besides the house." Adjectives have three degrees: *nagy* "big," *nagyobb* "bigger," *legnagyobb* "biggest"; there is also a degree expressing exaggeration, *legeslegnagyobb* "the very biggest." Personal pronouns have only two cases, nominative and accusative, the rest of the paradigm is supplemented by suffixed forms; *e.g.*, *én* "I," *engem* "me," but *bennem* "in me," *mellettem* "next to me."

There are two slightly different conjugational types: the so-called *-ik* verbs having the suffix *-ik*, and non-*ik*; *e.g.*, *es-ik* "he, she, it falls," *üt* "he, she, it beats." The categories are: mood (indicative; conjunctive, indicating condition or wish; and imperative); tense (present and perfect); number and person; and definiteness: there is a reference in each verbal form to the definiteness of a third person object, or the lack of it, *lát* "he, she, it sees" (in general, something indefinite or unknown), but *látja* "he, she, it sees" (something definite, like the house, my house, a known person, etc.); in the first person singular there is also an inclusive form indicating an object in the second person, *látlak* "I see thee or you."

Both nominal and verbal derivation plays a great role, as a device partly for augmenting the vocabulary, as in *köt* "bind," *kötél* "rope," *kötelez* "oblige," *kötelezvény* "I.O.U.," and partly for expressing nuances of reference, *csepeg* "drop," *csepereg* "drizzle," *cseppen* "drop (once)" from *csepp* "drop."

Syntax.—In attributive phrases adjectives are uninflected, *nagy ház* "big house," *nagy házakban* "in big houses." The article is the first element in phrases, *a* (preconsonantal) *nagy ház* "the big house," *az* (prevocalic) *ember* "the man." After numerals the "singular" form stands, *ezer ember* "a thousand men." Predicates are either verbal or nominal, and agree in number with the subject, *az ember lát* "the man sees," *az emberek látnak* "the men see," *az ember jó* "the man is good," *az emberek jók* "the men are good." The order of phrases in a sentence is relatively free, but the stressed element which includes contrastive stress, question and negation must stand immediately before the predicate, *ő otthon van* "he, she is at home," *ki van otthon* "who is at home?"

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HUNGARIAN LITERATURE. Nothing remains of the earliest Hungarian literature. Its existence can, however, be established with certainty. Through Hungarian folk tales and songs, elements have survived that can be traced back to pagan times. We also possess, unfortunately only in Latin and dating from between the 11th and 14th centuries, shortened versions of some Hungarian legends relating the origins of the Hungarian people; and episodes from the conquest of Hungary and from the Hungarian campaigns of the 10th century.

Earliest Works in Latin.—The establishment in 1001 of a Christian kingdom created the conditions for a new type of literature, Christian in content and Latin in language, which gradually ousted the older, unwritten, traditional preliterature, national in content and Hungarian in language. Up to the 13th century to write meant to write in Latin.

The first Hungarian writers in Latin appeared toward the middle of the 11th century. They were the bishops Maur (Mór) and Nicholas (Miklós), the first the author of the first Hungarian saint's life, the second probably the author of the first Hungarian chronicle. This kind of literature centred around the royal court, the bishoprics and a Benedictine convent founded in 997 at Pannonhalma. In the second half of the 12th century the court of King Béla III (1172–96) became a centre of literati in which, besides Hungarian writers and scholars who had been studying at French or Italian universities, there were also representatives of

the *Minnesang* and troubadour schools of poetry.

In the first four centuries of the new Hungarian kingdom, chronicles, lives of the saints and hymns were the principal literary products in Latin. Some of the chronicles stand out for the excellence of their form and originality of their conceptions. A notary of King Béla III—known as the Anonymus—wrote a *Gesta Ungarorum* in which lack of historical accuracy is counterbalanced by literary merit. Simon of Kéza, working under King László (Ladislaus) IV (1272–90), originated a theory which gained immense popularity in Hungary: that of the identity of Huns and Hungarians, which, though not warranted by historical fact, has haunted even modern research. In the 14th century Marc Kálti compiled a history of Hungary which was to serve as a basis for all later Hungarian histories.

The earliest saint's legend, dealing with the lives of St. Zoard and St. Benedict, was written *c.* 1060 by Bishop Maur. About 1100 were written the three legends of St. Stephen (the first Christian king of Hungary), the two legends of the bishop St. Gerard and the legend of St. Emeric, son of King Stephen. They were followed at the end of the 12th century by a legend of St. Ladislas. These legends are works of some individuality, and their heroes emerge as richly characterized human beings.

Hymns were mainly written in the 13th and 14th centuries for feasts of Hungarian saints. Mention should be made of a *Planctus destructionis regni Hungariae*, which gives a heart-rending picture of the destruction wrought by the Mongol invasion of 1241–42.

Earliest Works in Hungarian.—The first written traces of the Hungarian language consist of Hungarian words, mostly proper names, embedded in the Latin text of legal or ecclesiastical documents. The first connected example of the language is a short funeral oration written *c.* 1200, original and moving in its simplicity. The 13th century saw many translations from Latin, only one of which has come down, a free version of a poem by Godefroy de Breteuil; it is a complaint of the Virgin over her Son's body. This is the first poem written in Hungarian to survive. The 14th century also produced translations of the legends of St. Margaret and of St. Francis of Assisi. The so-called *Jókai codex*, written *c.* 1440, which contains St. Francis' legend, is the oldest extant Hungarian codex.

The 15th century saw the first translations from the Bible. Two Hussite preachers, Thomas and Valentine, were responsible for this work, of which the prophetic Books, the Psalms and the Gospels have survived. A great part of the vocabulary, created for the purpose, is still in use. The Latin sermons of the Franciscan Pelbárt Temesvári constitute perhaps the greatest single achievement of Hungarian literature in that epoch. Though written in Latin they were intended for a Hungarian public, and became very popular in other European countries. A number of Temesvári's sermons have come down in Hungarian translations. Other translations include the first Hungarian drama, *On Three Christian Virgins*, a translation of the legend of St. Catherine of Alexandria and the beautiful translation of the Song of Solomon. There is also a Hungarian version of a Latin hymn in honour of St. Ladislas, and a hymn to the Virgin Mary by András Vásárhelyi.

Hungarian literature was not entirely religious. The existence of a history of the Trojan war and of a Hungarian version of the Alexander romance can be inferred from their south Slavonic translations. In the 14th century, with laymen going in ever greater numbers to school, conditions for the development of secular literature greatly improved. Much of this literature was simply occasional verse, of which very little has survived. We are fortunate enough to possess a song written in 1476 after the capture of Szabács by King Matthias Corvinus. From the 14th century onward more laymen went to study at universities abroad, and on their return tried to introduce the literary forms they had learned.

Renaissance and Reformation.—Even in the 15th century and at the beginning of the 16th Latin remained the language of serious literature. This perpetuation of Latin was a result partly of humanist influences in Hungary. In the second half of the 14th century Italian influence became predominant in Hungary through King Louis I of Anjou, a member of the royal house of Naples. In 1367 the first Hungarian university was founded. In the middle of the 15th century, with the accession of King Matthias I, the court became a centre of humanism. Matthias' famous library, the Corvina, became widely known; he later founded a university in Pozsony and established in Buda the first Hungarian press. While vernacular literature was making its first hesitating steps, Latin literature reached its peak in Janus Pannonius, the greatest humanist of Hungary. Nephew of the archbishop of Esztergom, Janus Pannonius was educated in Italy. He achieved greatness only after his return to his own country, when, abandoning an earlier witty vein, he wrote a great number of elegies. The troubles of a responsible statesman, difficulties in combating the Turks, love of country, sorrow at his mother's death, his own illness, were all sources of inspiration. He also found it difficult to adapt himself to the iron discipline of Matthias' court.

The 16th century brought changes in the political, spiritual and literary life of Hungary. Politically the Turkish wars were the dominating factor. After the battle of Mohács (1526) the country was split into three parts, and the centres of humanist and literary thought were destroyed. Many distinguished humanists had to emigrate, among them Miklós Oláh (1493–1568), who belonged to the circle of Erasmus and who spent much time in the Netherlands; János Zsámboki, better known under his latinized name, Sambucus (1531–84), who worked in Vienna; and András Dudich (1533–89), who spent long periods in Poland and Silesia. The 16th century brought the dawn of a new era. The new impulse that transformed Hungarian literature was the Reformation.

In the 16th century not only Hungary but its literature was a battleground, and the aims of the writers of this period were above all practical. They wrote not for posterity but for their contemporaries. It was an age not of contemplation but of action, and it is small wonder that in such circumstances no major works of art were produced. This element of actuality had, however, an important consequence. In order to be understood by as wide a circle as possible, the writers had to write in Hungarian. Hungarian national literature really begins with the Reformation. Mention must here be made of three forerunners of this new era: Benedek Komjáthy, Gábor Pesti and János Sylvester. All three were of humble origin, were disciples of Erasmus and were active in translating parts of the Bible. With methods infinitely superior to those employed 100 years earlier by the Hussite teachers, they translated with a philological accuracy worthy of Erasmus himself. Pesti made also a very readable translation of Aesop's *Fables*, and in 1538 published a Latin-Hungarian dictionary. In 1539 Sylvester published the first Hungarian grammar and, to show the adaptability of his mother tongue to classical verse forms, wrote the first Hungarian poem in distichs. In 1541 he published a translation of the whole New Testament.

With the spread of the new religion the need for hymns in Hungarian became acute. Most of these were translations of the hymns of Luther or other German Protestant authors, or of the Psalms. Among translators must be mentioned András Batizi, also author of a world history and of several stories based on the Bible. Mihály Sztárai, who played an important role in the Hungarian Reformation, translated some of the Psalms into Hungarian verse. The most original in this group was András Szkhárosi Horvát, author of didactic poems, versified sermons and versified paraphrases of biblical stories, perhaps the greatest Hungarian satirist.

The second half of the 16th century saw the beginnings of Hungarian drama. Sztárai gave dramatic form to fictitious religious disputations: *Papok házassága* ("The Marriage of Priests") and *Az igaz papság tüköre* ("The Mirror of True Priesthood"). As plays these are primitive and have little to commend them. Another similar drama with an anti-Trinitarian tendency, *Debreceni Disputa* ("The Dispute of Debrecen"), is much better. *Balassi Menyhárt árulásáról irott komédia* ("Comedy on the Betrayal of Menyhárt Balassi"), by an unknown author, is perhaps the most interesting literary achievement of the Reformation. This satirical comedy centres round a Hungarian aristocrat well known for his intrigues.

Gáspár Heltai (d. 1574) made a good adaptation of Aesop's *Fables*. A huge collection of sermons is the main product of Péter

Bornemisza's (1535–84) literary activity. He gives an entrancing view of Hungarian life in the 16th century, teeming with fresh observations, vivid descriptions and original psychological comments. His volume "On the Temptations of the Devil" gives an interesting picture of sexual problems in the 16th century. A poem of farewell, written on leaving the country, is one of the gems of early Hungarian poetry.

Perhaps the greatest single literary achievement of the Hungarian Reformation was the translation of the Bible by Gáspár Károlyi (1590). This played a role similar to that played by the Authorized Version in the development of the English language.

Though contemplation and interest in religious and philosophical problems are by no means characteristic of the Hungarian mind, up to the 18th century religious literature seems to have fared better than secular literature. This was due partly, as has already been mentioned, to the fact that secular literature was not written down. The existence of secular literature is, however, well attested. The late 16th-century minstrels were men more learned than their predecessors, often driven to such a profession by the difficult economic conditions of the age. Many of their works were circulated in manuscript; many were printed. Perhaps the most important of these minstrels was Sebestyén Tinódi (d. 1556). By temperament he was more of a historian than a poet. He described the wars against the Turks with remarkable accuracy, but his verse is monotonous and shows little imaginative power. Tinódi also wrote music which assures him a place in the history of Hungarian music. Péter Ilosvai Selymes was the author of a romance, *Miklós Toldi* (1574), of little poetic merit, which achieved, however, great popularity in Hungary and served as a basis for János Arany's masterpiece in the 19th century. The hero, a man of immense strength who lived in the 14th century, is one of the most popular figures in Hungarian literature. This romance is the one piece of original conception in the steady flow of secondhand matter which characterizes the literature of the 15th century, a literature intended merely to entertain. Its principal genre is the so-called *széphistória* ("beautiful story") called after the Italian *bella istoria*. Perhaps the best is the "History of Argirus" by the otherwise unknown Albert Gergei. Though based on an Italian original, the story—written in verse—is interwoven with elements of Hungarian folklore and has a naïve charm. Most of the other *széphistória* are more or less free adaptations of western European originals.

The balance sheet of Hungarian literature in the 16th century would be depressing were it not for the figure of Bálint Balassi (1554–94). Balassi's life was a harassed one, spent in endless pursuit of lost rights, in fighting against the Turks, in wars, in adventures. He created a poetry highly original, reminiscent in many respects of that of the Cavalier poets of English literature. But if he has the dash and the frivolity of these writers, he has also a depth which they lack. Balassi calls to mind François Villon, enjoying fights, love, the good things in life, but with sudden and deeply sincere religious impulses. Unlike Villon, however, he shows a knowledge of nature. Balassi was not only a great poet, he was also a versifier of great dexterity. Technically, his verses are unmatched in early Hungarian literature.

Balassi had many imitators and followers. Perhaps the most important was János Rimay (1573–1631), a personal friend of Balassi and the editor of many of his verses.

The 17th Century.—The political situation of 17th-century Hungary makes it difficult to give a clear outline of the literature. The country was still divided into three parts. The first, under Turkish rule, played no part in the development of Hungarian literature. The second, under Habsburg rule, was open to western and Catholic influence; whereas the third part, Transylvania, was isolated from the main current of European thought. Though Transylvania had no university like that founded in 1635 in Nagyszombat (Trnava) by Péter Cardinal Pázmány, the Protestant college of Gyulafehérvár, patronized by the prince of Transylvania, Gabriel Bethlen, played a similar role. Transylvanian intellectuals turned toward Protestant Germany, Holland and England. The most important was Albert Szenczi Molnár (1574–1634). He translated the *Institutes* of Calvin and the Geneva Psalms (1607). He also compiled a Latin-Hungarian and Hungarian-Latin dictionary, a Hungarian grammar, and wrote many sermons.

From the beginning of the second decade of the 17th century many Hungarian Protestant theologians went to Dutch universities. Some even visited England and translated the works of such puritan theologians as William Perkins and William Ames. From this epoch dates the first Hungarian travel book (*Europica Varietas*, 1620) by Márton Szepsi Csombor (1594–1623). The greatest Protestant scholar and writer of the 17th century was the puritan János Apáczai Csere (1625–59). His chief work, a Hungarian encyclopaedia in which he endeavoured to sum up the knowledge of his time, marks an important step in the development of a technical vocabulary. Protestant writers seem to have been interested more in learning than in letters. An interesting figure is that of the printer and pamphleteer Miklós Tótfalusi Kis (1650–1702) who modernized Hungarian orthography.

By the end of the 16th century the Counter Reformation was gaining momentum in the western parts of Hungary. Among its representatives the vigorous personality of the Jesuit Péter Cardinal Pázmány (1570–1637) stands out. A master of Hungarian prose, he was an orator and essayist of the first order. A vigour of style, always clear though far from simple, a use of popular expressions and a solidity of argument are the chief qualities of his work. As is to be expected, all his work is controversial, and his *Isteni igazságra vezérlö kalauz* ("Guide Leading to the Divine Truth," 1613) is a refutation of non-Catholic religious doctrines. Another Jesuit, György Káldi, produced in 1626 the first Catholic translation of the Bible.

Under the influence of the Jesuits, many Hungarian aristocrats returned to the Catholic faith, and sent their sons to the Austrian Catholic universities and to Rome. There they became acquainted with the baroque style and introduced it into Hungarian literature. Baroque influence can be seen in the work of Miklós Zrinyi (1620–64). He belonged to a family with great traditions, and became one of the greatest Hungarian statesmen and generals of his time. Most of his prose work is an exposition of his political and strategic ideas. His greatest literary achievement is his epic *Szigeti Veszedelem* in 15 cantos. The subject is the siege in 1566 of Szigetvár, defended against the Turks by Zrinyi's great-grandfather. Though the influence of the epics of Homer, Virgil, Ariosto and Tasso is clear, the work remains in concept and character profoundly original and Hungarian. Zrinyi succeeds in imbuing the historical facts, to which he closely adheres, with a symbolic value, which conveys his own political ideas.

Another epic poet of this time, István Gyöngyösi (1629–1704), was concerned with lesser subjects. He composed many epithalamia, was inventive and handled rhyme with great ease. His poems were much read during the 17th and 18th centuries.

The works of aristocratic poets like Zrinyi and Gyöngyösi form but a fraction of the poetic harvest of the 17th century, when writing poetry seems to have become the fashion among all classes. The so-called *Kuruc* songs stand out by their high artistic merit. The *Kurucs* were Hungarian partisans fighting against the Germans and the Habsburgs. Their poems—largely anonymous—give gripping descriptions of their poverty and misery, but also of their joys. Many celebrate the deeds of the great figures of the insurrection, particularly those of Francis Rákóczy, prince of Transylvania and leader of the last great rising (1703–11). Many Hungarian poets have sought inspiration in these *Kuruc* songs.

Decadence.—The period between 1711 and about 1770 was a time of decadence in Hungarian literature. Memoirs form what is best in the prose literature of this period. The autobiography of Miklós Bethlen (1642–1716), a leading Transylvanian politician, and the *Confessions* and *Mémoires* of Rákóczy, written respectively in Latin and French, make absorbing reading. The *Letters* of Kelemen Mikes (1690–1761), a companion in exile of Rákóczy, were addressed to an imaginary aunt. In choosing this genre Mikes was inspired by French influence, and his work stands out for its excellent style. The *Metamorphosis Transylvaniae* of Péter Apor (1676–1752) is a nostalgic reminiscence of the "good old days" in Transylvania before German customs had penetrated it.

Poetry of this epoch has little to offer. The poems of László Amadé (1703–64) are both in form and in content rococo. Amadé creates a Hungarian version of the *poésie galante*. He is matched by Ferenc Faludi (1704–79) who, however, takes his expressions from popular language.

The middle of the 18th century saw the beginning of the "school dramas," so called because they were the Hungarian versions, prepared in schools, of foreign dramas.

This period of literary decadence produced notable works only in the fields of history and history of literature. Some of these were written in Latin. Among historians Mátyás Bél, György Pray and István Katona are most important. The first historian of Hungarian literature, Dávid Czwittinger (1676–1743), wrote the biographies of about 300 Hungarian writers. His work was continued and improved by Péter Bod, whose *Magyar Athenás* ("Hungarian Athenaeum," 1766) deals with more than 500 Hungarian men of letters.

The Period of the Enlightenment.—The period between about 1772 and 1825 is often called that of the Enlightenment. Though immensely important in the development of the Hungarian spirit, it produced few writers of the first rank. However, this period prepared the ground for the splendid harvest of the 19th century, when Hungarian literature reached its greatest height. The Hungarian Enlightenment was more receptive of foreign (French and English) ideas than productive of original developments, and the main task of its exponents was to adapt the new ideas to the particularities of the Hungarian scene.

The first interpreter in Hungary of the ideas of the Enlightenment, György Bessenyei (1746–1811), decisively influenced Hungarian literature. It is with the publication, in 1772, of his first literary work, a translation (from the French) of Pope's *An Essay on Man*, that the new era begins. Bessenyei's aim was knowledge rather than pure art, and all his works serve a didactic purpose. From 1765 to 1782 he lived in Vienna, where he came to realize the backwardness of his own country. His best drama, *Agis tragédiája* ("The Tragedy of Agis," 1772), serves as a somewhat creaking vehicle for his antidespotic ideas. The problems touched upon in Greek guise remain recognizably Hungarian. His best work, *Tarimenes utazása* ("Tarimenes' Journey," 1802–04), the first real novel in Hungarian, remained unpublished for over a century. It is a bitter attack on everything that conflicts with the views of Enlightenment. With destructive irony, reminiscent of that of Swift, Bessenyei examines the shortcomings of human society.

The purely literary merit of Bessenyei's work is slight, but by writing in Hungarian, by trying his hand at various literary genres such as the drama and novel, hitherto practically unknown in Hungary, and by knocking at the closed door of Hungarian civilization with the new ideas of the Enlightenment he started a movement which put an end to the literary stagnation of the early part of the century. His personal influence induced several of his fellow officers—*e.g.*, Sándor Bárotzi (1735–1809) and Ábrahám Barcsay (1742–1806)—to try to convey the ideas of the Enlightenment in Hungarian to a Hungarian public. This public was, as yet, virtually nonexistent, and works like those produced by Bessenyei were unlikely to create much desire to read.

Spurred on by new ideas, but basically traditionalists, the general of the cavalry, József Gvadányi (1725–1801), and András Dugonics (1740–1810) achieved works of some literary merit and amusing enough to become popular. Gvadányi's best work *Egy falusi nótárius budai utazása* ("The Journey to Buda of a Village Notary," 1790) is a long narrative poem describing with humour and irony the adventures of a somewhat pretentious but basically sane notary who, on reaching the capital, is deeply shocked by the foreign fashions prevailing there. The whole work is an apology for national and traditional values against encroaching foreign ideas. The novel *Etelka* (1788) by Dugonics, a sentimental love story in a historical setting, was the first Hungarian "best seller." It is a bad work by any standards, unoriginal, full of deplorable anachronisms, but its praise of the golden days of the Hungarian past and of popular tradition had a general appeal. Both Gvadányi and Dugonics used a popular language, free from foreign influence, and this is perhaps their greatest merit. Ádám Pálóczi Horváth (1760–1820) belonged to the same group of writers representing national resistance to foreign ideas. His epic poem *Hunnias* (1787) on János Hunyadi would not justify the presence of his name in this survey. He left, however, in manuscript a collection of 450 poems (*Ötödfélszáz énekek*, 1953), which is a treasure house of popular poetry and music and incorporates a number of poems of his own making. Those in the popular vein are still enjoyable, and his psalmlike religious poems are moving by their vigour and sincerity.

This period at the end of the 18th century is a period of discovery, and of experiments with language. Minor attempts at changing the traditional Hungarian verse form had been made by Bessenyei, Lőrinc Orczy and others, but other men were to explore the road on which János Sylvester had taken the first steps: the use of classical metre for Hungarian verse. The pioneers, Dávid Baróti Szabó (1739–1818), József Rajnis (1741–1812), Miklós Révai (1750–1807) were followed by Benedek Virág (1754–1830) who, influenced by Horace, imbued with poetic inspiration verse forms which for his predecessors were merely formal exercises. It fell to Dániel Berzsenyi (1776–1836) to show what use a really great poet could make of classical metre.

Berzsenyi is a giant of expression. What he has to say is neither particularly original in itself nor in its forms. It is the terseness and vigour of the expression, the power of conviction, that make his lines memorable. His ode to *Magyarokhoz* ("The Hungarians"), his *Fohász* ("Prayer"), his elegy *A közelítő tél* ("On the Nearing Winter"), belong to a category beyond criticism. Berzsenyi could perceive, as few others could, the transitoriness of power, glory, friendship, of everything but God "whose existence shines like the burning sun but cannot be looked upon." He had taken from his beloved Horace the acute perception of the ephemeral, but his *carpe diem* ("seize the day") is a mild, melancholy echo, almost a renunciation. Only the destinies of his country can really move him, "moral rectitude is every country's mainstay and foundation." He exults at the sight of groups of men abiding by their loyalties; and, looking into Hungary's past, he finds solace in the thought that "eagles engender but eagles, and the leopard of Nubia will not bear timid rabbits."

The ideas of the Enlightenment were not universally welcomed in Hungary. The traditionalist elements looked, as we have seen, with distrust on any imported ideas, and the government was increasingly distrustful of a spiritual trend which had led to the French Revolution and, in Hungary, to the conspiracy of Martinovics. László Szentjóbi Szabó (1776–95), Ferenc Verseghy (1757–1822), János Batsányi (1763–1845) went to prison—where Szentjóbi Szabó died—for the crime of sympathy with these ideas. The most talented among them, Batsányi, secured his place in the history of Hungarian literature by his poem *A franciaországi változásokra* ("At the Changes in France"), a vigorous warning to all tyrants "to cast their watchful eyes on Paris."

Sentimentalism found its interpreters in József Kármán (1769–95) and Gábriel Dayka (1769–96). Kármán's only work of importance, *Fanni hagyományai* ("The Papers of Fanny"), is a sentimental novel, written in the form of letters and diary entries. Very much on the lines of Goethe's *Werther*, the work nevertheless marks an important step in the history of the Hungarian novel. Dayka, a poet, died too young for the full measure of his talent to be realized.

The first really important lyric poet since Balassi was Mihály Csokonai Vitéz (1773–1805). A widely read, intelligent man, Csokonai continued the purely Hungarian poetical tradition, and his many songs to "Lilla" are a happy blend of rococo grace and thoughts less superficial than they appear. The influence of Rousseau is very noticeable in some of his longer philosophical poems which make a curious contrast to his popular drinking songs. He is an absolute master of form, and his poems, filled with subtle grace, show no trace of the acute sufferings of his life.

Pope's *The Rape of the Lock* served as a source of inspiration for Csokonai's comic epic *Dorottya* ("Dorothy"), but Csokonai's poem is original and very much Hungarian. The heroine, an old spinster, leads a revolt against men reluctant to marry. The language of the poem, not exempt from some slight vulgarity, is vigorous, the comic situations somewhat coarse but amusing.

Mihály Fazekas (1766–1828), a friend of Csokonai, won fame by his *Ludas Matyi*, a humorous narrative poem relating the clever vengeance of a serf on his cruel lord.

The place of Sándor Kisfaludy (1772–1844) in Hungarian literature is secured by his first work *Kesergő szerelem* ("Plaintive Love"), a song cycle depending on a very thin narrative thread: the hero Himfy finds no response to his love for Liza; in despair he goes to the wars, and returns to find that Liza still refuses to become his wife. Writing in a very elaborate verse form of 12 lines, devised by Kisfaludy and called the Himfy verse, the poet displays an astounding ingenuity in finding new variations on the theme of unhappy love. Though no one reading the whole cycle could escape a sense of monotony, the individual songs are often beautiful. "Plaintive Love" had an immense success, which prompted Kisfaludy to publish a second song cycle *Boldog szerelem* ("Happy Love," 1807), in which, with similar skill but less verve, he tried to find varied expressions to convey the apparently undisturbed bliss of his marriage. Among his better works must also be reckoned three tales, *Csobánc*, *Tátika*, *Somló*, written in the romantic mood of *Rittergeschichten* ("stories of chivalry").

Few, if any, of the names mentioned in this account of the period following Bessenyei's appearance on the literary scene can be dissociated from Ferenc Kazinczy (1759–1831), a mediocre poet but an influential man of letters: for about 40 years he was the pivot of literary life. Aristocratic, cool, formal, efficient, his political conceptions were progressive, a luxury for which he paid with six years' imprisonment. His aim was to purify Hungarian literature from all vulgarity. He wanted a literature refined and limpid, neither baroque nor popular. What he hated above all was bad taste. His interest was focused on style, on presentation, on construction; the thoughts expressed were for him secondary. To satisfy his desire for a more refined literature he became the head of the *neologi* who, opposed by the *orthologi*, tried to renew and enrich the Hungarian language to make it suitable to express the most elaborate thoughts. This language reform, which lasted through much of the 19th century, enriched Hungarian and made of it the most versatile instrument a poet can hope for. Kazinczy's activity—his correspondence and memoirs, his biting, satirical epigrams, his extensive translations of works, sometimes ill-chosen, but of varied nature so as to serve as stylistic exercises, and, above all, his great personal prestige and influence—left an indelible mark on Hungarian letters.

The Early 19th Century.—The literary revival caused by Kazinczy's activity continued after his death, and even in the last years of his life the literary leadership of the country was assumed by Károly Kisfaludy (1788–1830), brother of Sándor. In 1822 he founded the literary magazine *Aurora*, the first of its kind, which achieved real popularity and to which all the important writers of the period contributed. Károly Kisfaludy's other important contribution to Hungarian literature was in the field of drama, where he was the first representative of romanticism and the first playwright to achieve considerable popular success. Among his many historical tragedies, *Iréne*, set in 15th-century Constantinople, and the *Voivode Stibor* are the best, though they fall short of the requirements of a really good play. His comedies are still enjoyable, and portray well a number of characters of the contemporary Hungarian society. He also tried his hand at short stories, and his satirical descriptions, still amusing and instructive, had at the time a political message which, with its mildly progressive ideas, was not unwelcome in a society basically conservative but more and more convinced of the necessity of social and political reforms.

While Kisfaludy's tragedies, often very shallow, were applauded all over the country, one of the best tragedies in Hungarian, published in 1820, remained entirely unknown. Its author, József Katona (1791–1830), a lawyer who in his student days had been attracted by the stage, translated from German a great number of dramas and wrote several original plays, all insignificant. In 1815 he wrote his masterpiece, *Bánk bán* (the *bán* was a high Hungarian dignitary). Set in the 13th century, the play is a masterful combination of national and individual conflicts culminating in the murder of the queen by Bánk, who wrongfully accuses her of having helped his brother Otto to violate Bánk's wife. The queen, though responsible for many wrongful acts, had been innocent of this specific crime, and Bánk realizes too late his fatal mistake. Particularly effective is the role of Tiborc, a poor peasant, whose figure has remained ever since the symbol of the oppressed. The tragedy, written in a vigorous prose, is a real work of art in content as well as in form.

Though it would be difficult to overestimate Kazinczy's contribution to the development of Hungarian letters, he himself, like his circle, produced no outstanding works of art. All the good, and many of the bad, poets were indebted to him; but the really strong talents had to break away and find, indeed create, their own forms of expression. This was the case with Berzsenyi, Csokonai, Károly Kisfaludy and another poet who had been in closer touch with Kazinczy than any of these: Ferenc Kölcsey (1790–1838). Kölcsey's poetical production was comparatively small, and his first poems belong to the somewhat anemic type which could cause no offense to Kazinczy. Later Kölcsey produced a number of striking poems, vigorous in thought and expression, grave, even sombre when they deal, as so often, with the problems of his country's situation. The most impressive manifestation of this mood, the *Hymnus* (1823) is a passionate plea to God to have pity on a people which through the bitter sufferings of the past "has already expiated the past as well as the future." The poem, set to music by Ferenc Erkel, is the Hungarian national anthem. Kölcsey was a politician of great standing and a brilliant orator; his literary criticisms are also of very high standard, though unduly severe.

Mihály Vörösmarty (1800–55) resembles Kölcsey in his general pessimism and his patriotic preoccupations. But unlike Kölcsey, whose manifold interests, as it were, softened his impact in any one field of his activity, Vörösmarty's whole genius was focused on literature. After Kazinczy and Károly Kisfaludy died, Vörösmarty became the central figure in literary life, but with much better claims to this role, as far as pure literary achievement is concerned, than either of his predecessors. He tried his hand at every literary genre, and in each produced works of abiding value. His first appearance on the literary scene, with a long epic poem written in hexameters, *Zalán futása* ("The Flight of Zalan," 1825), was a great success and was followed by many other historical tales, written in a romantic vein but not without an eye to contemporary political and social problems. These appear also in many of his best lyric poems, and his *Szózat* ("Appeal") is a worthy pendant to Kölcsey's *Hymnus*. Much interested in drama (he translated *Julius Caesar* and *King Lear*), he had little sense of the requirements of the stage. His best work, a charming and symbolic fairy tale, *Csongor és Tünde*, contrasts, in a fashion reminiscent of *A Midsummer Night's Dream*, the airy lightness of fable and poetry with the grotesque earthiness of men.

In Hungarian literature poetry was far ahead of drama, and the novel seemed slow in taking root. The first successful novelist, Miklós Jósika (1794–1865), a disciple of Walter Scott, made his appearance in 1836 with the historical novel *Abafi*, which marks a turning point in the history of the Hungarian novel. It remained his best work. Once the novel was well established as a literary medium, others tried it with increasing success.

József Eötvös (1813–71), who after the 1848 revolution was to become an important political theorist and at the end of his life was minister of public instruction, produced in his early years a few novels of which two, *A falu jegyzője* ("The Village Notary") and *Magyarország 1514-ben* ("Hungary in 1514"), published respectively in 1845 and 1847, figure among the best Hungarian novels. The first gives a depressing but not melodramatically exaggerated picture of feudal life in Eötvös' time, the second deals with György Dózsa's peasants' revolt. Though the novels are lengthy and difficult to read, they have extraordinary qualities of characterization, both of individuals and of periods. Eötvös' vigorous realism had great evocative power; his heroes are set with a firm and knowledgeable hand against the background of violent social clashes. His novels are political manifestos in support of the oppressed, and against the appalling injustices which lead to revolutions—of which the writer disapproves as a political means.

From the mid-1830s literature had become sufficiently appreciated to make writing attractive. Literature and politics were

closely connected and their association was to become instrumental in the explosion of 1848. In the proliferation of writers and poets —except for those already mentioned—few showed real talent. The novelists Ignác Nagy (1810–54) and Lajos Kuthy (1813–64), the playwrights József Gaál (1811–64), Károly Obernyik (1815–55) and Zsigmond Czakó (1820–47) deserve mention.

Poetry was on an altogether higher level. Gergely Czuczor (1800–66) produced a few epic poems of a fairly high standard, but his best poems were in the style of folk songs. Many returned to the people and became a part of popular poetry. János Garay (1812–53) owes his fame, in Hungary, to his amusing tale in verse *Az obsitos* which relates the story of the mendacious braggart János Háry, immortalized in Zoltán Kodály's opera, *Háry János*. József Bajza (1804–58), popular in his time, lacks originality and his poems are too diffuse to be really effective. Bajza's significance lies in his activities as a literary critic. He played an important role in the organization of theatre life and became the first "administrator" of literature. His scrupulous honesty and his uncompromising rejection of complacency had a salutary influence. His friend Ferenc Toldy (1805–75), a critic himself, made important contributions to the previously almost uncultivated field of the history of literature.

The folk song and folk ballad collections of János Erdélyi (1814–68) and János Kriza (1811–75) exerted great influence on the further development of Hungarian poetry.

"Popular poetry is the only real poetry" was a firmly held opinion of Sándor Petőfi (1823–49), one of the greatest Hungarian poets. The quality of Petőfi's production is uneven, but his best poems must rank among the masterpieces of world literature. He was an innovator, a revolutionary, by nature as well as by conviction. He hated convention and—not without a desire to *épater le bourgeois*—made a break with conventional subjects and with so-called poetic language. His descriptive poems are striking in the immediacy of the perception, in the directness of the language and in Petőfi's extraordinary capacity to infuse poetry into almost any subject. The revolutionary violence of his patriotic poems, which are often frankly political, has a counterpart in the exquisite melancholy and tenderness of his love poems. Petőfi's thought lacks the depth of, say, Berzsenyi, Vörösmarty or Arany, but the sincerity and force of his expression brings it home to the heart of the reader, hence his great influence during the revolution in 1848. Petőfi's many songs are enchanting in their simplicity: in this genre he remains unsurpassed. In him the great popular song tradition, from the *Kuruc* songs and Balassi through Csokonai and Kisfaludy, reached its peak. Petőfi's epic poetry is of less value, though his naïve popular epic poem *János vitéz* (1845) and his comic epic *A helység kalapácsa* ("The Hammer of the Village," 1844) are enjoyable. Petőfi's early death—he disappeared on July 31, 1849, in a battle with the Russians—was a tragic loss to Hungarian literature.

The torch falling from Petőfi's hand was picked up by his friend, and in some ways his follower, János Arany (1817–82). Though older than Petőfi he became known only when Petőfi was already famous. They shared the same conviction of the value of popular poetry, but their approach to it was different. The difference between them is largely that between an extrovert and an introvert. Petőfi proclaims his feelings, almost carelessly, and only his genius saves him from writing bad verse. Arany, modest and retiring, is reluctant to unveil his inner self. (He never wrote a love poem.) He chooses his subject with great care, very often from history, and treats it with deep understanding of the human mind, and with impeccable artistry. His language is exquisitely chosen. He does not try to be popular but has the assurance of one who knows that what he writes *is* the language of the people, lifted to a degree rarely attained and never surpassed in Hungarian. His ballads, often romantic, have virile vigour, conciseness and uncommon evocative power. His great narrative poems, such as his *Toldi* trilogy and *Buda halála* ("Death of Buda"), while firmly rooted in Hungarian tradition, reflect eternal human problems. It is Arany's great merit that he is never boring to read, his philosophy appears through his characters and not in lengthy digressions, and a subtle humour brings welcome relief to mounting tensions.

The Late 19th Century.—The peaks of poetry reached by Petőfi and Arany remained inaccessible during the rest of the 19th century. The second half of the century produced a host of imitators. Even the more gifted found it difficult to get out of the rut. This does not apply to Mihály Tompa (1817–68), a contemporary and friend of Petőfi and Arany, an original but mediocre poet whose popularity is today difficult to understand.

Hungary, prostrated by the unsuccessful revolution of 1848–49, remained until 1867 under Austrian rule. The "epoch of compromise" which then followed was hardly more favourable to literature. The defeat was followed by half-hearted acceptance of the compromise and by a self-deceiving optimism which produced complacency and uninspired traditionalism. The strongest talent in this period of decadence, János Vajda (1827–97) trod a lonely path beset with devouring passions, gloomy visions. Solitary in his life as well as in his poetry, little recognized by his contemporaries, his influence on coming generations was great. Gyula Vargha (1853–1929), Sándor Endrődy (1850–1920), József Kiss (1843–1921), Gyula Reviczky (1855–89) and Mihály Szabolcska (1862–1921) all produced one or two poems of real beauty.

The theatre, steadily growing in popularity, could, even less than poetry, produce works of lasting value. In 1837 a national theatre was formed to produce works of merit, but the level of the plays was low. The inexhaustible Ede Szigligeti (1814–78) wrote more than 100 plays. His tragedies are weak, but his comedies are amusing and he created a special genre, the so-called *népszínmű*, plays giving an idealized picture of village life. Szigligeti had a good sense of the stage and catered for a public delighted to watch plays presenting no problems.

Problems, social, political, religious, constituted the principal preoccupation of Imre Madách (1823–64), whose *Az ember tragédiája* ("The Tragedy of Man") is one of the glories of Hungarian literature. This dramatic poem, which follows man's destiny from his creation through different stages of history into the future of a phalanstery and the ultimate extinction of life, shares some of the characteristics of such philosophical poems as Goethe's *Faust*. But it not only displays original thought incisively expressed, it is also remarkably effective on the stage. It is a play to be seen rather than to be read, and, well-produced, will hold its audience spellbound.

Gergely Csiky (1842–91), after Szigligeti the most popular and most prolific playwright of this epoch (35 plays), was a pseudo realist. The social conflicts which appear in his plays for the first time on the Hungarian stage are, to a large extent, artificial, second-hand and second-rate adaptations.

Only among the novelists were there really outstanding achievements. Zsigmond Kemény (1814–75) is, in many respects, a disciple of Balzac. Whether he sets the scene of his novels in the past as in *Zord idő* ("Grim Times," 1862) and *Rajongók* ("The Fanatics," 1858) or in his own time as in *Férj és nő* ("Husband and Wife," 1852), he displays a masterly skill in minute psychological analysis. His novels breathe tragedy; his characters are pushed toward their gloomy fate by a host of circumstances, never fortuitous but determined by their own deeds. Analysis often takes the place of action in Kemény's work and because of the effort needed to read them his novels have never known wide popularity.

The opposite is true of Mór Jókai (1825–1904), undoubtedly the most popular Hungarian novelist. Jókai is a born storyteller, endowed with an exceptional imagination, which, although able to evoke any epoch, any milieu, remains firmly rooted in Hungarian soil. His characters are idealized, his descriptions inaccurate, but they carry the reader into a dream world so realistic that he is tempted to forget that it is but the projection of Jókai's mind. In his works (more than 100 volumes), historical novels alternate with others centred on the problems of contemporary society, of which almost all the strata interested him. In following the hero—and a hero he is—the reader becomes acquainted with a variety of worlds, strangely reminiscent of each other, for all owe their existence to Jókai.

Kálmán Mikszáth (1847–1910) is entertaining in a different way: he observes with a keen eye his contemporaries, politicians, civil servants and their contacts with the people, and relates their doings

with sly humour. The shortcomings of the society in which he lives are obvious to Mikszáth but, though a politician, he is little concerned with improvement. Mikszáth is only less popular than Jókai.

Though his principal works were published early in the 20th century, Géza Gárdonyi (1863–1922) is a spiritual child of the 19th. His historical novels, well-constructed, easily read, are well meaning and harmless; *e.g., Az egri csillagok* ("The Stars of Eger," 1901), *A láthatatlan ember* ("The Invisible Man," 1902).

During the 19th century, literary life in Hungary became, to some extent, organized, and literary societies played an important part. The Kisfaludy and Petőfi societies, founded in 1836 and 1876 respectively, were particularly influential, though the authority of the Hungarian Academy, founded in 1825 by István Széchenyi, remained unchallenged. The principal literary critic of the second half of the century was Pál Gyulai (1826–1909), himself a poet and writer. Literary criticism, the history of Hungarian literature, attracted some of the best minds. Gusztáv Heinrich (1845–1922) and Zsolt Beöthy (1848–1922) were among the leading figures in this field.

The 20th Century.—As we have seen, with a few exceptions, such as Madách, the second half of the 19th century was an era of decline in which writers imitated Petőfi or Arany, and based their work on social and political ideals which were becoming sterile. The great majority of Hungarian writers had been recruited from the ranks of the nobility which, in fact, constituted in Hungary the middle class. Only at the end of the century did some writers of lower middle-class origin come to the fore. The first important manifestation of the new era was the periodical *A Hét* ("The Week"), founded in 1890 by József Kiss, which without any definite program became the organ of a number of more or less gifted writers who brought some fresh air into a stifling *fin de siècle* atmosphere. Zoltán Ambrus (1861–1932), a disciple of Maupassant, and an outstanding theatrical expert, was the most important among them. Sándor Bródy (1863–1924) and Gyula Krudy (1878–1933) did not belong to any school and, perhaps because of that, wrote original short stories and novels.

The year 1906, when Endre Ady (1877–1919) burst into Hungarian life "with the new songs of a new epoch," marks a turning point. Ady's revolutionary political ideas, which provoked violent storms, made it difficult for some sections of society to accept that he was a poet of unusual genius. In form and content Ady is a lyrical poet of such originality that he defies comparison. He rejuvenated Hungarian language and poetical thought, and his rich production is of uniformly high quality. His poetry is infinitely varied; perhaps humour is the only note missing. Love, friendship, hatred and war, social and political problems, death, a desperate search for God, are among the chief sources of his inspiration. His method of expression is symbolic. An external event—we are rarely told what it is—inspires a dream which defies any other description but that given in the poem itself.

In 1908 was founded the literary periodical *Nyugat* ("The West") with Hugó Ignotus (1869–1950) and Ernő Osváth (1877–1929) as editors. The influence of this left-wing periodical, without any definite political program but strongly biased against the political fool's paradise of Hungarian life, cannot be overestimated. It brought together vigorous talents and lifted Hungarian letters to a level remarkable by any standards.

Mihály Babits (1883–1941), an intellectual poet, master of form and a deep original thinker, was from 1929 editor of *Nyugat*. He was also a translator of exceptional ability; his *Divina Comedia* is probably the best existing translation of Dante. Dezső Kosztolányi (1885–1936), the greatest impressionist in Hungarian poetry, was a sensitive poet and an accomplished short-story writer. On a slightly lower level Árpád Tóth (1886–1928), reminiscent of Keats, and Gyula Juhász (1883–1937) were masters in voicing the distress of the solitary and the oppressed. The delicate, reticent poetry of Lajos Áprily and Aladár Komjáthy, the deliberately childish verse of Ernő Szép, the light, *chanson*-like poems of Jenő Heltai (1871–1957) must also be mentioned.

Zsigmond Móricz (1879–1942) was undoubtedly one of the greatest novelists in Hungarian literature. His descriptions of provincial life are outstanding for their masterly portrayal of peasants and gentry, of the terrible conflicts between man and man, man and woman, man and misery. Móricz was a realist in the true sense of the word, down to earth but perceptive, robust but capable of extraordinary tenderness. Margit Kaffka (1880–1918), the first great woman writer in Hungary, was another important novelist. Frigyes Karinthy (1888–1938), without producing "major works," exerted a considerable influence on his generation. His splendid pastiches are studied in schools; his queer, inquiring mind had an uncanny ability to discover the absurd and the preposterous in human behaviour.

It is always dangerous to give schematic pictures of anything as complex as literature, but for the sake of convenience it can be said that from 1908 there were three main streams discernible in Hungarian literature: the *Nyugat* group already mentioned which included the greatest talents; an official literature written by conservative-nationalist writers; and, lastly, a superficial boulevard literature with hardly any aim but entertainment. The principal writer of the second group was Ferenc Herczeg (1863–1954), author of many novels and some plays showing considerable theatrical skill. Cecil Tormay's historical novels gained more official recognition than their value would warrant. Of the third type, entitled, nevertheless, to literary recognition, must be mentioned several playwrights: the impressionist Dezső Szomory, with definite literary ambitions; Menyhért Lengyel whose *Typhoon* (1909) has known success all over the world; and the exceptionally gifted Ferenc Molnár (1878–1952), whose plays, imperfectly adapted to the tastes of international theatre audiences, do little justice to a talent which shows itself best in some little-known short stories on Budapest life.

The real importance of the *Nyugat* as the organ of a literary movement diminished considerably after World War I, the great writers and poets of the group gained official recognition and the conflict which opposed them to the traditionalist men of letters became less violent. The literary cake was in any case large enough to feed both groups. Solitary writers found it more difficult to obtain recognition. Lajos Nagy (1883–1954), a socialist short-story writer, and Jenő J. Tersánszky, with his descriptions of vagabond life, deserve mention.

The solitary giant Dezső Szabó (1879–1945), an unsurpassed master of Hungarian prose, author of some powerful and bewildering novels and stories, alienated sympathy with his venomous, though often pertinent, attacks on almost everything. Lajos Kassák (1887–) was the first worker to secure a place in Hungarian literature. A painful search for poetical form led him to an expressive, often pathetic, blank verse. His novels and particularly his moving autobiography (*Egy ember élete*, 1927) give a true picture of working-class life.

The period between World Wars I and II is one of extraordinary flowering in Hungarian letters. Most of the new writers of the prewar period were still active and many new names appeared.

In poetry the greatest figure is that of Attila József (1905–37). His subjects, similar to those of Kassák, are treated with tender lyricism, changing sometimes into violent outbursts against the existing social order. Lőrincz Szabó (1900–57) was a master of fine observation, and a gifted translator of foreign poets. The Catholic priests László Mécs and Sándor Sík brought new life to religious poetry. Oszkár Gellért and Milán Füst belong to the most talented poets reared by the *Nyugat*. The poetry of Miklós Radnóti (1909–44) reaches a tragic climax in his splendid poems written in a German camp and during a death-march in which he himself was to perish.

Gyula Illyés (1902–), considered by many as the greatest Hungarian poet of the mid-20th century, found inspiration in the life of the peasantry, also the subject of his many essays and semi-documentary descriptions, which exerted some influence on Hungarian opinion. Among postwar poets, Sándor Weöres, György Faludy, Ferenc Juhász, László Benjámin and László Nagy were probably the most talented.

In Hungary, as elsewhere, the novel became the principal form of literary expression. To the writers already mentioned, who had been active before World War I, other names must be added. Be-

tween the wars Lajos Zilahy (1891–) and Sándor Márai produced good descriptions of the Hungarian *bourgeoisie;* Áron Tamási and József Nyirő wrote on various aspects of Transylvanian life. The realistic novels of Pál Szabó, János Kodolányi, József Darvas, the firsthand accounts of peasant life by Péter Veres, are probably among the best representatives of literature laden with a social "message." Problems of socialism had influenced some of the writers (*e.g.*, Attila József, Veres) even before World War II; later social and political considerations became overwhelming and, for some years, they alone constituted the materials of literature. Much of this is negligible, but the novels of Tibor Déry are of literary value. Almost all the important novelists and poets (*e.g.*, Móricz, Heltai, Kodolányi, Zilahy, Illyés) tried writing drama, but the greatest achievements in this field are the historical plays of László Németh (1901–). Centred on powerful personalities of the past (*e.g.*, Galileo, Pope Gregory VII) they excel in the evocation of historic settings and in the picturing of eternal conflicts which oppose the honest man, bent on improvements, to the incomprehension and hostility of his contemporaries.

During the 20th century literary criticism and the history of literature kept pace with growing production and an increased interest in letters. Of the older generation Aladár Schöpflin (1872–1950), for many years chief critic of the *Nyugat;* of the generation between the wars, Antal Szerb (1901–45) are among the most outstanding figures. It is impossible not to mention György Lukács (1885–), the great Marxist literary theorist, though Hungarian literature has formed but a small part of his studies. Jenő Pintér produced a number of manuals, lacking imagination, but useful compendia of facts. In János Horváth (1878–), a dignified and scholarly personality, Hungarian literary research reached a level which it would be difficult to surpass.

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HUNGARY (MAGYAR NÉPKÖZTÁRSASÁG OR MAGYARORSZÁG), a landlocked republic of central Europe, the limits of which were determined after World War I. The area is 35,919 sq.mi. The frontiers coincide roughly with the limits of the compact area of Magyar settlement, except in the north where Hungary and Czechoslovakia have a common frontier. Most Hungarians are therefore also Magyars. The traditional kingdom of Hungary was about coincident with the Middle Danube basin, with an area of 125,402 sq.mi. and a heterogeneous population of which the Magyars formed just over half. It is only since 1918, therefore, that the terms Magyar and Hungarian have been at all interchangeable. The Hungarian People's Republic has frontiers with Austria, Czechoslovakia, the U.S.S.R., Rumania and Yugoslavia. There are few natural separative features between it and neighbouring states, except for the marshy valley of the Danube in the northwest and that of the Drava in the southwest. The limits are those of language.

This article contains the following sections and subsections:

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  2. Climate
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II. Geographical Regions
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I. PHYSICAL GEOGRAPHY

1. Geology, Relief and Drainage.—Hungary occupies the central part of the Middle Danubian basin. This is a large depression within the Tertiary fold mountains, which apparently began to form in the Tertiary era and in which subsidence continued steadily through this and the Quaternary era. It is often held, quite mistakenly, that Hungary is uniformly flat. One striking feature of the country, however, is the "backbone" of highland running across it from the northeast to the west centre, dividing it according to relief into a smaller north and larger south. The groups of hills, the Hegyalja, Bükk, Börzsöny, Mátra, Pilis and Bakony, are roughly in alignment and reach an average of 2,000–3,000 ft. They are connected structurally with the surrounding Tertiary highlands and consist basically of great blocks of sedimentary rock partly submerged by the depression of the whole middle basin. (Some of the limestone hills, especially those to the north of the Bükk group, show remarkable karstic formations; for example, the great Aggtelek or Baradla caves which run under the Magyar-Slovak frontier.) The hills show much faulting on the southern side, and the Hegyalja and Mátra groups are almost completely covered in volcanic material. The Bakony group, and to a lesser extent the Mátra group, are noted for the great bauxite resources. The hills have kept a crown of deciduous woodland covering and the lower slopes have a rich loess blanket and sometimes great fertility of soil deriving from volcanic rock.

Three distinctive regions border the highlands, two on the south and one on the north. South of the hills and west of the Middle Danube is Transdanubia (Dunántúl), the rolling country, not unlike English downland, remarkable in its fertility. (The Magyar use of the name "Transdanubia" to describe the country west of the Danube is a reminder of their steppe origin. For them the western side was the farther side. It corresponds to the southeastern part of classical Pannonia.) One curious feature of it is the symmetry of the parallel streams running southeast to northwest to flow into the southern side of Lake Balaton (*q.v.*) and emphasized by canalization. It is suggested that this regularity of course arose from the exposure of the area to strong northerly winds at a time when the climate was drier than it is now. The Transdanubian downs are widely covered with loess, the deposition of fine loam which accounts for about one-third of the surface topography of Hungary. The origin of the loess covering is the subject of much controversy and the various opinions have been summarized and rehearsed by a Hungarian geographer, L. Kádár. He points to the variety of loess formations in Hungary—the widely extended plain loesses, the loess blankets on hill slopes and the specks of it on the fluvial terraces. He accepts the traditional idea of the wind-blown deposits studied by the Silesian F. von Richthofen (*q.v.*) in the mid-19th century and also, in part, the findings of the Soviet scientist L. S. Berg, who contends that all loess formations are water-borne in origin. The steppic basins of middle and lower Danubia are transitional between the huge, compact loess zones of eastern Europe and central Asia, and the scattered loess patches of central and western Europe.

In the south, Transdanubia rises again to the Mecsek massif, a granite highland under 3,000 ft. in height, and with Coal Measures to northeast, centre and south. The alignment of the faulting is like that of the hill backbone, but the massif possibly belongs geologically to the Great Rhodope block, the core of the Balkan peninsula highlands far to the south. The only substantial coal resources of the republic are in this region.

To the northwest of the hill backbone lies the Kis or Little Alföld (Little Plain), through which run the frontiers of Hungary with Austria and of Hungary with Czechoslovakia. The core of this plain is the braided stream of the Danube. Indeed the regime of this great stream in its middle course is the central theme of the physical geography of Hungary. The problems of its variations in level, of the winter ice floes, of its great burden of silt which

chokes and shifts the navigation channels, are ever-present to the Magyars and to some of their neighbours. The Danube emerges from the Little Carpathian gorge at Bratislava and wanders uncertainly through the flat country until the valley narrows again between Esztergom and Budapest to cut through the hill backbone and turn sharply to the south. On the Hungarian side of the river enormous marshlands stretch away south and west to become almost contiguous with the other great frontier marshes of the Fertő or Neusiedler lake. The southern part alone of the tributary Rába basin is more attractive to settlement and land use.

The Nagy Magyar Alföld or Great Alföld (Great Plain), south of the hills and east of the Danube, is enormous by comparison. It is divided into Cumania (the country between the Danube and its Tisza tributary) and Nyírség (the sandy country to the northeast). The Banat, the third lowland region in the southeast, is now in Rumania. In the Great Plain the river systems again are the most conspicuous features, whether as assets or liabilities to the inhabitants. Both the main stream of the Danube and its huge tributary, the Tisza, are subject over much of their courses to violent seasonal flooding. In the upper Tisza the shallow river bed can hardly take the runoff, released in spring by the melting Carpathian snows, especially as there is no lake reservoir to act as a natural check. The flood water surging down the Tisza can in some years meet the Danube high level water at the point of confluence, and the Tisza stream is then forced back on itself with destructive lateral overflow. Long sections of both rivers are diked to control the powerful streams, but in the past catastrophic flooding afflicted the lower Tisza towns. Sporadic attempts to drain the swamp areas of the valleys produced problems akin to those in the English fen—the shrinkage and subsidence of the drained soils and thus the continuous raising of the river beds in relation to the countryside. An aerial view of the plain would show the dominance of the rivers and the attempt to control them —some canalized sections carrying traffic, some braided interlacing natural courses, some old meanders and oxbow lakes, and here and there the dry valley of a former stream.

The second characteristic is the importance of the soil types. This emerged after the mid-19th century, for at that time the Magyars began really to cast off the long-lasting and stultifying effects of the Turkish occupation and systematically to settle and farm the Great Plain. Thus the distinctions became apparent between rich loess, poorer sand and alluvium of varying worth, and the Alföld, from being monotonous grassland, started to acquire the patchwork quilt effect as the rewards of farming became calculable.

2. Climate.—The climate of Hungary is transitional between the mild and moderate conditions of western Europe and the harsh extremes of eastern Europe. The pattern of the prevailing winds and the quantity and distribution of rainfall are affected by the periphery of rugged country to the Middle Danube basin and by the smaller hill backbone. The foehn character of the winds in the Pannonian basin, especially in the summer months, is conspicuous, and the protection of soil and crop against strong, hot, dry destructive wind is one of the great problems of farming, especially on the exposed plain of the Alföld. Throughout the country a long, hot summer from April to September contrasts with the severity of winter. The table shows the wide temperature range between

TABLE I.—*Temperature and Rainfall*

Stations	Height above sea level (in feet)	Mean temperatures (in °F.)			Rainfall (in inches)
		Annual	Jan.	July	
Budapest	502	50.9	30.9	68.9	24.02
Debrecen (N.E.)	423	50.2	28.6	70.0	22.26
Keszthely (Balaton)	436	52.5	30.0	71.4	26.67
Szeged (S.E.)	312	51.6	31.1	71.1	25.58

January and July and the uniformly small rainfalls, although neither of these features is as marked as in lower Danubia beyond the eastern Carpathians. Within the country the heat and drought of the summer months in the east distinguish this part of the Great Plain from the rest and imply a growing need for efficient irrigation if the soil is to be used to the full. (H. G. S.)

3. Vegetation.—In Hungary three altitudinal vegetation zones are found. The first is the zone of woody steppes, to which belong the Nagy Alföld and the south-southeastern slopes of the hill backbone. The succession of plant communities changes on the sandy soil of the Nagy Alföld and on its loess fringes to oak woods and on the plains to riverside forests, while on warm, dry slopes a mosaic of karst (*q.v.*) areas, covered with brushwood, and steppe meadows has developed. The second zone, at moderate altitudes, is of oak woods with Turkey oak (rarely of calciphilous or chalk-loving oaks) and farther up oak woods mixed with hornbeam. The third zone, of beech woods and beech with hornbeam, lies at an altitude between 2,500–3,000 ft. Unmixed beech woods are widespread in Transdanubia and on the Alpine foothills. On the latter, mixed woods of oak and Scots pine or pine woods become dominant.

The Hungarian basin includes parts of four central European floristic provinces. The northeastern corner of the hill backbone belongs to the Carpathian province and the western part of these hills to the Alpine province (beech woods mixed with pine and spruce woods). South Transdanubia belongs to the Illyrian province with Balkan and submediterranean species and wood communities. The Hungarian floristic province can be divided as follows: (1) The northern hill backbone, rich in Carpathian and Pannonian endemic species, glacial relicts and eastern elements. (2) The Transdanubian mountain sector of the hill backbone characterized by submediterranean, Illyrian and subalpine species, preglacial relicts, limestone woods and brush woods of Balkan character. Woods are scattered over these mountains on acid soils, in gorges and rocky places, while grasses are widespread and transition *Sphagnum* moors are found in places. (3) West Transdanubia, or the foothills of the Alps, a transitional region between the Pannonian and Alpine floristic provinces. Its vegetation is calcifuge (acid-loving): pine woods, chestnut groves, *Calluna* heaths. (4) The Nagy Alföld, which was steppe at the beginning of the postglacial period and later woody steppe, and has been cultivated by deforestation and drainage. The original plant cover is disappearing and now survives chiefly on the sandy and calcareous steppes, in riverside groves, in a few oak-hornbeam woods with some relict species, and in fen woods of alder, ash and birch. The steppe species originated partly from the warm slopes of the hill backbone and partly from the Pontic steppes.

The flora of Hungary includes about 2,100 species of seed-bearing plants and about 600 ferns and mosses. (R. So.)

4. Animal Life.—The animal life of Hungary, as might be expected from its geographical position, is typically mid-European, but includes among the mammals such eastern or southeastern forms as the jackal, the suslik or ground squirrel, and the mole rat. The wolf and lynx still occur in small numbers, and among game animals the wild boar, the roe and the red deer are numerous in suitable habitats. The bird life is particularly rich at the two great lakes, Balaton and Neusiedler (on the Austrian border), where waterfowl of many species abound, while among the more interesting larger birds of the Great Plain are the great and little bustards and the black stork. Southwest of Lake Balaton is the Kis Balaton bird sanctuary. Fish (perch, carp, pike, sheatfish) are plentiful in rivers and lakes. (Ro. W. H.)

II. GEOGRAPHICAL REGIONS

In common with most Communist countries the state has evolved new regional divisions based on the actual and potential use of resource. These may in some cases prove more ephemeral and suggest mainly a grouping of productive activities, while the policies of growing industrialization and the reorganization of farming are in process of being tried out.

M. G. Markos, with A. Kez, M. Pecsi and G. Szurovy, in *Magyarorszag földrajza* (*Geography of Hungary*) (1950), outlined the pattern of these regions based on the expectation of expanding production. The first five suggest the growth of industry and trade accruing from the raw materials of the highland backbone and the Mecsek massif.

1. The manufacturing region of Salgótarján in the north has a potential tourist trade in the hill country as well as possibilities of increased coal mining and heavy industry. Urban development

is still meagre and based on three old towns (each with a population under 30,000), Salgótarján, Eger and Gyöngyös.

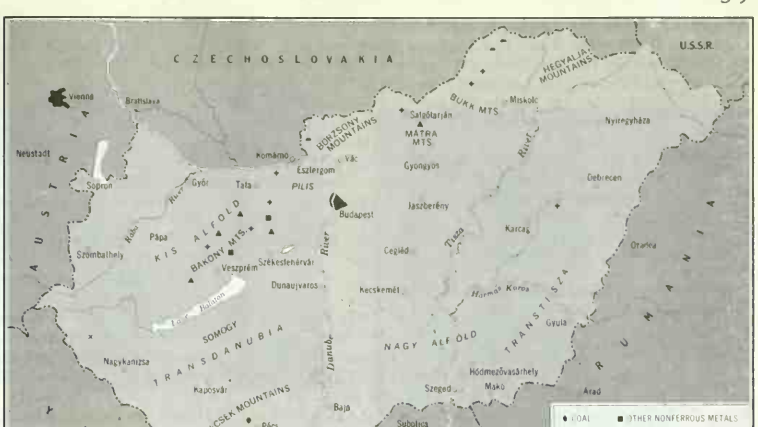
2. The manufacturing region of Borsod-Miskolc in the northeast centres around Miskolc.

3. The industrial region of Tatabánya and Székesfehérvár, including the Vértes group of hills, is noted for bauxite mining and the aluminum industries.

4. The Veszprém industrial region in the Bakony hills has some bauxite mining with a possible development of oil mining in the extreme west near the Burgenland frontier (Nagykanisza, Pápa, Veszprém and Zalaegerszeg [light industries]).

5. Coal is mined in the region of Pécs-Baranya (Pécs, Mohács and Szekszárd).

The possibilities of regional planning based on expanding industry are thus greatest in Transdanubia and the hill region.



FROM P. GEORGE AND J. TRICARD, "L'EUROPE CENTRALE," VOL. II; REPRODUCED BY PERMISSION OF PRESSES UNIVERSITAIRES DE FRANCE

NATURAL REGIONS AND PRINCIPAL MINERAL RESOURCES OF HUNGARY

The other planned regions have a farming rather than an industrial predominance, whether actual or potential.

6. Kis Alföld has a generally rural character of economy which is counterbalanced by the steady growth of Győr with varied manufactures and by the textile and leather production of the old Burgenland cities, Sopron and Szombathely.

7. Somogy, the farming country of the parallel streams between Lake Balaton and the Mecsek massif, produces mainly grain, sugar beet and fruit. Kaposvár has industries based on farming products.

8. The Danube-Tisza region, with a tradition of grain farming, has extreme nucleations of settlement based on rural activity. Its chief towns are Kecskemét, Cegléd, Kiskunfélegyháza, Kiskunhalas, Nagykőrös and Baja.

9. Viharsarok, the southern part of Cumania and the southeastern extremity beyond the Tisza, with great fertility of soil, produces mainly wheat and maize (corn). Szeged shows a rapid growth of textile industries over and above those based on farming. Hódmezővásárhely and Makó are urban developments from old nuclei.

10. The middle Tisza is still largely rural in character with a big production of wheat and maize.

11. The upper Tisza region of the northeast coincides approximately with the traditional Nyírség, in which the discovery of natural gas and the possibilities of irrigation are changing the economic prospects of this once rather desolate part of Hungary. Debrecen is the main city.

The regions have some affinity with geographical criteria, especially the Kis Alföld and the upper Tisza. Viharsarsok is approximately the area of pronounced summer heat, which encourages specialization in maize.

Between the two groups of eastern and western regions with their different potentialities for planning, the capital together with its growing suburbs ranks as a separate and in many ways a key region with a tendency to expansion to the east and south. It suggests one of the classic examples of a capital city's creating a radius of influence which varies according to history and policy, and evolving a region which is nonetheless important for being indeterminate.

III. THE PEOPLE

The ancestors of the present Magyar people took possession of and settled in the Middle Danube basin in the 9th century. They were a group of tribes from the Russian steppes between the Volga and the Urals who, before their migration to central Europe, had already absorbed Turkish features into their Ugric branch of the Finno-Ugric languages (*q.v.*). They settled lands in the Middle Danube basin through the conquest and displacement of previous Hun and Avar peoples. The long history of the old kingdom of Hungary with its Magyar nucleus and rim of heterogeneous hill peoples (Slovak, Ruthene, Rumanian, Serb and Croat) suggests an endless amount of mixture of physical types and cultural influences; so also does a great episode and calamity of Hungarian history, the Turkish conquest and occupation of the 16th and 17th centuries.

L. Bartucz wrote of the variety of physical types in the Hungarian republic. He noted an average stature of 167–168 cm. tending to increase in the east, and that this greater height was noticeable among the Hungarian minority in Rumania; there was a marked breadth of skull (about 87%) in the south, in the neighbourhood of Szeged. He commented too on the occurrence (approximately 25%) of the flattish, concave noses suggesting an original Mongoloid ancestry. The most numerous single racial type appeared to be the Neo-Danubian, accounting for about 35% of the population and with predominance in northeast Hungary. The Dinaric characteristics (about 20%) belonged to the south and southwest, and the most frequent evidence of mixture with the Turks was said to occur in the regions of strongly pastoral tradition.

The question of religious denominations has its own peculiar significance in a country of Communist government. There is no adherence to nor practice of the different forms of Christianity in the normal and independent tradition of Christian Europe, and religion is controlled by the Allami Egyházügyi Hivatal (state office for church affairs). Before World War II about 65% of the population was Roman Catholic, 25% was Protestant (mainly Reformed), 6% was Jewish and 3% was Greek Orthodox. The Calvinist character of the centre and east of Hungary was marked in all classes, especially in the "village-town" communes and among the eastern landowning families. The Jewish minority suffered severely during the German occupation of World War II.

See also HUNGARIAN LANGUAGE; HUNGARIAN LITERATURE; MAGYARS. (H. G. S.)

IV. HISTORY

The history of the countries which were later to constitute the kingdom of Hungary, up to the close of the Roman period, will be found under PANNONIA and DACIA. The Romans were succeeded by Germanic tribes, and these in turn by the Huns (*q.v.*). After the death of Attila (453) his kingdom declined, and Germanic (Gothic) tribes again entered Pannonia and Dacia. The 6th

century A.D. found the Lombards established in Pannonia, the Gepidae in Dacia. The Avars (*q.v.*), allying themselves with the Lombards, crushed the Gepidae in 567 and in the following year they occupied Pannonia, the Lombards migrating to Italy. As the Avar kingdom declined, the western and northern portions of Hungary recovered independence under Slavonic rulers. Charlemagne crushed the Avars between 791 and 797 and established the first Ostmark (*see* AUSTRIA, EMPIRE OF), which probably occupied all the land between the Danube and the Sava rivers. North of the Danube, the important Slavonic kingdom of Moravia (*q.v.*) was founded about 828, while the heritage of the Avars east of the Danube is believed, on slight authority but with great probability, to have been under the suzerainty of the Bulgars.

A. THE KINGDOM TO 1526

The Árpáds.—The Magyars, the founders of the Hungarian state, were by origin a Finno-Ugric people from the Belaya-Kama basin, between the Volga river and the Urals, but they were driven into the steppes north of the Black sea early in the Christian era, and there mingled with Turki peoples. From the 5th to the 9th century A.D. they were living around the mouth of the Don river in a federation known as the On-Ogur (*i.e.*, literally, the "Ten Arrows"), from the Slavonic pronunciation of which the name "Hungarian" is derived. In the early 9th century they were vassals of the Khazars (*q.v.*). They were then organized in seven hordes, or tribes, under hereditary chieftains. The chiefs of the most powerful single horde were also hereditary overlords of the entire nation. Under pressure from their eastern neighbours, the Pechenegs (*q.v.*), the nation migrated westward, accompanied by three dissident hordes of Khazars, known as the Kavars or Kabars, and some other minor Turki tribes. Some of them arrived at the mouth of the Danube in A.D. 889 and took service with the Greek emperor against the Bulgars, who, however, allied themselves with the pursuing Pechenegs. Meanwhile the emperor Arnulf had enlisted the help of other contingents in his war against Svatopluk of Moravia; and, seeing in the Middle Danube basin a place of refuge from its pursuers, the entire nation, under its leader Árpád (*q.v.*), migrated across the Carpathians (896). Although they numbered no more than 25,000, they easily subjected the scattered populations of the central plain, destroyed the empire of Great Moravia in 900 and defeated German forces gathered to oppose them in 907. They were then firmly established in what was then Hungary; but its mountainous and trackless periphery was only gradually brought under effective control and in these areas the earlier, non-Magyar populations, although subjugated, lived on.

The Magyars proper settled chiefly in western Hungary; the Kavars on, and east of, the Tisza. During the early part of the 10th century the invaders repeatedly raided Germany, Italy, the Balkans and even France in search of booty and slaves. The turning point in their history was the crushing defeat inflicted on them by the emperor Otto I on the Lechfeld, outside Augsburg (Aug. 10, 955). Forced onto the defensive, they began to consider the necessity of entering the European political and religious community. Some of their chieftains had already adopted Byzantine Christianity; but Árpád's great-grandson, Géza, who succeeded to the chief leadership in 972 and was able to re-establish its authority after a period of near anarchy, turned to the west. An embassy was sent to Otto II at Quedlinburg in 973, and in 975 Géza and his family were baptized into the Western Church.

Stephen I.—Géza made little headway against the popular opposition, which stubbornly resented the pope's insistence—which would, indeed, have undermined the whole national economic system—that no Christians might be kept in slavery. But he married his son Stephen (István) to Gisela, daughter of Henry II of Bavaria and sister of the future emperor Henry II, in 996(?); and Stephen, when he succeeded his father in 997, crushed the leading representatives of the old regime with the help of armoured Bavarian knights. Pope Silvester II bestowed a crown on Stephen in 1000 or 1001, and Silvester's relations with his former pupil Otto III enabled Hungary to enter the western religious community without admitting the political suzerainty of the empire. Stephen then crushed the last ruler of the Kavars, who had hitherto remained independent, and reorganized his state as a political and religious unit on a system which remained for many centuries the essentially unaltered basis of Hungary's entire social and political structure.

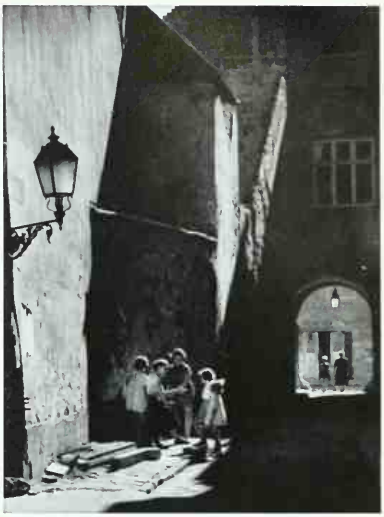
The subdivision into tribes disappeared, as did the separate status of the Kavars and other associated elements, although the social subunit of the clan remained. The freemen, descended from the old Magyar and Turki warriors, retained their personal freedom, which was inalienable except on conviction for proved crime. They were entitled to meet in general assembly, and their lands (which, since the economy was still mainly pastoral, were largely held by each clan as common property) were inalienable and free of any obligation except that of military service. All land not occupied by the freemen (a substantial proportion of the whole) became crown property and its occupants tenants of the crown. Adopting the Frankish model, Stephen divided Hungary into 46 (later, when the effective frontiers were pushed forward, 72) counties (*vármegyek*), each under a count (*comes*), who was a nonhereditary official of the crown. The *comes* exercised jurisdiction over the inhabitants of the county, free or unfree. He collected rents and dues from the unfree tenants; two-thirds of this he transmitted to the royal treasury, keeping one-third for administrative purposes. In war he led the freemen of his county. An impoverished freeman who took service with the *comes* paid dues for any crown land cultivated by him, and an unfree tenant cultivating a freeman's land paid dues to the owner.

The unfree population could not acquire technical membership of the Hungarian *regnum* (*i.e.*, the status enjoyed by the descendants of the old conquerors) except by royal grant; but it was no longer enslaved. The immigrants, who then entered the country in large numbers, could often make advantageous terms for themselves amounting to personal freedom. They were often governed, in minor matters, by their own personal law, and no effort was made to magyarize them. The frontier zone (*gyepü*) was under a special dispensation, its inhabitants usually forming free communities subject to no liability except that of defending the marches. As the effective frontiers were advanced, these areas were absorbed in the county systems. Large parts of Transylvania retained the *gyepü* organization for many centuries. The king's representative and head of the whole administrative system was the palatine.

Ecclesiastically, Stephen divided Hungary into 10 (later 12) dioceses, of which that of Esztergom and later also that of Kalocsa were archiepiscopal. The church was entitled to tithes from all taxable land, and Stephen bestowed large estates on the sees and on the monastic orders, among which the Benedictines were prominent. This order was the main civilizing and Christianizing agent in Hungary, and its foundation of Pannonhalma (1001) was an "archabbey," exempt from episcopal jurisdiction.

The 11th Century.—Stephen, who was canonized in 1083, enjoyed immense personal prestige (*see* STEPHEN I). His rule at home, once established, was unquestioned. He fought few foreign wars and his long reign was thus a period of consolidation and growing prosperity during which the economy largely changed from stockbreeding to agriculture. But when Stephen died in 1038 the country refused to accept Péter, his nephew by marriage and designated successor, and in 1041 put up a rival king, Aba. With the help of his kinsman, the emperor Henry III, Péter drove out Aba (1044), then doing homage to Henry for Hungary and introducing foreign officials and clerics. The Hungarians brought back from Poland three brothers, Stephen's cousins. One of these, Andrew (Endre; 1046–60), expelled and slew Péter and then married his own infant son Salomon to Henry III's daughter Judith and had him crowned king in his own lifetime. The accepted law of succession entitled the eldest male member of the ruling family to succeed, and this act inaugurated a long struggle. Andrew's brother Béla I (1060–63) evicted Andrew with Polish help, but on Béla's death the emperor installed Salomon. Béla's sons Géza and László, representing the national party, revolted in 1074 and expelled Salomon, defeating a German army sent to his aid. It was the moment of the investiture conflict and Géza I (1074–77) appealed to Pope Gregory VII for help, accepting his kingdom in return as a fief of the Holy See. The emperor then abandoned his attempts to sub-

View of Budapest, the capital of Hungary, seen from Gellért hill on the Buda side. The city is split by the Danube and Pest lies across the river to the right



A narrow cobbled street in the capital's older section, Buda

View northeast across Balaton, Hungary's largest lake, from the rocky Tihany peninsula. An ancient Benedictine abbey lies atop the hill and the Biological Research institute of the Hungarian Academy of Sciences is at the foot

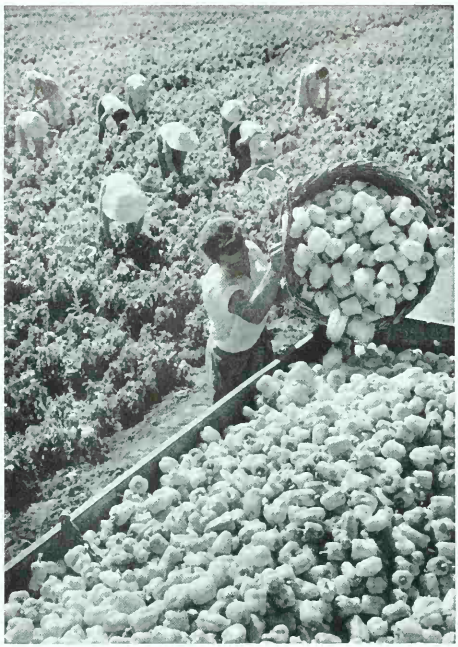
VIEWS OF HUNGARY

Town of Eger in northern Hungary dating from medieval times. Minaret (115 ft.) at left is the sole surviving feature of a mosque built during the Turkish occupation

Aerial view of Győr, capital of Győr-Sopron *megye* (county) near the Czechoslovak border, at the confluence of the Rába (Raab) with a southern channel of the Danube

PHOTOGRAPHS, MTI BUDAPEST

HUNGARY



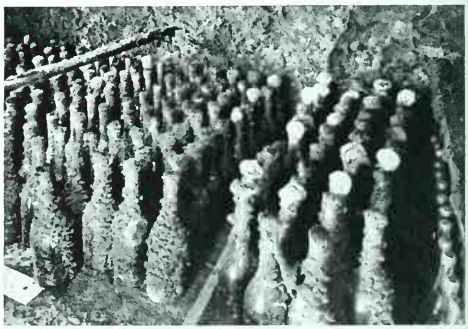
Red pepper harvest at the agricultural research station farm at Szentes in southeast Hungary. Paprika is prepared from the peppers

A hot-rolling mill, part of the centre of iron and steel production, at Dunaujvaros on the Danube

The Herend porcelain factory, northwest of Veszprém in the Bakony mountains. The hand-painted china, mostly copied from old oriental designs, has been famous for more than a century

AGRICULTURE AND INDUSTRY IN HUNGARY

A well for watering cattle, operated by a balance beam, in the Hortobágy *puszta* (steppe) near Debrecen, northeast Hungary



Bottled Tokay wine of old vintage preserved in the wine museum at Tokay (Tokaj), the village which has given its name to the wine produced from grapes grown on the slopes of the nearby Hegyalja

PHOTOGRAPHS: (TOP LEFT, CENTRE) HUNGARIAN NEWS AND INFORMATION SERVICE. (TOP RIGHT, BOTTOM RIGHT) CAMERA PRESS—PIX FROM PUBLIX. (BOTTOM LEFT) MTI BUDAPEST

jugate Hungary. On Géza's death László I (1077–95), a heroic and beloved figure who was canonized in 1192, re-established internal order and reaffirmed the position of Christianity, which had been shaken by two great pagan revolts in 1046 and 1061. By intervening in the affairs of Croatia, he established a claim to the Croatian crown. His nephew and successor, Kálmán (1095–1116), made the claim effective; in 1102 Croatia (later part of Dalmatia) was united with the lands of the Hungarian crown, while retaining its own diet and laws. It was ruled for the crown by a viceroy or ban.

The 12th Century.—Kálmán (Koloman; *q.v.*) revised and modernized Hungary's laws but, although an enlightened and capable man, he was cruel and treacherous. To make the throne secure for his son Stephen, he blinded his own brother Almus and the latter's infant son Béla. Stephen II (1116–31), Hungary's worst king, died childless, and the blinded Béla II ruled from 1131 to 1141. His son Géza II (1141–62), a capable ruler, completed the organization of Transylvania by settling German immigrants, the Saxons, north of its southern passes; the eastern passes were already guarded by the Szeklers (*q.v.*), a magyarized race of Turki origin. Both Saxons and Szeklers were privileged communities, self-governing under the crown, and all Transylvania was governed as a unit under a voivode. Hungary was then little molested from the west, where neither the Austrian nor the Bohemian dukes could threaten its independence, but was involved throughout the 12th century in an intermittent struggle with the rejuvenated Byzantine empire, which disputed its position in Dalmatia, contested its claims in the Balkans and supported rival claimants to the crown. Thus the reign of Stephen III (1162–72) was disputed by his two uncles László II and Stephen IV, who were supported by the Byzantine emperors. Béla III (1173–96) had himself been brought up in Constantinople and was designated to marry the emperor's heiress, when Hungary would have become a vassal of the Byzantine empire, but on his accession he married a French princess and reconstituted Hungary's position. Under him the country achieved great wealth and power, extending its influence far and wide in eastern Europe: Galicia was made a feudatory of Hungary and Serbia a satellite. At home the royal authority was re-established. Urban life developed and western cultural influences penetrated the national life.

The Golden Bull.—Béla's good work was mostly undone by his younger son Andrew, who disputed the succession of his elder brother Imre, or Emeric (1196–1204), expelling the latter's infant son László III in 1205. Both Imre and Andrew bought adherents by lavish grants of crown land. The recipients exercised feudal rule over the crown tenants and even over the local freemen. When Andrew became king as Andrew II (1205–35) he continued this and other abusive practices in order to pay for an extravagant court and a foreign policy of personal ambition and adventure including the crusade on which he set out in 1217. In 1222 the freemen, or "nobles," reacted and forced Andrew to promulgate the famous "Golden Bull," to which every Hungarian king thereafter had to swear, as the basic charter of the national liberties. It was, in fact, essentially a reaffirmation of earlier rights: for the nobles, of those agreed between their forefathers and St. Stephen; for other communities, such as the Saxons, of their charters, fortified by safeguards against abuse on the part either of the king and his officials or of individuals. But the nobles also modernized their rights; thus, as war was no longer a co-operative profit-earning enterprise, they were not to be forced to serve abroad, except for pay. The famous *jus resistendi* gave them the right to resist infringements of the bull. Soon after the nobles gained control of the counties.

The Later Árpáds.—Hardly had Andrew's son Béla IV (1235–70) succeeded his father when the Mongols (*q.v.*) invaded Hungary (1241–42), ravaging and depopulating the country. To reconstruct and defend it, Béla had to invite many new colonists and of necessity to build fortresses and to confer extensive near feudal rights on their seneschals, thus, after all, promoting the power of a new oligarchy. Some of these great "barons" achieved semi-independent status during the troubled times that followed.

Much disorder was caused also by the wild, pagan Kumans who had fled to Hungary in great numbers before the Mongols and molested the country. To bind these unruly elements closer to his dynasty, Béla married his son Stephen V to a Kumanian princess. After a short reign (1270–72) Stephen was succeeded by his son László IV "the Kuman" (1272–90), a wild youth who cared only for his Kuman companions, refused to beget lawful issue and so favoured his pagan friends that Pope Nicholas IV preached a crusade against him. He died without issue, leaving Hungary in turmoil. Local magnates ruled as *de facto* sovereign princes, and rival European dynasties claimed succession to the throne. His partisans succeeded in putting on the throne the last of the Árpáds, Andrew III (1290–1301), but he also died young, leaving no issue.

With him the house of Árpád became extinct. Some of its members had been weak and foolish, but they had enabled the Magyar nation to blend its ancient traditions with the newer ones of western civilization in a synthesis which was at once European and national. Their foreign policy had never been purely individual or dynastic, or at least never foreign-based, so that Hungary was still essentially a national state and subject of its own policy. Although it had good kings thereafter, few of them wholly identified their own interests with those of Hungary.

The Angevins and Sigismund.—The crown was then claimed by Wenceslas II of Bohemia for his son Wenceslas III, by Otto III of Bavaria and by the papal candidate, Charles Robert of Anjou, of the house of Naples, then still a child. After a confused struggle, Charles Robert was left in possession as Charles I of Hungary (1308–42). After growing to manhood, he gradually established his authority, and peace and prosperity returned. Under his reign and that of his son Louis (Lajos) I the Great (1342–82), who in virtue of a compact with his father-in-law Casimir III the Great of Poland also ruled over Poland after 1370, Hungary enjoyed great power and prosperity. The newly born Rumanian principalities of Moldavia and Walachia were at first under Hungarian suzerainty. A chain of banats was organized in the northern Balkans, and Bosnia and Serbia were made vassals.

It is true that during the latter years of Louis' reign Hungary was increasingly threatened by the advance of the Turks, before which threat Louis had to acknowledge the independence of the king of Bosnia. But Hungary itself was hardly yet directly menaced so long as Serbia stood. In Italy the Angevins followed an ambitious dynastic policy that for a time brought their house splendid successes, although it cost the nation a disproportionate price in blood and wealth. However, the exploitation of the gold and silver mines of the Szepes or Spis area (the yield of which fell to the royal treasury) brought the Angevin kings immense resources. Their domestic rule was rather despotic, as they seldom convoked the diet, but they respected the acquired rights of the various classes of the population. Imbued as they were with the ideas of western feudalism, they did not seek to abolish the "magnate" class, only replacing the turbulent oligarchs who had disputed their rule with new men loyal to themselves: in this era, indeed, the "prelates, barons and notables" appeared as a constitutional factor distinct from that of the "common nobles," but membership was ex-officio, not hereditary. As, however, the great landowners were then made to supply contingents (*banderia*) of their own tenants for war, to supplement the noble *levée en masse*, the structure of Hungary became partially feudal.

When Louis died in 1382 his daughter Mary was crowned. A rival, Charles of Naples, was crowned in 1385 but was assassinated the next year. Mary survived to marry Sigismund of Luxembourg (1387) who ruled with her until her death in 1395, then alone until 1437. His first years were greatly disturbed by his struggles with the partisans of the Neapolitan dynasty and by the Turkish danger, which had become pressing after the annihilation of the Serbian power at Kosovo (1389). Sigismund led a crusaders' army into the Balkans but was heavily defeated at Nikopol (1396) and barely escaped with his life. After this he followed a defensive policy in the south, converting Belgrade into a large fortress. But Serbia was lost to the Turks, and elsewhere Sigismund suffered setbacks also. Bosnia, Walachia and Moldavia renounced their allegiance; Dalmatia was lost to Venice; the Szepes mining towns were pledged to Poland.

Sigismund's frequent and prolonged absences from Hungary after he became Roman emperor and king of Bohemia were unfortunate for the country. The oligarchy recovered its power and there was much social unrest, partly occasioned by the spread of Hussite doctrines from Bohemia. The nation felt itself sacrificed to foreign interests.

János Hunyadi.—Consequently, although the estates accepted Sigismund's son-in-law Albert of Austria (1397–1439) as his successor when he died, they did so only with the stipulation that he should not accept the imperial title or reside outside Hungary without their consent; in his absence he was to be represented by the palatine, who was to be elected jointly by the king and the estates. Crowned king of Hungary on Jan. 1, 1438, Albert was in fact elected German king as Albert II in March 1438 but died in Oct. 1439, leaving his widow Elizabeth with child.

To avoid an interregnum, the estates elected Wladyslaw III Jagiello of Poland king (Uászló I) but when he fell in the disastrous battle of Varna (1444) they accepted Albert's posthumous son as László V, appointing as his guardian and governor of Hungary the great hero János Hunyadi (*q.v.*), who had been successfully defending Hungary and, in particular, Transylvania against repeated Turkish attacks. He kept up the defense under increasing difficulties, being constantly thwarted by the jealous magnates and harassed by the Czech mercenary Jan Jiskra, while the emperor Frederick III encroached on the western provinces. László himself had been brought up in Austria; his supporters were identified in the national eyes with the Austrian-based and feudal Habsburg rule. Hunyadi died in 1456, immediately after winning a last great victory over the Turks at Belgrade. László's partisans, led by Ulrich of Cilli, instigated the murder of Hunyadi's elder son, László; but soon afterward the young king himself died, whereupon the common nobles, asserting their ancient claim—never yet formally abandoned—that the monarchy had been elective since the extinction of the male line of the Árpáds, proclaimed as king Hunyadi's surviving son Matthias (Mátyás) Corvinus.

Matthias Corvinus.—The only national king to reign over all Hungary after the Árpáds, Matthias Corvinus (1458–90) has been much lauded by the historians of Hungary. He was in truth a brilliant figure, an enlightened despot in advance of his age; a strong ruler, an efficient administrator, a patron of the cities and of the arts and letters. He reformed the administration, reorganized justice, founded a new university, curbed the oligarchy, protected the peasants. But although he began by buying off the emperor (whom a party of nobles had elected antiking), cultivating friendship with the Bohemian George of Podebrady and carrying on his father's work in the Balkans, he soon dropped or at least postponed the idea of serious offensive operations against the Turks (although conducting further successful but limited campaigns in 1463 and 1476) and engaged in ambitious schemes in the west. He dreamed of uniting central Europe under his own rule and of acquiring the imperial crown. He attacked Bohemia in 1468 and was crowned king by the Catholic party there; under the peace of Olomouc (Dec. 7, 1478) he had to allow George's successor Vladislav (Wladyslaw, son of Casimir IV Jagiello of Poland) to share the royal title and rule over Bohemia, but kept Moravia, Lusatia and Silesia under his own rule. In 1477 and again in 1485 he besieged Vienna, taking it in the latter year, whereupon he annexed Austria, Styria and Carinthia. To help him achieve his ambitions, he organized a standing mercenary force, known as the "Black army," largely drawn from Silesia and Moravia, for the upkeep of which he forced even the Hungarian nobles to pay. He retained his popularity to the last among the small nobles and was deeply beloved by the peasants, but earned the bitter hatred of the great oligarchs; when he died suddenly in 1490, not only did his Czech and Austrian possessions at once break away from Hungary (which had benefited little by his conquests) but a strong internal reaction set in. (*See* MATTHIAS I.)

The Jagiello Kings, 1490–1526.—The throne was now claimed by two Jagiello brothers—Vladislav, king of Bohemia since 1471, and his younger brother John Albert—and by Maximilian of Habsburg, while the lesser nobles favoured the succession, which Matthias himself had been trying to secure, of his illegitimate son John (János) Corvinus. The magnates favoured Vladislav, precisely because he was notoriously weak. Hiring the Black army for the coup, they got Vladislav crowned (he reigned as Uászló II, 1490–1516). John Albert stood down in favour of his brother, and John Corvinus did not press his own claim. Maximilian, by the treaty of Pressburg (Hungarian, Pozsony; Slovak, Bratislava; Nov. 7, 1491) agreed to recognize Vladislav in return for the restoration of the Austrian provinces, an indemnity and a promise of the succession for himself or his issue if Vladislav died without male heirs. The Habsburg connection was very unpopular in Hungary, and the diet refused to ratify the treaty; but Vladislav considered it binding on himself and soon slipped into the position of Maximilian's friend and client. He had got himself into a complicated matrimonial tangle which long prevented him from begetting lawful issue. At last he succeeded in marrying lawfully the French princess Anne de Candale, but her first child was a daughter, Anne. The national party, led by John (*q.v.*) Zápolya, voivode of Transylvania, extracted from the diet of 1505 a resolution never again to accept a foreign king. But then a son was born (1506). Zápolya's Polish ally, King Sigismund I, changed his anti-Habsburg policy in return for renunciation by the Habsburgs of their claims on Poland, and agreement was reached in Vienna (1515) whereby Louis married Maximilian's granddaughter Anne, while his sister was betrothed to Maximilian's grandson Ferdinand. A double link then joined the Hungarian crown with the Habsburg dynasty.

Meanwhile the magnates, having used the Black army to achieve their purposes, had stipulated that it should be disbanded and Matthias' other "innovations" cancelled. Vladislav was a powerless puppet. He had to consent to strict limitation of the royal prerogatives; thus in 1507 the principle was established that no royal decree was valid unless confirmed by the royal council. His resources were so diminished by the extravagance and peculations of his entourage that at times he was literally dependent on charity for his personal upkeep. With the king out of the ring, the magnates and the small nobles fought bitterly for control. The latter strengthened their constitutional rights, on paper, considerably. They secured the passage of many laws safeguarding their position both in the central and in the local government and also the great codification of Hungarian customary law produced in 1514, under the name of the Tripartitum, by the jurist István Werbőczy (himself a member of the lesser nobility). This work, although never promulgated as law, was universally taken, up to 1848, as the authoritative handbook to the Hungarian constitution, reaffirming all the cardinal liberties of the Hungarian nobility and laying down the principle of the equality in law of all nobles. In practice, however, the magnates could take advantage of the near anarchy to direct the affairs of state and to acquire enormous individual fortunes.

As everywhere in central Europe at the time, the position of both the towns and the peasants declined rapidly. Many oppressive decrees were passed against the peasants. Then in 1514 the cardinal Tamás Bakócz collected about 100,000 of them for a crusade against the Turks. Their commander, György Dózsa, instead turned them against the lords. They were put down after atrocious fighting, and Dózsa was tortured to death in horrible fashion. The diet of 1514 condemned them to "real and perpetual servitude" and greatly increased their burdens.

When Vladislav died on March 13, 1516, his son was proclaimed king as Louis II, being then only ten years old. Rival cliques squabbled for control, and the nation's interests were ignored. Defense, in particular, had been totally neglected since Matthias' death. The Turks had been quiet for 30 years, but in 1521 the sultan Suleiman the Magnificent suddenly sent Louis a demand for tribute. It was refused, whereupon Suleiman assaulted and reduced the fortresses of Sabac and Belgrade. Granted a respite by the sultan's decision to proceed first with the conquest of Rhodes, the Hungarian nation then suddenly became alive to its danger and voted the re-establishment of a standing army; but little was done to raise the force, as each party tried to put the burden of its upkeep on the other. Appeals for help from abroad met with only a small response.

Suleiman renewed his advance in the summer of 1526. Péter-

várad (Peterwardein) fell at the end of July. The general *levée* had been proclaimed and Louis, having gathered a few thousand men round him, moved slowly down the right bank of the Danube, to give time for the local contingents to join him. But there was disorganization, delay and contradictory orders. The most important forces—Zápolya's from Transylvania and Krsto Frankopan's from Croatia—failed to appear. On Aug. 28 Louis made contact with the Turkish army in front of Mohács and, although his force consisted only of about 16,000 Hungarians and 2,000 mercenaries, decided, on the advice of Archbishop Paul Tomori of Kalocsa, to give battle. On Aug. 29 the Hungarians attacked; the king and his whole government led the centre of the line. The little army was utterly routed; Louis, one of the few survivors of the fighting, was drowned in his flight. The sultan could not believe that this pitiful array which he had so easily overcome could be the national army of Hungary. Advancing with extreme caution, he occupied Buda on Sept. 10, but speedily returned across the Danube, taking with him more than 100,000 captives. By the end of October the last Turkish regular had left Hungary; but where the armies had been it was as utterly destroyed as if a flood had passed over it.

B. The Period of Partition, 1526–1699

When the Turks were gone, one party of nobles elected Zápolya king (Nov. 10, 1526); but Louis II's brother-in-law, Ferdinand, archduke of Austria and later Holy Roman emperor as Ferdinand I, also claimed the throne in virtue of the Habsburg-Jagiello family compact, and his adherents crowned him, too, in 1527. An internecine struggle, in which Suleiman supported Zápolya, went on until 1538, when by the secret treaty of Nagyvárad, mediated by György Martinuzzi (*q.v.*), Hungary was divided: Ferdinand took western Hungary with Croatia; Zápolya had the remaining two-thirds, with the royal title and his capital at Buda, and Ferdinand was to succeed on Zápolya's death. Zápolya, however, remarried and begot a son, John Sigismund (1540–71), whom on Zápolya's death in 1540 his adherents elected king. Ferdinand asserted his claim and laid siege to Buda. Suleiman then, posing as John Sigismund's protector, himself occupied Buda (1541) and in subsequent campaigns conquered most of central Hungary. He granted Ferdinand a truce in 1547, allowing him to keep western Hungary subject to payment of an annual tribute. Central and southern Hungary were incorporated in the Ottoman empire, while Transylvania and the counties adjacent to it became an autonomous principality under the suzerainty of the sultan.

The tripartite division of Hungary was to last, with minor changes, for about 150 years, for several efforts made by Ferdinand to obtain possession of Transylvania were unsuccessful. Ferdinand's successor, the emperor Maximilian II, concluded the peace of Adrianople in 1568, recognizing the autonomy of Transylvania. Turkish Hungary suffered terribly in this period. It was rendered largely uninhabited and, indeed, uninhabitable. Such of its Magyar inhabitants as were not annihilated by war, plague or starvation, or carried off into slavery, clustered into the great village-towns of the plains, which afforded them a partial protection. Their places in the open country, which had largely reverted to swamp and forest, were taken by Serbian or Vlach shepherds. "Royal" Hungary was spared utter devastation, but ruled by the Habsburgs from Vienna, with scant regard for the national liberties and traditions. These survived best in Transylvania, in the internal affairs of which the Sublime Porte did not attempt to interfere. It developed its own constitutional system, based on political representation of the three "nations" of Hungarian nobles, Saxons and Szeklers, and on religious freedom and equality among the four "received" religions—Roman Catholic, Calvinist, Lutheran and Unitarian. The religious question, above all, gradually brought Transylvania into conflict with the Habsburgs, for in all Hungary, before Mohács, the tenets of Protestantism had won wide acceptance, its Calvinist form ultimately prevailing among most of the Magyars, while the Germans and some of the Slovaks remained Lutheran. Thus after war had broken out again between the empire and the Porte in 1593 and Sigismund Báthory (*q.v.*) of Transylvania had helped the former to victory, the imperial general, Giorgio Basta, initiated so cruel a persecution of the Transylvanian Protestants that István Bocskay (*q.v.*), the elected prince of Transylvania, expelled the imperial armies with Turkish aid and, by the peace of Vienna (June 23, 1606), forced the emperor to promise to respect political rights and religious freedoms in all Hungary, besides recognizing Bocskay himself as independent prince of an enlarged Transylvania.

The next half century was Transylvania's golden age. Its princes were in practice wholly independent and the country prospered politically, economically and culturally. Gabriel (Gábor) Bethlen (*q.v.*; 1613–29) intervened repeatedly against the emperor Ferdinand II in the Thirty Years' War; György (George) Rákóczy I (1630–48) forced Ferdinand III to reaffirm Hungary's political and religious liberties (the peace of Linz, Dec. 16, 1645). In spite of this, absolutism and Counter-Reformation gained ground in royal Hungary. Péter Pázmány, primate from 1616 to 1637 and founder of the university of Nagyszombat (Trnava), reconverted most of its nobles to Catholicism.

The Turkish power revived when Mohammed Köprülü became grand vizier under Sultan Mohammed IV in 1656. The next year he re-established effective Turkish suzerainty over Transylvania. Miklós Zrinyi pleaded for a national army to drive the Turks out of Hungary with the help of the imperial armies; but the new emperor, Leopold I, wished to placate the sultan in order to free his hands in the west. Thus, although the Turkish army was heavily defeated at Szentgotthárd (Aug. 1, 1664), the ensuing peace of Vasvár actually left the sultan holding more Hungarian territory than ever. A group of magnates, led by the palatine Ferenc Wesselényi, thereupon conspired to expel the Habsburgs with Turkish and French help. The plot was betrayed and its leaders executed (1670). Leopold's Hungarian advisers, György Szelepcsényi and Lipot Kollonics, renewed the cruel persecution of the Protestants, which provoked a new rising, led by Imre Thököly (1678). His successes inspired the Turks, who led a great army against Vienna (1683).

Then the tide turned. After failing to take Vienna, the Turks were driven back gradually. Buda was recaptured in 1686, all central Hungary and Transylvania cleared in the following years. The peace of Karlowitz (Karlovci; Jan. 26, 1699) left the emperor in possession of all historic Hungary except its southeastern corner.

C. The Habsburg Monarchy, 1699–1918

As his armies advanced, Leopold consolidated his power. He forced the diet of Eperjes (Presov) to accept the hereditary title of the Habsburg dynasty in the male line in 1687 and to renounce the *jus resistendi*. A separate administration was set up for Transylvania (1691) and the southern fringe of Hungary was organized as a Military Frontier directly under Vienna. Other areas left desolate by the Turks, or rendered so during the wars of liberation, were declared *neoacquisita*, or at the disposal of the crown, and bestowed on imperial adherents, Hungarian or foreign, or kept as crown property. Confiscations were wholesale and religious persecution intense.

One more great rebellion broke out in 1703 when the emperor, involved in the War of the Spanish Succession, withdrew almost all his troops from Hungary. The first insurgents in this case were mainly peasants or masterless men, but they found a leader in the young and idealistic Ferenc (Francis) Rákóczy II, scion of Transylvanian princes and the greatest landowner in northern Hungary, and he was soon joined by many nobles (*see* Rákóczy). So long as Leopold was fully occupied in the west, Rákóczy's movement met with considerable success, but the Hungarians' cause was doomed once the battle of Blenheim had destroyed the hope that France would send any serious aid. A declaration by the diet of Onod dethroning the Habsburgs and proclaiming Rákóczy prince (1707) was a last attempt to secure effective help from abroad, and the Hungarians' faith in their own cause flagged. But Joseph I, who had succeeded his father in 1705, desired peace, and in 1710 negotiations were opened between Count János Pálffy, the Hungarian commander on the imperial side, and Rákóczy's lieutenant, Count Sándor Károlyi. Interrupted by Joseph's death in April 1711, they were successfully concluded immediately after: a meet-

ing of civil and military leaders at Szatmár (Satu Mare) on April 26 agreed that Hungary should lay down its arms in return for the promise of the new monarch Charles VI (III; 1711–40) to grant a general amnesty, to stop the confiscations, to respect the constitutional and religious position as defined in 1687 and to consider complaints at a diet which was to be convoked.

This general understanding was elaborated in the following years in detailed agreements which formed the basis of Hungary's relations with the Habsburgs up to 1918. Charles promised in 1715 and again in 1723 to respect the rights of the estates and of the Hungarian nobility; to rule Hungary through its diet, which was to be convoked regularly, and only in accordance with its own laws, existing or to be legally enacted, and not "after the pattern of other provinces"; to defend its integrity; and not to incorporate any part of it in his other dominions. In return the diet of 1723, following the initiative of the Croat delegates, accepted the Pragmatic sanction allowing the female succession of the Habsburgs; so long as this lasted, Hungary would regard itself as united "indivisibly and inseparably" with the monarch's other dominions, this union being valid "for all events and also against foreign enemies."

At the same time the diet accepted, and even begged for, the institution of a standing army for the national defense, quartered in Hungary but to be composed of two-thirds "foreigners"; it consented to pay for the upkeep of this force (by taxation levied on the socage peasants), provided only that the money and contingents must be voted by itself. This was a move necessitated by Hungary's exhaustion and depopulation, but it proved very detrimental to the national cause; a separate Hungarian war council should have been set up, but this was never done, so that a mainly non-Hungarian force, controlled from Vienna, became a powerful instrument of centralized rule.

In many other respects Charles interpreted his undertakings somewhat elastically. Transylvania and the Military Frontier were not reunited with inner Hungary; and when after another war the Turks evacuated their last holdings in Hungary (peace of Passarowitz, March 13, 1718), the area recovered, afterward styled the Bánát of Temesvár, was likewise kept as a separate unit, governed from Vienna, and was colonized with non-Magyars, mainly Germans. The promised independence of the Hungarian chancellery and other central organs, especially that of the camera, was only nominal; the diet was left unconvoked; and a religious settlement imposed by Charles in 1731, after the Hungarians themselves had failed to agree, left the Hungarian Protestants not very much better off than their Austrian coreligionists.

Maria Theresa.—The picture did not alter radically when Charles was succeeded by his daughter, Maria Theresa (1740–80). The famous agreement between the young queen and the diet was in fact reached only with difficulty and after hard bargaining. After this Maria Theresa seldom convoked the diet, and she restored neither the integrity of the country nor the independence of its central governmental institutions. Yet she was grateful to the Hungarians for having saved her throne, respected their fundamental privileges and refused to extend her new centralizing reforms to Hungary. She drew the higher aristocracy into her system, giving them posts in the army and diplomacy, as well as the Hungarian offices, and created some real attachment to Habsburg rule among them. The greatest benefit conferred by her rule on Hungary was that of peace, which brought with it, above all, a great increase of population. The accepted figures (which may, indeed, be rather too low) put the total population for the whole country, including Transylvania, at only about 2,500,000 in 1715. By the end of the century this figure had been trebled. This enabled wasteland to be brought under cultivation, agricultural production to increase and wealth derived from it to accumulate, as evidenced by the splendid new palaces which began to adorn parts of the country and the smaller towns. On the pretext that it was paying less than its proportionate share of taxation, Hungary was excluded from the planned and subsidized industrialization of the monarchy which began in earnest in Maria Theresa's reign; it was to be kept as the agricultural complement to industrial Austria. Its own industry hardly rose above the handwork level. Its towns were little more than market centres, themselves half agricultural; the small burgher class was, incidentally, mainly German-speaking. The gold and silver mines were becoming exhausted. And even agriculture could not be commercially profitable, except under special conditions. Communications were so bad that only estates near the frontier, or near a waterway, could export bulk commodities such as wheat. Since a noble's land was inalienable, he could not mortgage it for improvements or pay hired labour. He had to squeeze what he could out of his peasants, whose conditions remained deeply unsatisfactory, although in 1767 Maria Theresa, against the opposition of the nobles, forced through an *urbarium* limiting the peasants' burdens.

Most serious of all, in the long run, was the decline of the Magyar element in the population. The magnates became half denationalized; and although the class thus affected was small, it was politically most important. Furthermore, the growth of the population had been due largely to immigration and colonization by non-Magyars and it was also the Magyar areas which had suffered most severely under the Turkish occupation. The Slovaks, Ruthenes and Rumanians of the mountains had suffered less and began to spill down into the plains; some of them were settled by landlords deep in the plain. Large numbers of German colonists were brought in and Serbs and Rumanians from the Balkans sought refuge in Hungary. The whole centre of the Croat people moved northward. According to Hungarian estimates, the Magyar-speaking population of the country had been about 75% of the whole in the 15th century; by 1790 the figure was probably under 40%. Only the central plains were then Magyar by majority; the north, chiefly Slovak; Transylvania, more than half Rumanian; southern Hungary, German and Serbian. Among the non-Magyars the Serbs, in particular, formed an alien and hostile element; 36,000 families led by their patriarch had entered Hungary en bloc in 1692. They should have returned to their homes when these were liberated, but as the liberation never ensued, they remained in Hungary. The Hungarians succeeded in thwarting their request to receive territorial and political autonomy, but they retained ecclesiastical autonomy under their patriarch and were always a willing instrument if the imperial authorities required one against the Hungarians; the easier to hand, because many of them were settled in the Military Frontier area.

Joseph II.—When Maria Theresa died, Joseph II (1780–90) hoped to weld his dominions into a centralized state, autocratically ruled on enlightened principles. Postponing his coronation, to escape the obligation of swearing to respect the Hungarian constitution, he introduced by decree many measures, some of them in themselves salutary, in furtherance of his ideas. His Toleration patent accorded greater freedom both to Protestants and to Jews; the peasants received further alleviations; the guilds were reformed. But then, in 1785, after uniting Transylvania and the Bánát with inner Hungary, he divided the whole, including Croatia, into ten districts, each under a royal commissioner. The counties were reduced to simple executants of the commissioners' orders. In 1787 German was introduced (in the place of Latin) as the language of administration and justice. Finally, preparations were made to introduce a general land tax.

The resistance, in which interest and national sentiment mingled, was fierce and widespread. Taxes and supplies were refused and Hungarian malcontents sought contact with Prussia. Smitten by illness on his ill-fated Turkish campaign, Joseph was forced to retract all his decrees relating to Hungary except the Toleration patent, the decrees in favour of the peasants and one other (Jan. 28, 1790), promising to convoke a diet and to send the holy crown back to Hungary. Three weeks later he died.

Leopold II and His Successors to 1848.—Joseph's brother and successor, Leopold II, convoked the diet, submitted to coronation and confirmed the fundamental pacts concluded a century earlier between the crown and the nation. Joseph's administrative innovations and his land tax were dropped. Leopold died suddenly on March 1, 1792. His timid and narrow-minded successor, the Austrian emperor Francis I (Francis II as Holy Roman emperor) (1792–1835), believed safety to lie only in a complete freezing of the *status quo;* and the prosperous Hungarian nobles, equally

frightened of revolution coming from above (as under Joseph II) or from below (as in France), were only too willing to put aside dangerous ideas, even at the price of shelving desired reforms; the so-called "Jacobin conspiracy" of Ignazius Martinovics (1794) was the work of a few men only. The magnates were the more willing to drop agitation because the country was making good money out of supplying the armies during the Napoleonic Wars, which hardly touched Hungarian territory. Thus a long period of political calm ensued, which was, indeed, accompanied by a remarkable linguistic and cultural revival, partly a reaction against Joseph II's attempted germanization, partly a product of the spirit of the age. This renaissance gave the Magyar people increased self-consciousness and self-confidence and set their national feeling on a broader basis, while carrying within it the seeds of later conflicts with the non-Magyars of Hungary.

The political truce with the crown was never cordial and there was a sharp conflict over finance in 1811. Francis dissolved the diet and ruled without it for several years. However, the wartime prosperity had passed and tempers were rising, and when in 1823 Francis tried to raise recruits and supplies by unconstitutional means, there was such resistance that he had to convoke the diet in 1825 and regularly thereafter. For several years the diet, although bolder than before and more impatient in demanding redress of grievances, went no further than its immemorial demand for respect of its ancient liberties. But a great reform movement was set on foot *c.* 1830 by Count István Széchenyi (*q.v.*), who declared boldly that the constitution itself was out-of-date and called for drastic reforms which could be achieved only at the expense of the old privileges. He thought, however, that social and economic reform should come first and should be achieved by the nation itself, at the cost of personal sacrifices (in which he himself set the example). He solemnly warned the nation against tampering with the link with Austria. He was soon shouldered aside by a younger generation whose mouthpiece was the fiery Lajos Kossuth (*q.v.*), who championed the introduction of every kind of liberal reform with fervour and unexampled eloquence but maintained, with some justice, that no real progress could be made until the control by Vienna was removed, and thus turned the national movement back into a political struggle for national independence, although this was sought not only for its own sake, but as the necessary preliminary to political and social reform.

The reform movement quickly gathered momentum. The best men in Hungary, such as Ferencz Deák and Baron József Eötvös, joined it. The council, which after Francis' death ruled Austria for the simple Ferdinand, wavered between severity and appeasement. Pro-Austrian officials were appointed in 1837 and Kossuth and others were imprisoned; the prisoners were released in 1840 and emerged as popular heroes. Metternich then allied himself with the Progressive Conservatives, a group of young magnates led by György Apponyi, with a program of material benefit and some social reform combined with political authoritarianism. In reply, Deák united the reformers in 1847 on an oppositional declaration, which called for a responsible, genuinely national, government; extension of the franchise, national and local, to non-nobles; general taxation; compulsory abolition (against compensation for the landlords) of the peasants' dues and services; equality before the law; equality for all recognized religions; union with Transylvania; and freedom of the press and of assembly. The elections to the 1847 diet brought into the lower house a strong party pledged to this program and led by Kossuth.

Croatia and the "Nationalities."—Meanwhile, the Croats and the non-Magyars of inner Hungary had entered the struggle. Friction between the Hungarian and Croatian estates had begun when the former pressed for the replacement of Latin by Magyar in the diet and civil services. As the Magyar national movement became more widespread and more impatient, it was countered by an equally headstrong Croat nationalism, vociferously hostile to Hungary and anything Magyar. A variant of this movement wanted to unite the Croats with the Serbs and other southern Slavs in an "Illyrian" nationality and polity. The wish for autonomy revived among the Hungarian Serbs and there were similar stirrings among the Slovaks. The Hungaro-Magyar chauvinists replied by pressing through the diet legislation on the use of the Magyar language in public life and education which did real injustice to the non-Magyars, denouncing their protests as treason and telling them that their duty to their state and to the cause of liberty and progress was to become Magyar. Most of the German burghers of western and central Hungary, the Jews and some of the Slovaks magyarized willingly enough, but among the more acutely conscious nationalities pressure only stimulated resistance, creating an explosive situation which presented Vienna with willing allies.

The picture was reproduced on a smaller scale in Transylvania. There the Rumanians had begun to revolt against their inferior status in the 18th century. A terrible *Jacquerie* of the oppressed peasants had occurred in 1784. Leopold II had refused the Rumanians' request for recognition as a fourth "nation." When extreme Magyar nationalism spread to the Hungarians of Transylvania after 1840 and the diet enacted linguistic legislation modeled on the Hungarian example and demanded union with Hungary, the Rumanians renewed their protests, in which the Saxons then joined.

The Revolution of 1848.—Conservatives and reformers were at loggerheads in the diet when, on March 3, the news of the revolution in Paris reached Pozsony and gave Kossuth his chance to press through the lower house an address to the crown calling for a responsible Hungarian ministry. On the outbreak of revolution in Vienna on March 13 and the fall of Metternich, Kossuth induced both houses to accept an amplified address which included all the opposition's demands. On March 17 the harassed monarch appointed Count Lajos Batthyány provisional prime minister. On April 7 he agreed to Batthyány's list, which included Deák (minister of justice), Kossuth (finance), Eötvös (education) and Széchenyi (communications and public works). On April 11 Ferdinand gave formal sanction to the April laws which embodied the reformers' program.

Ferdinand's Slavophile minister, Count Franz Anton von Kolowrat-Liebsteinsky, had, however, before his retirement, secured the appointment of Josip Jelacic (*q.v.*) as ban (governor) of Croatia. Jelacic repudiated the authority of the Hungarian diet, declaring that he accepted that of Vienna only, replaced Magyar officials by Croats and proclaimed martial law. The Hungarian Serbs demanded complete autonomy (May 13) and when this was refused made contact with the Croats; analogous, although less far-reaching, demands came from Slovaks and from the Rumanians. The court at first supported Batthyány, who had offered to send troops to Italy; Jelacic was disavowed and dismissed. But the Hungarians set up their own national army (invoking the danger from the southern Slavs) and Kossuth attached impossible conditions to the dispatch of the troops to Italy. Meanwhile, the revolutionary stirrings in Galicia had been crushed; the Czechs were seeking alliance with the crown; and although Vienna remained in a semi-revolutionary state and sought to make common cause with the Hungarians, the provinces had withdrawn their support and the danger presented to the monarchy by Pan-German liberalism was dwindling. When Josef Radetzky's victory at Custozza (July 22–25) set free the imperial armies in Italy, the emperor reinstated Jelacic on Sept. 4 and he invaded Hungary on Sept. 11. Last efforts at mediation having failed when the mob of Buda lynched the intermediary, Count Franz Philipp Lamberg, the court placed Hungary under martial law and appointed Jelacic its plenipotentiary. The Hungarian ministry resigned, leaving Kossuth in charge at the head of a committee of national defense.

War of Independence.—At first the Hungarians, helped by a further revolutionary outbreak in Vienna, defended themselves successfully, but Prince Alfred von Windischgrätz reduced Vienna. The court camarilla replaced Ferdinand by his young nephew, Francis Joseph, on Dec. 2, 1848. He issued a proclamation declaring his intention of "uniting all lands and peoples of the monarchy in one great state." Kossuth declared the change illegal and called on the nation to resist it. Armies under Windischgrätz and Jelacic invaded Hungary and took Buda (Jan. 5, 1849) and the Hungarian government retired to Debrecen. On March 4 a new Austrian constitution was issued at Olomouc (Olmütz). It abrogated all Hungary's separate institutions that were contrary to its

own provisions, which in effect meant all of them, treated Transylvania and Croatia as separate crown lands and promised a separate status to the Hungarian Serbs. The Hungarian diet replied on April 14 by declaring the Habsburgs forfeit of the throne, and Hungary an independent state. Kossuth was elected governor.

Meanwhile, the Hungarian armies, especially those of Arthur Görgey (*q.v.*) in northern Hungary and of Gen. Jozef Bem (a Pole) in Transylvania, had won considerable successes; the capital was reoccupied on May 25, 1849. But the Russian emperor Nicholas I came to Francis Joseph's help. A Russian army under Gen. I. F. Paskevich invaded Hungary from the north, another Austrian army, under Gen. J. J. Haynau, from the west. Dissension broke out among the Hungarians: between Kossuth and Görgey, between moderates and extremists. The Hungarians were driven back, and after their main army had been defeated by overwhelming forces at Temesvár (Timişoara; Aug. 9), Kossuth handed over his powers to Görgey on Aug. 11, who surrendered to the Russians at Világos on Aug. 13. Kossuth fled the country.

Repression and Reaction.—Haynau began by having Batthyány executed in Budapest and 13 senior officers, thereafter known as the "martyrs of Arad," executed at Arad (Oct. 6, 1849). Many other people were executed or imprisoned. On Oct. 17 a provisional administration was introduced, which cut off from Hungary Transylvania, an enlarged Croatia-Slavonia (with Fiume), the Military Frontier and a Serbian Voivodina in the south; the rest of the country was divided into five districts. The autonomy of the counties and municipalities was suspended and the whole country was ruled through a mainly non-Hungarian bureaucracy, assisted by a newly created gendarmerie. The various nationalities inhabiting Hungary were declared equal and their languages equal also; but in practice German was the sole language of administration and education on all except the lowest levels. In all this, the military were gradually replaced by civilians and the provisional settlement became permanent in Jan. 1852.

The principles on which Alexander von Bach, the minister of the interior, worked were in many respects enlightened, but the oppressive and absolutist character of his regime united the nation against him; even the non-Magyars and the peasants declined to regard it as a change for the better. At first the nation pinned its hopes, fostered by Kossuth and the other *émigrés*, on foreign intervention. Meanwhile Deák, leader of the moderate party, counseled passive resistance, in particular the nonpayment of taxes. This policy proved very successful, and the burden of keeping so many administrators, as well as soldiers to guard against a possible rising, with so little return, grew almost intolerable to the Austrian exchequer. When its difficulties were brought to a head by the Italian war of 1859, Francis Joseph dismissed Bach and introduced various constitutional experiments; but in spite of the attempted mediation of the Old Conservative party, the nation refused to collaborate and a series of concessions—including the abolition of the quinquepartite division (1859) and the restoration of the court chancellery and of Magyar as the official language (1860)—had no effect. When, under the February patent of 1861, a diet was convoked to elect representatives for a central Austrian parliament, it simply reaffirmed the validity of the April laws.

The Austro-Hungarian Compromise.—By then, however, it was clear that the monarchy was not about to disintegrate. Both the crown and the nation wished to end the struggle. Negotiations were initiated in which Deák and Gyula Andrássy (*q.v.*) took the lead on the Hungarian side. They dovetailed in with the parallel negotiations in the Austrian half of the monarchy, and an unwritten alliance, similar to that of 1848, emerged between the Hungarians and the liberal German centralists at the expense of the Slavs in each half of the monarchy. The crown suspended the February patent in July 1865 and appointed a provisional Hungarian government. A diet opened in December appointed a committee to work out a compromise. Deák insisted that the April laws were legally valid, but might be modified by agreement, and that when Austria became a constitutional monarchy, Hungary could treat with its representatives on matters recognized under the Pragmatic sanction as of common interest to Hungary and to the monarch's other dominions. The Seven Weeks' War of 1866 interrupted the negotiations, but Deák did not raise his terms after Austria's defeat by Prussia. On Feb. 17, 1867, a responsible, independent ministry was formed under Andrássy. The parliament adopted the new laws on May 29, and Francis Joseph was crowned king on June 8. The "Compromise" (*Ausgleich*) designated foreign affairs and defense as questions common to Hungary and Austria, each under a joint minister (alternately from Austria and Hungary); a third joint minister was in charge of the finance for these portfolios; delegations from the Austrian and Hungarian parliaments discussed the subjects; the respective quotas to be paid by each half of the monarchy were reconsidered every ten years, as were commercial and customs agreements. At first, the two countries formed a customs union.

In all other respects, Hungary was completely independent, also recovering its territorial integrity. The Voivodina had already been dissolved, and the union with Transylvania re-enacted. The incorporation of the Military Frontier followed. Fiume and the Muraköz (Medjumurje) returned to Hungary, but the three Slavonian counties passed to Croatia, with which a separate agreement was concluded in 1868. The Nationalities act (1868) stipulated the equality of all languages insofar as was consistent with the practical requirements of administration and allowed non-Magyars the free use of their own languages in private life, the press, the courts and local administration; records could be kept in those languages where desired by one-fifth of those concerned. The state was bound to provide facilities for any person to receive secondary education in his own language and communities, churches and individuals were free to found and maintain schools, which enjoyed equal status with state schools.

The Dualist Era.—During the next decades Hungary made much progress, especially in material respects. A network of railways was constructed, the regulation of the Tisza river completed, industry advanced and the towns, especially Budapest, grew apace. The administrative and professional classes expanded rapidly and a new entrepreneur class came into being. In some quarters there was ease, even luxury. When the nation celebrated its millennium in 1896, the national complacency was not entirely unjustified.

But the picture contained many shadows. The prosperity was unevenly divided. A further rapid increase of population (from 13,000,000 in 1850 to 19,250,000 in 1900) outstripped the accumulation of capital. The new industrialization, which had to struggle hard against the more advanced Austrian industry and made only slow progress before 1900, when the state came to its support, could take up only a fraction of the surplus; and the industrial proletariat created by it lived under miserable conditions. The liberation of the peasants in 1848 had created a considerable class of small freeholders who at first were prosperous enough, especially as they were not required to pay anything for their acquisitions, but as time went on holdings were divided and subdivided until half the agricultural population of the country was on holdings too small to afford a livelihood and an equally large class was totally landless. Large-scale emigration overseas reduced the congestion only partially and in the 1890s there was widespread agrarian unrest. By contrast the magnates, the court's favourites, retained and even increased their holdings: in 1913 half the area of Hungary was held in estates of over 60 ha. and one-quarter of it in latifundia (large estates) of over 12,000 ha.—and with it went their social and political dominance. But their economic position was undermined after the 1880s by the competition of cheap American wheat. The smaller members of the old landowning class were largely ruined by the application of the land reform. They found a refuge in the civil service, but the new business and professional classes were recruited rather from among the thrifty descendants of German colonists and, still more, from among the Jews, who came to dominate the economic and financial life of the country and, to a large extent, its intellectual life. Finally, although the non-Magyars were relatively passive in the first decades after 1867, it soon became clear that the lull was unlikely to last.

For a long generation, however, political life occupied itself little with social, national or even, directly, with economic questions. Active social or national discontent was prevented from finding expression by the simple expedient of a very restricted franchise,

exercised openly and thus susceptible to official pressure, which was freely applied, and by the centralization of power in the ministries at the expense of the old autonomous bodies. The same methods were used also against what was then by far the strongest single opposition force in the country, that of Magyar nationalism. The pure Magyar constituencies were far larger than those in the non-Magyar areas. But no conceivable device could keep the Magyar nationalists out of parliament altogether and an envenomed struggle went on between the "Independence" and "1848" parties, who stood for restoration of everything which Hungary had received in 1848 or more, and the "1867" politicians. This struggle had its economic aspects, since one of the points at issue was the customs union with Austria, but turned chiefly round questions of national sentiment and prestige. It was not until 1896 that a major political party, Count Nándor Zichy's People's party, was founded which was not primarily devoted to attacking or supporting the compromise of 1867. The Deák party was in power from 1867 to 1875, but was gradually crumbling. Then Kálmán Tisza, leader of the left centre, jettisoned his earlier oppositional program and effected a fusion between his followers and the remnants of the Deák party under the face-saving name of Liberal party. A cynical but supremely able party boss, Tisza, who himself held the premiership from 1875 to 1890, kept his party in power by repressing opponents and rewarding supporters, but after his fall his successors, Gyula Szapáry (1890–92), Sándor Wekerle (1892–94), Baron Dezső Bánffy (1895–99) and Kálmán Széll (1899–1903), had increasing difficulty in repelling the clamour for concessions (especially in connection with the common army) which Francis Joseph absolutely refused to make.

Social unrest was growing and finding mouthpieces in a Social Democratic party and a bourgeois Radical party of left wing intellectuals, mainly Jewish. The non-Magyars, too, were awakening again. The complaint heard by the world was that the law of 1868 was disregarded, and magyarization enforced in education and public life. This was completely true, but the real conflict was a deeper one, of conflicting national ambitions. The nationalities were strongly encouraged by the unconcealed dislike of the heir to the throne, the archduke Francis Ferdinand (*q.v.*), for the dualist system and its beneficiaries, and his known intention to break it, on accession, by a reorganization of the monarchy. But the true aim of the Serbian and Rumanian leaders was unification with the national states across Hungary's borders. Some of the Serbs also made contact with Croats in a revived Illyrian movement, also anti-Hungarian, and the pure Croatian nationalists were as hostile to Hungary as in 1848.

When István Tisza, son of Kálmán, battling with the national opposition from 1903 to 1905, held elections which were relatively free, the Liberals were disastrously defeated. After an interval of extraparliamentary rule under Baron Géza Fejérváry (1905–06), Francis Joseph in 1906 allowed a coalition under Wekerle to take office, in which the "1848" parties were represented, but only under conditions which in effect pledged them to support the compromise. The crown further insisted that the franchise must be extended, and although a few of the "Independence" politicians favoured this, both on principle and in the belief that it would strengthen their hand, others feared that it would endanger Magyar supremacy. After four years of divided, disingenuous and inglorious rule, the coalition gave way in 1910 to the Party of National Work, a new "1867" party organized by Tisza. This party was in office in 1914, Tisza himself having succeeded Count Károly Khuen-Héderváry (1910–12) and László Lukács (1912–13) as premier in the preceding year.

World War I.—For the first two years of the war, Tisza, a man of iron will, upheld the internal system and held the country to its international course; and when Francis Joseph died, he persuaded the new king, Charles IV, to accept coronation (Dec. 30, 1916), thus binding himself to uphold the integrity and constitution of Hungary. Charles, however, insisted on electoral reform, and Tisza resigned (May 1917). While minority governments under Count Móric Esterházy (June–Aug. 1917) and Wekerle (Aug. 1917–Oct. 30, 1918) struggled with increasing difficulties, the threefold agitation grew: of the Hungarian nationalists, against a war into which, they maintained, Hungary had been drawn in the interest of Germany and Austria; of the political left, growing daily more radical under the stimuli of privation and the Russian Revolution; and of the nationalities, encouraged by the favour which their kinsfolk were finding with the entente. The country began to listen to Count Mihály Károlyi, leader of a fraction of the Party of Independence, who proclaimed that a program of independence from Austria, repudiation of the alliance with Germany and peace with the entente, combined with social and internal political reform and concessions to the nationalities, would safeguard Hungary against all dangers at once.

D. Revolution and Counterrevolution, 1918–20

When, in Oct. 1918, it was clear that the war was lost, the opposition took the offensive. On Oct. 25 a national council was formed, under Károlyi's presidency. Popular demonstrations demanded the appointment of Károlyi. To save bloodshed the king yielded, and on Oct. 31 Károlyi took office at the head of a coalition government composed of his own followers, Radicals and Social Democrats. The king "renounced participation in the affairs of state" on Nov. 13 and the national council dissolved parliament and proclaimed a republic on Nov. 16 with Károlyi as provisional president. The appointment was made definitive on Jan. 11, 1919.

Immediately on taking office, Károlyi had opened up negotiations with the nationalities, but their representatives had already turned their backs on Hungary. When, moreover, Károlyi, in the hope of obtaining favourable armistice terms, went to Belgrade to meet the Allied commander, Gen. Louis Franchet d'Espèrey, he had to accept (Nov. 8) terms under which the Hungarian troops had to evacuate all southern Hungary and most of Transylvania. Serbian troops entered the southern areas, Rumanians the eastern and Czechs the northern. The Hungarian government had disbanded its returning soldiers in an attempt to emphasize its pacific character and thus could not resist these encroachments. The internal confusion was complete and while the government made its preparations to introduce the promised political and social reforms, the unrest spread. The bourgeois elements in the government were steadily pressed back by the Social Democrats, who were themselves being outbid by Communist propaganda spread by Béla Kun (*q.v.*), a Soviet agent of Hungaro-Jewish origin. When the Allies' representative in Budapest sent a note on March 20, 1919, ordering the Hungarian troops and authorities to withdraw still farther west, into purely Magyar territory, and indicated that the new military line would form the future political frontier, the government resigned. The Social Democrats had already agreed to fuse with the Communists and to establish a dictatorship of the proletariat in alliance with Soviet Russia (March 21), who, Kun promised, would help against the Rumanians. Many bourgeois and professional soldiers at first supported Kun in this hope, but the help never materialized. Kun attacked the Czechs with some success, but was forced by the Allies to withdraw. At home his methods, which began by being doctrinaire and ended by being terroristic, alienated the *bourgeoisie*, the leading members of which fled abroad and formed *émigré* committees in Vienna and Szeged (then under French occupation), the peasants and even the industrial workers. In an attempt to restore his position Kun attacked the Rumanians, but was defeated. He and his chief lieutenants fled to Vienna (Aug. 1).

The Rumanians occupied Budapest (Aug. 3), in which various nondescript governments failed successively to maintain themselves. The Rumanians, who meanwhile had looted the capital very thoroughly, were induced to retire on Nov. 14. The *émigrés* had by then formed a counterrevolutionary government with a national army, the latter commanded by Adm. Miklós Horthy de Nagybánya (*q.v.*). This force entered Budapest on Nov. 16. The Allies attempted to bring into being a broad, democratic coalition government, recognized (Nov. 25) the appointment as minister-president of Károly Huszár and insisted on the holding of elections under a secret suffrage (Jan. 25, 1920). Already, however, counterrevolutionary detachments had taken violent and indiscriminate reprisals against the workers' leaders and the Jews. The Social Democrats abstained in protest from the elections, which returned

two almost equal parties: Christian Nationals and Smallholders. Only a fraction of the latter, however, represented the peasants. The government restored the legal continuity by canceling Károlyi's and Kun's changes and formally dissolved the link with Austria. Hungary remained a kingdom and, pending the future settlement of the constitutional issue, Admiral Horthy was elected regent (March 1, 1920).

E. The Regency, 1920–45

The Treaty of Trianon.—On June 4, 1920, Hungary had to sign the treaty of Trianon, which gave to its neighbours 192,000 sq.km. (74,130 sq.mi.) of its area of 283,000 sq.km. (109,266 sq.mi.; Croatia-Slavonia excluded) and 10,649,416 of its population of 18,264,533. Almost all its non-Magyar-speaking populations were separated from it, and more than 3,000,000 Magyars, many of them living in immediate juxtaposition to the frontier. Its armed forces were limited to 35,000 men, lightly armed, and it was required to pay a sum, to be determined subsequently, in reparations. The treaty incidentally disrupted its entire economic structure. Hungary's determination to secure revision of it thereafter governed its whole foreign policy and in particular its relations with the three main beneficiaries of the treaty, Czechoslovakia, Rumania and Yugoslavia. Its relations with Austria were also at first disturbed by the latter's claim to the German-speaking areas of western Hungary. Part of these were in fact ceded, but the protocol of Venice (Oct. 12, 1921) provided for a plebiscite in the city of Sopron (Ödenburg), which remained with Hungary after the vote.

Reconstruction.—The ministries of Huszár (Nov. 23, 1919–March 15, 1920), of Sándor Simonyi-Semadam (March 15–July 19, 1920) and of Count Pál Teleki (July 19, 1920–April 14, 1921) had to face many difficulties. There was much economic and financial disorganization, in the course of which wild inflation set in. The workers' leaders who had fled abroad conducted a vigorous agitation against the excesses of the "white terror" that had followed Kun's "red terror." The peasants demanded land reform. The middle classes were embittered and impoverished by the inflation. The distress of the large numbers of officials and other middle-class elements who had been expelled by the successor states and had arrived with their families in Budapest, completely destitute, was particularly acute. These elements, which were strongly nationalistic, formed the backbone of a radical undercurrent which was opposed at the same time to the Habsburgs, the feudal system associated with them and the ideas of 1919. It was by playing these various discontents off against one another that Count István Bethlen (*q.v.*), while remaining in the background, was able to negotiate a general internal settlement. The Socialist leaders signed a regular treaty agreeing to give up agitation abroad or in the country districts and to support the government's foreign policy, in return for an amnesty, the secret ballot in the towns and certain other concessions. The Smallholders partly were pacified by a land reform which took 1,300,000 *hold* from the largest estates (a further distribution was to follow later) and by the promise of partnership in the government. They agreed that the open franchise should be reintroduced in the rural districts as a safeguard against Socialist agitation and in the faith that the government would not favour a Habsburg restoration. King Charles had already attempted to return to Hungary on March 7, 1921, but had been forced by domestic and foreign opposition to leave. It was after this that Bethlen succeeded Teleki. The king made a second attempt, equally unsuccessful, to recover his throne on Oct. 29. He was removed, and under pressure from the powers parliament enacted a law declaring the Habsburgs forfeit of the throne. Next spring, having passed through his new franchise bill by emergency legislation (against strong obstruction from the Legitimists), Bethlen dissolved parliament and held new elections. These and all subsequent elections of the period between World Wars I and II gave a safe majority to what was always popularly known thereafter as the "government party," against relatively weak minorities of Socialists and Liberals on the one side and Legitimists on the other. The Legitimists became a declining force after the death of the king in exile.

Bethlen then completed the liquidation (begun by Teleki) of the right-wing extremists, who were quite impotent during his regime, which they declared bitterly to be one of subordination to the forces of feudalism and big capital. Bethlen negotiated Hungary's admission to the League of Nations in 1923 and the following year succeeded in raising a reconstruction loan, with the help of which the inflation was stopped and the pengö, a new stable currency based on gold, introduced. In connection with this a new, independent Hungarian bank of issue was set up on June 24, 1924. Under the new and more peaceable conditions, money, somewhat recklessly lent, poured into the country. The national economy was readapted and reconstructed: much industrialization carried through—sufficient to counteract, though not perceptibly to diminish, the rural overpopulation that was Hungary's biggest internal problem (especially since U.S. legislation had closed the outlet of emigration). Industrial employment was good. The middle-class refugees were supplied with posts in an elastic state service, or pensioned off. Abroad, Hungary's relations with the west were good. There were a few not explicitly official escapades, such as an attempt made in 1925 to finance propaganda by forged French francs, but revisionist agitation was damped down, although Hungary's relations with its chief neighbours—then firmly linked in the little entente (*q.v.*)—could not seriously improve. Bethlen did, however, draw Hungary out of its isolation, partly by winning sympathy for it in the west and notably by concluding a treaty of friendship with Italy (April 5, 1927).

The weak point of the structure was that the balance of payments was invariably passive. The gap was closed by further borrowing, but the continued success of the operation depended entirely on the maintenance of satisfactory prices for Hungary's main exports, especially wheat. When the world economic crisis broke out in 1929, Hungary was not immediately involved. In April 1930 Bethlen secured the settlement of the reparations question and the lifting of the League of Nations' financial control. He held new elections in May–June 1931 which returned him to parliament at the head of another large majority. Immediately after, however, the full force of the financial crisis hit Hungary. Payments had to be suspended and revelations of the real financial position caused a bitter outbreak of popular feeling against the government. Bethlen resigned (Aug. 19, 1931) in favour of the puritan Count Gyula Károlyi who, strictly pressed by Hungary's creditors, set himself to carry through a policy of retrenchment and budgetary reform. He initiated settlements with Hungary's foreign creditors, but the internal agitation against the "system," led on the one hand by the indebted farmers (who founded a new Smallholders' party) and on the other by the middle-class elements in the state services and professions, was too strong for him. On Sept. 21, 1932, he resigned.

The Gömbös Ministries, 1932–36.—The new prime minister was Gyula Gömbös (*q.v.*), former minister of defense, the leader of the "Right Radicals," notorious for his fascist, anti-Semitic and militarist views and, in foreign policy, the adherent of an alliance to consist of Hungary (within its historic frontiers), Italy and Germany. By an immediate visit to Italy, Gömbös committed Hungary to a "dynamic" foreign policy, thereby also consolidating his position at home against either "democratic" or "feudal" forces. The alliance, however, could not be formed, as Italy and Germany were at loggerheads over Austria. Moreover, on a visit to Berlin (June 1933) Gömbös learned that Adolf Hitler, while willing to let Hungary share in the partition of Czechoslovakia, was opposed to its aspirations in Rumania and Yugoslavia. All Hungary could do was to link itself with Italy and Austria under the Rome protocols (March 17, 1934), which relieved it from the economic pressure of the little entente but also committed it to an anti-German line over Austria. The pressure of the financial crisis, international and domestic, also forced Gömbös to postpone all the revolutionary measures at home promised by him in favour of a sober program of technical and orthodox reconstruction. He forced the regent's hand in March 1935 and carried through elections which gave him a parliamentary majority of his own followers, but internal opposition was still holding him in check when he fell fatally ill in June 1936. He died on Oct. 6 and six days later the regent appointed

the more conciliatory Kálmán Darányi to succeed him.

Darányi, Imrédy and Teleki.—Meanwhile renewed intimacy with Italy had brought Hungary into further conflict with the little entente over the murder (Oct. 9, 1934) of King Alexander of Yugoslavia, for which it was partly responsible and openly blamed. Hungary began feeling itself directly threatened by Germany, but did not dare seek agreement with the little entente, even if concessions had been offered in return. It began, however, a tentative *rapprochement* with Yugoslavia, by a separate agreement.

Darányi at first made considerable concessions to anti-German opinion; during his term of office, also, a new franchise was enacted which, while restricting the number of voters, restored the secret ballot in the rural districts. But he was hard pressed by the right wing of his own party and by extremist groups even further to the right. He and his foreign minister, Kálmán Kánya, visited Berlin in Nov. 1937 and there acquired the conviction that Hitler meant soon to incorporate Austria and attack Czechoslovakia. These reports strengthened the hand of the military party, which urged the necessity for uncompromising rearmament and also for a more active policy against the Jews. Darányi announced a rearmament program and a law limiting the participation of Jews in certain professions in March 1938. He also offered concessions to Ferenc Szálasi, the leader of the principal extremist movement, the Arrow Cross. For this he was dismissed by Horthy in favour of Béla Imrédy, formerly Gömbös' minister of finance (May 13, 1938). Imrédy had Szálasi imprisoned, took other measures against the extreme right and made several last-hour attempts to win support from the western powers—which, in the view of himself, Horthy, Bethlen and Teleki (who had returned to office as minister of education), were certain to win the coming war. When Horthy, Imrédy and Kánya paid a state visit to Berlin and Kiel (Aug. 21–25, 1938), they rejected overtures made by them by the Germans to co-operate against Czechoslovakia on the plea of Hungary's unarmed condition; and when the Munich crisis broke out they limited Hungary's official demands to the ethnically Magyar area and attempted to get them satisfied by the general consent. Britain and France having shown them little sympathy, they had to fall back on Italy's support. Eventually an arbitral decision, rendered by Germany and Italy in Vienna on Nov. 2, 1938, awarded Hungary an area of 12,012 sq.km. (4,638 sq.mi.) with a population of 1,048,537, preponderantly Magyar but containing also Slovak minorities.

The hostility that Hungary had encountered from Germany during the negotiations, together with the impression of the feebleness and indifference of the west, had convinced the government that it must follow a more definitely pro-Axis policy. Kánya, who had personally offended both Hitler and Joachim von Ribbentrop, was dropped in favour of István Csáky on Dec. 10, 1938. The latter visited Hitler (Jan. 17–18, 1939) and promised full co-operation, to be documented by Hungary's signing the Anti-Comintern pact (which it did on Feb. 2, 1939) and leaving the League of Nations. Imrédy announced his intention of introducing authoritarian methods and further anti-Jewish legislation. A revolt of the conservative elements in his party put him in a minority. Horthy refused to accept his resignation, but his enemies discovered a Jewish strain in his ancestry and he resigned (Feb. 16, 1939). Teleki, a man fundamentally opposed to the Germans, took office and put up what resistance he could to Germany at home and abroad. On the breakup of Czechoslovakia, Hungary, which had prepared for the event in advance, occupied Ruthenia (12,061 sq.km. [4,656 sq.mi.], pop. 664,226, mainly Ruthenian), thus securing a long-desired common frontier with Poland (March 14, 1939). When Teleki visited Berlin with Csáky (May 1–2), however, he did not dare go back on Hungary's previous promises to follow an "Axis policy," only stipulating that Hungary would not participate, directly or indirectly, in an attack on Poland. On May 28–29 Teleki held elections, under the secret franchise, but with the disconcerting result that the Arrow Cross and similar parties secured 42 seats out of 260 and the right wing of the government party was as strong as ever.

World War II.—When Hitler attacked Poland, Hungary refused a request to allow German troops transit across its territory. Both groups of belligerents wished southeastern Europe to remain out of the war, and this suited Teleki well enough, as he wished to realize his further claims by general consent when the war should be over. Hungary proclaimed itself nonbelligerent. Meanwhile, while maintaining its claims against Rumania, it sought the friendship of Yugoslavia more pressingly than ever. At first this patient policy was very popular in the country, but after Hitler's successes in the spring of 1940 Teleki was strongly attacked by the right for having backed the wrong horse; when, therefore, the U.S.S.R. sent its ultimatum to Rumania on June 26, 1940, he raised Hungary's claims on Transylvania. Before his threatening insistence the Axis powers agreed to mediate and finally rendered the second Vienna award (Aug. 30) which gave Hungary 43,104 sq.km. (16,642 sq.mi.; about two-fifths of the total) with a population of 2,577,260, including about 1,000,000 Rumanians. After this Hungary made some further concessions to the right and adhered to the German-Italian-Japanese Tripartite pact (Nov. 20) but, in an attempt to counteract the effect of this and to strengthen its rear against Germany, signed a "Pact of Eternal Friendship" with Yugoslavia (Dec. 12). Since September, however, it had been allowing German troops to cross its territory into Rumania. Germany then prepared to use these troops to attack Greece. Then a *coup d'état* in Yugoslavia in March 1941 overthrew the government that had signed the Tripartite pact, and Hitler prepared to attack Yugoslavia. The Hungarian government refused to join in the attack, but did not attempt to deny Germany the use of its territory and decided to move into the vacuum of the Voivodina if Croatia declared its independence. Great Britain showed strong disapproval of this plan, and Teleki committed suicide (April 2–3). His successor, László Bárdossy, carried out the program on April 5. The reannexed area comprised 10,619 sq.km. (4,100 sq.mi.) and the population 1,030,027. Great Britain then broke off diplomatic relations.

Originally Hitler had not meant Hungary to participate in the war against the U.S.S.R.; but a party in the country, fearing to be left behind by Rumania in the race for Germany's favour, was anxious that it should do so. After aircraft had dropped bombs on Kosice (Kassa) on June 26, 1941, Bárdossy, accepting the version that the aircraft were Russian, declared the following day a state of war to exist between Hungary and the U.S.S.R. Only a small expeditionary force was sent out at first, and it was recalled in the autumn. It was then still thought that the war would be short and easy and not involve Hungary in complications with the west. But Great Britain declared war on Hungary on Dec. 6, and Hungary itself, under strong German pressure, declared war on the United States on Dec. 12. Germany demanded a serious military effort of Hungary and extracted a promise in Jan. 1942 to send out about 200,000 men, some of whom Germany undertook to equip. Just at that time a lamentable incident occurred in Novi Sad (Újvidék), the largest town in the occupied Yugoslav territory. There had been partisan activity, and the officer sent to restore order rounded up and massacred several hundred persons, some Serbs, others Jews, others even Magyars who had been taken as hostages. Horthy was further irritated by Bárdossy's handling of a bill to make his son, István Horthy, deputy regent (in reality, successor presumptive to the regency), and replaced him on March 9, 1942, by Miklós Kállay, a politician of the so-called Conservative-Liberal school.

Like Horthy, but unlike Bárdossy, Kállay believed not only in an Allied victory but also in the possibility of splitting the east from the west. He allowed the troops to go out, although insisting that Hungary's struggle was purely defensive, but avoided any hostile acts or even words toward the west. He and the veteran minister of the interior, Ferenc Keresztes-Fischer, gave the Jews a measure of real protection almost unparalleled on the continent and allowed the press and parties of the left much freedom. Under their protection an Independence front began to take shape. Its members were the Social Democrats (with the crypto-Communists in the background); the Smallholders' party, which professed strongly democratic ideals; "progressive intellectuals," who either remained unorganized or (since the leader of the Liberal party, K. Rassay, refused his co-operation) attached themselves to the

Smallholders' party; a small group of intellectuals who formed a National Peasant party; and some Legitimists.

The ill-equipped and spiritless Hungarian army suffered a grave defeat at Voronezh in Jan. 1943, losing a large part of its effectives and nearly all its equipment. The survivors of the fighting units were then brought home, but some second-line divisions left as occupation troops. Kállay sent several emissaries to make secret contact with the Allies in August; one of these actually agreed with the British ambassador at Ankara, Turk., on an instrument of unconditional surrender, to take effect when the Allied troops reached Hungary. The Germans became increasingly irritated by Kállay's actions and suspicious of his intentions. On March 17, 1944, Hitler called Horthy to Salzburg and presented him with an ultimatum: either to co-operate fully or to submit to the occupation of Hungary by German, Slovak, Croat and Rumanian troops. Horthy accepted the former alternative, but before his train had returned, German forces had entered Hungary and SS. units, armed with long-prepared lists, were arresting prominent liberal and left-wing politicians, Legitimists and Jews.

A collaborationist government under Döme Sztójay sent another army to the front and promised co-operation at home. The Germans took advantage of the occasion to round up and deport, for the gas chambers, the Jews of Hungary. Although nearly all the Jews of the country districts, about 400,000 in number, suffered this fate, the government seems really not to have been aware of the exterminations until June, when this was reported to Horthy. He ordered the deportations to stop and, although two more country districts were "cleared" after the order, the Jewish population of Budapest was saved. It had to submit to the full rigour of the Nürnberg laws, however.

When Rumania surrendered (Aug. 23, 1944) Horthy decided to extricate Hungary from the war. It was no easy operation, for its only properly armed forces were at the front, whereas Hungary was full of German troops. To make things worse, Horthy insisted, as a point of honour, on giving Germany notice of his intention. Finally, he still hoped to keep the Russians at bay and to open the frontiers to Anglo-American troops: only after some weeks, when the Russians were long across the Carpathians, did he send a mission to Moscow, which on Oct. 11 concluded a preliminary armistice. The whole affair was shot through with mutual misunderstandings. Horthy issued a proclamation of intention to surrender on Oct. 15, but the few officers prepared to obey him failed to get back to Budapest, or their troops refused to follow them. Two days later German troops occupied Buda and removed Horthy as a prisoner. Szálasi assumed nominal power but in fact authority was in the hands of the German and Hungarian military in western Hungary, of the Russians in eastern Hungary.

The German-Hungarian armies left Buda, abandoning it to the Soviet army on Feb. 13, but taking with them the ministries, skilled workers and equipment from the factories and supplies of all kinds. More than 1,000,000 persons left Hungary, with much of its portable wealth. Fighting on Hungarian soil went on until April 4, 1945.

F. The People's Republic

Meanwhile, a new provisional government had been formed at Debrecen, under Soviet auspices, on Dec. 22, 1944. This consisted nominally of a coalition of the parties of the Independence front, together with some members of Horthy's mission to Moscow and as prime minister Gen. Béla Miklós, who had surrendered to the Soviet army. This government signed an armistice with the Allies on Jan. 20, 1945, which compelled it to withdraw its military and civilian authorities to behind the Trianon treaty frontiers, to reduce its armed forces to eight divisions and to accept an obligation to pay in reparations to the U.S.S.R., Czechoslovakia and Yugoslavia a sum equivalent to $300,000,000. The peace treaty, signed in Paris on Feb. 10, 1947, restored the Trianon frontiers, with the aggravation that Czechoslovakia's bridgehead opposite Bratislava (Pozsony) was extended. The Debrecen government had to face extraordinary difficulties. Many of Hungary's towns were in ruins, its communications largely destroyed. Ravaged by war and stripped by the retreating Germans, it was subsequently denuded still more completely by the Soviet occupying army, whose conduct, in every respect, was shocking. For a year the urban populations were on the verge of starvation and the depreciation of the currency reached a world record.

But the crucial question was whether Hungary was to belong to the east or the west. The Communists did not at first show their hand. The program put before a provisional national assembly drummed together in Debrecen provided for radical expropriation of all sizable landed estates and the nationalization of mines and heavy industry, but guaranteed private property and promised that private enterprise should be fostered in small industry and trade. While "Fascist" organizations and parties were to be dissolved and war criminals punished, the program guaranteed democratic rights and freedoms, and promised elections under a general, equal, direct and secret suffrage.

In fact, the only radical measure to be carried out speedily was the expropriation of the estates, and the first postwar elections, held on Nov. 4, 1945, were really free, with the disconcerting result that the Communists polled only 17% of the votes and the Social Democrats fewer still, while the Smallholders, behind whom the conservative elements not disfranchised had rallied, with 60% of the votes secured an absolute majority. But Marshal K. E. Voroshilov, commanding the Soviet occupying force, insisted on the continuation of coalition government and although the first prime ministers were Smallholders (Zoltán Tildy from Nov. 1945, Ferenc Nagy from Feb. 1946, Lajos Dinnyes from May 1947 and István Dobi from Dec. 1948 to Aug. 1952), the Soviet authorities saw to it that the Communists controlled the key posts, especially the ministry of the interior, and they squeezed their partners out by blackmail and terror. The Bourgeois Radicals were soon eliminated altogether; the National Peasants party was reduced to a handful of crypto-Communists; the Smallholders were terrorized into repudiating one group after another of their members as "Fascists." The next elections, held on Aug. 31, 1947, under strong pressure, found the Smallholders reduced to only 14.6% of the voting. The Communist-Socialist coalition still polled only 37%, for a considerable vote went to various opposition parties, but these were successively liquidated and their leaders forced to flee the country. The Social Democrats in their turn were forced to disavow and expel their old leaders in 1948 and to merge with the Communists in a Hungarian Workers' (Communist) party (June 14). The next elections (May 15, 1949) were of the Soviet type, the electors being allowed only to register their votes openly for or against a single list which was composed only of Communists, with a few stooges. The first regular national assembly had proclaimed Hungary a republic (Feb. 1, 1946). In Aug. 1949 a new constitution was introduced, on the Soviet model. All real power now rested with the ruling party secretariat and Mátyás Rákosi, as first secretary, was the all-powerful national boss. It remained for the "Muscovites" to liquidate their rivals within the party itself. The leading National Communist, László Rajk, himself a former minister of the interior, was hanged Oct. 15, 1949, after a farcical trial and his chief adherents executed or imprisoned. Meanwhile, the army and civil service had been purged to leave only Communists or fellow travelers in the responsible posts, and an enormous state security police (the Államvédelmi Osztaly, or A.V.O.) created.

By this time the state had consolidated its grip on the economic machine. A three-year plan, described as designed chiefly to repair war damage, was introduced in Aug. 1947. Under it all banking and finance, mining and industry, wholesale and foreign trade and most retail trade were successively nationalized. Therewith the ruin of the former capitalist classes was completed. Many of them were subsequently deported to remote villages. The trade unions lost their last vestiges of independence. The chief remaining focuses of resistance were the peasants and the churches. The former were little molested before 1948, although only part of the land confiscated from the big estates was distributed to them, much of it being turned into state farms. Rákosi announced in 1948 that the goal of the government was the collectivization of agriculture, although no compulsion was to be employed. There was, in fact, no legalized compulsion, but kulaks (farmers employing hired labour) were viciously persecuted by various devices and

inducements and pressure exerted to bring the small peasants into the collective farms.

The struggle with the churches centred on their endowments and the control of the numerous church schools. The Protestant and Jewish confessions accepted compositions in 1948 under which their former educational establishments, with a few exceptions, were nationalized. The churches accepted the leadership and authority of the state, which guaranteed freedom of worship and of optional religious instruction. The Roman Catholic Church, under the leadership of the cardinal primate, József Mindszenty, refused to accept an analogous arrangement. The government forcibly nationalized the church schools in 1948, arrested the cardinal on Dec. 26 and sentenced him to life imprisonment on Feb. 8, 1949, for alleged conspiracy against the state. In 1950 all religious orders except four were dissolved, their premises closed and their members thrown onto the streets. The church perforce accepted the state's main terms in 1951, but even after this the struggle continued. It was only in 1959 that the church explicitly accepted the authority of the regime.

In 1950 the three-year plan was followed by a more ambitious five-year plan designed, according to Rákosi, to "turn Hungary into a country of iron and steel." Vast sums were invested in the construction of heavy industry, which was in fact largely employed in manufacturing armaments for the U.S.S.R., while agriculture was, by comparison, neglected and the production of consumer goods was diminished. Rákosi, who also took over the premiership on Aug. 14, 1952, seemed more firmly ensconced than ever. After Stalin's death, however, he was evicted from the premiership (July 4, 1953) in favour of Imre Nagy and given two coadjutors in the party secretariat. Nagy loosened the reins. The deportations stopped, concentration camps were liquidated and prisoners released. The plan was revised to allow the production of more consumer goods and peasants were allowed to leave the collectives, the membership of which fell precipitously. But a hard core of Communists, inspired by Rákosi, continued to oppose these changes and on April 18, 1955, after the fall of G. M. Malenkov in Moscow, Nagy was forced to resign the premiership and divested of his party functions; Rákosi was reinstated as the party's first secretary, although András Hegedüs was made nominal premier. The old course was resumed. Hungary, which from Jan. 25, 1949, was a member of the Soviet-dominated Council for Mutual Economic Aid, became a cosignatory of the Warsaw treaty of military alliance on May 14, 1955 (*see* WARSAW TREATY ORGANIZATION).

N. S. Khrushchev dismissed Rákosi again on July 18, 1956, but this was only to please Marshal Tito (Josip Broz), whom Rákosi had offended, and his successor was Ernő Gerő, as fanatical a Muscovite as Rákosi himself. Discontent mounted, and on Oct. 23 exploded, spontaneously and almost accidentally. The university students organized a demonstration of sympathy for Poland and took the occasion to read out demands for the introduction of genuine democracy and the cessation of Soviet dictation and exploitation. Huge crowds joined them. The A.V.O. and, later, Soviet troops, called in by Gerő, fired on the crowds, turning them into revolutionaries. The crowds called for Imre Nagy, whose appointment to the premiership was announced the next day. At first only minor concessions were offered, but by then all Hungary was inflamed. As the popular pressure increased and armed resistance became more organized, Nagy gave way step by step. He promised to introduce genuine reforms and to negotiate with the U.S.S.R. for the withdrawal of its troops from all Hungary. On Oct. 27 the Soviet army in fact evacuated the capital and Nagy, who had already taken some non-Communists into the government, promised a real return to coalition government. The democratic parties reconstituted themselves. Cardinal Mindszenty was released and brought in triumph to Budapest. On Nov. 1 a genuine coalition government of the democratic parties was formed.

But meanwhile, Soviet reinforcements had been massing behind the frontiers. They re-entered Hungary on Oct. 30, fanning out to surround the capital. Nagy cabled to the United Nations announcing the withdrawal of Hungary from the Warsaw Treaty organization and asking for help and for Hungary to be recognized as a neutral state under international protection. But the help never came. On Nov. 4 the Soviet troops entered the capital. An hour later, voices from behind the Soviet lines announced the formation of a new "revolutionary peasant-worker government."

Heavy fighting went on for a fortnight, and for many weeks Hungary was paralyzed by a general strike, but eventually the inevitable end was reached, leaving Hungary ravaged by the fighting and the poorer by 160,000 refugees, mainly students and workers, who had fled across the frontiers. The executions were resumed. They included Nagy and Gen. Pál Maléter, commander of the resistance forces, both of whom had been dishonourably abducted. Cardinal Mindszenty sought asylum in the U.S. legation. The United Nations passed several resolutions condemning Soviet intervention.

The new prime minister, János Kádár, a former "national Communist," began by making many promises, but none of them was kept that would have involved any deviation from the Moscow policy of the day. There was, indeed, a change of personnel on the top level: Rákosi and Gerő, who had fled the country, were disavowed and made scapegoats for all past shortcomings. The new men, Kádár, Ferenc Münnich (who became prime minister on Jan. 27, 1958, Kádár remaining the party's first secretary) and their team were mostly former national Communists or Social Democrats. Their regime was less systematically brutal than that of their predecessors, and the U.S.S.R. played its part by making the economic exploitation of Hungary less complete, at times even offering help. The Soviet policy of coexistence was reflected in a less hostile attitude toward the west and its products. The standard of living was allowed to rise markedly. But the dictatorship of the Communist party was re-established, and all the other gains of the revolution were liquidated one by one. The emphasis of the economic planning swung gradually back to heavy industry. The peasants who had left the collectives in large numbers during the revolution were left in peace for a couple of years, but a high-powered drive in 1959, and another in 1960, conducted with ruthless methods, forced them back, and by the early 1960s the state claimed that Hungarian agriculture was completely collectivized.

Other aspects of Hungarian history may be found in TRANSYLVANIA; CROATIA; AUSTRIA, EMPIRE OF. (C. A. M.)

V. POPULATION

The Magyar population of the old kingdom of Hungary in 1900 was 8,588,834, just over half the total of the whole political unit. That of the Magyar republic in 1930 was 8,683,742. Substantial Magyar minorities had been lost to Czechoslovakia (745,431) and to Rumania (1,700,000). The population of the republic in 1960 was 9,976,530, 93% Magyar with 1,500,000 Magyars in Rumania. About 300,000 Magyars had returned from Czechoslovakia in exchange for Slovak peasants moving north. Nearly 500,000 of the people had perished during the German occupation and in sporadic fighting.

Possibly the most interesting work on the growth of the Magyar population is that of E. D. Beynon in the *Geographical Review* (1937). He emphasizes the inequality of settlement densities in

TABLE II.—*Area and Population*

Megyék (counties)	1949 (sq.mi.)	1949 census	Density	1960 (sq.mi.)	1960 census	Density
Budapest (capital city)	201	1,590,316	7,192.0	203	1,807,299	8,903.0
Bács-Kiskun	3,253	588,606	183.8	3,229	587,028	181.8
Baranya	1,776	360,582	203.0	1,750	400,029	228.6
Békés	2,165	472,377	218.2	2,188	468,303	214.0
Borsod-Abaúj-Zemplén	2,782	630,635	226.7	2,798	726,365	259.6
Csongrád	1,664	429,083	257.9	1,646	434,626	264.0
Fejér	1,711	296,155	173.1	1,700	360,119	211.8
Győr-Sopron	1,585	363,702	229.5	1,549	391,734	252.9
Hajdú-Bihar	2,404	498,271	207.3	2,398	523,003	218.1
Heves	1,399	316,273	226.1	1,405	348,756	248.2
Komárom	867	220,661	254.5	870	270,208	310.6
Nógrád	981	214,757	218.9	983	236,393	240.5
Pest	2,477	686,883	277.3	2,466	783,108	317.6
Somogy	2,348	363,858	155.0	2,349	371,783	158.3
Szabolcs-Szatmár	2,292	558,084	243.5	2,292	587,257	256.2
Szolnok	2,153	450,189	209.1	2,151	462,516	215.0
Tolna	1,376	270,290	196.4	1,384	267,415	193.2
Vas	1,290	282,958	219.3	1,289	283,096	219.6
Veszprém	1,965	345,551	175.9	2,002	393,331	196.5
Zala	1,266	265,568	209.8	1,267	274,161	216.4
Total	35,905	9,204,799	256.4	35,919	9,976,530	277.8

TABLE III.—*Municipal Population of Major Cities*

City	1920	1930	1941	1949	1960
Budapest	929,690	1,006,184	1,164,063	1,590,316	1,807,299
Pestszenterzsébet	40,549	67,907	76,894	—	—
Ujpest	57,464	67,400	76,072	—	—
Kispest	51,064	64,512	65,139	—	—
Debrecen (Hajdú-Bihar)	104,186	117,275	125,943	110,963	129,671
Győr (Győr-Sopron)	50,036	50,881	57,190	57,542	70,812
Kecskemet (Bács-Kiskun)	73,109	79,467	87,267	57,327	66,819
Miskolc (Borsod-Abaúj-Zemplén)	56,982	63,913	109,433	109,124	143,364
Pécs (Baranya)	47,556	61,663	73,000	88,302	114,713
Szeged (Csongrád)	123,565	135,071	136,752	86,640	99,061

the different counties and the variety of birth rates for these units; *e.g.,* 25.4 per 1,000 for the republic as a whole, 35.8 for Szatmár *megye* (county), 37.6 for Szabolcs *megye*. The existence of many Magyar peasants on the margin of destitution which was evident in the extent of migration for seasonal harvesting was related largely to certain *megyék;* for example, Borsod in the north and Zala in the southwest. There the number of peasants with no land or very little land was marked, but distress derived more from the social and material inequalities and intolerable agrarian traditions than from very high densities. Beynon points out the extent to which the practice of limiting births had been accepted in the early 20th century in parts of Hungary. Certainly the natural rates of increase among the Magyars have for long been less than those of two of their neighbours, the Rumanians and the Yugoslavs. In the great transatlantic migration of the late 19th and early 20th centuries from this part of Europe, the Magyar movement was certainly much less than that of the Slavs, and the loss of peasant labour from farms or other enterprises was considered a misfortune rather than a relief.

Historical episode has certainly affected the demography of Hungary both in the past and in the 20th century. The military victory and northward push of the Turks in the 16th century were marked by the flight and slaughter of the Magyar peasantry, especially in the southeast of the Great Plain. The devastations of this conquest were evident in Magyar population and settlement patterns centuries later. The collapse of the Austro-Hungarian monarchy after World War I and the hard fate of Hungary as a residual state shocked and strained Magyar confidence in any prospects in central Europe. The stresses of the present regime, endured by a people of strong pride and long tradition, are partly expressed in the disquieting reports emerging from Hungary on the unwillingness of many people to rear children to an existence in an authoritarian state.

The rural pattern of settlement shows an even peppering of small communes in the west and north of Hungary, mainly clustered round the developing cities. In contrast, in the south and east, the extremes of nucleated settlement are conspicuous, great "village-towns" at considerable distances from each other, the result of the need for protection from the Turks. Nowhere else in Europe is there this extent of peasant conglomeration to form city populations settled in streets of farmhouses and with roots and interests in the countryside. It has confused somewhat the pattern of urban growth in eastern Hungary, although Szeged and Debrecen in the 20th century have become urban centres, emerging as authentic towns from "village-towns." In central Hungary the growth of Budapest has been outstanding. In spite of the vicissitudes of Magyar history the capital has acquired a size and control which set it in a different class from any other city in Hungary.

(H. G. S.)

VI. ADMINISTRATION AND SOCIAL CONDITIONS

1. Constitution and Government.—Hungary is a people's republic under a written constitution on the Soviet model, promulgated on Aug. 20, 1949. Its amendment requires the qualified majority of parliament which is single-chamber. Functions of a head of state are performed by the presidential council (21 members) elected by parliament from among its own members. It also acts as an interim legislative body between parliamentary sessions. The council of ministers, the attorney general and the president of the planning office are elected by, and responsible to, parliament.

Members of parliament are elected every four years (338 deputies in 1958) by direct and universal suffrage, with the qualifying age at 18, and secret ballot, from single lists presented by 3,400 local committees of the Hazafias Népfront (Patriotic People's front). There is no parliamentary opposition, rival parties having been dissolved or absorbed into the front which is controlled by the Magyar Szociálista Munkáspárt (Socialist Workers' party), the only political party which is composed of party members, nonparty individuals and mass organizations such as the trades union federation, the Kommunista Ifjusági Szövetség (Communist Youth league) and the Magyar Nők Országos Tanácsa (National Council of Hungarian Women).

The depository of actual power is the central committee of the Socialist Workers' party. It initiates legislation, recommends governmental changes and issues resolutions which forecast legislative and executive measures.

Local Government.—Administrative units under direct jurisdiction of the presidential council include 19 *megyék,* or counties (each divided into districts), the capital city, Budapest, and Debrecen, Miskolc, Pécs and Szeged, with county status, each divided into boroughs. Under the jurisdiction of the counties are 128 districts and 58 towns with district status. Under the jurisdiction of districts are 3,210 villages.

The county, city, town, borough, district and village councils are elected under the same principles as parliament. Each council elects, from among its own members, an executive committee. Local economic, social and cultural affairs are controlled by the councils. They draw up their own economic plans and budgets, direct and supervise their enforcement, promote production and may levy taxes for local development.

2. Taxation.—Only 6½% of the budget is covered by direct taxes paid by individuals. Workers and employees in the nationalized sector of economy pay no income tax, which is confined to retail tradesmen, artisans and farmers who do not belong to co-operatives, and to professionals who undertake free-lance work. Direct taxes paid by co-operatives are counterbalanced by subsidies.

3. Living Conditions.—There is ostensibly no unemployment in Hungary, which is partly because of organized allocation of manpower. The monthly earning of an average urban worker was estimated in the early 1960s to exceed 1,570 forints (about £47.10s or $131). Necessities (basic rent, public services, staple food) are cheap while industrial goods, luxuries in particular, are expensive. An average urban household spends 46.2% of its budget on food, 7.6% on rent, 16.8% on clothing, 10.4% on durable consumer goods, 3.9% on hygiene, 2.8% on entertainment, 2.3% on transport and 10% on incidentals.

After World War II the number of flats increased by 400,000 but in 1961 there were 2.5 inhabitants per dwelling room, about the same as before the war. The number of rooms allocated to families is limited by law but, after Aug. 1960, additional allocations could be obtained against payment of high supplementary rents.

4. Welfare Services.—Social insurance, administered by the trades union council, covers 95% of the population and includes free medical services and medicine, sickness and maternity benefits and a pension scheme. After ten years' service the pension amounts to 56% of the last earning.

There are nearly 16,000 physicians and surgeons but only about 3,000 panel doctors. The majority of physicians and surgeons are engaged in outpatient clinics and hospitals; the extent of private practice is negligible. There are about 7 hospital beds per 1,000 inhabitants and 8 doctors per 100 hospital beds. Municipalities and some factories maintain infant nurseries but the number of accommodations per 1,000 children of infant nursery age is under 60.

5. Justice.—The hierarchy of the courts is similar to that of the administrative units: supreme court, county, city, town and district courts. The organization of criminal and civil courts is not separated. The courts are composed of professional judges and people's assessors (lay judges). There are special military courts of the first instance; military cases of the second instance are tried before the supreme court.

According to the constitution all judicial offices should be filled by election but, for the time being, with the exception of the chief justice of the supreme court, elected by parliament for a period of five years, all professional judges are appointed. Assessors of the supreme court are elected by parliament, and those of the lower courts by the respective councils, on nominations submitted by the Patriotic People's front, social organizations, factories, agricultural co-operatives, etc.

The police, the frontier guard and the organs of state security are under the authority of the minister of the interior.

Legal aid is available to all, but only a selected number of lawyers may act as counsel in political trials. Lawyers have been forced into lawyers' co-operatives.

6. Education.—Prior to 1948 nearly two-thirds of all primary and more than one-third of all secondary schools were operated by religious bodies, especially the Roman Catholic Church. With the exception of about a dozen secondary schools and theological colleges run by the churches, all educational institutions have been nationalized and the curriculum and the textbooks standardized.

Education is compulsory and free of charge for eight years beginning at the age of six. In the early 1960s more than 6,300 general primary schools catered for most of this age group. For pupils between 14 and 18 years of age there were, at the same time, about 420 secondary schools providing further education for more than a quarter of the age group concerned.

There are 43 institutions of higher education including the Loránd Eötvös (formerly Peter Pázmány) university (founded about 1635) in Budapest, Lajos Kossuth university (1912) in Debrecen, and the universities of Pécs (first founded in 1367, refounded in 1922) and Szeged (1872). These were split and reorganized into several independent units. The educational system was reformed in 1961 to bring school children and university students into contact with industry and agriculture through practical training courses.

7. Defense.—Military service is compulsory: the minimum time is two years, but length of service varies according to the branch of service. The army—not including paramilitary organizations—consists of five mechanized divisions with modern equipment including Soviet tanks. The strength of the air force is estimated at 450 aircraft. There are several rocket sites in the country. Four Soviet divisions are stationed in Hungary under the provisions of the Warsaw treaty. (P. Ka.)

VII. THE ECONOMY

In the formative years of the 19th century the old kingdom of Hungary, with the Magyar nucleus and the highland surround of varied language groups, was the framework of activity. This unit, whatever its political and cultural problems, had a reasonable endowment of resource both in quantity and variety, although the small extent of the high-grade (Mecsek) coal field was a drawback. Hungary was not in the years before World War I wholly relegated to the role of food provider to the Austro-Hungarian monarchy, as some contemporary literature implies. There were great inequalities, much poverty, and a very limited knowledge of some resources, for example the bauxite of the Hungarian hill country. But the manufacture and trade of the capital was already actively linked to the mining and immigrant labour force of the Alpine surround. Prussian capital supported the development of resource, and the Magyar farms supplied substantial industries which had a European reputation: milling, brewing and sugar refining, as well as a big trade in livestock. Some of the produce of the east Hungarian farms was exported directly to industrial Europe.

The material plight of the short-lived Magyar republic set up immediately after World War I came not only from political calamity, but from the complete disruption of the traditional pattern. Industries were cut off from raw materials, exporters from sources of supply and markets; the spider web of communications lost point and efficiency with the severance of its extremities; the support of German capital was destroyed. For a number of reasons, the agrarian reform attempted in the successor states to the old kingdom was meagre in interwar Hungary. Thus the social inequalities appeared glaring and the resources of the residual state were seen to be limited in quantity and range.

After World War II the economy of Hungary became state-controlled and based on a series of economic plans patterned on the Soviet model. The plan of 1947–49 was one of economic reconstruction; the first 5-year plan (1950–54) aimed at rapid and forced industrialization; while that of 1956–60, designed to further industrialization, was discarded after the Oct. 1956 revolution and was replaced by a 3-year plan (1958–60), which was followed by another 5-year plan (1960–65) also emphasizing industrial production. Agriculture was organized on Communist lines in state farms and collective farms.

1. Production.—The great endowment of the widespread loess soils and of the volcanic soils of the northern foothills remains predominant, with its encouragement to grain farming (mainly maize [corn], wheat and barley) and sugar beet production. Viticulture is important along the northern shores of Lake Balaton, in the northern hills around Tokaj and in the dune areas of the Great Alföld. There is strong tradition of livestock farming and trading, and in the east and southeast there are the possibilities of new commercial crops, such as cotton and rice, especially with the increase of irrigation. The fullest and most profitable use of Hungarian soil awaits the good will of the rural population, for the rigorous attempts to enforce a Communist pattern of farming on a reluctant peasantry have had small response in farming efficiency. The problem is evident in the slow increase in yields. It can be argued that in many parts of Hungary, especially the east and southeast, climatic conditions are against the establishment of prosperous small-scale farming. But the fact remains that peasant proprietorship in Hungary, as elsewhere in that part of Europe, was the objective of the rural population for generations and the shock of losing this goal, and of having it described as vile instead of admirable, have taken the heart and energy out of much peasant farming. There is still no close relationship between potential and actual farming activities.

There is evidence of much effort since World War II toward the growth of industry. It plainly suggests one solution to the problem of overmuch dependence on the farms and on imported goods. The development of bauxite mining (in parts of western Hungary) and of the associated aluminum industries are examples of this. So also is the planned growth of heavy industry at Dunatepele to the south of the capital and the encouragement of light industry at Szeged and Debrecen. The state has concentrated on developing its engineering exports: railroad cars, motor vehicles (including buses, trucks and motorcycles), bicycles, tractors, lathes, diesel engines, television and radio sets, electronic instruments and equipment, sewing machines and river boats. The chemical industry has been accelerated. The resources behind state planning, and the wider trading relationships which are implied in a Communist state within the greater framework of eastern Europe, probably encouraged broader foundations to the Hungarian economy and better possibilities of marketing farming exports, whatever the accompanying miseries. Output of solid fuels exceeds 25,000,000 metric tons annually and meets about three-quarters of the country's fuel requirements. Brown coal, comprising more than 70% of total production, is mined near Dorog, in the western Bakony hills and in the northeastern hills, and is mostly used on the spot to generate electricity. Hard coal (10%–15%) is mined around Pécs and Komló in the Mecsek region. Natural gas is of growing importance and in the early 1960s production (mainly for fuel) exceeded 340,000,000,000 cu.m. Most electric power is thermally generated as water power potential is limited. The Tiszapalkonya power station produces about 20% of the nation's electric energy.

2. Trade and Finance.—Hungarian trade is almost entirely dominated by connections with neighbouring and totalitarian states. Imports (coal, petroleum, iron ore, coke and raw cotton) are received chiefly from the U.S.S.R., Czechoslovakia, the German Democratic Republic and Poland. Exports, mainly to the U.S.S.R., Czechoslovakia, the German Federal and Democratic republics, include motor vehicles and rolling stock, cotton fabrics and cattle for slaughter. Most of the revenue is derived from the profits of state enterprises, fiscal fees (taxes and duties) and social insurance contributions. More than half the expenditure is earmarked for

economic planning and over one-quarter for social and cultural purposes.

Banking is centred on the Magyar Nemzeti Bank (National Bank of Hungary). The monetary unit is the forint with an exchange rate of 11.74 forints to the U.S. dollar and 32.8 to the pound sterling.

3. Transport and Communications.—Three sets of circumstances have affected the growth of transport in Hungary. One is the possession by the country of a large part of the Middle Danube waterway. The Magyars have had to contend with the many difficulties associated with the use of this river. The chief of these are the variations in level between maximum and minimum flow, the danger of the moving ice floes in early winter, a nuisance to navigation which coincides with the height of the movement of grain, and the burden of silt carried in proportion to the capacity of the current to scour the bed. This last problem implies maintained and costly dredging to secure navigation channels free from sandbanks. Hungary is indirectly affected by the limitations set to shipping by the Kazan gorge and the Iron Gate, separating the Middle Danube from the Lower Danube to the southeast of the present Hungarian frontiers. However, if many circumstances, physical and human, have combined to make the Danube waterway much less in importance than the streams crossing the German plain, the main stream and its bigger tributaries, together with some sections of canal, remain useful routes for the transport of farming goods. Not only long-distance and international traffic, traceable in statistics, but also the sum of much small-scale, short-distance traffic, more difficult to analyze and assess, depend on the network of rivers, and Budapest (a free port) ranks as one of the major river ports of Europe. (*See* also DANUBE.)

The second is the position of the capital. Budapest has an orientation alike to Transdanubia, the hills and the Nagy Alföld. The development of the railway network and of the roads radiating from the city emphasized its important role whether in the old kingdom or the Magyar republic. The growth of the capital as the main focus of transport was meant to encourage the establishment of industry and to attract the corresponding labour force. No other city in the old kingdom, the residual republic or indeed in the Middle Danube basin had or yet has the same size and standing. Belgrade, Yugos., lies at the hydrographic centre of Middle Danubia as the great streams converge in the south of the basin. But Budapest with its planned web of railways and roads looks like and is the nuclear point of transport in this region.

The third set of circumstances has been mentioned already; severe and adverse political change with substantial loss of territory chopped off the extremity sections of roads, railways and canals at all points of the compass, leaving the original pattern in many cases meaningless and futile. Recovery from such stripping off of roads and railways in all directions was hardly possible in terms of complete independence. Possibly the position of Hungary within a wider framework of economic planning may ease this long-standing problem.

There is an international airport at Ferihegy near Budapest. Radio broadcasting and television, like the transport facilities, are government monopolies and are controlled by the Magyar Radio és Televizio from Budapest.

See also references under "Hungary" in the Index volume.

(H. G. S.)

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HUNGER AND THIRST. Human beings and animals normally manifest the symptoms of hunger and thirst when their bodies are depleted of food and water; ingestion of food and water follows. How this depletion, or physiological deficit, leads to the initiation, maintenance and cessation of eating and drinking, and why certain substances are selected, is the concern of this article.

Initiation of Activity.—The physiological deficit gives rise to a variety of biochemical changes, only some of which act on the nervous system to produce hunger or thirst. In the case of thirst, for instance, the relevant change is not the absolute loss of water; intravenous injection of hypertonic saline solution may lead to a desire to drink, even though the total volume of water in the body is above normal. The relevant change is loss of water from the body cells. In the case of hunger, the precise biochemical factors that initiate eating are unknown. The situation is complicated by the fact that there are many kinds of hunger and also by the fact that (as is shown below) there are two factors present in each case, the first concerned with initiating and maintaining ingestion and the second concerned with its cessation.

The points within the body at which the initiating factors (whatever they are) act, though in essence a subsidiary question, historically speaking has been the main subject of theories of hunger and thirst.

Peripheral Theories.—These hold that it is such peripheral changes as dryness of the throat or contractions of the stomach that signal physiological deficit. Advocates of this view rely on a correlation between such physiological processes and introspective reports of hunger (or thirst). In a well-known experiment (W. B. Cannon and A. L. Washburn, 1912) this was demonstrated by use of a balloon, swallowed and then inflated in the stomach. Pressure on the balloon by stomach contractions could be recorded, and it tended to coincide with the report of the subject when he felt hungry. The physiologists who propounded this theory, such as Cannon and A. J. Carlson, thought of it as accounting for the experience or sensation of hunger or thirst; psychologists (most notably C. L. Hull) regarded it as a physiological basis of drive in the behavioural sense—for instance, to explain the activities of eating and food seeking. However, evidence is available that such peripheral changes are incidental rather than essential factors in hunger and thirst. If neural impulses from a dry throat or a contracting stomach cause the experience of hunger or thirst, then alteration in these tissues should cause abnormalities of hunger and thirst. Yet when the stomach is completely removed (as in some human surgical cases and in experimental animals) the subject continues to manifest normal symptoms of hunger and, in the case of human patients, to report feelings of hunger. Similarly, dryness of the mouth due to congenital absence of the salivary glands in man does not cause increased water intake, and salivary experiments with animals yield similar results. Therefore peripheral changes such as stomach contractions or dryness of the throat are best viewed as incidental factors in hunger and thirst.

Central Theories.—These hold that physiological deficit in hunger and thirst essentially involves localized brain areas. This "central hypothesis" has received overwhelming experimental support. In the case of hunger, there are indications that the lateral area of the hypothalamus may be responsible for converting the biochemical changes into neural messages that lead to eating. Bi-

lateral destruction of this area in laboratory animals produces complete loss of desire to eat, and such animals starve to death in the midst of plenty. Moreover, electrical stimulation of this centre produces ravenous eating and exaggerated food-seeking behaviour. Similar findings have been made in the case of thirst. Other work suggests that these effects may be due to the interruption or stimulation of nerve fibres connecting the lateral area of the hypothalamus with a nearby brain area (the *globus pallidus*). Similarly, an increase in drinking has been demonstrated when certain regions of the medial hypothalamus have been stimulated electrically or with minute quantities of hypertonic saline solution. In these cases the animals will not only drink but also seek out sources of water about which they have previously learned.

Termination of Activity.—Though it is possible to give some account of how bodily depletion of food and water initiates eating and drinking, it is difficult to extend this account to explain how the appropriate amount is eaten or drunk. There are three main types of theory about how this is regulated. According to the first type, current among the behaviourists, the cessation of the state of affairs that leads to ingestion (the afferent stimulation caused by a physiological deficit) coincides with the cessation of ingestion. However, it can be objected that, if this is the case, eating and drinking should continue until the digestion of the ingested substances is complete; but the process of digestion may not be complete for hours (*see* DIGESTION). Evidence that the cessation of drinking is independent of the restoration of water balance is afforded by experiments on dogs with esophageal fistulas. When a dog with such a fistula drinks, water is expelled through the opening in the esophagus before it reaches the stomach. Yet the amount of water the dog drinks before voluntarily stopping, though somewhat in excess of the estimated deficit, is strictly proportionate to it. If the stomach is artificially distended at the same time, the amount drunk is about the same as would be drunk normally. Such an observation seems to give support to the second type of theory, in which the duration of such an act as drinking is explained by the idea that the act itself discharges a neural centre that had previously been charged or loaded. The duration of an activity would thus be proportional to the energy required to produce discharge.

However, a parallel experiment in the case of eating shows that a hungry dog with an esophageal fistula will continue to eat to the point of physical exhaustion. Further, it has been demonstrated that when food is artificially introduced into the stomach, eating stops before digestion can occur. In these cases there has been no eating activity to produce discharge, yet satiation occurs. This objection is in agreement with the everyday observation that the time spent eating is not simply in proportion to the deficit built up but that it also varies according to the kind of food eaten.

According to the third theory, termination of eating and drinking is achieved by messages generated by these activities. It is supposed that such messages impinge on the neural centres that have been excited by bodily deficits and render them progressively less excitable. Thus activity may terminate in spite of the persistence of deficits. The greater the physiological deficit, the higher the level of central excitement and the greater the number of messages necessary to render the centres unexcitable. The amount drunk, for instance, will be related to both the excitation level of the hypothalamic thirst centres and the number of water messages generated per unit volume of the ingested solution. This has been demonstrated for hypotonic saline solutions; in these the amount of water signal generated per unit volume drunk is lower than for distilled or tap water, and the amount of saline ingested by a thirsty animal is consequently larger. This accounts for the fact than an animal stops drinking when it has swallowed the usual volume of water, even if the water does not reach its stomach.

The third theory postulates a similar mechanism in the case of hunger. Here the afferent message (indicating satiety) appears to be generated in the upper part of the digestive tract and is relayed, most probably biochemically, to the ventromedial nucleus of the hypothalamus. It is theorized that this nucleus then acts to reduce neural activity in the lateral portion of the hypothalamus or in the associated *globus pallidus*. Placing food in the stomach causes cessation of eating; in addition, intravenous injection of a 30% sucrose solution has a similar effect on hunger symptoms.

The nature of the biochemical message that is sent to the ventromedial nucleus of the hypothalamus has not been determined with certainty, though glucagon, a protein secreted by the alpha cells in the pancreas (*q.v.*), is implicated; injections of glucagon diminish hunger and the amount eaten.

Consistent with this theory, destruction of the ventromedial nucleus of the hypothalamus leads to gross overeating (hyperphagia) and obesity; conversely, stimulation of this region causes a decrease in eating.

Varieties of Hunger and Food Selection.—So far the factors initiating and terminating food ingestion have been discussed. These were relevant to the making-up of caloric deficit. Similar questions arise about other, specific kinds of deficit, when the diet is deficient in some essential component, such as salt; these give rise to specific appetites. Specific appetites also exist whose relation to physiological deficits is obscure, as for instance the hunger for sweet-tasting substances. In this case the afferent message terminating consumption appears to be carried neurally directly from the tongue. Ingestion of sweet-tasting substances seems to be independent of their nutritional value; rats will drink large quantities of saccharin solution, which does not reduce physiological deficit. Though it has been argued that appetite for sweet-tasting substances is learned, it appears that the taste for sweet substances functions even during fetal life to regulate the amount of amniotic fluid. Polyhydramnios (a painful swelling of the abdomen resulting from an excess of amniotic fluid) has been cured by injecting saccharin into the amniotic fluid. It has been speculated that in the normal condition the fetus drinks the fluid because it tastes sweet; in the case treated with saccharin the amniotic fluid did not have the usual taste.

The specific appetite for salt has also been studied in some detail. An animal with a salt deficiency ingests appropriate quantities of saline material even where previous learning is most unlikely, and it appears to be the taste of salt rather than the physiological consequences of its ingestion that is immediately rewarding and that leads to intake. A similar specific appetite for calcium appears in rats when the parathyroid gland is removed. Animals may indeed learn to seek out certain tastes on the basis of beneficial aftereffects (as in the case of certain vitamin deficiencies), but such learning is slow.

Selection of Ingestible Substances.—*Attractive Properties.*—In many instances animals learn what objects in their environment may be consumed, but there is evidence that there are also innately fixed cues, aside from the gustatory and olfactory, that determine food selection. For instance, it has been shown, under conditions where choice could not have been influenced by selective reward or punishment, that chicks exhibit what seems to be an unlearned preference in pecking at round as opposed to square or triangular objects.

Repulsive Properties.—Most objects or substances in an animal's environment may be divided into (1) those that possess characteristics or qualities that lead to their ingestion when the animal is hungry or thirsty and (2) those that are devoid of these characteristics and are consequently ignored. Some deleterious objects (certain mushrooms, for example) have qualities that would lead to their selection as food, but in general they also possess other qualities that tend to provoke reactions of disgust. Thus many objects (such as rotten eggs), in spite of possessing many characteristics of what the animal takes to be food, will not be ingested. Removal of the amygdala (a part of the temporal lobe of the brain) in monkeys and dogs, however, causes these animals to ingest substances that previously were avoided, as if the mechanism subserving the function of disgust had been disrupted. The scale of preference for ordinary foods remains intact, and the ingestion of substances normally avoided cannot be accounted for by sensory deficit.

The hungrier an animal, the less fastidious it becomes; the "disgust" mechanism seems to be overridden by the intensity of excitation arising from the hunger centres. Conversely, as the animal eats, it is theorized, the intensity of excitation decreases, and there

comes a point at which the aversive qualities of the food cause it to cease eating. This can be clearly seen in the case of animals with lesions of the ventromedial nucleus, the structure that seems to mediate normal satiety. Even such grossly obese animals cut down their intake and lose weight when they are given a somewhat less palatable diet.

See J. A. Deutsch, *The Structural Basis of Behavior* (1960).

HUNGERFORD, WALTER HUNGERFORD, BARON (d. 1449), English warrior and statesman, prominent in the royal service during the first half of the 15th century, belonged to a family that had been settled in Wiltshire since the 12th century. His father, Sir Thomas (d. 1398), who sat for Wiltshire in 11 parliaments and for Somerset in 5, was the first speaker of the commons to be named as such in the rolls of parliament. Since Sir Thomas was steward of the household of John of Gaunt, duke of Lancaster, the family became strongly attached to the Lancastrian cause. Walter, heir of Sir Thomas by his second wife, Joan, was knighted at the accession of Henry IV, sat as knight of the shire for Wiltshire in five parliaments and for Somerset in one, and acted as speaker of the commons in the Leicester parliament of 1414. He served both Henry IV and Henry V as a soldier and on the eve of the battle of Agincourt (1415) it was he, not the earl of Westmorland, as depicted by Shakespeare, who expressed regret that the English had not 10,000 more men there. He was appointed in 1417 steward of the household to Henry V and was created in 1421 a knight of the Garter. In 1422 he was made an executor of Henry V's will and became a member of the council appointed to govern England during Henry VI's minority. Hungerford was created steward of the household to Henry VI in 1424 and he was treasurer of England from 1426 to 1432. In 1426 he was first summoned as a baron to parliament. He served as ambassador on many occasions, notably at the council of Constance (1414–15), the congress of Arras (1435) and the conference of Calais (1439). By royal grants and two wealthy marriages he added largely to the family estates. He died on Aug. 9, 1449, at Farleigh and was buried in Salisbury cathedral with his first wife, who had borne him three sons.

See J. S. Roskell, "Three Wiltshire Speakers of the House of Commons," *Wiltshire Archaeological and Natural History Magazine*, vol. 56 (1956). (A. R. M.)

HUNGERFORD, a market town of Berkshire, Eng., near the Wiltshire border 8 mi. W. of Newbury. Pop. (1951) 3,020. It lies on the Dun where it joins the Kennet (trout and crayfish streams), in a valley in the Berkshire Downs; the Kennet and Avon canal also passes through it. John of Gaunt gave to the citizens manorial rights, including common pasture and fishing, in memory of which a red rose of Lancaster is still presented to a reigning sovereign first passing through the town. On Tuttiday or Hockney day, the second Tuesday after Easter, the burgesses, summoned by a horn blown from the town hall, attend their Hocktide court to elect the constable and other officials for the year. The two tuttimen with garlanded poles collect the "head penny" from each house enjoying common rights. At Lambourn, to the north, are well-known racing stables.

Hungerford rural district, comprising 25 parishes, had a population of 9,660 in 1961.

HUNG HSIU-CH'ÜAN (1814–1864), titular leader of the T'ai P'ing rebellion (*q.v.*) in China between 1851 and 1864. After repeated failures on civil service examinations he fell ill, saw visions, embraced some aspects of Christianity and launched a religious-political movement to overthrow the Manchu dynasty. After achieving considerable success in Kwangsi province and establishing their capital at Nanking, the T'ai P'ings were defeated and Hung Hsiu-ch'üan took his own life.

HUNG WU (CHU YÜAN-CHANG) (1328–1398), the usual designation for T'ai-tsu, founder of the Ming dynasty (1368–1644). A native of Anhui (Anhwei) province, Chu belonged to a poor peasant family and was orphaned at the age of 17. He entered a monastery for subsistence. When popular rebellions broke out against the Yüan dynasty (1280–1368), he joined the force of Kuo Tzu-hsing and distinguished himself in battle. With the death of Kuo in 1355, he commanded his own army for the conquest of the south. Nanking was captured in 1356; he defeated his leading opponent, Ch'en Yu-liang, in 1363; and he proclaimed himself prince of Wu in 1364. By 1367 south China was subdued, and he marched toward Peking, which was captured in 1368. There he proclaimed a new dynasty and established his capital at Nanking.

His reign was devoted to the pacification of the empire and the restoration of the traditional order. In 1368 and 1369 his general, Hsü Ta, campaigned against the Mongols in Shansi and Shensi. In 1371 Szechwan was captured, and Ming forces moved into Manchuria and occupied Liaotung. In 1382 the twelfth Mongol governor of Yünnan (Nan Chao) was taken and decapitated, and Yünnan became a part of China proper. Ming forces went as far as Karakorum and Hami (in Dzungaria). In eastern Asia, Ming influence was extended to Korea, although Japanese pirates continued to raid the Ming coast.

Internally, defenses were built, city walls repaired, and the Grand canal repaired and deepened. In 1373 the Ming code, based upon that of the T'ang, was promulgated; the civil service examinations were reinstated; the empire was divided into 15 provinces; taxation was regulated; and a national currency was introduced. Toward the latter part of his reign, the emperor became suspicious and irrational, and sent many able officials and their families to their deaths. He made the mistake of creating principalities for his sons, which later became a source of trouble. *See* also MING. (D. B. CH.)

HUNKERS AND BARNBURNERS, in U.S. history the popular names given to the two factions into which the Democratic party of the state of New York split during the 1840s. The Hunkers (from the Dutch word *hunkerer*, referring to one who seeks office for himself) were led by William L. Marcy and Daniel S. Dickinson and were the conservative urban group. The Barnburners, whose name was supposedly derived from the act of a farmer who set his barn afire to rid it of rats, were led by Martin Van Buren and were the radicals. The Hunkers advocated the use of canal revenues for additional internal improvements, whereas the Barnburners favoured using the money to pay the state debt. The two factions disagreed also on the chartering of state banks (favoured by the Hunkers) and on the distribution of patronage.

Their opposing views on slavery brought the two factions into national politics briefly. After 1844 the Hunkers supported the annexation of Texas and violently opposed all antislavery agitation. The Barnburners opposed the extension of slavery into new territories. In 1848 they left the Democratic national convention, nominated Van Buren for president, and joined the Free-Soil party, which also nominated Van Buren. This coalition won no electoral votes but weakened the regular Democratic candidate in New York and contributed to the election of Gen. Zachary Taylor as president. Later some of the Barnburners returned to the Democratic party, but when the Republican party was organized the younger Barnburners joined it. (N. A. G.)

HUNS (HUNNI), a nomadic pastoralist people who invaded southeastern Europe *c.* 370, built up an enormous empire there and in central Europe in the following years, and ceased to play an effective part in history after 455. Their origin is almost as obscure now as it was to the Romans in the 4th century A.D., although it has been the subject of interminable and for the most part fruitless discussion since at least the 18th century. Appearing from beyond the Volga river some years after the middle of the 4th century, they first overran the Alani (*q.v.*), a pastoral people who occupied the plains between the Volga and the Don, and then quickly overthrew the great empire of the Ostrogoths (*see* GOTHS) between the Don and the Dniester. The aged Gothic king Ermanaric committed suicide and his successor, Vithimiris, was killed in battle by them. About 376 they fell upon the Visigoths living in what is now approximately Rumania, rapidly defeated their chief Athanaric (*q.v.*), and thus arrived at the Danubian frontier of the Roman empire.

The earliest systematic description of the Huns is that given by the historian Ammianus Marcellinus, writing *c.* 395. From his chapter on them it may be inferred that they were primitive pastoralists owning herds of cattle and horses but knowing nothing of

agriculture. They had no settled homes but roamed the steppe in search of pasture and water. For their food supply they also relied on hunting and food gathering. Their clothes were made either of linen (presumably acquired by trade from foreign peoples) or of the skins of animals. They all but lived on horseback, taking their food, bartering their products and negotiating their treaties without dismounting. Ammianus notes that they had no kings. Each group was led by *primates*, as he calls them, though he does not tell us what the powers of these *primates* amounted to or indeed whether they held their leading position in peacetime or in war only. But he seems to imply that they had no single over-all leader in the 4th century, even when engaged on major campaigns. On this point, however, he would seem to be contradicted by the historian Jordanes, who says that they attacked the Ostrogoths under the leadership of one Balamber.

As warriors the Huns inspired almost unparalleled fear throughout Europe. They were mounted archers. The accuracy with which they used their compound bows never failed to astonish Roman observers. Their horses were ugly but hardy; and their complete command of horsemanship, their ferocious charges and unpredictable retreats, the clouds of arrows which they could discharge so rapidly, the speed of their strategical movements, brought them their overwhelming victories over the Goths and at a later date over the Romans.

It may be that Ammianus made out the Huns to be rather more primitive than they were in fact. Various tombs found in the region of the Dnieper river and elsewhere have been assigned by archaeologists to Huns, and, if the identification is correct, the Hun leaders had amassed wealth to a degree which would seem to contradict Ammianus' description of their poverty.

For half a century after the overthrow of the Visigoths in 376 comparatively little is heard of the Huns. They raided the Danubian provinces of the Roman empire several times (the raid of 395 was very severe), and early in the 5th century they extended their power over many of the Germanic peoples of central Europe. About the year 430 Huns are actually found operating under a certain Octar against the Burgundians in the Main valley. But Hun bands are also found fighting for the Romans in this period. A certain Uldin, who raided Moesia in 408, had in the year 400 defeated Gainas (a Goth in Roman service, who had rebelled against the Roman government in the previous year) and had also helped Stilicho (*q.v.*) to repel the invasion of Radagaisus in 406. And during the '30s of the 5th century a body of Huns was assisting Aetius (*q.v.*) to defeat his enemies in Gaul. In 432 the leadership of the various groups of Huns had been centralized, and they were then ruled by a single king, one Rua or Rugila, the brother of Octar. When Rua died in 434 he was succeeded by his two nephews, Bleda and Attila. For their subsequent campaigns *see* ATTILA.

The chief source of information for the Huns under Attila is the fragments of the Greek historian Priscus, who himself visited Attila's headquarters in Wallachia in 449 and who more than once during his visit saw Attila himself. Since Ammianus' day the Huns had acquired huge sums of gold as a result of their treaties with the Eastern Romans. About 430 the Eastern emperor Theodosius II undertook to pay them 350 lb. of gold per annum. In 435 this annual tribute was doubled. In 443 they received a lump sum of 6,000 lb. of gold, and the tribute was raised to 2,100 lb. of gold each year. In addition, they obtained incalculable sums by way of plunder and by selling their prisoners back to the Romans.

This influx of wealth altered the character of their society. The military leadership became hereditary in one family, that to which Attila belonged. Attila, at any rate after he murdered his brother Bleda *c.* 445, had autocratic powers in peace and war alike. He personally planned and led his people's campaigns and also negotiated in person with foreign powers. He administered justice among his followers: Priscus describes him as standing at the door of his log hut and pronouncing his judgments on the spur of the moment without reference to any of his lieutenants. He had the power of life and death over his men, who regarded him as a god. He administered his huge empire by means of "picked men" (*logades* is the Greek term used by Priscus). They frequently went on diplomatic missions for him and were sometimes allowed to negotiate with foreign envoys who came to Attila's headquarters and whom Attila for one reason or another did not wish to see. But their main function concerned the government of the Hun empire. Each of them had a force of Huns under his command with which he governed and collected food and tribute from those of the subject peoples who had been assigned to him by Attila. A sort of hierarchy existed among the *logades* (one of whom, oddly enough, was a Roman—Orestes, the father of Romulus Augustulus), and Attila gave more honour to some than to others, though all alike were in possession of great wealth. When they went on campaigns the Huns brought with them considerable contingents of warriors from their subject peoples. Apart from their military value, it might have been dangerous to leave these men at home when the main Hun forces were far away. But some of the kings of the subject peoples, especially Ardaric, king of the Gepidae, won considerable influence over Attila. The rank and file of the subjects, however, seem to have hated the rule of the Huns fiercely and to have been severely oppressed by them, though no details exist as to the amount of food and tribute extorted from them.

It was these subject peoples who finally brought about the downfall of the Hun empire. In 451 Attila was defeated in Gaul by Roman and Visigothic forces under Aetius and the Visigothic king Theodoric I and repulsed from Italy by plague and famine in 452. After his death in the following year his sons, who were very numerous, divided up his empire among them and at once began quarreling among themselves. They then began a series of costly struggles with their subjects, who had revolted, and were finally routed by a combination of Gepidae, Ostrogoths, Heruli and others in 455 in a great battle on the unidentified river Nedao in Pannonia, though our authority, Jordanes, exaggerates when he says that 30,000 of them were killed. The East Roman government thereupon closed the frontier to the Huns and broke off all trading relations with them, and the export of weapons was particularly forbidden. For the following period the sources of information are very meagre. Occasional raids on the Roman frontier by various sons of Attila are recorded, but these achieved little. Other groups of Huns were settled in the provinces by the Eastern emperors. Yet others are heard of as fighting unsuccessfully against the Ostrogoths. Before the end of the century the Huns had disintegrated and had ceased to play any significant part in history, though Jordanes says that two groups of them still existed inside the empire in the middle of the 6th century. The Huns are in no way connected with the modern Hungarians.

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HUNSTANTON (pronounced locally Hunston), a town and urban district of Norfolk, Eng., lies on the east shore of the Wash, 47 mi. N.W. of Norwich by road. Pop. (1961) 4,843. A seaside resort with an agricultural background, it has wide, sandy beaches behind which cliffs rise to 60 ft., and golf links at Old Hunstanton (1¼ mi. N.). The centre of the town is the Green, an open greensward, and most of the buildings are of reddish local carstone. Hunstanton hall, at Old Hunstanton, is a mainly 16th-century building which until 1949 was the seat of the Le Strange family, who were granted rights by William the Conqueror. Sir Roger L'Estrange (*q.v.*) was born there. (W. H. Bx.)

HUNT, HENRY (1773–1835), English radical leader, known as "Orator" Hunt and prominent among the more extreme reformers during the first part of the 19th century, was born at Upavon, Wiltshire, on Nov. 6, 1773. He was a farmer, like his father, and on one occasion in 1800 was sentenced to six weeks imprisonment for challenging his superior officer in the Wiltshire yeomanry to a duel. He first became actively engaged in politics in 1806. In person, training and character he much resembled William Cobbett with whom, nonetheless, he had a number of sharp quarrels. Cobbett's reputation has been preserved and increased by his writings; Hunt's oratory, his greatest gift, was more ephemeral.

Hunt's first dramatic appearance in English politics was in Aug. 1819 when he presided at the great meeting at St. Peter's fields,

Manchester, which was attacked by the yeomanry (*see* PETERLOO). The white hat he wore on that occasion, and which was stated to have been stove in by a sword cut, became the badge of reform, and for several years to wear a white hat was as symbolical as it later was to wear a red tie. Hunt was tried at York in March 1820 and was sentenced to imprisonment for two and a half years; from his prison he sent out *A Peep Into a Prison*, an exposure of the conditions in Ilchester jail. He later took a great share in the popular parliamentary reform movement which reached its climax in 1832. In 1830 he was elected member of parliament for Preston, one of the few boroughs with a working-class electorate. In parliament he presented a petition for women's rights, and moved (despite his farming connection) for the repeal of the corn laws. But the Reform act of 1832, in granting the vote to the middle class and standardizing the franchise, caused Hunt to lose his seat in the election of 1832. He died on Feb. 15, 1835, at Alresford in Hampshire. (A. BRI.)

HUNT, HENRY JACKSON (1819–1889), U.S. army artillery officer in the American Civil War, was born on Sept. 14, 1819, in Detroit, Mich. He graduated from West Point in 1839 and served with distinction in the Mexican War. In 1856 he was appointed member of a board to revise artillery tactics and in 1860 completed an artillery manual. After the Civil War broke out he fought at the first battle of Bull Run and was then placed in charge of the artillery in the defense of Washington, D.C. He was also responsible for organizing the artillery reserve in Gen. G. B. McClellan's army. Throughout the war, Hunt participated as chief of artillery in the Union army of the Potomac, his services being especially conspicuous at the battles of Malvern Hill, Antietam, Fredericksburg, Gettysburg and Petersburg. He directed the artillery fire that stopped Pickett's charge at Gettysburg. Attaining the rank of brevet major general during the war, he contributed more than any other officer to the effective employment of the artillery arm in the field. He retired from the army in 1883, and died on Feb. 11, 1889, in Washington, D.C. (W. W. HA.)

HUNT, SIR (HENRY CECIL) JOHN (1910–), British soldier, mountaineer and explorer, was the leader of the expedition which made the first ascent of Mt. Everest (29,028 ft.). Born on June 22, 1910, and educated at Marlborough and the Royal Military college, Sandhurst, he was commissioned to the 60th Rifles and served in India and Burma, partly on police work. From there he made acquaintance with the Karakoram (1935) and the Sikkim Himalaya (1937, 1939). He served with his regiment during World War II, and took part with distinction in the north African and Italian campaigns. For his command of the 11th Indian brigade during the Greek rebellion (1944–46) he was awarded the commander of the Order of the British Empire.

In 1952 he was recalled from an army post in Germany to lead the 1953 British Everest expedition. His leadership was characterized by thorough planning and by the personal part he took in every job. On the mountain he finally went up with one Sherpa in support of the first summit pair, leaving loads at 27,300 ft. on the southeastern ridge. The success of the expedition was in great measure the success of its planning and *esprit de corps*. He wrote *The Ascent of Everest* (1953) and in 1956 left the army to become the first secretary of the Duke of Edinburgh's award, a plan to foster the idea of adventure and service among boys. (C. W. F. N.)

HUNT, (JAMES HENRY) LEIGH (1784–1859), English essayist and poet, editor of several influential periodicals and friend of John Keats, was born at Southgate, Middlesex, on Oct. 19, 1784. In 1791 he entered Christ's hospital, where he was a near contemporary of Coleridge and Charles Lamb. His *Juvenilia* were published in 1801. In 1807 he published *Critical Essays on the Performers of the London Theatres* and became editor of *The Examiner*, the first number of which appeared in Jan. 1808. In 1809 he married, and two years later he met Shelley. In *The Reflector* for 1812 he published "The Feast of the Poets," a poem that he more than once revised in a way that makes it a barometer of avant-garde taste at this time. In 1813 he and his brother John were imprisoned for libeling the prince regent. Before he was released in 1815 he wrote a good deal and became something of a hero with those who deplored the reactionary policies of the government. Soon after his release he went to live at Hampstead, where he published *The Story of Rimini* (1816) and met Keats, whose guide to the world of books and of pictures he at once became. Although Keats grew tired of him, Hunt did a great deal for the young poet. Hunt's other friends included William Hazlitt, Charles Lamb, Benjamin Haydon and many other men of genius and talent.

There was a persistent (though shallow) vein of melancholy in Hunt's temper, and throughout his life he deliberately cultivated his powers of enjoyment. It is characteristic of him to have written an essay on "Poetry and Cheerfulness." His poems show his love of Italian literature and his enthusiasm for painting. He looked to Italy (in particular) for guidance toward that "freer spirit of versification" which he sought. He believed that he had tropical blood in his veins, attributing to this his "southern insight into the beauties of colour." Unfortunately, amorous description was the fatal Cleopatra for whom he lost the world, and was content to lose it. At one moment he can write "The laughing queen that caught the world's great hands" and at another inform us that Francesca "had stout notions on the marrying score."

The *Examiner's* support for parliamentary reform, the abolition of the slave trade, Catholic emancipation and the reform of the criminal law was sustained and influential, as was its advocacy of the new poets, particularly Shelley and Keats. In the prospectus of *The Reflector*, a quarterly magazine (1810–11), Hunt wrote that "politics, in times like these, should naturally take the lead in periodical discussion, because they have an importance and interest almost unexampled in history, and because they are now, in their turn, exhibiting their re-action upon literature, as literature in the preceding age exhibited its action upon them." Yet *The Indicator*, a weekly periodical (1819–21) in which Hunt felt at liberty to take a holiday from politics, contains a great deal of Hunt's finest and most characteristic writing. "They tell me that I am at my best in this work," he acknowledged, and from the first *The Indicator* sold well and won high praise from such judges as Hazlitt and Lamb. Hunt also played a prominent part in *The Liberal* (1822–23), a short-lived but distinguished collection of "Verse and Prose from the South."

In his own essays Hunt is a pupil of the 18th-century essayists, and particularly of Oliver Goldsmith. Yet his aim is less to point a moral than to communicate enjoyment. The same tendency informs his literary criticism: he wrote almost exclusively of what he enjoyed, and few men have had a more catholic faculty of enjoyment. No critic of the time was more perceptive about his contemporaries. He outlived most of them, acclaiming Tennyson and being satirized by Dickens (as "Skimpole" in *Bleak House*). He died at Putney on Aug. 28, 1859. A modern reader should begin with a few of his essays and with his *Autobiography* (1850, an earlier version having appeared in 1828 as *Lord Byron and Some of His Contemporaries*).

Hunt published his *Poetical Works* (really a selection) in 1832. His other works include: *Sir Ralph Esher*, a novel (1832); *Christianism* (1832); *Imagination and Fancy* (1844), an important volume; *Wit and Humour* (1846); *Stories From the Italian Poets* (1846); *Men, Women and Books* (1847); *A Jar of Honey From Mount Hybla* (1848); and *The Town* (1848). Further periodicals in which he was concerned are: *The Round Table* (1817), mainly by William Hazlitt; *Leigh Hunt's London Journal* (1834–35); and *Leigh Hunt's Journal* (1850–51).

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HUNT, RICHARD MORRIS (1828–1895), U.S. architect, who introduced 19th-century French traditions into American

architecture, was born in Brattleboro, Vt., on Oct. 31, 1828. He studied in Europe (1843–54), mainly in the École des Beaux-Arts at Paris, and in 1854 was appointed inspector of works on the buildings connecting the Tuileries with the Louvre. Under Hector Lefuel he designed the Pavillon de la Bibliothèque, opposite the Palais Royal. In 1855 he returned to New York and was employed on the extension of the Capitol at Washington. He designed the Lenox library (now torn down) and the Tribune buildings in New York; the Theological library and the Marquand chapel at Princeton; the Divinity college and the Scroll and Key building at Yale; the Vanderbilt mausoleum on Staten Island and the Yorktown monument. For the administration building at the World's Columbian exposition at Chicago in 1893 Hunt received the gold medal of the Institute of British Architects. Among the most noteworthy of his domestic buildings were the residences of W. K. Vanderbilt and Henry G. Marquand in New York city; George W. Vanderbilt's country house at Biltmore, N.C.; and several of the large "cottages" at Newport, R.I., including Marble House and The Breakers.

Hunt was the leader of a school that established in the United States the manner and the traditions of the Beaux-Arts. He took a prominent part in the founding of the American Institute of Architects, and from 1888 was its president. His talent was eminently practical; and he was almost equally successful in the ornate style of the early Renaissance in France, in the picturesque style of his comfortable villas, and the monumental style of the Lenox library. He died on July 31, 1895.

HUNT, WILLIAM HOLMAN (1827–1910), English artist and principal member of the Pre-Raphaelite Brotherhood, to whose tenets he remained faithful throughout his career. He was born in London on April 2, 1827, the son of a city warehouse manager. At first discouraged in his artistic ambitions, he worked as a clerk to an estate agent, but in 1843 began studying in the National gallery and British museum. The following year he entered the Royal Academy schools where he met his lifelong friend John Everett Millais, two years his junior. His first Academy picture, "Hark!" was exhibited in 1846, followed by a subject from Walter Scott, "Dr. Rochecliffe Performing Divine Service in the Cottage of Joceline Joliffe at Woodstock" (1847), and another from Keats's "Eve of St. Agnes," "The Flight of Madeline and Porphyro," in 1848. In August of that year D. G. Rossetti began working with Hunt. To the Academy exhibition of 1849 Hunt sent his picture "Rienzi" (Mrs. M. E. Clarke collection) on which appeared the initials "P.R.B." after his surname. The works of these three men, Hunt, Millais and Rossetti, with their clear hard colour, brilliant lighting and careful delineation of detail heralded the new movement (*see* PAINTING: *Great Britain*). Also in that year, Hunt accompanied Rossetti on a visit to Paris and Belgium.

Public opinion, at first unreceptive, became actively hostile toward the Brotherhood when in 1850 Hunt showed his "Christians Escaping From the Druids" (Ashmolean museum, Oxford). John Ruskin praised "Valentine Protecting Sylvia From Proteus" (1851) and it gained a prize at Liverpool, while in 1852 "Strayed Sheep" (Tate gallery, London) was similarly honoured at Birmingham. Religious subjects, foreshadowed by "The Hireling Shepherd" (1853; later version in Manchester), henceforth dominated Hunt's attention, and in 1854 "The Light of the World" (Keble college, Oxford), an allegory of Christ knocking at the door of the human soul, was championed by Ruskin and brought the artist his first public success.

In Jan. 1854 Hunt began a two-year visit to Syria and Palestine to glean firsthand knowledge of the Holy Land. After considerable difficulties and adventures he completed in July 1855 "The Scapegoat" (Lady Lever Art gallery, Port Sunlight), a solitary outcast animal on the shores of the Dead sea, the subject being inspired by Isa. liii. 4–6, and Lev. xvi, 20–22. Painted in part at Usdum on the Dead sea, and in Jerusalem, the work was rightly criticized by Ruskin for atmospheric inconsistencies and inadequate anatomical verisimilitude. Artistic qualities suffered at the expense of religious symbolism, and this defect recurred in the elaborate "The Finding of the Saviour in the Temple" (1854–60; Birmingham), sold to Gambart for a record sum of 5,500 guineas. Hunt paid two more visits to Jerusalem, in 1869 and 1875, and "The Shadow of Death" (1870; Manchester) contains a view of Nazareth seen through the windows of the carpenter's shop. Among the most important of his later paintings are "The Triumph of the Innocents" (two versions: 1884, Tate gallery, London; 1885, Liverpool), "May Morning on Magdalen Tower" (1889; Lady Lever Art gallery) and "The Miracle of the Sacred Fire" (1898)—finished just before his sight began to fail.

In 1905 Hunt succeeded G. F. Watts to the Order of Merit and received a doctorate of civil law from Oxford university. He died in London on Sept. 7, 1910, and was buried in St. Paul's.

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HUNT, WILLIAM MORRIS (1824–1879), U.S. painter, most important for the French influence he brought to America, was born at Brattleboro, Vt., on March 31, 1824. He attended Harvard, but his real education began when he studied with Couture in Paris and then came under the influence of Jean François Millet. The companionship of Millet had a lasting influence on Hunt's character and style, and his work grew in strength, beauty, and seriousness. Through the Boston society circles in which he moved, he introduced the works of Millet, Rousseau, Corot and others of the French Barbizon school, and he more than any other turned the rising generation of American painters toward Paris. On his return in 1855 he painted some of his best pictures, reminiscent of his life in France and of Millet's influence. Such are "The Belated Kid," "Girl at the Fountain," "Hurdy-Gurdy Boy," etc. But the public called for portraits, and it became the fashion to sit for him.

Among his best paintings of this kind are those of William M. Evarts, Mrs. Charles Francis Adams, the Rev. James Freeman Clarke, William H. Gardner, Chief Justice Shaw and Judge Horace Gray. Unfortunately many of his paintings and sketches, together with five large Millets and other art treasures collected by him in Europe, were destroyed in the great Boston fire of 1872.

Among his later works American landscapes predominated. They also include the "Bathers" (twice painted) and the allegories for the senate chamber of the state capitol at Albany (N.Y.), now lost by the disintegration of the stone panels on which they were painted. Hunt was drowned at the Isles of Shoals on Sept. 8, 1879. He wrote *Talks about Art* (1878).

HUNTER, ROBERT (d. 1734), colonial governor of New York and New Jersey, and later of Jamaica, was born at Hunterston, Ayrshire, Scot. Forsaking his apprenticeship as an apothecary, Hunter joined the British army and fought at Blenheim (1704) under Marlborough, with whom he seems to have been personally acquainted. In 1707 Hunter was chosen lieutenant governor of Virginia, but on the way to America he was captured by the French and remained their prisoner until exchanged. Hunter was commissioned as governor of New York and the Jerseys in 1709. Accompanying the new executive to America in 1710 were 3,000 German Protestant refugees who were ordered to undertake the production of naval stores along the Hudson river. This venture proved to be a failure despite the governor's intense interest in it. Hunter's career in America was characterized by a series of political and religious entanglements, but he was one of the best-loved administrators ever selected by England. In 1719 he returned to England, and for several years was consulted as an authority on colonial affairs by the board of trade. His last commission was the governorship of Jamaica, an office he held until his death on March 31, 1734. (R. L. BE.)

HUNTER, SIR ROBERT (1844–1913), English lawyer and philanthropist, who devoted much of his time to safeguarding the rights of the public in regard to open spaces and the preservation of rights of way, was born on Oct. 27, 1844. In 1882 he became solicitor to the general post office. One of the principal promoters

of the Commons Preservation society, founded in 1865, he became in 1868 its solicitor and successfully conducted suits for preserving Wimbledon and Wandsworth commons and for recovering a portion, wrongfully enclosed, of Epping forest. Ashdown forest, Hampstead heath, Hindhead and the New forest also were safeguarded by him. He was made a knight commander of the Order of the Bath in 1911, and died at Haslemere on Nov. 6, 1913.

HUNTER, ROBERT MERCER TALIAFERRO (1809–1887), Virginia politician and member of the Confederate government during the American Civil War, was born in Essex county, Va., on April 21, 1809. He graduated from the University of Virginia in 1828, studied law and was admitted to the bar in 1830. From 1837 to 1843 and from 1845 to 1847 he was a member of the U.S. house of representatives, being speaker from 1839 to 1841. From 1847 to 1861 he was in the senate, where he was chairman of the finance committee (1850–61). He held strong states' rights views and became a close friend and ally of John C. Calhoun.

Hunter did not regard Lincoln's election in 1860 as being of itself a sufficient cause for secession, and in Jan. 1861 he proposed an elaborate but impracticable scheme for the adjustment of differences between the North and the South. When this and several other efforts to the same end had failed, he withdrew from the U.S. senate and quietly urged Virginia to pass the ordinance of secession. In 1861–62 he was secretary of state for the Confederacy and in 1862–65 was a member of the Confederate senate, in which he was, at times, a caustic critic of the administration of Jefferson Davis. Hunter was one of the Confederate commissioners who conferred with Union representatives at the unsuccessful Hampton Roads conference in 1865. After the surrender of Gen. R. E. Lee, Hunter was summoned by President Lincoln to Richmond to confer regarding the restoration of Virginia in the Union. From 1874 to 1880 he was treasurer of Virginia, and from 1885 until his death near Lloyds, Va., on July 18, 1887, was collector of the port of Tappahannock, Va.

See E. M. Coulter, *The Confederate States of America* (1950).

HUNTER, WILLIAM (1718–1783) and **JOHN** (1728–1793), brothers, were among the most distinguished and influential of British medical teachers and practitioners. Both brothers excelled particularly, although in different ways, in the teaching of anatomy. William was pre-eminent in the practice of obstetrics and John was outstanding as a surgeon. John, in addition, carried out many highly original and important studies and experiments in many areas of comparative biology, anatomy, physiology and pathology.

William and John Hunter were both born at Long Calderwood, in East Kilbride, Lanarkshire; William on May 23, 1718, and John on Feb. 13, 1728. They were the seventh and tenth children, respectively, of John and Agnes Hunter, and were descended on their father's side from the Ayrshire family of Hunter of Hunterston. Their brother James, the fifth child, showed great promise of success in medicine before his early death at the age of 30. Their sister Dorothea, the eighth child, married James Baillie and became the mother of the distinguished pathologist Matthew Baillie and of the dramatist Joanna Baillie (*qq.v.*).

William's education and training were considerably more formal than were John's. William matriculated in 1731 at the university in Glasgow, then began his medical study late in 1736 or early in 1737 by taking up residence with William Cullen in Hamilton. After having attended medical lectures in Edinburgh in 1739 and 1740, he went to London in 1740, residing first with William Smellie and later with James Douglas. He became a surgical pupil at St. George's hospital in 1741 under James Wilkie, and was admitted to the Corporation of Surgeons in 1747. He received the degree of doctor of medicine from Glasgow in 1750, and, becoming disfranchised from the Corporation of Surgeons, was admitted a licentiate of the College of Physicians in London in 1756. William became surgeon-man-midwife to the Middlesex hospital in 1748 and to the British Lying-in hospital in 1749, but presumably, since he abandoned surgery by 1756, the tenure of neither of these positions was of long duration.

William first began to teach in 1746. It is often claimed that his first lectures were delivered to a society of navy surgeons, but this is incorrect, since the society was not founded until after Hunter had begun to teach. He continued to lecture throughout his life. His lectures dealt principally with surgery or anatomy; they were erudite, extremely polished and always well attended. His most distinguished pupil was his brother John. Through his teaching he revivified the teaching of anatomy in Great Britain, which was badly in need of reform. He had traveled in France in 1743–44 and also in 1748 and introduced to Great Britain the Paris method of providing each student with a cadaver to dissect for himself. In 1766 he purchased a house in Great Windmill street, began to teach in it in 1767 and later took up residence there, having had it rebuilt to contain an amphitheatre, dissecting rooms and a fine museum. He amassed a splendid collection of anatomical and pathological preparations for use in his teaching; he was an avid collector also of ancient coins and medals, of minerals, shells and corals, and especially of books. His library was outstanding for any age. Ultimately after his death these collections became the property of the University of Glasgow. When the Royal Academy was founded in 1768 Hunter was appointed professor of anatomy and lectured on anatomy to artists.

William Hunter's practice, after 1756, was devoted principally to obstetrics, and he was the most successful specialist in this field in Great Britain during his day. Among his many distinguished patients the most distinguished of all was Queen Charlotte. She first consulted him during her first pregnancy in 1762, and he was named physician extraordinary to her majesty the same year. He attended her also during two subsequent pregnancies. He was influential, in the history of British obstetrics, through his opposition to the use of the forceps. But further than this, by virtue of his high standards of teaching and practice, obstetrics was removed from the hands of the midwives to become an accepted branch of medicine itself.

William Hunter published three books. One, *Two Introductory Lectures*, published posthumously (1784), illuminates the character of his teaching. Another, *Medical Commentaries* (1762; *Supplement*, 1764) is of principal interest in that it contains details of his controversies with the Monros over priority for the injections of the testicular tubules and for the discovery of the absorptive functions of the lymphatics, and with Percivall Pott over credit for the elucidation of the nature of congenital hernia. But he was really a man of one book, and his great masterpiece was the *Anatomy of the Human Gravid Uterus, Exhibited in Figures*, an elephant folio published in 1774 as the only medical publication to be issued by the famous Baskerville press. William spent 30 years in its preparation, Jan van Riemsdyck made many of the drawings for the 34 plates, Robert (later Sir Robert) Strange prepared some of the engravings, and the book has rarely been excelled as an anatomical monograph. William published in addition to his books a small number of scattered essays or case histories, dealing principally with the circulatory, the skeletal or the reproductive organs. Other subjects covered were emphysema, the cellular membrane, the pupillary membrane, signs of murder, the lacrymal ducts, a description of an animal from India, and so forth.

John Hunter, in contrast to his brother, never completed a course of studies in any university, and, as was often customary for surgeons during the 18th century, he never attempted to become a doctor of medicine. He first went to London in 1748 to assist in the preparation of dissections for the course of anatomy which William had begun to teach two years before, and for 11 winters he continued to learn anatomy in his brother's dissecting rooms. In the summers of 1749 and 1750 he learned surgery from William Cheselden at Chelsea hospital, and when Cheselden became ill may have become a pupil at St. Bartholomew's in 1751. He is said to have become a surgeon's pupil at St. George's in 1754. In the spring of 1755 he entered as a gentleman commoner at St. Mary's hall, Oxford, but apparently remained for less than two months; his interest was in nature, not books. He seems to have become house surgeon at St. George's in 1756, and was admitted a member of the Corporation of Surgeons in 1768.

Like William, John devoted great energy to teaching. During his second year in London he is said to have superintended some

of his brother's pupils in practical anatomy, and he is reputed to have assisted him in lecturing after 1754. In 1753 he was elected a master of anatomy at Surgeon's hall, with the duties of reading lectures. He started his own private lectures on the principles and practice of surgery in the early 1770s and continued them until 1790. In addition, he had teaching duties from 1768 at St. George's (to which he had been elected surgeon in 1758), and these included taking house pupils. His various students included many who were later to become famous in their own right: Edward Jenner, John Abernethy, Anthony Carlisle, Henry Cline, Astley Cooper and William Blizard were among the British, and Philip Syng Physick, John Morgan and John Shippen among the Americans, who profited from his teaching. As a lecturer, he was far less fluent than William. His ideas spilled from his mind faster than the words from his tongue or his pen, and his use of language was far less elegant than his brother's. Yet the range of his interest and knowledge in widely various aspects of medicine and natural history, his lively curiosity and his penetration of thought were such that he could not fail, no matter what the manner of his style or delivery, to be highly stimulating to his students. Like William, he became a collector, and amassed a collection of well over 10,000 anatomical, pathological and biological specimens. By his will, his collection was after his death offered for sale to the government. The government purchased it in 1799; the Corporation of Surgeons became its custodian, and when the corporation was constituted as the Royal College of Surgeons in 1800 the Hunterian collection was among its most important assets. The specimens were unfortunately mostly destroyed by enemy bombing during World War II.

From the time of his appointment in 1756 as house surgeon to St. George's, John excelled in surgery. In 1760, after an illness, he accepted a commission as surgeon on the staff of the army, and accompanied the expedition against Belle-Île-En-Mer in 1761. He returned to London in 1763 and practised surgery there until he died. He was the leading surgeon in London and, like William, had many distinguished patients. In 1776 he was named surgeon extraordinary to George III; he was appointed deputy surgeon general to the army in 1786, and surgeon general and inspector general of hospitals in 1790. His services to surgery were to some degree similar to those of Williams's to obstetrics. He not only made specific contributions of great importance, as for instance by the introduction of the high operation for aneurysm of the popliteal artery; he attained for surgery the dignity of a scientific profession, basing its practice on a vast body of general biological principles.

The range of John's accomplishments was very different from that of his brother. He published three books before he died: *The Natural History of the Human Teeth, A Treatise on the Venereal Disease*, and *Observations on Certain Parts of the Animal Oeconomy;* the *Animal Oeconomy*, like William's *Medical Commentaries*, was not a unified book but represented a collection of separate articles. These had either been previously published in periodicals or would have been appropriate for such publication. In addition, a fourth book, *A Treatise on the Blood, Inflammation and Gun-shot Wounds* was published posthumously in 1794, the year after he died. The books on the teeth, the venereal disease and on the blood would each of them alone have sufficed to bring him fame as an investigator and thinker, illustrating, as each did, his faculties of searching deep into principles to the benefit of practice.

In addition, John published a number of shorter communications describing some of his other discoveries, dealing with such topics as post-mortem digestion of the stomach (1772), air sacs in birds (1774), production of heat by animals and vegetables (1775), apparent transmission of smallpox from mother to fetus (1780), organs of hearing in fishes (1782), descent of the testis (1786), structure of the placenta (1786), secretion by the crop of the breeding pigeon (1786), extirpation of one ovary (1787), structure and economy of whales (1787), introsusception (1789), horny excrescences of the human body (1791), bees (1792), fossil bones presented to the Royal society (1794, posthumous) and so forth.

These reflect only a fraction of the diversity of John Hunter's interests. He expended apparently boundless energies on anatomical, pathological, biological and even geological investigations. His first anatomical studies were made when he was still in William's school. When he was on the military expedition to Portugal he acquired considerable knowledge of gunshot wounds and inflammation, but also studied digestion during hibernation in reptiles. After 1772, when he moved to a house at Earl's Court, he kept a small menagerie at his residence for the purposes of study and experimentation: hedgehogs, bees, leopards, blackbirds, to name only a few of his varied animals. He did not confine his experimental studies to lower animals; in an attempt to demonstrate that gonorrhea and syphilis are manifestations of a single disease he inoculated himself and contracted syphilis, and there are some who believe that this caused much of the illness that he suffered during his later years.

He enjoyed due recognition for his discoveries. He was elected a fellow of the Royal society in Feb. 1767, three months before William. He was Croonian lecturer at the Royal society from 1776 to 1782; he received the Copley medal, the highest honour in the Royal society's award, in 1787, and was elected to membership in the American Philosophical society in 1787.

The full diversity and depth of John Hunter's investigations will never be known. Only a small proportion of his work was published during his lifetime, and after his death the major part of his manuscripts was destroyed by his brother-in-law, one of his executors, Everard (later Sir Everard) Home, who claimed that he destroyed the papers on Hunter's directions. They were not burned, however, until 1823, and there are many who believe that Home plagiarized their contents before destroying them.

The accusation of plagiarism was first made by William Clift, Hunter's amanuensis at the time of his death. Clift copied a number of the original notes between 1793 and 1800, and his copies are published in John's *Essays and Observations on Natural History, Anatomy, Physiology, Psychology and Geology*, which appeared in 1861 under the editorship of Richard Owen, Clift's son-in-law.

There are fine portraits of both brothers, including one of William by John Zoffany, and one of John by Sir Joshua Reynolds of which an equally fine engraving was made by William Sharp.

William remained a bachelor, his fiancée, Jane Douglas, having died in 1744. John in 1771 married Anne Home, a poetess of no mean merit, who published her poems and wrote words for some of Haydn's English Canzonets.

Four children were born to Anne and John Hunter. Two died young; the other two, Agnes Margaretta and John Banks, survived, but both died without issue.

The various differences already alluded to in the lives and accomplishments of the two brothers reflected very real differences in their personalities. William was in many ways a restrained person, scholarly in outlook, frugal and very nearly ascetic in his habits and probably somewhat vain in regard to his social and professional position. John, in contrast, was unconstrained, unbookish, sometimes crude though often vivid in his expression, and honest, unself-conscious and generous perhaps even to a fault. His warmth and vitality found little counterpart in his brother.

While the association between William and John was close during their early years in London, the brothers later, perhaps in part because of their differences in temperament, drifted apart. William was not invited to John's wedding in 1771, and relations between the brothers were finally completely ruptured during 1780 as a result of a public controversy between them over priorities for the discovery of the nature of the uteroplacental circulation. They never again met except once when John gave surgical attention to William during the latter's final illness. John did not attend his brother's funeral and was not mentioned in William's will.

Yet for all their differences, they shared in common what was probably the key characteristic for their total accomplishment, their complete and utter devotion to their work. They both died at work, William, on March 30, 1783, having ten days before arisen from his sickbed to lecture; John, on Oct. 16, 1793, during a board meeting at St. George's. William was buried in the vaults

of St. James's, Piccadilly, and John in those of St. Martin-in-the-Fields. In 1859, through the efforts of F. T. Buckland, John's remains were reinterred in Westminster abbey on the north side of the nave. William had reformed and refined the teaching of anatomy in Great Britain, and had raised obstetrics to the rank of a respected medical discipline. John had not only established the principles of surgery soundly on a broad biological basis, but had also enriched many fields of natural history through his indefatigable study and experimentation. The legacy of both brothers remained not only in their museums and their writings, but also in their vitalizing influence on anatomy, obstetrics and surgery, which is still felt.

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W. R. LeFanu, "The Writings of William Hunter F. R. S.," *The Bibliotheck* 1:3–14 (1958), presents a bibliography of William's writings. LeFanu, in *John Hunter: a List of His Books* (1946), presents a bibliography of those of John's works which were printed in book form. No such accurate bibliography has been compiled for John's articles, but LeFanu in the *List of Books* gives references to the available lists of them. (J. M. O.)

HUNTER RIVER, a river of New South Wales, Austr., is 290 mi. long. It rises in the Mount Royal range of the Eastern highlands and flows southwestward to the vicinity of Denman and then southeastward to reach the Pacific at Newcastle. The wide lower valley is continued inland by that of the Hunter's main tributary, the Goulburn river, leading to the low (1,600-ft.) Cassilis gap through the highlands. The drainage basin of these two rivers exceeds 6,000 sq.mi. The climate of the valley is both warmer and more humid than that of neighbouring territories. With generally good soils, the valley favours agriculture and especially fruit growing. Vineyards, formerly more widespread, today specialize in the production of fine light wines. The rough country of the upper valleys is mainly devoted to the grazing of cattle, sheep and horses, and there is much timber cutting on the higher slopes. The scattered sawmills along the streams provide hardwood timber for furniture-making and construction work. Dairying is the main farming pursuit in the middle and lower valley, and wheat growing has given way to the cultivation of forage crops—maize (corn), hay and lucerne (alfalfa).

The Hunter has eroded its valley in a structural basin of coal beds of Permo-Carboniferous Age, and rich coal seams outcrop in many places. When John Shortland discovered the river in 1797 (naming it for John Hunter, the governor of the colony) he reported an exposure of coal near where Newcastle now stands. Working of these upper or Newcastle seams began as early as 1800, and coal export was well established by 1850. The richer lower or Greta seams were discovered in 1886 and have long provided the greater part of the output. The most important mines lie along the eastern outcrop of the Greta coals, south of the lower river between Maitland and Cessnock. Opencast working is carried on to the northwest near Muswellbrook on the upper Hunter. The seams are generally thick and relatively easily worked and the coal is of good quality, though often with a rather high sulfur content. Proximity to a good harbour (Newcastle) made coal shipment easy to oversea and Australian coastal markets. Labour troubles frequently checked development, but output increased steadily after World War II. Greater internal consumption, in industry and on the railways, and the growing use of oil fuel in ships caused a considerable falling off in exports. Though the Hunter river is navigable as far as Morpeth (25 mi. from the sea) it is little used for transport because of erratic changes of level.

The valley is subject to severe flooding but dams have been projected for the purpose of controlling the flow of water and providing water for irrigation.

See F. R. Mauldon, *A Study in Social Economics: the Hunter River Valley* (1927); *Monographs* of the Hunter Valley Research foundation (1958–). (O. H. K. S.)

HUNTING is the seeking, pursuing and taking of game and wild animals for subsistence, profit or sport. Hunting for sport is defined in Great Britain and western Europe as the taking of any wild animal by the aid of hounds that hunt by nose. In the United States and elsewhere, hunting refers also to the field sport of shooting small and large game. For bow and arrow hunting *see* ARCHERY. *See* also FALCONRY. For zoological information on various animals see articles under their common names, as ANTELOPE; DEER; for occurrences *see* articles on continents, countries and states and provinces.

The present article deals with the sport of hunting in its various aspects throughout the world, and is arranged as follows:

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1. INTRODUCTION

1. History.—To early man, hunting was a necessity. It was not only a means of obtaining food, but provided many of the other necessities of life such as clothing and tools (*see* HUNTING AND FISHING, PRIMITIVE). As a civilization advanced, certain animals were domesticated and new breeds developed to serve the needs of man. Hunting at length became a privileged sport, primarily indulged in by the landed aristocracy of Asia and Europe.

As new areas were opened up in America and Africa, hunting again became a principal means of survival, and has remained so in remote parts of the world. In the new areas, such as those in North America from the end of the 16th century until into the 20th, there seemed to be an unlimited game supply and there was much unnecessary waste. As populations increased so did the amount of hunting, and wild animal populations were reduced at a correspondingly quicker rate. When hunting was no longer necessary people turned to it as a sport, hunting some species to extinction; the quagga, for example, once plentiful on the African plains, is extinct. The bison, once innumerable in America, exists only because a few survivors were formed into a breeding herd and carefully preserved. Among birds the passenger pigeon, also an American species and once common, has entirely ceased to exist.

The process is continuing, notably in Africa.

2. Controls.—Because game was being slaughtered indiscriminately by market hunters and sportsmen, laws were passed in nearly every country to protect wild game. Limits were put on the number of animals that each hunter was entitled to kill, and licences, which bring in a substantial revenue, became part of modern game management. In the United States, for example, the federal government controls migratory game birds within the U.S. borders since these migrate not only from state to state, but between Canada and Mexico. Other game comes under the jurisdiction of the individual states, all of which have highly developed programs and trained staffs to enforce regulations covering hunting seasons and game-in-season bag and possession limits. Game again became relatively plentiful and even abundant in many areas where it had formerly become scarce. Similar game conservation schemes began to be implemented in India in 1860, in Africa at the end of the 19th century and in eastern Europe in the years after World War II. In Britain, Scandinavia and the rest of western Europe the right to hunt is generally attached to the ownership of land, and the preservation of wild life is a function exercised or delegated by landowners.

See also WILDLIFE CONSERVATION. (E. P. B.; W. S.)

II. BIG GAME HUNTING

The pursuit of large game (often at great risk to the hunter) and the search for gold probably share the credit for drawing the majority of explorers into the unknown, and there can be no doubt that big game hunting has always exercised great fascination for mankind.

1. Planning.—The sportsman should ascertain the best time of year for hunting. Quite apart from the question of health, should he visit the country at an unfavourable season he may stand small chance of sport because of some peculiar local condition, for example, high grass which may prevent him from seeing anything. Another factor is water; as a rule this is fairly plentiful in any district where game is abundant, but at some seasons remains only in certain localities round which the game concentrates. Information on these points will be given by the game department of the country concerned, and the following information should also be obtained: (1) what stores and equipment can be obtained locally; (2) what means of transport is generally used between the proposed base and the actual shooting grounds; (3) whether this transport is easily obtained, and how; and (4) whether trackers are available. Good maps of the country are another essential item.

The question of the most suitable firearms is largely a matter of personal preference built upon experience, but generally speaking the best weapon for stalking (see *Methods*, below) is a rifle of the "magnum" small calibre type which develops a very high muzzle velocity and so gives a flat trajectory, thus eliminating the difficulties of judging distance. It is always a mistake, however, to select a rifle that does not fire a fairly heavy bullet, as very light bullets are liable merely to wound without killing, and 150 grains is a fairly safe minimum weight. For dangerous game shot at close quarters the inexperienced hunter will be well advised to use a heavy double-barreled rifle of a calibre of about .470. Many experienced hunters use nothing but small calibre but the beginner can adopt such methods when he has gained experience for himself. Nearly all big-game territories possess, in addition to their conservation departments, private firms of safari organizers. Their services, and advice on local conditions and technical matters, are generally relied upon by visitors.

2. Methods.—The methods of hunting depend on the type of country in which the game is found, and on the size and habits of the creatures themselves. In open country free from trees, game can be viewed from afar; in these conditions a slow and stealthy approach is necessary, use being made of every tuft of grass, rock or hollow as a means of concealment and attention being paid to the direction of the wind. This is known as "stalking."

In dense bush or scrub it is impossible to see more than a few yards. Game in these conditions is come upon suddenly and the best chance of getting a shot is to walk slowly and cautiously, ever on the alert. This form of hunting has been described by different names but none is so graphic or realistic as the North American "still hunting."

Some animals cannot be stalked or still-hunted, for instance big beasts that herd together, as do elephants. They leave well-defined tracks, or spoor, in soft ground and a skilful hunter can follow their trail even on hard ground. This method is called "tracking."

Other animals inhabit, or retire to, patches of dense jungle so thick that it is impossible for a man to advance silently within shooting distance. Tracking and still hunting are out of the question and there the best chance of success is to drive the animal out into the open or along some path where the sportsman is waiting. This is done with the help of a number of men or dogs, or, in certain parts of India, with a line of elephants—methods universally known as "driving" or "beating." If, however, no form of help is available in circumstances such as these, the only course for the sportsman is to wait in hiding over some spot where the animal will probably pass or return. Such a place may be a water hole, game trail, crossing point or a salt lick; in the case of beasts of prey, it may be a half-eaten kill. This waiting method is known as "sitting up," or "sitting." It should, however, be noted that sitting up over water or a salt lick is not generally considered a sportsmanlike procedure and it is prohibited by law in some localities.

Another form of hunting which is commonly practised in pursuit of deer is known as "calling." It consists of waiting in hiding and making noises in imitation of the call of a female during the rutting season or else of the challenge of a male. In either case a male will answer and will gradually come right up to the sportsman believing him to be a possible mate or a probable antagonist. Calling deer is one of the oldest European hunting techniques, dating back long before the introduction of firearms. Much used by hunters of roebuck in Germany and Austria, it has been successfully adopted by moose hunters in North America. (G. BU.; X.)

A. North America

North America offers many opportunities for hunting, and the sport is popular. There are many types of hunting there, depending on the type of game, the terrain, the climate, and the preferences of the hunter. He may depend solely on his own devices and pursue his game on foot, and without the aid of dogs. He may travel by horseback, jeep or other motor vehicle; in some of the vast and remote hunting areas of North America a horse or jeep is practically a necessity. Airplanes are increasingly used to reach wilderness areas. Most hunting, however, is done within a mile or so of roads because of the difficulty of getting game out of remote country. This is unfortunate in a way because in a number of inaccessible areas game, such as deer, for example, becomes too plentiful for the food supply and the animals grow poor or die of starvation.

1. Deer.—Deer are the most widely hunted big game animal, since they are widely distributed and thrive in areas close to civilization. The term is usually used to cover three species, white tail, mule and black tail. Moose, elk (wapiti) and caribou are also members of the deer family (Cervidae); they are discussed below under their popular names.

The white tail deer are distinguished by their antlers; the main beams first grow upward and then project forward horizontally and the spines grow off them at the vertical; the mule deer and black tail deer have much in common and there is disagreement as to whether they represent one or two separate species. They are distinguished by the fact that the mule deer has a white rump and a black tip on the tail which is held down when running. The black tail deer raises its tail when running but the tail appears all black when it is down. Both have forked antlers, and the ears of the mule deer are particularly large.

White tail deer are generally considered an eastern deer, while mule deer or black tail deer inhabit the far west, but the ranges overlap in most of the western United States and northern Mexico. Mule deer are called black tail deer along the west coast where they are found from California northward through British Columbia.

In the east, deer are usually found in thick pine growth, brush or dense forest undergrowth. "Jumping" a deer and placing a telling shot in this kind of country is difficult even for an experienced hunter. Still hunting is one of the most successful methods employed, but "sitting" (see *Methods*, above) offers other good opportunities—the saddle between two mountains, for instance, makes a natural crossing point for deer as well as other game. The successful hunter must always be conscious of the wind direction, for a deer may come within range if it does not scent the hunter and if it sees no movement. Hunters sometimes form themselves into groups, one group taking stands near known crossing points, while the other drives toward them. In a few areas in the east where there are swamps, or where hunting is for other reasons difficult, the law permits driving deer with dogs, though this is generally illegal.

The same methods are used for hunting mule deer in the west, but there is more open country where the hunter can observe a great area with the aid of a telescope or binoculars, and there are greater opportunities for long-range shooting. When disturbed, deer seldom run straight and are inclined to circle. It is not uncommon for a hunter, who has put up a deer in front of him, to find it later behind him.

2. American Elk (Wapiti).—The American elk, a member of the deer family, at one time roamed most of the United States and southern Canada. Elk are now found primarily in the Rocky mountain region of the western United States, where in the fall they come down from the high mountains for wintering. A few have been reintroduced in the east, as in Virginia, but the numbers are small and there is no open season for them. Elk are hunted much in the same way as deer. A large bull elk may stand 60 in. at the shoulder and weigh from 800 to 1,000 lb. Any of the high-powered medium calibre rifles (.25 cal. or above) are adequate for taking elk.

3. Moose.—The moose is the largest of the deer family; an unusually large bull will weigh from 1,400 to 1,600 lb., stand about 75 in. at the shoulder and have an antler spread of up to 75 in. Moose are now found in a few of the western states of the United States and in Canada and Alaska. The Alaskan moose are the largest and darkest in colour, and one of the popular hunting grounds for these animals is the Kenai peninsula. Moose are not easily found; they travel fast and over long distances. Many are taken with medium-powered cartridges.

4. Pronghorn Antelope.—The pronghorn antelope (*Antilocapra americana*, a group distinct from that to which the African antelope belongs) are plains animals which at one time inhabited much of the plains area of the United States and parts of Mexico. They became very nearly extinct and were reintroduced in many areas, where they remained fully protected until the herds increased to the point where hunting could be permitted. They multiply rapidly and are a popular game animal in the far western United States and north-central Mexico.

The male antelope averages about 100 to 120 lb. and stands about 24 to 36 in. at the shoulder. They are exceedingly swift and offer a difficult target when running. At 100 yd. range a hunter will have to lead a crossing antelope by 10–12 ft. A good stalk will permit a standing shot at reasonable range, but without one a hunter needs an accurate, long-range rifle.

5. Caribou.—In the 1850s the caribou (the name by which the North American species of the reindeer genus is known) were found not only in Canada, Alaska and Greenland but also in the northern part of the United States, including New England. Since then the southern limit of their range has moved northward and their numbers have decreased. There are several subspecies of caribou, depending largely upon geographical location.

The caribou and the reindeer differ from other genera of deer in that the female bears antlers. They are also the most gregarious, roaming in herds as large as 1,000 or more. A large mountain caribou may weigh 600 or 700 lb., the woodland caribou a little less and the barren ground caribou of the far north only about 300 lb. Caribou are hunted in Canada and Alaska, the woodland and mountain caribou being the most interesting to hunt and providing the best trophies.

6. Bear.—North America has the two largest carnivorous animals—Alaskan brown bears and polar bears. As the name might imply, the range of the Alaskan brown bear is limited to the Pacific slope in Alaska and the offshore islands. Brown bears are not only the most impressive of the North American big game animals but they are also the most dangerous, particularly when wounded. They may attack without provocation, and have great powers of recovery, so the hunter should be equipped with a powerful rifle. Alaskan brown bears come out of hibernation in May and the spring is generally the best time to hunt them. Kodiak Island is famed for its particularly large brown bears. A brown bear may stand 10–12 ft. tall on his hind legs and weigh in the neighbourhood of 1,500 lb. The claws may be four inches long.

The only rival of the brown bear in size is the Arctic polar bear. An average male weighs nearly 1,000 lb., but individuals may be as heavy as 1,600 lb. In the 20th century hunting polar bears in Arctic America has become an increasingly popular sport, although it is an expensive one.

During recent years, big game experts have come to the conclusion that the only difference between the brown bear and the grizzly bear is geographic. What is known as the brown bear lives near the coastal regions where a more bountiful food supply, and possibly other conditions, result in larger growth.

The bears that are found inland in Alaska (75 mi. from the coast) have been classified as grizzly bears for purposes of Boone and Crockett measurements. These bears are smaller, and a very large one would weigh not over 1000 lb. and measure not over 8½ ft. in length.

The grizzly bear has sometimes been referred to as the "silver tip" because some of them have grayish tips on the long hair of the upper parts. Like the brown bear, however, the grizzly varies greatly in colour. Some are almost black while others are light tan. In most of the United States they have become almost extinct, but a few are left in the Rocky mountain region and on the western coast of Canada. British Columbia is one of the favourite areas for sportsmen in search of these animals.

The most common and most widely distributed bear on the North American continent is the American black bear, which is not as aggressive as its larger cousins. Its weight varies from 200 to 500 lb. In spite of its size and the fact that it sometimes lives close to civilization, the black bear is not easy to find, for it has a good nose and sensitive ear. The best time of the year to hunt the black bear is in the spring, during the early berry season. Because of the difficulty in finding them, hounds are frequently used for tracking.

7. Sheep.—Mountain sheep, of which the Rocky Mountain bighorn is probably the most widely distributed, are found in the western North America mountain regions from Mexico to the Arctic circle. The white Dall sheep is found primarily in Alaska, and the dark-coloured Stone sheep ranges from British Columbia northward into the Yukon.

8. Predators.—Common predators include coyotes, foxes and bobcats. Dogs are sometimes used to hunt them, but calling is also employed; in the latter case, a sound akin to that of a wounded or snared rabbit is made.

On rare occasions jaguar and mountain lion (also known as cougar, panther, catamount and puma; *q.v.*) have been called, but the surest way of hunting these large cats is with well-trained hounds. The animals customarily take to a tree when the hounds track them down. They are both formidable enemies of dogs, however, and a too aggressive dog is apt to be hurt if he closes in on one of these animals. The jaguar, one of the highly prized trophies in America, is occasionally found in the southwestern region of the United States but more often in Mexico where it is known as *el tigre*. It is hunted successfully on the west coast of Mexico and on the eastern gulf coast in the region of Tampico and is also found in southern Mexico in the states of Campeche, Tabasco and Chiapas. The jaguar is also hunted in South America. Good hunting is to be found in Colombia, Brazil, Peru and Bolivia. The best time to hunt jaguar is during the winter months.

At one time mountain lions were found in many parts of North America but they are now extinct throughout much of their former

range. They are found in greatest numbers in the Rocky mountain region, from the southern part of the continent up into Canada. Vancouver Island seems to have a particularly high concentration and it is there that they have been known occasionally to attack humans, although they are generally considered to be somewhat cowardly. When one is cornered, or treed, it is advisable for the hunter to maintain a safe distance.

9. Wild Boar.—Although the European boar, sometimes called the Russian boar, is not native to America, there are some in the United States since they were imported for hunting on large private estates and later escaped to the wild; they can be hunted in the area of Newport, N.H., in Monterey county, Calif., and in Graham county, N.C., and Monroe county, the adjoining area in Tennessee. There are closed seasons in Tennessee and North Carolina, where hunts are closely regulated, but none in California and New Hampshire. Locating a wild boar is difficult without the aid of dogs or of a guide who knows the country. Wild boars are largely nocturnal, and during the day retreat into cover. At dawn they are sometimes found feeding in the open. In California they are hunted from horses or jeeps, or on foot. A hunter sometimes walks or rides along the ridges in the early morning looking into canyons on either side. If he sees nothing before 9 A.M. the hunt is finished for the day, for by that time the boars have sought cover. An unusually large boar may weigh as much as 500 lb. Boars are formidable beasts and can be dangerous at close quarters.

10. Peccary.—The peccary, known also as the javelina, wild pig or musk-hog, is not a member of the swine family although it resembles a pig in many ways, roots with a piglike snout and grunts like a pig. It is small in comparison with the wild European boar, and is native to America. There are two subspecies, the collared peccary of the southwestern United States and Mexico, and the white-lipped peccary of the Central and South American jungle regions. A good-sized collared peccary will weigh about 50 lb., while the white-lipped peccary may weigh closer to 75 lb. Collared peccaries have been considered primarily a desert animal and they thrive under desert conditions. However, they have been noted ranging up into the pine region of Arizona.

Peccaries live primarily in caves and are gregarious creatures. With their sensitive noses and ears they are difficult for the hunter to find. The collared peccary travels in herds of about ten, but the white-lipped peccaries are customarily found in great numbers and it is not unusual to find 50 or more in one group. If the wind is right the hunter may smell or hear them before sighting them, and can then stalk them.

11. Musk-Ox.—The musk-ox is a shaggy wild ox of arctic America. The Eskimos have hunted it intensively for food and clothing and it is feared that the herds face extinction, although rigid protective measures have been instituted. (E. P. B.)

B. Europe

1. Great Britain.—Great Britain's only true big game animal is the red deer. The hunting of stag with hounds by mounted hunters (see *Hunting With Hounds*, below) was formerly called "hunting at force," and in the 20th century it continues in parts of England. On the open mountains of the Scottish highlands red deer are stalked with the rifle. The stalking season begins at the end of September and lasts three weeks, ending when the rut (mating season) begins, since it is not customary in Great Britain to take game at any season of the year when mating or breeding occurs. In woodland areas of the British Isles fallow deer and roebuck are stalked with the rifle. The method generally used is similar to American "still hunting," but since World War II some British sportsmen have adopted the German *hochstand* technique, in which the hunter waits on a platform erected in a tree to ambush animals passing below.

2. Northern Europe.—In Scandinavia the game to be found includes reindeer, red deer, roe deer, European elk and bear. Of these the elk is probably the most important and, in Norway, it is more widely distributed than any other species of big game. Its habitat includes all the larger areas of coniferous forest, but it is a great wanderer and will on occasions invade districts where it has been previously unknown. Elk are hunted either by still hunting or with special hounds which run them to bay.

The European reindeer is of the barren-ground type, being smaller in the body than the woodland types of Canada and Alaska and carrying long, slender horns which show less palmation than those of the North American caribou. In former times reindeer were very widely distributed throughout the whole of Scandinavia, but after mid-20th century they were found only on the mountain plateaus above timber line; in summer they prefer those mountains where there are plenty of snow fields.

Red deer are not very widely distributed in Scandinavia, existing only along the western coast of Norway from Bokn fjord in the south to Namdal in the north, and in a few other scattered areas. The only localities where they are found in any numbers are the two islands of Tustna and Hitra. Bears still exist, but in such small number that they are negligible from a sporting point of view. Polar bears, however, are hunted on the arctic ice fields of northern Norway.

Much of the big game of central and southern Russia has been exterminated, but some of the best hunting grounds of the future may lie in northern Russia in Europe and Siberia in Asia. From Scandinavia to the eastern coast of Siberia, elk and reindeer are to be found. Farther north reindeer exist everywhere on the tundra and they are particularly common on the Kola peninsula and the island of Novaya Zemlya.

Other species of game to be found in Russia are lynx and bear, both of which are plentiful, while big gray timber wolves are ubiquitous and follow the elk. Polar bears are fairly common in the northern parts of the island of Novaya Zemlya and walrus may sometimes be encountered on the ice floes.

3. Central and Southern Europe.—The magnificent red deer, brown bear and roebuck that formerly inhabited the reserved forests of central Europe have been sadly depleted. In the Carpathians game still exists in considerable numbers. Chamois, red and roe deer run large in these mountains and it is probable that better heads are to be found there than anywhere else in Europe. Similarly Tirol has been less affected than the lower lands. Chamois are to be found in the Alps in fair numbers, although all the best districts are preserved.

In Spain the big game are brown bear, red deer, chamois and Spanish ibex, the latter a magnificent creature very strictly preserved. Red deer are found in the forests of the Sierra Morena and Andalusia. Bear are very scarce and are confined almost entirely to the Pyrenees and Cantabrian mountains in the north, as are the chamois or izards. These are somewhat smaller than the chamois of Tirol, both in size of bodies and heads.

In the Balkans game has been carefully preserved. Yugoslav red deer are probably the finest in the world, and possibly the most expensive to shoot. The country also supports fallow and roe deer, ibex and bear.

The Sardinian mouflon offers the sportsman of moderate means an opportunity to hunt big game. It inhabits the higher mountains, especially the Gennargentu mountains, and good heads may still be obtained although they are becoming more scarce every year. This handsome wild sheep is also found in Corsica.

In the Federal Republic of Germany hunting is strictly controlled both by statute and custom. The chief big game animals are red, fallow and roe deer and wild boar in the forests, and ibex above the snow line. The regard in which such animals are held, and the ceremony which attends all hunting in Germany, ensures that sport of a high order is maintained, although it is necessarily limited. Similar comments apply to the Belgian Ardennes and the undulating woodlands of Maastricht, Neth. France and Italy possess the same types of game as Germany but have failed to conserve it. In Italy progress is being made on a code of conduct designed to eliminate undesirable competition among sportsmen for the necessarily restricted game stock. (G. Bu.; W. S.)

C. Asia

Asia contains greater variations both in climate and physical features than any other continent and, although its big game may not be quite so numerous either in species or actual numbers as those

of Africa, it offers unique attractions to the big game hunter.

1. Western Asia.—Mouflon, similar to the Sardinian species but larger, are to be found in the mountains of Asia Minor, while the Russian Caucasus provides some of the most difficult yet splendid sport in the world. In the higher ranges lives a fine wild goat, the West Caucasian tahr (tur), which in the east gives way to the East Caucasian tahr, an animal that carries horns very similar to those of the Himalayan bharal, or wild blue sheep, but that has a short beard and is a true goat. In the wooded valleys may be found the maral, a magnificent specimen of the red deer species almost as large as the American wapiti. The pasan, or Persian wild goat, inhabits the Caucasus, the ranges of northern Iran down to Baluchistan, and the hills on the Indian frontier in Sind, where it is known as the Sind ibex.

In Iran, tigers live in the low-lying forests to the south of the Caspian sea and probably farther east as well, while the maral of the Caucasus extends well into Iran. The mountain ranges hold at least one variety of wild sheep, which is very similar to the Indian urial but slightly larger in body and with a much finer head, and the plains carry several varieties of gazelle. Leopards are common in many parts. Mesopotamia offers little hunting, although gazelle are found in the desert. A species of ibex inhabits the mountains of the Sinai peninsula, and possibly extends farther inland, while specimens of the Arabian oryx can be obtained from Aden. The Arabian tahr inhabits the mountains of Oman and gazelle are found in the desert.

2. Central Asia.—The whole of this vast area is a good hunting ground. In the higher ranges are wild sheep with widely sweeping horns. Of these the *Ovis poli* (Marco Polo's sheep) of the Pamirs is probably the best known and certainly carries the longest horns, although they are not so massive as those of the *Ovis karelini* of the Tien Shan, or of the *Ovis ammon* of the Altai, which has the most massive horns of all. The range of these central Asiatic wild sheep is large, extending right through Manchuria to Kamchatka, and different species and subspecies exist throughout the mountains and hills of Manchuria and northern China. Southward, on the plateau of Tibet, they are represented by the *Ovis ammon hodgsoni* (Tibetan argali), the ammon of the Indian sportsman and the nayaur of the Tibetans. Ibex range from the northern bank of the Sutlej river through the Himalayas, Karakorum and Pamirs, to the Tien Shan, the biggest heads being found in the north.

3. China.—In the mountains of northern China wild sheep are found, and tigers extend throughout the forests of eastern China from Manchuria to the extreme south. There are strong grounds for belief that Manchuria is the original home of the tiger and that it later extended its range southward. At birth tiger cubs are woolly, indicating a natural protection against cold, and although tigers are found in the hottest jungles of India they dislike heat and their pads will blister when they are forced to cross open ground in the hot weather. The tiger is found in China, Thailand, Burma, India, Malaya and Indonesia. In southern China the forests and cultivation give way to uncultivated higher lands which culminate finally in mountains where game typical of southern Tibet, the bharal and the takin, are to be found.

4. Southeast Asia.—Indochina holds, in addition to tiger, leopard and is probably the eastern outpost of the Indian elephant, gaur and rhinoceros. These animals all also exist in Thailand and there, too, may be found the curious Schomburgh's deer with its widely spreading and many-pointed antlers, as well as a small representative of the Indian sambar. This grand deer probably originated in India, for it is in that country that it attains the greatest size of both body and horn, but it has a very wide habitat, being found throughout the Malay peninsula, Indonesia and Borneo as well as in Ceylon.

5. Tibet and the Himalayas.—South of the Kunlun mountains lies the Tibetan plateau, the highest and most extensive in the world. Only one animal seems to be almost ubiquitous throughout Tibet and that is the bharal, or wild blue sheep of the Himalayas, regarded by some naturalists as the connecting link between sheep and goats. Tibetan antelope roam the Chang Thang, the desert of northern Tibet which has an average altitude of 15,000 ft., and there, too, are to be found herds of wild yak. Farther south the Tibetan argali and Tibetan gazelle may be obtained, while in the lower districts to the east of Lhasa there are forests which hold Thorold's deer, a large deer very few specimens of which have ever been obtained by European sportsmen. Also in Tibet are small bluish bears and numerous wolves while in the west, bordering on the Himalayas, the snow leopard (ounce) and Tibetan lynx exist but are rarely encountered.

The Himalayas provide magnificent stalking, the quarry being, in addition to those Tibetan animals already mentioned, ibex, tahr, markhor and urial, while other game animals are goral, serow and two species of bear, one black and one brown. The latter exists only in the higher ranges near the snow line and is a variety of the brown bear of Europe. In the western Himalayas are to be found specimens of the Kashmir stag, a deer very similar to, but larger than, the red deer of Scotland, while in the east there is an isolated pocket of territory in the Chumbi valley which is the home of a still larger stag, the shou.

6. India, Ceylon and Burma.—India contains the oldest and best-known hunting grounds of all. Sportsmen had been accustomed to shooting tigers there long before any big game hunter had set foot in Africa. The principal game fields are the Terai, a narrow belt of tropical jungle which runs along the foot of the Himalayas from the Jumna river to Assam and which holds tiger, elephant, rhinoceros, sloth (or honey) bear, black Himalayan bear, sambar, or Ceylon elk, cheetah, swamp deer and other smaller varieties; the jungles of central India in which tiger, gaur (commonly called the bison), sambar and sloth bear are the most important big game; the damp and intensely thick jungles of southern India and the Mysore plateau where elephant, gaur and tiger are found; and the Nilgiri hills where there is a species of wild goat locally known as the "ibex" which is really a variety of tahr. Assam and Sundarbans, the semiflooded delta of the Ganges, are the home of the buffalo, which was also common at one time in Madhya Pradesh, but which has become almost extinct in that district. In India there are some firms and government agencies that make a business of conducting visiting sportsmen on hunting tours.

Burma is the best ground for elephant, gaur and tsine (banteng; *q.v.*), a wild ox akin to the gaur. Leopard abound in all the areas mentioned while the Indian antelope, or black buck, and gazelle exist in large numbers on the plains, especially in the deserts of Bikaner and the Punjab. The big game of Ceylon is very similar to that of India except that tigers do not exist on the island and all the horned or antlered game carry much smaller heads, while the elephants are almost invariably tuskless. (G. Bu.; X.)

D. Africa

1. General Considerations.—Although the game fields of the African continent were the last to be discovered they have suffered from the attacks of hunters more than those of any other part of the world, except some parts of North America. Such attacks, however, have not been delivered by the man who shot for sport, and if sport alone had been the object of pursuit it is doubtful whether the number of game would have decreased very materially. The settlers shot for the sake of meat and hides, and wherever commercialism entered into the question the fate of wild game was sealed. The Dutch settlers must be held responsible for the complete extinction of the quagga (a kind of zebra) and the general extermination of game from the greater part of the country which lies to the south of the Limpopo river. Similarly the early elephant hunters had much for which to answer. However, shooting alone has not been responsible for the elimination of big game from huge areas of Africa. Colonization by European settlers drove the wild animals into country that was unsuitable for them, and this advance of civilization has been the most serious menace to the African fauna. The spread of industry and agriculture, accelerated by modern methods of forest clearance, have opened up Africa at unexpected speed, and a further element is the presence of a native population newly possessed of opportunities to destroy wild animals on a large scale, and in places eager to do so for motives of profit. There are, however, gigantic tracts of country quite unsuitable for colonization and in these areas the game should

flourish for many years if the game laws existing in most parts of the continent can be efficiently administered.

The real wealth of Africa as far as big game is concerned lies in its wonderful variety of antelopes and gazelles. There are more than 60 different species, but no specimen of the deer tribe seems to be indigenous to the continent. A few red deer exist in northern Africa in the neighbourhood of Tunis, but it is probable that these were either imported or else are the descendants of some that migrated from Spain before the formation of the Strait of Gibraltar. Africa shares with Asia the rhinoceros and the elephant, but both African varieties of rhinoceros (black and white) are different from any variety of Asiatic rhinoceros. The giraffe and okapi are quite distinctive and peculiar to Africa, while the African buffalo, with all its varieties, is as distinctive as is the African elephant. The leopard is distributed throughout the continent and is similar to the Asiatic species, although an experienced sportsman can usually detect the difference in the skins. The lion reigns supreme among the wild creatures throughout the whole of Africa.

Legal codes have been drawn up for the protection of wild life, but these are more easily devised than enforced. Several factors, apart from the vast distances common to most African countries, combine to make enforcement difficult. There are, for instance, different game codes in different territories and, except in those instances where major rivers or mountain ranges separate one national territory from another, migrating game herds crossing the frontier may be in double peril because of conflicting regulations on either side of it. These regulations define hunting areas, closed seasons and numbers which sportsmen are permitted to kill, but they necessarily vary from year to year.

The lion, the leopard, the buffalo, the rhinoceros and the elephant have long dominated the imagination of hunters. They are raised to a class by themselves by the fact that to shoot them the hunter must risk his life. All of these animals are aggressive when threatened, and well able to take care of themselves. The lion, which traditionally has been the hunter's most desired quarry, exists in diminishing numbers. Some ecologists believe that in the Africa of the future the lion may be in danger of extinction as a wild animal. The spread of farming communities has meant that lions, though they seldom become man-eating, have nevertheless become regarded as a menace to human life, and they are hunted down over ever widening areas. Elsewhere, tribesmen have freely employed their newly acquired means of destruction. Simultaneously, the general contraction of game areas has reduced the number of beasts on which lions prey, also restricting their habitat. The consequence is that few heavy-maned lions remain outside the Masai tribal areas (where, it is worth noting, the spearing of lions is a tribal custom and test of manhood). Lions remaining elsewhere are generally of inferior type, and of less interest to the sporting hunter. Licences to shoot lion have been issued on a reduced scale by several African administrations.

Much the same is true, and for similar reasons, of rhinoceros, except that the situation has been even more serious and for some years the decline in rhinoceros numbers has accelerated to a serious and even grave degree. Two further causes were the susceptibility of the rhinoceros to drought, which in the 1950s repeatedly affected rhinoceros-inhabited areas, and the market in powdered rhinoceros horn as an aphrodisiac for which high prices continued to be offered.

Leopards are now unevenly distributed over Africa but remain a much-sought quarry of big game hunters eager to pit their skill against the most cunning, and perhaps the most resolute, of the major cats. In European and native farming areas where leopards have become extinct the local populations of baboons have increased to a point at which they constitute a constant hazard to agriculture. Cheetah are nearly extinct. Elephants maintain their number where their habitat remains undisturbed, though such areas are decreasing. With the same reservations, buffalo also maintain their strength and, being most formidable, do not invite much attention from poachers. The remaining African animals which by tradition rank as game were in the past sought for the trophies provided by their heads, rather than the hazards which their taking involved. Of the trophy game which inhabited the forests, both the greater and the lesser kudu seem safe from the danger of drastic reduction. The hunt for the greater kudu continues to be perhaps the most challenging of all safari enterprises. Sable antelope are rarer since they can be captured or killed more easily and their meat is valuable, especially that of the bulls. Roan antelope have suffered greatly through efforts to combat the tsetse fly by destroying game over wide areas, and have also suffered from poaching. The ecological position of the wary, forest-dwelling antelope, the bongo (*q.v.*), remains obscure.

Of the plains game, common giraffe have remained plentiful though some varieties have been reported to be growing rare. Populations of eland rise and fall periodically because the species is subject to rinderpest, but where their habitat remains their numbers are expected to be maintained too. Hartebeeste and wildebeeste (gnu) remain in great numbers. So do impala and Thomson's gazelle, though there are fewer Grant's gazelle. Zebra are much poached but the herds remain large. Fewer wart hogs were reported by the 1960s. Other animal life, such as apes and the lesser buck (bushbuck, reedbuck, steinbock and klipspringer) are not of interest to hunters who are principally interested in seeking trophies.

The trophy motive has been much reduced since in modern households large rooms are seldom available for the display of heads, and in recent decades there has been a tendency for the big game hunter to use a camera instead of a gun. However, this in itself cannot be expected to have much effect on animal populations, since it is not the sportsman but the poacher and the spread of civilization that are reducing the wildlife population in most African territories. (W. S.)

2. Principal Hunting Grounds.—*Northeast and East Africa.*—Most northerly of the major game territories is the Sudan which has a great variety of hunting grounds. On the east the hills hold ibex, while gazelles and oryx are found in the deserts of Kordofan and Dongola and Barbary sheep in the barren hills. But the chief hunting grounds of the Sudan lie in the south, up the Blue and White Niles. There may be obtained specimens of the giant eland (Lord Derby's) and the white rhinoceros, an animal which was once common in South Africa but is now unknown except in southern Sudan, northern Congo and Uganda. Elephants and buffalo are both common but the tusks of the former and horns of the latter are not big in the Sudan.

In Kenya, the most popular of the African big game fields, game may be seen in numbers to be encountered nowhere else in Africa in spite of the fact that the herds are not nearly so large or numerous as they once were. Every kind of country and climate is encountered in Kenya and each has its own fauna. Starting from the Indian ocean the first district is the coast belt, where game is plentiful but not so easily obtained as in other parts. The bag, however, may include elephant, buffalo, rhinoceros, eland, lion, bushbuck and some of the smaller antelopes. The next, and by far the most popular district, is the highlands which consist of great rolling plains interspersed with patches of bush and situated at an elevation of from 5,400 to 7,000 ft., in places reaching 9,000 ft. A great part of this area has been settled by Europeans but nearly 11,000,000 ac. are permanently reserved for the Masai tribe. The eastern half of this area is a game reserve but the western half is the most popular hunting ground, and specimens of almost every variety of East African game may be obtained there. A very large portion of Kenya is taken up by desert, to the north of the highlands, where the game is confined to oryx, Grévy's zebra, dikdik and Grant's gazelle, which gives place to Sömmerring's gazelle in the Jubaland region of the Somali Republic.

Southeast Africa.—The real tropical African country is not found much in Kenya but covers an extensive part of Tanganyika, where there is nearly as much possibility of varied sport as in Kenya. Here is the land of the sable antelope, which extends right down through Nyasaland, Northern and Southern Rhodesia to the frontiers of the Kalahari desert, but for really big sable antelope Angola is the best district. Rhodesia, both north and south, formerly was a fine hunting ground and still offers a chance of big kudu and roan antelope. Mozambique is heavily poached, but in the big swamps around the mouth of the Zambesi buffalo roam in

great herds. South Africa now has little to show in the way of big game, although the region of Zululand probably still offers the best chance for nyala and the Kalahari is the only place where gemsbok exists (*see* ANTELOPE).

Western, West Central and North Africa.—The west coast holds plenty of game but not nearly in such profusion as the east, and this fact combined with the doubtful climate prevent its attracting sportsmen in numbers. Further, the heads of animals run smaller as a rule than they do in the east, while elephants carry lighter tusks. The West African buffalo, or bush cow, is, however, a distinctive type which is found nowhere else. The immense tracts of Gabon and the Republic of Congo, the Central African Republic and the Republic of the (former Belgian) Congo are seldom visited by sportsmen other than professional elephant hunters, but bordering on the eastern boundary of the Republic of the Congo lies Uganda which is the district par excellence for elephant and buffalo, as well as that shy and retiring water antelope, the sitatunga (*see* ANTELOPE). To the north the great Sahara desert is the home of gazelles, and in the hills of Morocco and near Algiers the sportsman who does not have time for a long journey has a chance of finding Barbary sheep. (G. BU.)

3. Safaris.—Reliable safari organizations can be employed to make all arrangements for a safari into east or west Africa. Some short duration safaris (about ten days' hunting) into equatorial Africa have also been established. Costs, on an all-expense basis out of New York, for example, range from about $2,000. Safaris into east Africa are generally set up for a minimum of about 30 days of hunting. If the customer wants an all-around take of game or desires to go into the more remote areas, the safari organization will probably ask that he allow more hunting time. Hunting time may run to 60 or 90 days depending on the territory to be hunted and the game desired. There are no standard rates, but a safari into east Africa may cost the individual about $100 per day if there is one client per white hunter, less if there are two.

With the exception of all-expense safaris, licences are an extra expense. The cost of both general and special licences varies, and regulations change from time to time. The safari organizations furnish information about the costs and the white hunters serving as individual guides assist in procuring licences and gun permits. The organization will also recommend, and often supply, guns of the special large calibre used for large and dangerous game. Camping equipment, cooks, gun bearers, trackers, skinners and other services are generally covered by the fee. (E. P. B.)

E. OTHER GAME FIELDS

South America has little in the way of attractions to the big game hunter, the jaguar being the only animal worthy of pursuit. In Australia the only indigenous large animal is the kangaroo which is scarcely big game for the sportsman's rifle; but in the Northern Territory there are herds of buffalo, the descendants of domesticated animals which escaped into the bush and have been wild for many generations. Some of the bulls carry quite good heads.

New Zealand is very different and is a country of peculiar interest in that all its game has been imported. These experiments in importation have been most successful with the result that magnificent red deer heads have been obtained, and the following animals seem to have become acclimatized: red deer (to such an extent that it has become a pest); North American moose and wapiti; chamois; Indian sambar; Himalayan tahr; Virginia or white-tailed deer. (G. BU.; X.)

III. SHOOTING SMALL GAME

The field sport of hunting small game and game birds with a gun is known as "hunting" in the United States and Canada and as "shooting" in Great Britain. It is practised in most countries of the world, although what is regarded as game may vary from country to country. Sometimes game is defined as a product of the wild that is killed for meat; sometimes as an animal or bird that is hunted for sport or that state or other law specifies as legitimate quarry.

1. North America.—In North America game usually is classified as those animals and birds that can be hunted for sport, but which are protected with a closed season for part of the year and on which there is a definite bag limit. In some places certain fur-bearing animals are similarly protected but hunting or trapping these animals for commercial use technically removes them from the small game category. Animals or birds that may legally be hunted for sport but are not classified either as game or as fur bearers are usually known as predators or vermin.

Rabbits and hares probably are the most popular small game animals in North America and the cottontail, the common U.S. name for several species of rabbit (*q.v.*), is the most popular of these, in part because many hunters value its meat and in part because it is relatively plentiful. Some states in the United States do not even class the rabbit as a game animal, and those that do allow relatively long open seasons. Dogs often are used to hunt rabbits and shotguns usually are the preferred weapon. Hunters should be aware that rabbits are the most important source of human infection with tularemia (*q.v.*).

In some parts of North America the brush rabbit and the swamp or marsh rabbit are popular game. Among the hares are included the snowshoe rabbit (varying hare), several jack rabbits and the large arctic hare.

In many areas of North America gray and red squirrel rank second to the cottontail in popularity among hunters. A shy and elusive target, the squirrel tests the sportsman's marksmanship and woodcraft. A .22 calibre rifle is preferred but shotguns also are commonly used.

Other North American small game include the prairie dog of the western plains, opossum, raccoon and woodchuck. Dogs are used to tree opossom and raccoon, both of which are hunted at night. In some states of the United States the raccoon is considered a predator and is unprotected. Both animals also have been trapped and hunted as fur bearers.

The woodchuck, groundhog or whistler (French-Canadian *siffleur*), the North American representatives of the European marmots, and the somewhat similar but smaller prairie dog require superior stalking and shooting skill. Many are bagged with .22 cal. rifles but often longer range guns are used; high-velocity cartridges are preferred and telescopic sights recommended.

North American small fur-bearing animals include badger, beaver, fisher, marten, mink, muskrat, otter and weasel; all have been trapped commercially for their fur and all have been hunted as small game or as predators.

Common predators include bobcat or North American bay lynx, sometimes called wildcat, Canadian lynx, coyote, gray and red fox, skunk, wolf and wolverine. They are not classed as game but both the wolf and wolverine are protected in certain parts of Alaska. Winged predators include crow, owls and hawks, although many owls and hawks are protected. The great horned owl, the goshawk (largest of the hawks), the Cooper's hawk and the sharp-shinned hawk are not protected in all states because of their destruction of poultry.

Upland Game Birds.—Upland game birds provide some of the most popular sport for hunters (U.S.) or shooters (British). The ruffed grouse is a favourite, as are prairie chickens (sharp-tailed grouse and sage hen), spruce grouse and blue grouse (sooty grouse). Other popular game birds include chukar and Hungarian (European gray) partridge, pigeons and doves, ptarmigan and American woodcock. Quail, including bobwhite quail, mountain quail, valley quail and others, are widespread and attract many sportsmen. The ring neck pheasant, successfully introduced to North America, ranks high as a sporting bird. It is especially popular in the grain-belt area of the north central United States and Canada west of the Great Lakes into British Columbia. Perhaps the most highly regarded game bird in North America is the native wild turkey, which conservation measures have preserved in sufficient numbers for restricted shooting in most of the southern United States.

(*See* also *Game Shooting With Dogs*, below.) (E. P. B.)

Migratory Waterfowl Shooting.—The population of ducks and geese frequenting the U.S. flyways has varied greatly in the 20th century, yet, with the exception of rabbit shooting, more persons in the U.S. hunt wild ducks and geese than any other species of game.

Curtailment of legal limits and shortening of gunning seasons did not diminish the numbers of duck hunters, and there continued to be great pressures on the waterfowl populations. As in hunting upland game birds, however, the size of the bag should not be the gauge by which shooting success is measured; to the sportsman the number of birds secured is secondary to the pleasure of taking game in a sporting manner.

Wild ducks were formerly sold in the commercial market, and spring shooting (when waterfowl were on the return flight from the south to breeding grounds) was legal. Widespread slaughter of ducks to supply the market, especially in the spring when it prevented natural reproduction that might maintain flocks, threatened to bring about their extermination. The imposition of protective measures, however, was complicated by the fact that migration extended across international borders. The great bulk of the wild ducks and geese nest north of the 40th parallel. The population of these birds, therefore, depends to a great extent on conditions found in the northern United States and also in Canada during the breeding, hatching and rearing seasons, and on the protection of the ducks during these seasons.

On March 14, 1913, the U.S. government passed a law forbidding return-flight or spring shooting of waterfowl, and on Dec. 8, 1916, a treaty was entered into with Great Britain providing for similar protection of the birds in Canada. A law was enacted on July 3, 1918, to put the treaty into effect. From that date both spring shooting and the sale of wild ducks and geese were illegal. The act of 1918 was declared constitutional by the United States supreme court on April 19, 1920. A similar convention with Mexico was concluded in 1937.

Responsibility for carrying out provisions of the Migratory Bird treaty in the U.S. was vested in the fish and wildlife service of the department of the interior. This agency checks waterfowl populations to determine length of seasons and bag limits. Ducks Unlimited, an organization of sportsmen, and other groups also promoted measures devoted to the conservation of waterfowl.

Wildfowl travel over well-defined flyways, and four such routes in the U.S. are designated as the Atlantic flyway, Mississippi valley flyway, Central flyway and Pacific coast flyway. Certain shooting seasons are assigned each of the states on these flyways. Bag, possession limits and dates of open seasons, as well as hours of shooting, all of which may vary, are fixed by the U.S. department of the interior. State game administrators have some options in the application of regulatory measures, such as acceptance of split seasons. Wildfowl hunting regulations for each flyway have been announced annually since 1948.

Wildlife refuges established by the federal government in every section of the U.S. proved effective winter resting places for the wildfowl population. These sanctuaries, where no shooting is permitted, aid greatly in the conservation of wild ducks and geese, and provide future hunting opportunities.

Different ways of hunting wild ducks are pass shooting, jump shooting, timber shooting and shooting from a blind, a boat or a pit, with or without decoys. On the Canadian prairies, in the grain provinces, there is shooting in the stooks (stubble fields). The most popular form of duck hunting is over decoys from a blind. The shooter is concealed in a blind which may be in a lake or pond, along a shore line or in shallow water. Before the blind are placed decoys of wood, rubber, canvas or other material. Wild birds, passing over, notice the flock of "feeding ducks" and swing in to alight. When the decoyed birds come within range, the hunters fire. Some wildfowlers are extraordinarily skilful in using a duck call to entice the wild birds into gun range. It is recommended that a retriever be in the blind with the gunners. There are various types of blinds, all of which are made to appear as natural as possible so as to lull the suspicions of the ducks. Boats may be disguised with rushes or otherwise camouflaged. Tidal water duck hunters use a battery or sink box. Movement frightens waterfowl, and experienced duck shooters are more careful about remaining perfectly still and having their companions and dogs do so than in having their apparel and cover blend with the surroundings. Some claim a sedge- or golden-coloured dog is not so noticeable as a black dog; most experienced hunters, however, agree that stillness, rather than coat colour, is of greatest importance.

Wild geese are more wary than ducks. They are hunted most successfully from pits or blinds with decoys. Along the Mississippi valley flyway, the pit blind is used almost exclusively, and is required in some localities. Some of the finest goose shooting on the American continent is available in the wheat fields in the Horseshoe lake area of southern Illinois. (W. F. Bs.)

2. British Isles.—*Grouse Shooting.*—The best-known branch of the sport in Britain is undoubtedly grouse shooting. Red grouse inhabit the high heather-covered hills of Scotland, northern England, Wales and Northern Ireland. Their presence made sporting rights over the moors an important commercial asset, and large sums are paid for shooting tenancies by sportsmen from many parts of the world. By systematically burning off old heather to encourage younger and more vigorous growth, the birds' chief food supply can be greatly increased and the stock correspondingly multiplied. Large bags have been made as a result. Two examples are 2,929 grouse to eight guns in a day in Lancashire in 1915 and 1,070 in a day by Lord Walsingham alone in Yorkshire in 1888. Such performances are unlikely to be repeated, or indeed attempted, again.

There are two main methods of shooting grouse: driving and "dogging." In driving, teams of beaters maneuver the birds over shooters who wait in camouflaged butts, or shooting stands. In dogging, the shooters walk across the moor in line, preceded by dogs which mark the birds. Driving is considered to give the more difficult shooting and also has an advantage in that the older birds, which tend to become sterile after their first breeding season, are normally killed first and "birds of the year," being less strong on the wing and therefore slower over the guns, are left to form a vigorous parent stock for the following season. Dogging remains, however, the accepted method of shooting grouse in many districts in which beaters are not readily available.

Partridge Shooting.—The same two methods are used in the shooting of partridges, but this bird mainly inhabits the grain-growing areas and sport takes place over farmland instead of moor. After World War II the mechanization of farming reduced the land labour force, and therefore the supply of beaters, with the result that more shooting has been done over dogs. As in the United States and Canada, many changes in farming practice proved to be to the disadvantage of partridge and other game, especially the early plowing-in of stubbles, which removes winter food supply. The partridge population was thus much reduced in many areas. It seemed likely that gamekeepers, who hitherto did no more than protect partridges from attack by natural enemies and poachers, would need to rear some birds artificially. This was long believed impossible, but it was successfully accomplished in Denmark. By the 1960s a remarkable recovery had been achieved in the numbers of British partridges.

Pheasant Shooting.—In Great Britain, some sportsmen have felt that pheasants can supply sporting chances of shooting only under more or less artificial conditions. Preservation and artificial rearing are necessary to provide a concentration of birds, and, since gun dogs are not used in the same manner as they are in North America, the services of beaters are employed to put the birds over the guns at a height and pace to test the shooter's skill. Pheasants were introduced to Britain by the Romans, and the British, in their turn, took them to North America. The pheasant is the one bird which is now common to all countries where shooting is a recognized sport.

Black Grouse, Ptarmigan and Capercaillie.—Most of the shooting of other game in Great Britain is corollary to the sport to be had with grouse, partridges and pheasants. Black grouse, or blackcock (*q.v.*), for example, are to be found in most places where there are grouse, and the methods of shooting the two species are identical. Ptarmigan, on the other hand, belong only to the higher ranges of grouse country or to deer forests. They provide uninteresting shooting because of their tameness. Capercaillie, or capercailzie, may be found only in the neighbourhood of trees; the name is from the Gaelic "cabhar coille," or cock of the wood, and it is in pine and fir woods that this grouse makes its home. The birds are driven in winter, and give opportunities for high and fast shooting.

Snipe Shooting.—Snipe are to be found on most grouse moors, but snipe shooting is a sport by itself, enjoyed wherever there is suitable bogland. The bird rises from the ground like a flash, twisting this way and that, and to hit so elusive a mark needs a quick eye and hand. Snipe shooting is a sport of the winter months in Great Britain, for the home-bred birds are joined by the migrations from the continent in November. The largest bags of snipe have been made in the Hebrides, but Ireland and Wales, especially the former, provide some of the best snipe ground, and in England there are possibilities of good shooting in Norfolk.

Woodcock.—Woodcock shooting belongs principally to certain localities on the line of the birds' migration. As with snipe, large numbers of woodcock from the continent pass through the British Isles every autumn in a general direction from northeast to southwest. The shooting at Ballykine and its neighbourhood on the shores of Lough Mask in the Republic of Ireland is possibly the best in the world. Large bags are obtained in Cornwall, the limit of the line of flight in England, and in the west of Scotland, particularly the Isle of Islay. The difficulty of the shooting arises from the erratic movement of the bird when flying among trees. A woodcock in the open is a comparatively simple mark.

Hares and Rabbits.—Ground game provides shooting which is variously regarded as sport according to the standards of the shooter. Hares, which are destructive to crops, have to be shot down but hare driving produces few opportunities for interesting work with a gun. (See *Hunting With Hounds: Hare Hunting*, below.) Rabbit shooting, however, may afford considerable tests of hand, eye and brain, for a rabbit gets to its top speed in an amazingly small space of ground, and takes every advantage of cover and obstacle. The European rabbit, unlike the North American cottontail which normally nests above ground, lives in burrows and the main British methods of shooting rabbits are ferreting and laying out. In the former, ferrets are put to ground in the rabbits' burrows, or "buries," and the animals are shot as they bolt from the holes. If the second method, that of laying out, is adopted, a day or two before the shoot, the gamekeeper goes the round of the buries with some sort of evil-smelling mixture, such as paraffin (kerosene) and tar, which he sprinkles into each hole. The rabbits leave their holes at night to feed, but do not return to them, objecting to the smell. On the day of the shoot the rabbits are found lying out in the undergrowth, from which they are dislodged by beaters with sticks, or by spaniels.

Wildfowl.—Sport with wildfowl (ducks and geese) must always be of an uncertain nature, depending largely on the weather. The worse the weather the better, so far as the wildfowler is concerned; gales bring the fowl in from the sea to shelter, and frost confines the spaces of water where they can feed by night and rest by day. The shooter waits at dawn and dusk at certain points over which he knows the ducks will pass when flighting to and from their feeding grounds. A retriever is used to pick the birds in the dark or from the water into which they may fall. Duck hunters may use a "hide" or blind. Before World War II punt-gunning on the sea or in river estuaries was practised by a few amateurs and by professional hunters supplying birds for market. A flat-bottomed boat carrying a heavy swivel gun was used. The fowl were shot sitting, or just at the rise from the water.

Because little individual expenditure is involved in the conservation of the stock, wildfowl shooting is widely followed on both sides of the Atlantic ocean. (*See* also GUNS, SPORTING AND TARGET.) (W. S.)

3. Game Shooting With Dogs.—Sporting dogs have been used to find, point and retrieve game for centuries. The development of gun dogs to suit the needs of hunters, however, has covered a wide range of breeds and divergent hunting activities, embracing fox, deer, hear and rabbit hounds, the pointing breeds, spaniel varieties and the recognized retrievers. (*See* also DOG.)

Only the Chesapeake bay retriever and the American water spaniel are distinctively U.S. breeds; the various other gun dog types have emanated from the British Isles or other countries, chiefly in Europe. Through selective breeding, adaptation and training, the dogs have been developed for, and have become proficient in, hunting. (*See* also *Hunting With Hounds*, below.)

Gun dogs are generally classified according to the specialty of the breeds. The group of pointing dogs includes the pointer and English setter, the most popular of these breeds; also the Brittany spaniel, German short-haired pointer, Gordon and Irish setters, the wire-haired pointing griffon, Weimaraner, Vizsla and Spinoni. The sporting spaniels are headed by the English springer, the cocker (both English and American breeds), clumber, field, Sussex and Welsh springer spaniels. The retriever breeds include the Labrador, Chesapeake bay, Irish water spaniel, curly-coated, flat-coated and golden retriever and American water spaniel.

In the United States gun dog in the main implies one of the breeds adapted to finding, pointing and retrieving game from upland and marsh. Pointers and setters unquestionably are most prominent, but all of the pedigreed sporting breeds have their advocates. Thousands of dogs are bred and registered each year to supply demands as more and more hunters realize the effectiveness of a good dog. Under modern hunting conditions a dog is essential to find game and to avoid tiresome tramping in fruitless quests.

Choice of a Gun Dog.—Breeds are developed especially for certain work. Though such labels as "all-purpose" or "every-use" are applied to some breeds, these do not compare in performance with the specialized pointing dogs, the hunting spaniels and the recognized retrievers.

If a hunter concentrates on upland game bird shooting—quail, ruffed grouse, pheasant, woodcock, prairie chicken, Hungarian partridge and valley quail—a pointer or setter is his best choice, followed by such less popular but warmly admired breeds as the Brittany spaniel (the only pointing spaniel breed), the German short-haired and the Weimaraner. If ducks are hunted in addition to pheasants and rabbits, a spaniel may best serve the purpose, preferably an English springer or a cocker. If waterfowl shooting is preferred, with perhaps an occasional foray for ring-necked pheasants, the retriever breeds, expert in water work and able to do a satisfactory job on land as well, should serve effectively. The Labrador, Chesapeake and golden retrievers are the most popular of these varieties.

The excellence of U.S. gun dog breeds may be attributed to the field trial sport—competitions for sporting dogs held under actual or simulated hunting conditions. Field trials enable breeders to evaluate the natural qualifications and refinements of a performer and select for breeding purposes individuals that can contribute to breed improvement. Accurate ancestries are on record in public stud books, and authentic information on a dog's winning and producing record in field trials is readily available.

The ultimate purpose of field trials is breed improvement, or development of improved gun dog performance in the shooting field. The best shooting dogs, those that work in a manner highly satisfactory to the average hunter, are bred from the finest field trial stock. (*See* also FIELD TRIALS.)

While the type of gun dog preferred for various kinds of hunting may differ, the important natural qualities to look for, whatever the breed, are instinct to hunt, good nose, intelligence, good constitution, nervous energy, good eyesight and hearing, tractable disposition, courage, and good conformation, style and appearance. In the case of the pointing breeds, the instinct to point is an important qualification.

The hunting dog must possess bird sense and hunt to the course chosen, should search upwind for body scent of game, locate quickly and accurately, be well-mannered and steady to wing and shot. A pointing dog is expected to be staunch and to back a brace mate on sight or at command. He should not false point, potter (waste time) on foot-scent, blink birds (point but leave before the flush) or trail another dog with which he may be hunting.

Pointing dogs are versatile performers. They are efficient in hunting bobwhite quail in its native habitat; pheasants in meadowland, cornfield or swale; prairie chickens or Hungarian partridges in stubble; even ruffed grouse, characteristically found in woodlands or brush country; and, in Great Britain, red grouse. The accepted standards of performance for these various game birds differ, but this does not preclude a smart gun dog's being able to handle each satisfactorily. For example, the experienced quail dog can select objectives that are the most promising concealments,

knows the habits of the game quested, and searches likely places depending on the time of day, character of cover and weather conditions.

The various pointing breeds differ in their methods. Pointers and setters hunt at greater speed and wider range than the close-working types like the German short-haired, Brittany, Weimaraner and kindred types. Retrieving is an acquired art with these breeds, although predisposed, and for short-haireds and Weimaraners adeptness at water work is a desirable attribute.

Individuals in the different hunting breeds naturally vary in ability. It has been said the setter is relatively slow in learning but improves steadily with experience, whereas the pointer learns more readily and is usually more easily trained. Such generalizations, however, are refuted by many individuals of both breeds. It is true that the setter can take the cold and wet and punishing briars more unflinchingly than the pointer, thanks to his long-haired coat, but in burr-laden areas the same coat picks up the stickers.

Most upland game bird hunting is done on foot. Consequently extreme range is impracticable and dogs are required to be subservient to the gun. In the U.S. south, however, quail hunting from horseback continues to be popular, though the number of places where it may be enjoyed has dwindled. For quail, the wide-ranging dog is referred to as a covey dog; the close-searching, keen nosed, adjustable single-bird dog is preferred in some situations.

The use of spaniels in U.S. game coverts became popular in the late 1920s. The rise to popularity of the springer and cocker was coincident with the flourishing of the pheasant, for the methods of the spaniels proved particularly suited to hunting these birds. The pheasant's trick of fleeing afoot, running off from the point of a setter or pointer, is circumvented by the spaniel's method of quartering the ground ahead of the gun, covering all territory within ordinary shooting range at a fast, snappy pace. The spaniel springs his quarry and after flushing should immediately stop, assuming a sitting position. He is expected to retrieve only on command. It is essential that the spaniel be under control at all times. Most spaniels take to water readily and are what may be termed natural retrievers.

The retrievers are specialists. The Labrador, golden, Chesapeake and other retriever breeds have been bred, developed and trained to function in an important phase of bird shooting—the recovery of dead and crippled game. Although the retriever can be used in spaniel fashion ahead of the gun, his proper work is always after the shot. When hunting feather or fur, the retriever walks at heel, sits upon order and, when game is flushed, goes to retrieve when ordered to fetch. The dog is expected to mark the downed game, and should seek the fall in a brisk, quiet manner, thoroughly quartering the immediate area around the fall without unnecessary disturbance off the line. He should have a tender mouth and retrieve readily to hand.

When working on waterfowl, the retriever's place is in the blind or boat until actually ordered to go out. The fall of ducks should be noted and retained, for a requirement is the ability to mark several dead or wounded ducks, then deliver each in turn.

(W. F. Bn.)

IV. HUNTING WITH HOUNDS

In the British Isles, some parts of the United States and elsewhere, hunting with hounds is a communal pastime which arouses much local enthusiasm.

1. Stag Hunting.—In Great Britain the sport of stag hunting, formerly called "hunting at force," entails the chase of deer by horsemen with a pack of hounds. It has been practised in this manner for more than 700 years. That it had its inception as a recreation of royalty seems obvious, and once orthodox rules were put into effect, stag hunting became the most fashionable of noble sports, although fox hunting superseded it early in the 19th century. It may be presumed that the first pursuit of the stag with "running" hounds took place in France. As a sport of the chase, it was brought to England by the Normans. The monks and clergy enjoyed the chase, hunting in great style with large retinues of servants. Because of the extent of their hunting proclivities, they were severely criticized and rebuked by moralists for neglecting their teachings. They were later prohibited from owning hounds under penalty of imprisonment. William Twici, huntsman to King Edward II, wrote about stag hunting in *Art de venerie* (*c.* 1314), as did Count Gaston de Foix in *Le Livre de Chasse* in 1387. Edward III, while engaged in a war with France, maintained 60 couples of staghounds, which he took with him to the battlefields. The modern method of chasing the stag, buck and hind was developed in the reign of Queen Elizabeth I. The queen's privy buckhounds were kept by Lord Leicester at Kenilworth (1575), and, under the supervision of Ranger Pollard, the royal Devonshire staghounds were kenneled at Simonsbath in 1598 and continued to hunt until 1825. Of the 20th-century packs, their successors, the Devon and Somerset staghounds have the most distinguished continuous history, including the period of World War II. When hunting returned to normal after that war, there were five packs of English staghounds and one of buckhounds (the distinction being that staghounds hunt red deer while buckhounds hunt fallow), two of staghounds in Ireland and five in France. French conditions differ from those in Great Britain in that most of the hunting there takes place inside the forest, whereas in Great Britain pursuit involves galloping across open moorland. Some British packs hunt carted stag, which is never caught but returns in a horsebox to the hunt's headquarters at the end of the day. This is in contrast with British fox-hunting tradition, which insists that the fox shall be genuinely wild and on its own familiar ground.

When World War II began, the British government encouraged the stalking and shooting of deer for food. This method, however, could not be followed in the well-populated west country, and hunting with staghounds was resorted to in order to save farm crops from depredation by deer. The stag-hunting season opens on Aug. 10 and continues until Oct. 10, at which time the rut is due to begin and hinds (female red deer) are hunted instead of stags. Stags are again hunted for six weeks from the beginning of April, when they have regained their full strength. Only warrantable stags, judged from the evidence of their antlers to be five years old or more, are considered fair quarry. The method of hunting, unchanged for four centuries, begins when the harbourer (a hunt servant) locates a warrantable stag in covert. A few hounds with special scenting powers, known as tufters, then hunt the stag into the open, where the main body of the pack joins in and the chase commences.

2. Hare Hunting.—Hare hunting, in which hounds track by scent, is not to be confused with coursing (*q.v.*), in which pursuit is by sight. With mounted followers and hounds known as harriers, hare hunting ranked second only to stag hunting in Great Britain until fox hunting displaced both; until World War II it still took precedence in the hilly west of England. James I (1566–1625) followed the sport keenly, if unethically by modern standards, "live hares in baskets being carried unto the Heath." In a letter to his son Henry, prince of Wales, he had this to say about hare hunting:

> I cannot omit heere the hunting, namely, with running houndes, which is the most honourable and noblest sort thereof; for it is a thievish forme of hunting to shoote with gunnes and bowes; and greyhound hunting [coursing] is not so martial a game.

William Somervile (1675–1742), poet of the chase, referred to the joys of hunting hare, and keynoted its fascination in describing the tactics of the quarry—"a thousand shifts she tries." Somervile was an early advocate for "a diff'rent hound for ev'ry diff'rent chase." In the France of the Bourbons, the grandeur of the chase was unparalleled. An example of lavishness is cited by records of sport in the preserves at Chantilly, the residence of Prince Louis Henri de Bourbon. There, between 1748 and 1779, registered game accounted for in the chase totaled 77,750 hares, 3,364 stags and hinds and one fox. The prince maintained 240 horses and many packs of hounds.

Because of the multitudinous maneuvers of the hare, all followers of this sport are able to see a large proportion of what goes on. Whether a man rides hard or little, "or not at all," hare hunting is considered a fascinating sport and an excellent school of

horsemanship for its followers. In addition, this sport is much cheaper to conduct than other chasing sports and requires smaller areas over which to hunt.

3. Beagling.—The chase of the hare with hounds by foot followers is the oldest form of scent hunting organized as a sport. Xenophon wrote of it in Greece in 400 B.C. almost exactly as it is practised in Great Britain, where the word "beagle" is thought to derive from the Gaelic *beag* meaning "small"—the beagle being only about 14 in. tall. In the 20th century beagling increased rapidly in popularity both in Great Britain and the United States. Mechanization, resulting in the partial disappearance of horses, is doubtless an underlying cause. A contributory factor is its relative cheapness. Since the hare is capable of much greater speed than the hounds, and is the wiliest of quarries, its successful foot hunting is the art of venery at its highest. In Great Britain when hare is the object of the chase, whether by harriers or beagles, hunt uniforms are green, not scarlet as for the fox.

4. Otter Hunting.—Otter hunting is a sport particularly followed by enthusiastic fanciers of hounds who, when the fox-hunting and hare seasons are over, can enjoy the tracking of otter up and down the many streams in the British Isles. The season begins in mid-April and extends until about the middle of September. Because of the wandering propensities of the otter, the greatest difficulty encountered by the otter hunter lies in locating it. The otter starts its travels about midnight, and the earlier the hunter is afoot the more certain he is of being able to mark his quarry. It is necessary to strike his drag, or scent, and put hounds in the direction of his couch, a hole at the riverbank into which he may dive upon hearing the hounds. The scent is usually several hours old, and once hounds strike, there is the danger of their taking a line heel way, that is, going in the opposite direction to that which the otter was traveling when it made its trail. Terriers are used to bolt (uncover) the otter if it is marked in a holt (temporary refuge). Otter hunting is an arduous sport, and in spite of the otter's strong scent it often escapes hounds. The otter's scent seems to be an unwanted one for unentered (young) hounds, and there is often difficulty in getting them to take it. Otter hunting, as an organized sport with packs of hounds, is more than 800 years old.

5. Fox Hunting in Great Britain.—England is the home of fox hunting as a sport, and a lasting tradition has been established. Opinion varies as to when fox hunting first became a recognized sport. In its inception, it was tried as an adjunct to stag and hare hunting, with the same hounds used to chase each quarry. The fox was looked upon as a lowly creature and hardly an object of high sport. But once fox hunting took hold, the fox had few enemies except hounds and became a cherished object of the chase. Authentic and complete hunting diaries depicting the true situation prior to the 18th century are nonexistent. Honours for maintaining the first pack of hounds used exclusively for hunting the fox seem to be divided between Viscount Lowther, Lord Arundel and Thomas Boothby, with respective dates 1660, 1690 and 1698. In 1726 Squire William Draper devoted much of his time to fox hunting, with the express purpose of reducing the number of "lamb killing" foxes in Yorkshire. The form of modern fox hunting took shape in the 19th century shortly after Hugo Meynell—"the father of the modern English chase"—started hunting; and it soon developed into a national pastime. Whether in England or elsewhere, the traditional procedure is still observed and the proper kit worn. A fox hunt is conducted by the master, and, in theory, all who take part in it do so at his invitation even when they pay for the privilege. The hounds, generally 15–20 couple, are controlled by the huntsman, who may be the master himself but who is generally the senior paid servant of the hunt. He has two or three whippers-in to assist him in reconnaissance and in keeping the hounds together as a pack. Master, huntsman and whippers-in take precedence over all other riders to hounds. The huntsman controls hounds by voice, his calls being known as cheers, and by his horn—a copper tube about eight inches long, the two notes of which, though not loud, have a peculiar carrying and penetrating quality. A day's hunting begins with a meet, at which the followers join the hounds, acknowledge the master and are frequently offered hospitality by one of their number who acts as host for the occasion. On the command of the master, hounds move off to draw (search) the covert, which may be woodland, patch of gorse or field in which it is suspected that a fox may be. When the fox is found, the fact being signaled by the cry of hounds and notes of the horn, the hunt begins and ordinarily proceeds to the stage where the fox is viewed, a moment which is signaled by a holloa a high-pitched cry. If a kill follows, the brush (tail), mask (head) and pads (feet) of the fox may be given as trophies by the master to any followers whom he considers to have acquitted themselves so as to deserve the honour. The body of the fox is then thrown to the hounds.

Fox-hunting uniform is usually a scarlet coat with white stock (cravat) and black velvet cap for the master, huntsman and whippers-in. Followers of sufficient prestige are invited to wear scarlet, with the individual buttons of the hunt, and top hat (the velvet cap being strictly the prerogative of those actively engaged in the control of hounds, though by modern usage women also wear it). Other followers wear black coats, with top hats or bowlers. In the case of some ancestral hunts run by noble families the uniform may be green, yellow or gray instead of scarlet.

The entourage of a hunt includes among its lesser functionaries grooms, second horsemen (who ride relief horses for the master, his staff and leading followers), terrier men and earth stoppers. Of the last two, the former convey, either on horseback or foot, terriers which are sent down to bolt the fox should it escape into an earth (a fox's underground den) or drain; the duty of the latter is to ensure that the earths are temporarily closed on a hunting day to give the hounds the best chance of a kill. The most fashionable hunts operate in the midland counties lying around Leicester, but hunting takes place all over England, Wales, Ireland and parts of Scotland from November, when the harvest is gathered, until April, when new crops begin to grow. Cub hunting, when the young entries (hounds new to the sport) are taught to hunt with the pack, is carried on in September and October.

Just prior to World War I, fox hunting reached a zenith of popularity as an English field sport. Horse and hound breeding had arrived at a highly developed state, and hunting itself was well organized and regulated by the Master of Foxhounds association. While the sport undoubtedly lacked the golden flavour of hunting as it was enjoyed during the Victorian era, it nonetheless attained certain other compensating attributes. When the country was mobilized for war in 1914, many nonsympathizers felt that the death knell of this amusement had been tolled, but by judicious and drastic measures, which included reduction in the number of hounds, hunting weathered the storm.

An upsurge in interest following the war did not put an end to hunting difficulties. The changes in patterns of ownership and use conditions of rural England, begun prior to 1914, were accentuated. Great landowners and their tenant farmers began to be replaced by numerous small holders, and barbed wire became a menace. These threats to the sport were handled by the Master of Foxhounds association, whose members promoted the benefits of hunting to both the countryside and the community.

The experiences of World War I helped fox hunters to combat some of the problems of World War II. In spite of the scarcity of feed and other hardships, the government took the position that hunting on a vastly reduced scale served a useful purpose. Consequently, with the assistance of the many sporting farmers, with hunt staffs consisting of men ineligible for service, and also with the aid of women, establishments able to do so continued on a skeleton basis.

With the end of the war a section of the urban population of Great Britain initiated a campaign to prohibit fox hunting. Their efforts encountered vehement opposition in the countryside, and this was strongly reinforced with the return from military service of the more active hunters. It soon became evident that feeling on the subject was running high, but the anti-fox-hunting party promoted a bill to secure the abolition of the sport. When the measure was debated in the house of commons in 1949 the bill was defeated. Thereafter fox hunting rapidly re-established itself after its wartime difficulties. By the 1960s there were about 230

"Full cry" in a fox hunt with the hounds practically on the tail of the fox

Hounds tree the fox in a North Carolina fox hunt

Field moving off for the draw in an English stag hunt with Devon and Somerset staghounds

VARIOUS HUNTING SCENES

Hounds and master patrol riverbank in an English otter hunt

Hunters tie stag to pony after stalk in Scotland

BY COURTESY OF (TOP RIGHT) NORTH CAROLINA WILDLIFE RESOURCES COMMISSION PHOTOGRAPHS, (TOP LEFT) THREE LIONS INC., (CENTRE, BOTTOM LEFT, BOTTOM RIGHT) SPORT AND GENERAL PRESS AGENCY, LIMITED

HUNTING

SMALL GAME SHOOTING

Ring neck pheasant hunt in Nebraska, U.S.

Hunter takes aim at bobcat treed by hounds in Nebraska hunt

English shooting party raises a flight of birds

Hunter putting out decoys for mourning doves

Shooter with retrievers on English duck hunt

BY COURTESY OF (TOP, CENTRE LEFT) NEBRASKA GAME COMMISSION; PHOTOGRAPHS, (CENTRE RIGHT, BOTTOM RIGHT) SPORT AND GENERAL PRESS AGENCY, LIMITED, (BOTTOM LEFT) JACK DERMID

recognized packs of foxhounds in Great Britain and Ireland, approximately the same number there had been in 1939 on the eve of World War II; in 1885 there had been 191. (W. S.)

6. Fox Hunting in the United States.—*Early History.*—Contrary to general belief, fox hunting began awakening in North America at about the same time it did in England. A number of early settlers brought hounds, horses and hunt servants from England to America to carry on the type of sport in vogue at the time they left home. Authentic information as to when the first pack of hounds was devoted exclusively to fox is not more available in the U.S. than it is in England. There is evidence, however, that fox hunting of sorts was carried on in the colonies as early as 1650, following the arrival in Maryland of Robert Brooke. This man came from England in his own private ship with a pack of hounds, accompanied by his family and 28 servants. On the record, Brooke can be designated as the first known master of a pack of hounds in colonial America. His most important contribution to fox hunting was the Brooke hound, which has remained an entity and formed the basic breeding stock for such famous American hound strains as the Trigg and Walker. Whereas England developed fox hunting as a sport—its style, finesse and science—American fox hunters were the first to ride straight cross country while following hounds. In England, hunting at the outset was the pastime of royalty and the landed aristocracy, who considered the sport a personal hobby requiring the finest of clothes, good hunters, well-bred hounds and skilfully trained servants. Also, because the dictates of etiquette required a certain amount of dignity and restraint, all hunting procedure was conducted according to rule. In America, while all was unsettled, untamed and unrestricted, the country and its customs not as yet having been defined, almost everything was done in individual and uninhibited fashion.

When the sport spread from one locality to another, only the most casual notice was taken of how anyone else went about it. Had this not been the case, it would undoubtedly have taken many more generations for fox hunting to make real headway in North America.

While fox hunting in England started as an exclusively upper-class pastime, it worked down democratically, eventually becoming a national sport. In America, on the other hand, there came a period when attempts were made by certain groups to make of it a privileged sport, limited to a few select club members. Finally, in order to make of hunting all that it should be, attitudes were recast on a broader and more democratic basis.

In 1742 Thomas Walker of Virginia imported a pack of foxhounds from England and established himself as the master of the Castle Hill hounds, the only pre-Revolutionary pack to span the years into the 20th century without losing its specific identity. Fox hunting became the favourite pastime of several presidents of the United States, cabinet members, justices of the supreme court, senators, congressmen and high-ranking army and navy officers. George Washington devoted practically all his spare time to the chase, having learned the sport from his friend Lord Thomas Fairfax, who came to Virginia in 1746. Martha Washington also hunted occasionally. Thomas Jefferson was a "keen hunter, as eager after a fox as Washington himself."

In 1766 the Gloucester Foxhunting club was organized in Philadelphia by 27 prominent sportsmen and is important as the first recorded fox-hunting club established in America. Although it was disbanded in 1818, hunting continued in the neighbourhood of Philadelphia with increasing spirit, being conducted by many offshoot groups of the Gloucester. In New York city, fox hunting was extremely popular before and after the Revolution. Many early newspapers carried accounts of hunting on Manhattan Island as well as Long Island, North Riding and Westchester county. Col. James de Lancey and Gen. Statts Long Morris maintained well-known packs of foxhounds.

In 1783 the St. George Hunt club was organized in New York city with John Evers its first master. Evers had brought a pack from England in 1768. Members of the club included George Washington, Alexander Hamilton, Charles Lee and John Jay. When Evers died in 1807 Cadwallader D. Colden (mayor of New York city, 1818) became master. About this same period in New York there existed a Colonial hunt. Little is known of its make-up. During the period of the War of 1812, the Belvidere hunt was established on Manhattan Island by Edward and Rufus Prime, who lived at 1 Broadway. The Belvidere scheduled most of its fixtures at Cato's Inn, 67th street and Third avenue. Fox hunting continued on Manhattan Island until about 1821. The population of the city at that time was 123,706.

Other prominent organizations established in the 1800s included the Baltimore and Washington hunts. Among the Washingtonians who followed hounds in those days were Andrew Jackson, John Marshall and Roger B. Taney. In 1856 the Brooklyn Foxhunt club was organized by T. C. Carpendale. Henry W. Herbert, who gained fame as a writer under the pseudonym "Frank Forester," was a member of this hunt, as was William T. Porter, who established the *Spirit of the Times* (1831), early American sporting newspaper. The Brooklyn Foxhunt club was disbanded in 1861.

In Canada the Montreal hunt, founded in 1826, continued through the years to become the oldest organized hunt on the North American continent. The Toronto hunt was established in 1843. By the second half of the 20th century Canada had more than 100 recognized hunts associated with the Master of Foxhounds association of North America.

Growth of Fox Hunting in the United States.—Before the American Revolution, fox hunting, as indicated above, was a hit-or-miss affair, most packs being trencher-fed (hounds being owned individually and brought together only when hunting). Though the Revolution interrupted the sport, some informal activity in it continued. George Washington, for example, mentioned above as an enthusiast, often managed to enjoy a few hours of hunting between battles, according to his diary. Between the Revolutionary and Civil wars fox hunting was followed seriously by Americans, particularly the landed gentry of Virginia, Maryland and Pennsylvania. Hounds and hunt servants were imported from England, and much more attention was paid to formality than had been previously. The Civil War halted this, however, only four hunts surviving, two in Canada and two in the United States. But immediately following that war enthusiasm returned, and the importation of hounds and hunt staffs increased steadily.

The formation of the Masters of Foxhounds association in 1907 did much to stabilize hunting and improve it through organization. Territories were allotted to recognized hunts, hunt colours were registered, and type of country and preferred type of horse were listed. The period directly after World War I saw the establishment of many new packs, and the depression of the 1930s did not affect the sport seriously. Interest continued through World War II. But what wars and depressions could not destroy, prosperity seemed to threaten. The postwar increase in building meant the conversion of many large farms and estates to building developments. Thus land through which the hunt had been accustomed to gallop, especially around the big cities, was lost to the sport and hunting was curtailed. On the other hand, there developed a newly born interest in parts of the west, midwest and southwest, in territories formerly given over to ranching. By the 1960s there were 90 recognized fox hunts in the United States.

Differences Between Hunting in the U.S. and in England.—U.S. fox hunting, though it follows the etiquette and general rules of English fox hunting, has had to adjust itself to somewhat dissimilar conditions. In England the fox is protected, and the earths, drains, etc., are stopped (*see* above) during the night before a meet while the fox is out foraging. Furthermore England has fewer large, dense woodlands and swamps through which a horse and rider cannot penetrate. In the U.S. earths are not stopped, so the fox goes to ground more frequently than not, and most U.S. masters do not consider it sporting to dig out a fox except at the beginning of a run. Much of the territory is not negotiable by a horse. Consequently the method of hunting is different; in many parts of the country a more rugged type of horse is preferred and hounds must be trained to be more independent and to hunt much more on their own than are the English hounds, which are far better disciplined and less independent.

Country.—To a fox hunter the term "country" means topography of terrain and type of obstacle. There is the stone-wall

country of New England and upper New York state, for example, where the fields are small and the walls rough and often unjumpable except where they have been paneled with telephone poles called riders. Long gallops are few and checks frequent. A rugged, half-bred horse is preferred, one whose tendons will not suffer in heavy, muddy going. As a contrast, along the eastern seaboard and in Pennsylvania is the post-and-rail country, with great rolling fields enclosed in the familiar split chestnut rail fencing. These run from 4 to 4½ ft. in height, so many are paneled with "chicken coops," a solid board construction, wider at the bottom than at the top and shaped like a peaked roof. In this country the thoroughbred horse is usually preferred, as the going is much faster and not so rough as it is farther north. American fox hunters like timber jumps and find the hedges, ditches and banks of the British Isles terrifying, whereas the average British or Irish rider prefers a ten-foot bank to a three-foot barway. The modern wire fence bedevils the sport of both British and American enthusiasts, whereas the Australians train their horses to jump wire with complete aplomb.

But though hounds and countries may differ, in the 20th century as in the 18th, fox hunting is still a question of pitting animal intelligence against animal intelligence. Modern weapons have not been introduced. As in the days when the sport was the prerogative of kings and nobles, it is the hounds that do the hunting, the field following along as best it may.

"One-Gallus" Fox Hunters.—Another form of fox hunting which is strictly indigenous to the North American continent is that enjoyed by a very large number of individual, informal hunters. Often called night fox hunting, this sport, game or pastime might be described as a passive, "hill-topping" type of fox hunting—a fox race in which the only active participants are the fox and hounds with people sitting around a fire on top a hill in the moonlight and listening to hound music. Those who enjoy this pastime do so without ritual, equipment or style; all that is required is a foxhound. The respective owners of the individual hounds, who group them so as to make up a pack, possess a devotion to this form of recreation which cannot be claimed by many hard-riding foxhunters; viz., a knowledge and love of hounds. They know about hound breeding, hound development, what they do, how they run and how they speak to the line. Field trials include a U.S. open.

During the fox race, an owner by listening carefully can single out his own hound and its position in the race by the manner in which the hound throws its tongue. The fox-race type of American hound has been bred for nearly 300 years, and many individualized hound strains have become famous. The most popular are the Walkers, Triggs, Julys and Goodmans.

See also references under "Hunting" in the Index volume.

(J. B. VAN U.; M. C. SF.)

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HUNTING AND FISHING, PRIMITIVE. Both archaeological evidence from the past and observations on the simpler societies of the present day show an appreciation of animal food and considerable ingenuity in methods of capturing it. The earliest fossil teeth suggest that man was omnivorous, eating flesh as well as vegetable products; primitive hearths contain animal bones intentionally smashed with stones for the extraction of marrow; and stone weapons have been found embedded in vertebra and skull of Paleolithic reindeer (Dordogne) and Neolithic ox (Cambridge). The cave paintings of western Europe are thought to represent the efforts of hunters to obtain success in their hunting by magic.

Before the invention of agriculture primitive man everywhere depended on hunting and fishing for his supply of animal food. Later, hunting became accessory to agriculture, providing variety in the vegetable diet and surviving as sport or recreation; or was required to protect flocks and herds against predatory beasts. Primitive agriculture often is the work of women, while men are hunters. But where nature is sufficiently lavish in vegetable food, or where land mammals are comparatively few and small, hunting is of secondary importance to fishing, and fishing to agriculture, which then usually becomes men's work or the work of the entire family.

In modern times few tribes survive who support themselves entirely by hunting. Civilization and political control have encroached upon outlying less desirable lands into which hunting tribes had retreated. The development of aviation brought most regions of wilderness under routine observation, and the depletion of game makes it impossible for all but a few hunting bands to maintain themselves by hunting alone. In a few subarctic areas, as in Canada and Serbia, the seasonal trapping of fur-bearing animals can be followed on a scale sufficient to enable a small number of individuals to support their families on a bare subsistence level, depending upon the trader to supply trapping equipment, firearms, clothing and staple foods in exchange for furs. Nevertheless, these hunters are intermittently dependent upon government aid. The result is that surviving primitive hunters in most parts of the world have adjusted their living economy to that of the nations in control of their original territory, though they

still preserve the traditions of recent times when they were self-supporting. By collecting and integrating these traditions and surviving folkways the anthropological field researcher often is able to reconstruct the mode of life of a given tribe when the people did live as independent hunters.

This article is limited to the consideration of people who were gatherers of wild food as distinguished from those who produced at least a sizable fraction of their food by the domestication of plants and animals. For ages all human beings lived entirely by what nature provided but eventually some groups here and there began to supplement the available supply of wild food by the cultivation of plants and the taming of birds and mammals. In historical perspective by gradual extension of these practices agriculture and animal husbandry became the primary form of economy. Peoples may be characterized as pure hunters and food gatherers, primary hunters, secondary agriculturists, primary agriculturists, secondary herders, primary herders, and finally populations whose entire support is by farming and stock raising. Thus in 1492 the Indian tribes of North America east of meridian 100° W. and south of parallel 45° N. were for the most part secondary agriculturists. In a relatively small area comprising what are now New Mexico and Arizona, with a fringe in border states, the Indians were primarily agricultural, resorting to hunting for skins and a supplementary food supply only. But much of what is now the United States and Canada was occupied by pure hunters and gatherers. The aboriginal inhabitants of Mexico, Central America and the Andean highlands north of latitude 35° were primarily agricultural. For the most part the lowlands of the corresponding parts of South America were secondarily agricultural. Below parallel 35° S., the aboriginal tribes were almost entirely hunters and gatherers of wild foods. In the old world of corresponding date (1492) pure hunters and gatherers dominated Australia, a few isolated areas in Siberia, Africa and southeastern Asia. Most of the Pacific islands approached a primary agricultural economy, supplemented by the gathering of wild foods.

The term civilization implies (among other features) dense populations dependent on a well-organized integration of agriculture and animal husbandry, a form of living which had appeared in the valleys of the Tigris and Euphrates, the Nile and the Indus rivers by about 4000 B.C. (*See* AGRICULTURE, PRIMITIVE.)

Density of human population depends upon the group's mode of life. Under a pure hunting and food-gathering economy population must of necessity be sparse. It has been estimated that for people depending entirely upon food gathering and hunting there must be available from 7 to 500 sq.mi. per capita according to climatic conditions. Since a hunting and food-gathering form of existence seems to have prevailed until about 10000 or 8000 B.C. and, if the minimum space required for such a mode of life be taken as 7 sq.mi. per capita and the earth's surface as 50,000,000 sq.mi., it can be hypothesized that the total world population at that time could not have exceeded 7,000,000 persons. At any rate, great populations pertain to modern times. Hunters and even fishing peoples could not have maintained cities in the modern sense without engaging in extensive farming and stock raising. In fact permanent towns were rarely possible, the family group being forced to move whenever the supply of food began to decline. The existence of large populations is fundamentally dependent upon farming and animal husbandry.

The recognition of definite rights over hunting grounds or fishing waters is usually clearly established and poaching vigorously resented by the rightful owners, who are sometimes, however, placated by a share of the spoil. The Eskimo may form an exception to this rule, for it appears that they have no strict division of hunting territory. The rights of the individual or the hunting group over the game killed were sometimes definitely fixed in primitive societies. Usually the man whose arrow first struck the animal, or first struck it in a vital part, had first claim. In the Andaman Islands a pig belonged to the man whose arrow first struck it, but a bachelor had to be content to see it distributed by one of the older men, all the best parts going to his seniors, while he and his contemporaries received the inferior parts.

Magic plays a very important part in primitive hunting and fishing, and a man relies for his success on supernatural as well as natural means, while ill-success is ascribed less to lack of skill and inadequate weapons, than to failure in some preliminary ritual, or to the stronger magic of some rival force.

PRIMITIVE INVENTIVENESS IN FOOD GETTING

HUNTING

Methods of hunting vary with the nature of the country and of the animal hunted, the ingenuity and inventiveness of the hunters and the materials at their disposal. The Australians had few and plain weapons before European contact: their traps and snares were for the most part, simple and obvious. They depended on their stone or bone-tipped spears, wooden clubs and missile club or boomerang. They stalked both emus and kangaroos, used pituri plant decoctions to stupefy emus at water holes, and exploited the curiosity of the bird by luring it on to a pitfall in which it was speared. The Bushmen of the Kalahari desert, south Africa, run an unwounded springbok to a standstill in the hottest part of the day, keeping the animal constantly on the move, preventing it from lying down, until, by reason of the hot sand getting between its hoofs, it sinks exhausted to the ground. The Eskimos pursue sea birds in kayaks, following them by the bubbles when they rise, and, by tiring them out, catch them by hand. They also run down fawns in the spring, driving them into deep snow, a method formerly used by the Plains Indians for killing the floundering bison in winter.

Disguise, Traps, Snares, etc.—Patience and cunning of a higher order are seen in the devices by which the hunter conceals his approach and in the various nooses, snares, nets, traps, game pits and decoys found almost universally among primitive hunters. The Australian covers his head with waterweeds as he swims after waterfowl, or approaches the emu carrying a leafy branch to prevent the bird from noticing him. The African Bushman scatters a handful of dust over his head to make himself the same colour as the dry grass, or plaits a kind of saddle of grass, sticks some ostrich feathers in it and places it on his shoulders, holding up a long stick with the head curved to look like an ostrich. He imitates the actions of the bird, feeding, running, preening its feathers, and, always moving upwind, contrives to get as near as possible to the flock before discharging his poisoned arrow. Sometimes the imitation is too realistic, and the cock bird, resenting the advances of a rival, attacks the hunter. The North American Indians stalked deer disguised in deerskin, and put on a bison skin when stalking bison. Nooses, snares, traps and pitfalls are quite varied, and the peculiarities of the animal to be lured are carefully studied, human ingenuity being pitted against animal cunning. Firing the bush or prairie was a method of startling game, which could easily be trapped or knocked over in terrified flight. Fire formerly was used by African natives for elephant hunting. When a herd was discovered a large circle surrounding it was fired and the entrapped animals, crowded together, bewildered by the flames and blinded by the smoke, would be unable to escape. In North America the Plains Indians used fire in killing bison.

Weapons.—Any stick or stone can be picked up at random to knock over birds and small game, but specially shaped clubs or throwing sticks are common, such as the African knobkerry and the Australian waddy, which developed into the more specialized trombash of the upper Nile or the Australian boomerang (*q.v.*). The Australian spear is often only a stick, with its end hardened in the fire, though barbs may be added, or stone heads fixed in with gum. The knife is a sharpened stone or is made of the leg bone of the emu. In Australia, as in arctic America, the spear is propelled by the spear thrower to give greater range. Except in Australia bows and arrows are universal among primitive hunters, varying according to the skill of the maker, the materials at his disposal and the prospective victims. The blowpipe or blowgun is more silent than bow and arrow and, with its poisoned darts, is one of the deadliest weapons in the hands of the primitive hunter. (*See* BLOWGUN; BOW AND ARROW; WEAPONS, PRIMITIVE.)

Poisons.—Poisons are both animal and vegetable, and consist of many ingredients which are mixed with secrecy and magic. The central Australians catch emu by pounding up pituri (*Duboisia*

hopwoodi) leaves with water as a bait; the bird becomes stupefied and is easily speared. In parts of the Amazon region the poison is assacu sap. The Macusi of British Guiana make their famous curare (*q.v.*) poison from the climbing *Strychnos toxifera*, mixed with other plants, adding black and red ants, and the poison fangs of snakes. The Punan poison in Borneo is the dried juice of the upas tree. The Bushmen of south Africa have a wide range of vegetable poisons, including *Strychnos*, *Euphorbia*, *Digitalis*, *Strophanthus* and the "Bushman poison bush," *Acocanthera venenata*. They add snake poison glands, poisonous spiders and scorpions, and in particular the little and specially deadly caterpillar called *ngwa*.

Dogs.—Dogs have long been used to track and kill game, and their remains are found in deposits of Neolithic and earlier ages. The hunting dogs of the Lillooet of British Columbia were carefully trained and treated; one good dog was worth a large dressed elk skin. Among the Eskimo seal hunting would be scarcely possible without the help of dogs to smell out the breathing holes under the snow. Dogs help the Labrador Eskimo in hunting the polar bear.

Among the Gilyaks of the Amur river region, Siberia, the dog is held in high esteem, for at death the soul of the hunter is believed to pass into his favourite dog, which is fed with choice food and finally sacrificed on his master's grave.

The Nagas of northeastern India hunt in large numbers while the dogs drive out the game. Custom provides for the dogs (or their owners) a share of the quarry, known as the "dog's share."

The dog's share also is a recognized part of the spoil in Africa and in Melanesia.

Fishing

Fishing is commonly accessory to hunting and as widely distributed, but more restricted in its range, since purely fishing peoples are found only on the banks of large rivers or lakes or on sea coasts. There, however, if the fish are abundant, fishers are able to maintain a more settled life than hunters on land, supporting themselves entirely on their catch for food and trade. They are also less isolated than hunting peoples. Fish are not easily exterminated, and large groups can live in fishing villages, while the water provides a means of intercommunication.

There are tribes among whom fish forms the staple food the year round. The Indians on the banks of the great rivers of northwest America, where sturgeon grow to an extraordinary size, could catch and dry enough fish to last from one season to the next, and if not, there was scarcely a month in which some species of salmon could not be caught. The Eskimo are great fishermen and in the winter live mainly on sea or river produce. In the summer the women fish while the men hunt, and dried or frozen fish and seal meat form the winter provisions. At the extremity of the South American continent the coast-dwelling Fuegians fish from their frail boats made of bark and train their dogs to assist them by plunging into the water and driving the fish. Fishing is important on all the great rivers of Siberia. The Gilyaks and Golds of the Amur river live entirely on fish and on the bears which crowd down to join in the fishing when the salmon run. Transparent fishskin supplies the windows for their semisubterranean houses, and, in former days, the clothing was of salmon skin, ornamented with carp skin, a fashion later abandoned, although fishskin shoes are worn in the summer.

In Africa many people living on the banks of the great rivers or on the shores of the great lakes are mainly if not entirely dependent on fishing. Throughout the islands of the Pacific, fish, dugong and turtle are especially welcome as a change in the ordinary vegetable diet. In some islands anything connected with fishing is considered sacred; the type of fish eaten by pregnant women, priests and other special groups may be circumscribed. In southeastern Asia, in the Malay archipelago and on the Chinese coast are families and groups of families who seldom land on shore and never settle there for any length of time. Their homes are their boats and fishing is their livelihood, supplemented by trade, or, in former times, by piracy.

Simplest Methods.—The most primitive fishing methods consist merely in the collecting; the fish are caught by hand, speared or shot with bow and arrow. The Australians catch catfish with their feet, or, stirring up the water, hit or spear the fish coming to the surface. The African Bushmen spread grass on the surface of a pool; then, wading in, push the grass and fish into the shallows where they are easily caught. Farther north, near Stanley pool (Republic of the Congo), as the river shrinks in the dry season, fish are scooped out of pockets in the rocks with gourds, a pint or more at a dip. And when the sockeye, "fish of fishes" (*Oncorhynchus*), swam up the Fraser river (British Columbia) to spawn or the eulachon (*Thaleichthys pacificus*) choked the river in a plentiful run, the Salish Indians speared them in hundreds or scooped them up in buckets.

Weapons and Nets.—Spears, bows and arrows are the principal weapons for fishing as for hunting, to which may be added harpoons for larger fish and sea mammals. Nets are fairly general from the small hand nets, mainly used by women and children in shallow water and at low tide, to enormous seines or dragnets stretching right across reaches of the rivers or shallows of the sea; but the use of hook and line, though found among many primitive fishers, is not universal. The Andamanese, most skilful fishermen, used no hook or line; the central Australians had no hooks before the coming of the white man, and neither nets nor hook and line were known to the Tasmanians. The Bushmen have barbed harpoons for fishing, but rely on baskets instead of nets. In Torres strait the native islanders wade into the sea with conical baskets to scoop up the sardinelike shoals of *tup*. In central Australia nets made of rushes, without floats or sinkers, are stretched from tree to tree or stakes, and left there. If a man wants some fish, he swims out and helps himself.

Fire and Poison.—In fishing fire is man's ally, as in hunting, and fish are everywhere lured to destruction by the light of a torch. Poison is also commonly used. In Africa circles of *Euphorbia* stakes are planted in a river, and the fish become entangled and stupefied; or bruised stems of poisonous plants are thrown in, and the helpless fish float to the surface. The Polynesians mix *Tephrosia piscatoris* or *Barringtonia speciosa* with taro as a poison bait and catch the fish by hand.

Dogs and Suckerfish.—The dog is occasionally used to drive fish (*e.g.*, by the Fuegians, by the Ainu of Japan and in some places in England and Ireland) as otters are trained on the Yangtze; while in Chinese lakes and canals cormorants dive for fish, with a cord round their necks to prevent the catch from being swallowed. In Australia and Torres strait, as in Central America, suckerfish (*Echeneis naucrates* or *remora*) are used for catching small turtle. The fish is thrown out of a canoe with a line attached to the tail and attaches itself to the turtle. The line may then be drawn in, together with the turtle, or may serve as a guide to a man who swims down and gives the turtle a finishing blow.

See also references under "Hunting and Fishing, Primitive" in the Index volume.

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HUNTINGDON, EARLS OF. The English earldom of Huntingdon was held during the middle ages by several members of the Scottish royal family and since 1529 has been held by members of the Hastings (*q.v.*) family. The first known earl of Huntingdon was Turi, who harried Worcester (1041) at the order of King Hardicanute. A little later the earldom was probably held by Tostig, earl of Northumbria from 1055 to 1065 and brother of the future Harold II. When Tostig was banished in 1065 the earldom was given to Waltheof (d. 1076), son of the Danish Siward who had been earl of Northumbria before Tostig; Waltheof several

Fiji Islanders in the closing stages of a fish drive

HUNTING AND FISHING

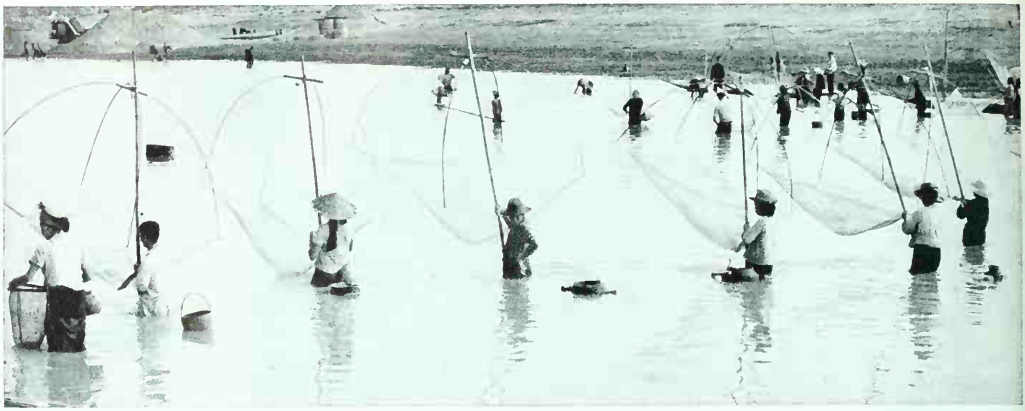
In South-West Africa the Heikum Bushman who does not make the kill carries the buck

Fish nets drying on the outskirts of Lagos, Nigeria

The pygmylike Aeta of the Philippines hunt with bows and arrows

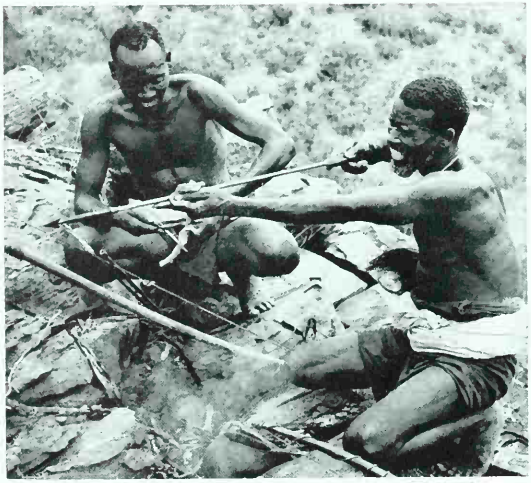
PHOTOGRAPHS: (TOP) ROB WRIGHT; (BOTTOM LEFT) KEN HEYMAN—RAPHO GUILLUMETTE; (CENTRE RIGHT) CAMERA PRESS—PIX; (BOTTOM RIGHT) P.A.—REUTERS PHOTO LTD.

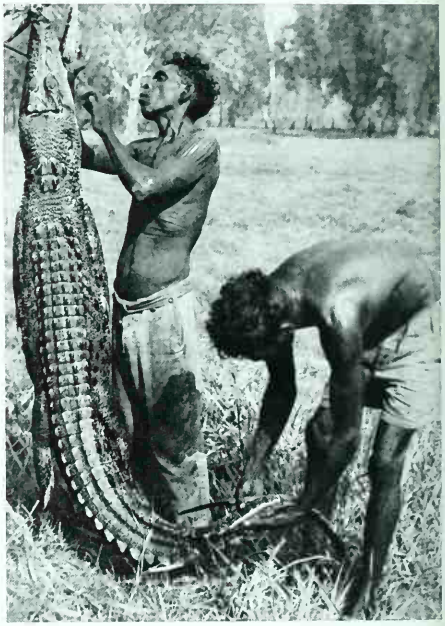
HUNTING AND FISHING, PRIMITIVE



Fishing with nets at Vientiane, Laos

African hunters ready poisoned arrows before stalking elephant





Skinning a crocodile in Australia

HUNTING AND FISHING

Fisherman of northeast Brazil on a balsa-wood raft (jangada), with which he sometimes ventures far out to sea

PHOTOGRAPHS: (TOP) NICHOLAS WOLLASTON—CAMERA PRESS PIX, (CENTRE LEFT AND RIGHT) CAMERA PRESS—PIX (BOTTOM LEFT) HANS MANN

times opposed William the Conqueror and in May 1076 was executed for plotting against him.

Waltheof had no male heirs; the next two earls of Huntingdon were the successive husbands of his elder daughter Maud, SIMON DE ST. LIZ (Senlis) I (d. *c.* 1111) and DAVID (d. May 1153), youngest son of Malcolm III of Scotland who became (April 1124) King David I. David resigned the earldom (1136) to his son HENRY (d. 1152) who did homage for it to King Stephen; both father and son, however, invaded England in 1138 and were defeated at the battle of the Standard. Held for a few months by SIMON DE ST. LIZ II (d. Aug. 1153), son of Maud by her first marriage, the earldom was then claimed by Henry's son MALCOLM IV (d. 1165); his right was confirmed (1157) by Henry II of England. Malcolm's brother and heir, WILLIAM THE LION (d. 1214), was earl until he joined the rebellion of 1173–74 against Henry II and was captured at Alnwick (July 1174). SIMON DE ST. LIZ III (d. 1184), son of Simon II, then received the earldom, but after his death without issue it was restored to William who resigned it (1185) to his brother, DAVID (d. 1219), earl of Huntingdon, whose numerous descendants were claimants to the Scottish throne in 1290 (*see* SCOTLAND: *History*). When his son JOHN died without issue in 1237 the earldom in that line became extinct.

From 1388 to 1461 the earldom was held, intermittently because of frequent attainders and forfeitures, by members of the Holand family, who were also, from 1397, dukes of Exeter (*q.v.*).

GEORGE, LORD HASTINGS (d. 1544), was created earl of Huntingdon in Dec. 1529. Members of his family held the earldom in unbroken succession until 1789, when the earldom was dormant until revived in 1818. The present earl of Huntingdon is FRANCIS JOHN CLARENCE WESTRENA PLANTAGENET HASTINGS (1901–).

See H. N. Bell, *The Huntingdon Peerage* (1820).

HUNTINGDON, SELINA HASTINGS, COUNTESS OF (1707–1791), the central figure in the evangelical revival of the 18th century in England and founder of the Countess of Huntingdon's Connexion, was born a daughter of Washington Shirley, 2nd Earl Ferrers, at Stanton Harold, Leicestershire, on Aug. 24, 1707. In 1728 she married Theophilus Hastings, 9th earl of Huntingdon, whose sister, Lady Margaret Hastings, an early convert to Methodism, was the means of her conversion. Attracted at first to the Moravians, she soon left them and joined the Wesleys' Methodist society in 1739. On her husband's death in 1746 she became the "elect lady" of the new movement. Using her right as a peeress, she appointed evangelical clergymen as her chaplains and built chapels in Brighton, Bath, Tunbridge Wells and other centres of society. George Whitefield was her favourite preacher, and the services in her drawing room became a popular resort of the aristocracy. She helped Whitefield's orphanage in Georgia, corresponded with George Washington (a distant relative) about the American Indians and assisted at the beginnings of Dartmouth college, New Hampshire, and Princeton university.

On the expulsion of six theological students from Oxford in 1767 under suspicion of "enthusiasm" (another word for Methodism) the countess in 1768 established Trevecca college in Brecknockshire for the training of evangelical clergymen at her own expense. Although a devout Anglican she aimed at providing preachers for dissenting churches as well, and the first president of the college was an Arminian, J. W. Fletcher, vicar of Madeley. The uneasy association between the Arminians under John Wesley and the Calvinists, of whom Whitefield was now the leader, came to a head in 1770 when the Wesleyan conference attacked Calvinism. In 1779 the countess was sued in the ecclesiastical courts for having established a chapel in Spa Fields, Clerkenwell, which the local clergyman insisted was an infringement of his rights. In order, therefore, to save her chapels she had to register them as dissenting meetinghouses, and all her Anglican chaplains resigned. She died at Spa Fields on June 17, 1791. Her college was moved to Cheshunt, Hertfordshire, in 1792 and to Cambridge in 1904. Her chapels are supported by grants from the trustees of the Connexion and are Congregational, apart from two or three where the evangelical type of service still continues. There are 36 chapels in the Connexion.

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HUNTINGDON, a municipal borough and county town in the Huntingdon parliamentary division of Huntingdon and Peterborough, Eng., on the Ouse, 60 mi. N. of London by road. Pop. (1961) 8,821 (includes Godmanchester). Huntingdon (Huntandun in 921) was recovered from the Danes about 921 by Edward the Elder, who raised a fortress there, probably on the site of the Danish defenses, but in 1010 the Danes again destroyed it. A castle was built by order of William the Conqueror to guard the river crossing but it was among those destroyed by order of Henry II in 1174. At the time of Domesday Book Huntingdon was a royal borough. Three monasteries and three hospitals were founded and 16 parish churches built in medieval times, but by 1550 only 3 churches and one hospital remained. The borough was incorporated by Richard III in 1484, (an earlier charter dates from 1205), and in 1630 Charles I granted a new charter, which continued until 1835. The burgesses were represented in parliament by two members from 1295 to 1867 and by one until 1885 when representation ceased. Huntingdon owed its prosperity to its situation on the Roman Ermine street which made it a coaching centre. It is now the centre of an agricultural area with other industries making beer, soft drinks, hosiery, foodstuffs and electrical equipment. Ornamental plants are grown. During the Civil War it was several times occupied by the royalists though they sacked it in 1645. It forms a twin town with Godmanchester (*q.v.*) with which it is linked by an old bridge (*c.* 1300).

The town is mainly Georgian and consists basically of one street, in the centre of which is the market place where are All Saints' church, the mother church of the borough, which was rebuilt between 1475 and 1520, the town hall (1745) and the 17th-century Walden's house, now the county council offices. The parish church of St. Mary is on the site of the Augustinian priory in which David Bruce, Scottish earl of Huntingdon, was buried. Some Norman remains of the 12th-century hospice of St. John the Baptist were incorporated in the buildings of Huntingdon grammar school.

HUNTINGDON AND PETERBOROUGH, an east midland county of England, is bounded north and west by Northamptonshire, southwest by Bedfordshire and east by Cambridgeshire and Isle of Ely. In 1964 an order was made for the administrative counties of Huntingdonshire and the Soke of Peterborough to be amalgamated on April 1, 1965. This article deals with the former county of Huntingdonshire; area 365.7 sq.mi., pop. (1961) 79,879.

Physical Characteristics.—The countryside is generally flat in the east and gently undulating in the west, where it reaches its greatest height of 287 ft. near Covington, while in the fens sea level is reached. The woodland mainly occurs in the west where the forestry commission has extensive holdings. The river Nene or Nen forms the boundary on the north, and the Ouse, for part of its course, divides the county from Bedfordshire and Cambridgeshire. The course of an extinct branch of the Ouse, known as the West water, forms part of the eastern boundary. The only tributary streams of note are the Kym, flowing from Kimbolton, and the Alconbury and Hen brooks, which enter the Ouse near Huntingdon and at St. Neots.

All the stratified rocks are of the Jurassic period except a small area of Lower Greensand in the extreme south. A narrow strip of Inferior Oölite reaches from Thrapston by Oundle to Wansford on the northern boundary. The Great Oölite series has, at the base, the Upper Esturine Clays, in the middle the Great Oölite Limestone, which forms the escarpment of Alwalton Lynch, and at the top the Great Oölite Clay. The Cornbrash occurs on the south side of the Nene valley from Woodstone to Elton. Over the remainder of the county the lower soils are covered by Oxford Clay, on which, in the vicinity of Fletton and Yaxley, is established one of the largest brickmaking centres in the country. Corallian formations are found in the southeast. Glacial drift clay, coloured blue or yellow and often containing masses of chalk and flints, or pockets of gravel and sand, covers the older rocks. Valley gravels of glacial origin occur in terraces along the Nene and Ouse valleys and form the raw material for an extensive gravel-digging industry.

KENNETH SCOWEN

(LEFT) CHINESE BRIDGE OVER THE RIVER OUSE AT GODMANCHESTER WITH THE SPIRE OF THE PERPENDICULAR CHURCH OF ST. MARY IN THE BACKGROUND; (RIGHT) HALF-TIMBERED HOUSES IN HOUGHTON, HUNTINGDONSHIRE

On the eastern side are the fens, where grew the forest of "bog oaks" whose trunks, preserved by the peat, are still found. The fenland is described in the article FENS.

The woodlands, of which Brampton wood (335 ac.) is the largest, are all situated on the clay and consist mainly of oak, ash and elm mixed with small quantities of birch and poplar and with hazel and maple undergrowth. The forestry commission initiated a program of replanting with mainly conifers and a few hardwoods.

The nature conservancy, in its three main holdings, controls a larger area than in any other English county. Woodwalton fen (514 ac.) is an area of undrained fenland with rare plants and insects and the sole British habitat of the large copper butterfly, reintroduced from the Netherlands in 1927 after becoming extinct in the neighbourhood in 1848. The Monks wood area is also well known for butterflies and moths and especially for the black hairstreak butterfly first discovered there in 1828. Holme fen, an area of 640 ac. once drained and later abandoned, has become naturally afforested by birch and alder. It contains the well-known Holme fen pillar, recording about 12 ft. of peat shrinkage after 100 years of drainage. Many of the extensive worked-out gravel pits in the Ouse valley form wildlife sanctuaries and attract a variety of both breeding and migrant birds.

History.—Flint implements of the Lower Paleolithic Age, together with contemporary mammalian bones, are found in most of the gravel workings of the Nene and Ouse valleys. By the early 1960s, however, no remains of the Upper Paleolithic or Mesolithic Ages had been identified. It is along these same areas of gravel and alluvial soil that there is most evidence of prehistoric settlement. Surface finds of chipped flint tools and flakes are common and can be attributed to the Neolithic and succeeding Bronze ages. During the Bronze Age the fen areas became drier and there, too, tools, weapons and pottery have frequently been found.

Population was scarce in the immediate pre-Roman Iron Age but after the Roman conquest most of the clay uplands were occupied in addition to the valleys and there is evidence of trade along the waterways.

Small walled towns were built along the Roman Ermine street at Godmanchester and Chesterton, and at the latter pottery making became an important national industry. There is no evidence of early Saxon settlement except in the north, south and east, the area between the Ouse and Nene being almost devoid of pagan cemeteries. The county was probably divided tribally between the Sweodora (west) and the South Gyrwas (east).

After their conquest of East Anglia in the latter half of the 9th century, Huntingdon became an important seat of the Danes. About 921 Edward the Elder wrested the fen country from the Danes and a few years later the district was included in the earldom of East Anglia. Religious foundations were established at Ramsey and St. Neots by the Benedictines in the 10th century and a cell at St. Ives before the Conquest. In 1011 Huntingdonshire was again overrun by the Danes and in 1016 was attacked by Canute. A few years later the shire was included in the earldom of Thored (of the Middle Angles), but in 1051 it was detached from Mercia and formed part of Harold's East Anglian earldom. Shortly before the Conquest it was granted by Edward the Confessor to Tostig, becoming an outlying part of the Northumbrian earldom. David I of Scotland acquired it through his wife and it remained a possession of the royal house of Scotland until 1337. A new earldom was then created and conferred on various persons including, in 1529, George Hastings, whose descendants now hold it (*see* HUNTINGDON, EARLS OF).

The Norman Conquest was followed by a general confiscation of estates, only four or five thanes retaining lands, and St. Neots priory was given to the Abbey of Bec. In the Domesday survey it is recorded that the abbot of Ramsey (*q.v.*) held 26 manors while most of the other holdings were divided between the crown and the sheriff, Count Eustace of Boulogne. This shrievalty was united with that of Cambridgeshire by 1155 and remained united except from 1636 to 1643. The county boundaries have hardly changed since the Domesday survey. At Huntingdon the castle remains as an earthwork, and the castle at Kimbolton is a mansion, restored by Sir John Vanbrugh and now acquired by Kimbolton school. Hinchingbrooke house (16th century) was once occupied by the Cromwells and later by the earls of Sandwich. Elton hall (1664) has a collection of pictures and rare books.

At the end of the 11th century Huntingdonshire was constituted an archdeaconry, comprising the deaneries of Huntingdon, St. Ives, Yaxley, St. Neots and Leightonstone, and the divisions remained unchanged until the creation of the deanery of Kimbolton in 1879. The county was transferred from the diocese of Lincoln to that of Ely in 1837.

During the reign of William the Conqueror the Benedictines established a nunnery at Hinchingbrooke, and in 1147 the Cistercian abbey was founded at Sawtry. In the same century the Austin canons established a priory at Huntingdon, and another at Stoneley is first mentioned in 1274. Toward the end of the 13th century the Austin friars had a house at Huntingdon.

Fine bridges span the Ouse at Huntingdon (*c.* 1300), St. Ives (*c.* 1400) and St. Neots (*c.* 1600). Great Paxton church is 11th century. There are outstanding 12th-century churches at Alwalton, Bury, Eynesbury, Fletton, Haddon, Ramsey and Southoe, and 13th-century churches at Alconbury, Kimbolton and Yaxley. St. Neots church is an interesting example of the late 15th century.

In 1174 Henry II captured and destroyed Huntingdon castle and during the Wars of the Roses the town was sacked by the Lancastrians. Huntingdon, although the birthplace of Oliver Cromwell, had royalist sympathies in the Civil War. St. Neots market square was the scene of a battle in 1648 when a royalist force was routed and the earl of Holland captured. In the reign of Charles I, Nicholas Ferrar founded the famous religious community at Little Gidding. Samuel Pepys's house at Brampton belongs to the Pepys society.

Although Huntingdonshire has always been mainly an agricultural county, there was, even during medieval times, a considerable volume of trade and industry based on navigation between The Wash and the riverside towns of St. Neots, Huntingdon, Godmanchester and St. Ives. At the last-named was held in the 13th century an annual cloth fair of international importance. This trade was intensified when locks on the Ouse were completed as far upstream as St. Neots in the early 17th century.

Population and Administration.—The population in 1961 was 79,924, of which 44,093 lived in the rural districts of Huntingdon, Norman Cross, St. Ives and St. Neots. There are two municipal boroughs, Huntingdon and Godmanchester (8,812) and St. Ives (4,082), and three urban districts, Old Fletton (11,677), Ramsey (5,697) and St. Neots (5,554).

Huntingdon (*q.v.*) is the administrative centre of the county. The county is in the South Eastern circuit, and assizes and quarter sessions are held at Huntingdon. Petty sessional courts sit at Huntingdon, St. Neots, St. Ives and Old Fletton. The county returns one member to parliament.

There are grammar schools at Huntingdon, Orton and Ramsey, a direct-grant grammar school at Kimbolton and secondary modern schools at Huntingdon, St. Ives, St. Neots and Orton. The only technical institute is at St. Neots.

Both the Ouse and Nene rivers are navigable throughout the

county and below to the sea. Use is made of both rivers by pleasure craft and fishermen and the unspoiled natural beauty of their valleys is one of the chief attractions of the county.

The Economy.—As in the past, agriculture is still the principal industry and about three-quarters of the county is under crops or grass. During World War II large drainage and reclamation projects were carried out; since then a high standard of husbandry has been maintained. The farmland can be divided into three types: the heavy claylands of the centre and west which grow cereals and ley, with some legume crops; the fenland of the east with Ramsey as the centre, where the chief crops are potatoes, sugar beet and vegetables with a large area of cereals; and the gravel and alluvial soils of the south and southeast where an even greater variety of crops are grown. In the south it forms part of the market gardening area of north Bedfordshire, and in the east a prosperous fruit-growing industry is established. On farms adjoining the river Ouse increasing use is being made of spray irrigation. Sheep, cattle, pigs and poultry are raised.

Most towns have undergone industrial development. In the north, around Fletton, is the great brickmaking industry in addition to sugar refining, food canning and various forms of engineering. Huntingdon's industries include food canning, sweet (candy) making and sheet metal work; rubber and plastic products, hosiery and knitwear, electrical and radio equipment are also among its manufactures. St. Neots produces wood products (including cricket bats), stationery, plastic goods, meat products, aircraft lamps, beer, flour, footwear and underwear. In the St. Ives area are woodworking, printing, light engineering, egg packing, precast concrete, chicory processing and the rearing of broiler chickens.

The centre of the county is traversed from south to north by the Great North road. Also from south to north runs the main line of the eastern region of British railways passing from St. Neots through Huntingdon to Peterborough. From St. Ives a line runs north to March and Wisbech and the northwestern border is served by a line from Peterborough to Wansford. Airfields under the control of the Royal Air Force are at Alconbury, Upwood, Wyton, Molesworth and Great Staughton.

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HUNTINGTON, a U.S. family whose fortune was established in the development of western railroads.

Collis Potter Huntington (1821–1900), U.S. railroad builder, was born at Harwinton, Conn., Oct. 22, 1821. He went to work when he was 14 and at the age of 28 he set out for the California gold fields. An early advocate of an overland railway, Huntington, with Mark Hopkins, Leland Stanford and the Crocker brothers, incorporated the Central Pacific Railroad of California in 1861. Huntington secured government land grants and financial aid to construct a line from the Pacific coast to a meeting with the Union Pacific. Later he turned his attention to the building of the Southern Pacific and completed the 9,600-mi. line. He also made the Chesapeake and Ohio a profitable line by extending its eastern terminus and operating it in connection with the Southern Pacific. Huntington died Aug. 13, 1900, near Raquette Lake, N.Y.

His nephew, Henry Edwards Huntington (1850–1927), was born at Oneonta, N.Y., Feb. 27, 1850. After working in hardware firms, in 1871 he supervised one of his father's sawmills, and ultimately held important executive positions with several railroads and promoted electric railway and utility development in California, particularly in Los Angeles. After 1910 he devoted considerable time to assembling a choice art collection and library, especially rich in rare editions of early English literature and in Americana. The library and mansion housing it were deeded to the U.S. public in perpetuity, and a trust fund of $8,000,000 was established for further additions, research and publications. He died in Philadelphia, May 23, 1927.

Archer Milton Huntington (1870–1955), the adopted son of C. P. Huntington, American Hispanic scholar, was born in New York city, March 10, 1870. While studying in Spain, he specialized in Spanish archaeology. In 1904 he founded the Hispanic Society of America, to which he gave a home, endowment and collections. He died Dec. 11, 1955, in Bethel, Conn. (W. H. D.)

HUNTINGTON, DANIEL (1816–1906), U.S. painter of the romantic school, was born in New York on Oct. 14, 1816. In 1835 he studied with S. F. B. Morse, and produced "A Bar-Room Politician" and "A Toper Asleep." Subsequently he painted some landscapes on the Hudson river and in 1839 went to Rome. On his return to the United States he painted portraits and began the illustration of *Pilgrim's Progress,* but his eyesight failed and in 1844 he went back to Rome. Returning to New York in 1846 he devoted his time chiefly to portrait painting, although he had painted many genre, religious and historical subjects. He was president of the National Academy, 1862–70, and again 1877–90. He died on April 19, 1906, in New York city.

HUNTINGTON, ELLSWORTH (1876–1947), U.S. geographer well known for his doctrines with regard to the influence of climate on civilization, was born at Galesburg, Ill., on Sept. 16, 1876, and educated at Beloit college, Wis. (A.B., 1897), Harvard (A.M., 1902) and Yale (Ph.D., 1909). From 1897 to 1901 he was an instructor in Euphrates college, Harput (Turkey), and in 1901 he carried out an exploration of the canyons of the Euphrates river for which he was awarded the Gill memorial of the Royal Geographical society. In 1903–06 he traveled widely with expeditions in central Asia, recorded in his books *Explorations in Turkistan* (1905) and *The Pulse of Asia* (1907), the latter one of his best. He then taught for some years at Yale, as instructor and later as assistant professor of geography; in 1917 was appointed research associate. In 1909 he headed the Yale expedition to Palestine and Asia and in 1911 published *Palestine and Its Transformation.* From 1910 to 1913 he was research associate of the Carnegie Institution of Washington and made climatic investigations in the United States, Mexico and Central America. His work was notably concerned with climate and its relation to land forms, geological and historical changes, and to human activities and the distribution of civilizations. His researches bore fruit in *The Climatic Factor* (1914), *Civilization and Climate* (1915; rev. ed., 1924) and *World Power and Evolution* (1919). These interests led him to investigate the causes of climatic variation, in *Climatic Changes,* with S. S. Visher (1922), and *Earth and Sun* (1923). In addition to a number of textbooks, several in collaboration, other important works are *The Character of Races* (1924); *The Pulse of Progress* (1926); *The Human Habitat* (1927). In later years he wrote extensively on heredity and eugenics. A vigorous and prolific writer who as a geographer gained a world-wide reputation, his last book, *Mainsprings of Civilization* (1945), provides an epitome of much of his wide-ranging earlier work. He died on Oct. 17, 1947, at New Haven, Conn.

See *Geographical Review,* pp. 153–155 (1948). (G. My.)

HUNTINGTON, SAMUEL (1731–1796), signer of the Declaration of Independence, president of the continental congress (1779–81) and governor of Connecticut, was born at Windham, Conn., July 3, 1731. He received little formal education but devoted his spare time to study, was admitted to the bar in 1758 and achieved rapid success as a lawyer. He served in the Connecticut assembly in 1765 and was annually appointed a justice of the peace for New London county from 1766 until his appointment in 1774 as a judge of the superior court. He served on the governor's council from 1775 until 1783, concurrently with his service in the continental congress. As a delegate to the continental congress, Huntington voted for and signed the Declaration of Independence in 1776. In 1779 he was chosen president of the congress, a position he held until July 1781.

Huntington returned in 1783 to Connecticut where he became chief justice of the state supreme court in 1784; lieutenant governor in 1785; and governor in 1786. He was re-elected governor each year thereafter until his death at Norwich on Jan. 5, 1796. (H. I. Be.)

HUNTINGTON, a city of West Virginia, U.S., and seat of Cabell county, lies on the Ohio river just below the mouth of the Guyandot river near the point where Ohio, Kentucky and West Virginia meet. It is an important railway, trading and manufac-

turing centre about 50 mi. W. of Charleston.

Huntington was founded and incorporated in 1871 as the western terminus of the Chesapeake and Ohio railroad, on the site of Holderby's Landing, a stretch of farm land that extended along the Ohio river from the west bank of the Guyandot. It was named for Collis P. Huntington, president of the railroad, who delegated his brother-in-law Col. Delos W. Emmons to purchase 21 farms embracing 5,000 ac. of level land along the river bank. He then employed Rufus Cook, a Boston engineer, to lay out a city of broad streets and boulevards. In a spirited election in 1887, the seat of Cabell county was moved from Barboursville to Huntington.

The yards, division point, general locomotive and car shops of the Chesapeake and Ohio railway were established there and the city grew rapidly.

Apart from the railway shops and offices there are foundries, nickel and nickel alloy plants, and factories producing electrical equipment, glass, cement, furniture and food products. There are a number of wholesale houses, and oil and gas interests. The Ohio river furnishes facilities for shipment of coal and for gasoline from Louisiana and Texas.

Huntington is the seat of a state mental hospital and six private hospitals. The oldest house of the city is preserved in Ritter park, where there is also an art gallery.

Marshall college (state supported) with an enrollment of about 3,500 was founded as Marshall academy in 1837 and named for Chief Justice John Marshall.

Huntington suffered from floods in 1884, 1913, 1936 and 1937; the 1937 flood was particularly disastrous. An 11-mi. wall was constructed with locks and dams giving maximum flood protection, and making Huntington one of the few walled cities of North America.

Pop. (1960) 83,627; Huntington-Ashland standard metropolitan statistical area (Cabell, Wayne counties, W.Va.; Boyd county, Ky.; Lawrence county, O.), 254,780. For comparative population figures *see* table in WEST VIRGINIA: *Population*. (K. K. McC.)

HUNTINGTON PARK, a commercial, industrial and residential city in south-central Los Angeles county, Calif., U.S. It is sometimes called the "shopkeeper of southern Los Angeles," and is located 7 mi. S. of the Los Angeles civic centre.

Throughout much of the 19th century, Huntington Park was a portion of the Rancho San Antonio. It remained a possession of the Lugo family from 1810 until 1865. After passing through a succession of hands without development, it was acquired by real estate subdividers after 1900. These men advertised the area as La Park, but in 1904 the name was changed to Huntington Park, after Henry E. Huntington's Pacific Electric railroad was completed through the proposed city. In 1906 Huntington Park was incorporated as a California General Laws city. It adopted a city-manager form of local government in 1957.

It became a major centre for retail sales, supplying a populous area of about 350,000, and its manufactures include oil-well equipment, automobiles and parts, rubber goods, paints, steel, iron and heavy hardware. For comparative population figures *see* table in CALIFORNIA: *Population*. (J. M. Wo.)

HUNTINGTOWER, a village in the parish of Tibbermore, Perthshire, Scot., on the Almond, 3 mi. N.W. of Perth. Huntingtower (originally Ruthven) castle was the scene of the Raid of Ruthven, when the Protestants under William, earl of Gowrie, kidnapped the boy king James VI. in 1582. The earl's sons were killed in the Gowrie conspiracy (1600), after which the Scots parliament ordered the barony to be known in future as Huntingtower. The castle has been restored. (G. S. P.)

HUNTLY, EARLS AND MARQUESSES OF. The Scottish earldom of Huntly was first created *c.* 1445 for ALEXANDER DE SETON (d. 1470), who may already have been styled Lord Gordon. His son GEORGE (d. 1502), 2nd earl, who took the surname Gordon, was married for a short time to Princess Annabella, daughter of James I of Scotland. He left several children, including, besides his successor ALEXANDER (d. 1524), 3rd earl, a second son Adam, who became earl of Sutherland, a third son William from whom the mother of Lord Byron was descended, and a daughter Katherine, the first of whose four husbands was Perkin Warbeck. The 3rd earl consolidated the position of his house as supreme in the north; he led the Scottish left wing at the battle of Flodden (Sept. 9, 1513), and was a supporter of the duke of Albany against the earl of Angus. His grandson GEORGE (1513–1562), 4th earl, who in 1549 was granted the earldom of Moray, played a leading part in the troubles of his time in Scotland. In 1562 he revolted against Mary Stuart and died after his defeat at Corrichie, near Aberdeen. His son GEORGE (d. 1576), 5th earl, was restored to the forfeited earldom in 1565. He helped the earl of Bothwell, who had married his sister, to obtain a divorce from her and he was a powerful supporter of Mary till he seceded from her cause in 1572.

GEORGE (*c.* 1563–1636), 1st marquess of Huntly, son of the 5th earl and Anne, daughter of the earl of Arran, was educated in France as a Roman Catholic. He approved of the execution of the earl of Morton in 1581 and helped in the delivery of James VI from the Ruthven raiders in 1583. He signed the Presbyterian confession of faith in 1588, but he was soon engaging in plots for the Spanish invasion of Scotland. Elizabeth I discovered this and sent on to James some of Huntly's treasonable correspondence with the Spanish authorities, but James soon pardoned him. Huntly thereupon raised a rebellion in the north of Scotland, but was obliged to submit and after a short imprisonment in Borthwick castle was again set at liberty. Within three years he had received a royal commission to proceed against his hereditary enemy, the earl of Moray. He set fire to Moray's castle of Donibristle in Fife on Feb. 7, 1592, and Huntly himself is said to have taken part in stabbing the earl to death. This outrage, which originated the ballad "The Bonnie Earl of Moray," brought down upon Huntly his enemies, who ravaged his lands. In December the "Spanish Blanks" (eight blank papers, two of which bore Huntly's signature, which were taken from a man leaving for the continent) led to another charge of treason against him. Despite the outcry of the ministers, James refused to take severe action against the powerful northern earls until, in the summer of 1594, Huntly joined Erroll and Bothwell in an open rebellion. Huntly and Erroll gained a victory in October over Argyll's troops at Glenlivet, but Huntly's castle of Strathbogie was blown up by James, and he left Scotland in March 1595. He returned secretly, submitted to the kirk and was restored to his estates. Huntly was created a marquess in April 1599 and soon after, with the duke of Lennox, he was appointed lieutenant of the north. He was treated with great favour by the king and was reconciled with Moray and Argyll. Doubts, however, as to the genuineness of his abjuration continued from time to time to trouble the kirk. He was excommunicated in 1608 and warded in Stirling castle until late in 1610, when he again signed the confession of faith. After the accession of Charles I in 1625 Huntly lost much of his influence at court. For the private war waged against the Crichtons after 1630, he was summoned before the privy council in 1635 and was imprisoned in Edinburgh castle. He died at Dundee on June 13, 1636, after declaring himself a Roman Catholic.

GEORGE (d. 1649), 2nd marquess, eldest son of the 1st marquess by Henrietta Stuart, daughter of the duke of Lennox, was brought up in England as a Protestant and was styled earl of Enzie during his father's lifetime. His influence in Scotland was employed by Charles I to balance that of the earl of Argyll in the dealings with the covenanters. In the Civil War Huntly took the king's side and was captured in 1647. On March 22, 1649, he was beheaded in Edinburgh by order of the Scots parliament.

His attainder was reversed by parliament in 1661 in favour of his grandson GEORGE (*c.* 1650–1716), 4th marquess, who in 1684 became duke of Gordon (*see* GORDON). On the extinction of the dukedom in 1836, the title of marquess of Huntly devolved on GEORGE GORDON (1761–1853), a distant cousin of the 5th duke. DOUGLAS (1908–), 12th marquess, succeeded to the title in 1937. (G. S. P.)

HUNTLY, a small burgh of Aberdeenshire, Scot., in the Strathbogie district, at the confluence of the Deveron and Bogie, salmon and trout rivers, 39 mi. N.W. of Aberdeen by road. Pop. (1961) 3,952. It is a market town and angling resort with industries that include the weaving of woolen cloth and the making of agricultural

machinery. Huntly is built on a rectangular plan, and in the market square are the "Stan'in stanes" (standing stones) of Strathbogie, probably prehistoric, and the Brander library, above which is the MacDonald museum. George MacDonald (*q.v.*) was born in Huntly. The Gordon schools were founded in 1839. Huntly (Strathbogie until 1506) castle, ½ mi. N. and now in ruins, was owned in the 14th century by the Gordons, who rebuilt it. It was blown up in 1594, restored in 1602 and in 1752 Huntly lodge (later a hotel) was built from its stones.

HUNTSVILLE, a city of northeastern Alabama, U.S., and the seat of Madison county, is about 85 mi. N. of Birmingham. It was founded in 1805 by John Hunt of Virginia, a Revolutionary War veteran, and was originally called Twickenham by Leroy Pope, a kinsman of Alexander Pope who had settled in the area, in memory of the English poet's home. In 1811 the settlement was incorporated as Huntsville by the territorial government, the first in Alabama to receive a city charter. It was the meeting place of the convention that framed the first state constitution (1819). During the Civil War, the town was occupied by Federal troops (1862). After the war, its former position as a commercial centre for hay, cotton, corn and tobacco was restored.

By mid-20th century the development of the U.S. Redstone arsenal as a centre for rocket and guided missile research had resulted in considerable growth of the city in area and population. The city's manufactures include textiles, sheet metal products, cottonseed oil, stoves, wire staples and farm implements. It is also known for its watercress nurseries. Monte Sano state park is nearby.

Huntsville has two Negro colleges, the Alabama Agricultural and Mechanical college (1875) and Oakwood college (1896).

The population of Huntsville in 1960 was 72,365. The standard metropolitan statistical area of Huntsville (Madison county) had 117,348 inhabitants in 1960. For comparative population figures *see* table in ALABAMA: *Population.* (B. CR.)

HUNYADI, JÁNOS (*c.* 1387–1456), Hungarian statesman and warrior and one of Christendom's most glorious champions, was the son of Vojk, a Magyarized Vlach who married Elizabeth Morsina. While a youth, Hunyadi entered the service of King Sigismund, accompanied him to Frankfurt in 1410, took part in the Hussite war in 1420 and in 1437 drove the Turks from Semendria (Smederevo). For these services he received numerous estates and a seat in the royal council. In 1438 King Albert I made him ban of Szörény (Turnu Severin) in western Walachia, a most dangerous dignity entailing constant warfare with the Turks. On the death of Albert in 1439, Hunyadi supported the candidature of the young Polish king Wladyslaw III (Uászló I in Hungary) against the partisans of the Austrian candidate László V (Ladislas Posthumus), took a prominent part in the ensuing civil war and was rewarded by Wladyslaw with the captaincy of the fortress of Belgrade and the voivodeship of Transylvania.

The burden of the Turkish war now rested entirely on Hunyadi's shoulders. In 1443 he advanced across the Balkans, captured Nish and, after taking Sofia, united with King Wladyslaw's army and defeated the sultan Murad II. When he returned home (Feb. 1444), he had broken the sultan's power in Bosnia, Hercegovina, Serbia, Bulgaria and Albania. Pope Eugenius IV, George Brankovich of Serbia and Skanderbeg of Albania urged him on his return to resume the war and drive the Turks from Europe. All preparations were made when Turkish envoys arrived in Hungary to conclude a ten years' truce. The pact was concluded, but was broken when news arrived that a Venetian fleet had sailed to prevent the sultan (who had retired to Asia Minor) from recrossing into Europe. In July the Hungarian army recrossed the frontier and advanced toward the Black sea coast to join the Venetian galleys. Brankovich, however, privately informed Murad of the advance and prevented Skanderbeg from joining Hunyadi. On reaching Varna, the Hungarians found that the Venetian galleys had failed to prevent the transit of the sultan, who now confronted them with fourfold odds, and on Nov. 10, 1444, they were utterly routed, Wladyslaw falling on the field of battle and Hunyadi narrowly escaping.

In 1446 Hunyadi was unanimously elected governor of Hungary on behalf of King László V, with regal powers. His first act as governor was to proceed against the German king Frederick III, to whom had been entrusted the guardianship of the boy king László V (*q.v.*) and who refused to deliver him up. After ravaging Styria, Carinthia and Carniola and threatening Vienna, Hunyadi made a truce with Frederick for two years. In 1448 he received a golden chain and the title of prince from Pope Nicholas V, and immediately afterward resumed the war with the Turks, who defeated him at Kosovo. In 1450 Hunyadi negotiated with Frederick the terms of the surrender of László. The young king created him count of Bestercze and captain general of the kingdom.

Meanwhile the Turkish danger had again become pressing. In 1455 Hunyadi provisioned and armed the fortress of Belgrade at his own expense and—leaving in it a garrison under his brother-in-law, Mihály Szilágyi, and his eldest son, László—proceeded to form a relief army and a fleet of 200 corvettes. Left entirely to his own resources, he had only one ally, the Franciscan friar Giovanni da Capistrano (*see* JOHN, SAINT, of Capistrano), thanks to whose preaching Hunyadi's small mercenary army was reinforced by a host of peasant volunteers. On July 14, 1456, Hunyadi with his flotilla destroyed the Turkish fleet. A week later he routed the forces investing Belgrade, forcing Mohammed II the Conqueror to raise the siege and return to Constantinople, thus securing the independence of Hungary for another 70 years. On Aug. 11, however, Hunyadi died of the plague in his camp.

Hunyadi was a great statesman and a soldier who recognized the insufficiency and the unreliability of the feudal levies and was one of the first to employ a regular army on a large scale. A man of average education, he owed his influence partly to his natural genius and partly to the transparent integrity and nobility of his character.

See D. G. Kosáry, *A History of Hungary,* with bibliography (1941). (GE. GR.)

HUNYADI, MÁTYÁS: *see* MATTHIAS I, king of Hungary.

HUON DE BORDEAUX, an Old French poem in epic metre. In a hypothetical early version, *Huon d'Auvergne,* the hero is dispatched by Charles Martel to demand tribute from Lucifer, who sends a devil with gifts, including a black charger on which Charles rides to hell. This grim other-world story is transformed in the later version into a burlesque fairy tale: Huon of Bordeaux slays Charlemagne's son Charlot in an ambush and is condemned to fetch the beard and four back teeth of the amir of Babylon (Cairo), who replaces the prince of the underworld; he receives help from Oberon, king of faërie. A late prose version, translated into English by Lord Berners in about 1540, was known to Spenser, Shakespeare and Keats.

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HUON PINE, botanical name *Dacrydium franklinii,* the most valuable timber tree of Tasmania, Austr. It is a member of the order Coniferae but is not a true pine (*Pinus*). It is a fine tree of pyramidal outline, 80 to 100 ft. high and 10 to 20 ft. in girth at the base, with slender, pendulous much-divided branchlets densely covered with the minute scalelike, sharply keeled bright green leaves. It occurs in Tasmania's swampy localities from the upper Huon river to Port Davey and Macquarie harbour, but is less abundant than formerly because of the demand for its timber, especially for ship- and boatbuilding. The wood is close grained and easily worked.

See also CONIFERS.

HUPA, the most advanced and best-known Indian tribe of the Pacific coast division of the Athabascan linguistic stock. At mid-20th century about 600 lived near the lower Trinity river in Hoopa valley, northwestern California. Their traditional culture, shared by the Yurok (*q.v.*) and Karok, was characterized by an economy of deer and elk hunting, salmon fishing and food gathering; canoes, frame houses of planks bearing individual names; clanless villages, a wealth aristocracy owning debt slaves, fishing places and oak

groves, shell and woodpecker scalp currency, treasures of albino deerskins, fine basketry, huge obsidian blades, furs, etc.; little political authority but an intricate law of property; wealth displaying, dancing to the recitation of narrative magical formulas. Theirs was the southernmost efflorescence of the native culture characteristic of the north Pacific coast, though lacking the potlatch festivals, secret societies and masks, totem poles and carving art of the northern tribes.

BIBLIOGRAPHY.—J. Goddard, "Life and Culture of the Hupa," *Univ. Calif. Publ. Amer. Archaeol. Ethn.*, vol. i (1904); A. L. Kroeber, *Handbook of the Indians of California* (1925); R. F. Heizer and M. A. Whipple (eds.), *California Indians: a Source Book* (1957).

HUPEH (HU-PEI SHENG), a province in the central Yangtze (*q.v.*) river valley in the heart of agricultural China. Area 72,394 sq.mi. Pop. (1957 est.) 30,790,000. The eastern part of the province (about two-thirds) is lowland. The Yangtze and its chief tributary, the Han, meander in great loops past a maze of shallow lakes, the chief of which, the Tung-t'ing Hu, lies just south of the border of Hunan. The western part (about one-third) is upland and rises to 5,000–6,000 ft. in the mountains of the Wu Shan and Ta-pa Shan. In the north the low T'ung-pai Shan divides the Han valley from the north China plain. On the east and southeast the ranges of the Ta-pieh Shan and Mu-fou Shan constrict the plain through which the Yangtze leaves the province.

Summers are hot and humid, winters relatively mild. The 300-day growing season and 47-in. average annual rainfall favour agriculture. The region is transitional between the rice and winter wheat realms, with rice dominant. This also is one of the three most important cotton regions of China. Maize, kaoliang, tea and sweet potatoes are other food crops, while soybeans, silk, hemp and tobacco are other industrial crops. Tung-nut-oil production from the western hills ranks high.

Iron ore at Ta-yeh and coking coal nearby form the basis for one of the most significant iron and steel complexes in China, with a steel plant built in the late 1950s at Huang-shih on the Yangtze near the southeast border. Gypsum is important, especially at Ying-ch'eng in the northwest.

The population is mostly concentrated in the eastern lowlands where the Han river joins the Yangtze at the great tri-city metropolis of Wu-han (*q.v.*). This major industrial and commercial centre had a population of 2,146,000 in 1957, with the heavier concentration in Hankow, the most important city in central China. The first bridge over the Yangtze, constructed there in 1956, permits through traffic from Peking to Canton. Commercially, Wu-han (Hankow, Wu-ch'ang and Han-yang) municipality commands the gateway to the Szechwan basin in the west and to Hunan and Kweichow in the south and southwest. Ocean-going steamships reach Wu-han and transport products to Shanghai and abroad. Across the Han river bridge from Hankow is the heavy-industry centre of Han-yang. From the latter runs the great bridge across the Yangtze joining Hankow and the provincial seat of Wu-ch'ang. I-ch'ang (*q.v.*) and Shasi (Sha-shih) farther up the Yangtze in south central Hupeh are important provincial and commercial centres. South of Sha-shih is the Ch'ing-chiang (Kingkiang) flood detention basin or reservoir covering about 350 sq.mi. In the middle reaches of the Han river is the twin city of Hsiang-fan (Siangfan), consisting of Fan-ch'eng on the north bank and Hsiang-yang (Siangyang) on the south bank, handling the products of the Han basin.

Under the Manchus, Hupeh was originally part of the ancient province of Hu-kuang. After Nanking fell to the Japanese in Dec. 1937 during the Chinese-Japanese War, Hupeh was host province to the National government of China, Hankow being the temporary capital until the government moved to Chungking in Szechwan. (H. J. Ws.)

HURD, RICHARD (1720–1808), English bishop, literary critic and editor of Horace, was born at Congreve, Staffordshire, on Jan. 13, 1720, educated at Emmanuel college, Cambridge (of which he became a fellow), and ordained in 1744. After experience as a preacher at Whitehall (1750, on the suggestion of William Warburton; *q.v.*), Lincoln's Inn (1765, where he gave the first Warburton lectures in 1768) and archdeacon of Gloucester (1767), he became bishop of Lichfield and Coventry (nominated 1774, consecrated 1775), and then of Worcester (1781) and was offered the primacy, which he declined, two years later. He died at Hartlebury castle, Worcester, on May 28, 1808.

Hurd's theological works—sermons, lectures and disquisitions on miracles and prophecies—have given place, like most of the *Dialogues* (*see* below), to his literary criticism. Substantially accepting the text of Richard Bentley (*q.v.*), he edited Horace's *Ars Poetica* (1749) and the *Epistola ad Augustum* (1751), with commentaries, copious notes and "A Discourse Concerning Poetical Imitation." He maintains that Horace, concerned about undue veneration of the ancients, is criticizing and defending Roman drama and contemporary poets, rather than prescribing rules. For Hurd the two great complementary critics are Aristotle and Longinus, and his commentary illuminates the classical contrasting of Art with Nature, pointing to the "sovereign quality" in a poet which transports his audience: "Rules, art, decorum, all fall before it. It goes directly to the heart, and gains all purposes at once."

Similar sympathies inform *Letters on Chivalry and Romance* (1762), the amplification of an argument begun in the third of Hurd's *Moral and Political Dialogues* (1759)—a series of imaginary conversations between historical personages—in which John Arbuthnot had upheld against Joseph Addison the value of chivalric jousts and pageantry in a discussion "On the Golden Age of Queen Elizabeth." Modern critics differ about the *Letters*. Their interest in the medieval period; defense of Ariosto and the fanciful parts in Tasso; justification of Spenser's form and subject in *The Faerie Queene* as a natural imaging of the feudal-chivalric customs and qualities in a work of appropriately "Gothic" structure, with its own unity and rules; and the setting of the artist's "consistent imagination" against "experience" and the "trite maxim" to follow nature may be taken as a forecasting of the romantic movement, or, with a reading of *On the Idea of Universal Poetry* (1766), as an extension of neo-classicism in line with the work of Thomas Warton, Edward Young, Lord Kames, Sir Joshua Reynolds and Edmund Burke.

As well as editing the works of Warburton (7 vol., 1788; "A Discourse by Way of General Preface," 1794) and *Select Works of Cowley* (1772), Hurd left materials for an edition of Addison (6 vol., 1811) to whom, he wrote to William Mason (a close friend since his Cambridge days), with "maturer judgment" at the "close of a critical life" he had returned, after a rapturous engagement with Shakespeare and the Italians. The emphases are typical in the closing stages of a critical epoch.

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HURDES, LAS (JURDES), a region of west central Spain, northwest of Plasencia in the central Cordillera. Area 182 sq.mi. The high plateau of Salamanca rises almost imperceptibly to the western ranges of the Sierra de Peña de Francia (5,330 ft.), which on their southern flank have been fractured by the Alagón basin and plunge precipitously 1,000 ft. or more. These steep mountains comprise the Hurdes, remote from the rest of the country and very poor. The Hurdanos who inhabit the region are thought originally to have been political or religious refugees. They remain peculiarly distinct and inhabit hamlets on the hard slates of the Sierra de Gata. In the high altitude hamlets they suffer from goitre; the valleys were formerly malarial. The mountains were early deforested and the landscape is barren. The meagre economy is based upon stock rearing but with a population of about 6,000 the area is overpopulated. Some improvements were made before the civil war; a new road was built from La Alberca to the Las Batuecas valley. There has been some reafforestation and the dam of Gabriel y Galán on the Alagón river was expected to aid development.

See M. Legendre, *Las Jurdes. Étude de géographie humaine* (1927).
(J. M. Ho.)

HURDLING, running races over a series of obstacles, called hurdles, which are set a fixed distance apart. Indoors the race distances vary from 45 yd. to 70 yd., over 42-in. or 30-in. hurdles, 15 yd. from the start to the first hurdle and usually with 10 yd. between hurdles. Outdoors the competitive distances are longer, and an additional competition over 36-in. hurdles is added. The standard hurdle heights and distances are often shortened for secondary-school competition, but collegiate and international outdoor competition is conducted at 120 yd., over ten 42-in. hurdles set 10 yd. apart with a 15-yd. start and finish; at 220 yd. over ten 30-in. hurdles set 20 yd. apart with 20-yd. start and finish; at 440 yd. over ten 36-in. hurdles set 38½ yd. apart with a 49¼-yd. start and a 46½-yd. finish. Oxford, Cambridge and National Collegiate Athletic association distances are 120-yd. high hurdles and 220-yd. low hurdles. Amateur Athletic union championship races are conducted in all three hurdle races in either metres or yards. For indoor competition the standard A.A.U. distances are 50 yd. (4 hurdles), 60 yd. (5 hurdles) and 70 yd. (6 hurdles).

History.—Hurdling began in 19th-century England, and the first races were held at Eton college about 1837. In those days hurdlers merely ran and jumped over each hurdle in turn, landing on both feet and usually checking their forward momentum. In an effort to gain more efficient hurdle clearance and to prevent stopping after each hurdle was cleared, a new form came into use in England shortly after 1840. Hurdlers began to "sail" over the hurdle with the body upright, front leg curled under the body and the rear leg trailing. This provided more efficient clearance and allowed for a landing on one foot, thus helping to maintain forward momentum.

Experimentation with standard numbers of steps between hurdles soon followed, and the step pattern for hurdlers was the result. Hurdlers take 3 steps between each high hurdle, 7 steps between each low hurdle and usually 15 between each intermediate hurdle. Further refinements in hurdling were made by A. C. M. Croome of Oxford university about 1885. He showed more economical hurdle clearance by using a straight front leg with a forward lunge of the trunk. This "step-over" action is the basis of modern hurdling style.

Alvin Kraenzlein of the University of Pennsylvania illustrated in 1898 the advantage of sprinting action between the hurdles when he turned from sprinting to hurdling to set world records; and Earl Thomson, later a U.S. navy coach, showed how more forward lean was advantageous with the introduction of his double-arm forward thrust as he cleared the barrier. Thomson's form made it possible for hurdlers to bring the trailing leg through nearly "flat," putting them in the best sprinting position for the next stride forward after the hurdle has been cleared. The pause or checking of forward momentum after the hurdle was cleared was virtually eliminated as a result.

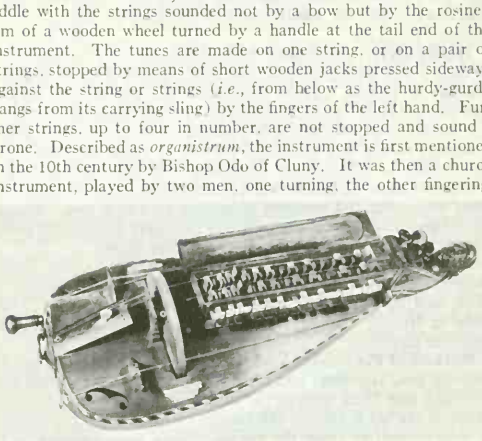
Method of Hurdling.—In clearing a hurdle, the athlete takes off about 7 ft. from the hurdle by leaning forward, raising the "lead" leg and extending the opposite arm (or both arms) directly forward as he drives from the ground. The rear or trailing leg, bent at the knee, is brought forward over the hurdle at right angles to the body as the arm thrust pulls the trunk forward over the thigh of the lead leg. As the hurdle is cleared, the leading leg is cut down about 5 ft. beyond the hurdle; the body maintains its forward lean so the trailing leg can be pulled through almost parallel to the ground with the toe up. As the hurdler comes off the hurdle, he must continue to pull the trailing leg completely through and forward into the next step, while maintaining his forward lean so he is in sprinting position for the steps between hurdles. Hurdlers must vary body angle slightly when running the different hurdle races. The forward lean is extreme in the high hurdles, moderate in the intermediate hurdles and almost erect in the low hurdles as the hurdler steps over the 2 ft. 6 in. barriers.

Champions.—United States athletes have dominated international competition in the 20th century with some outstanding stars of modern times being Dick Attlesey, Fred Wolcott, Harrison Dillard, Jack Davis and Lee Calhoun in the high and low hurdles and Glenn Hardin, Charles Moore and Glenn Davis in the intermediate hurdles.

For Olympic hurdling records *see* Olympic Games.

Bibliography.—Don Canham, *Track Techniques Illustrated* (1952); J. Kenneth Doherty, *Modern Track and Field* (1953); Richard I. Miller, *Fundamentals of Track and Field Coaching* (1952); United States Naval Institute, *Track and Field* (1950).
(D. B. Cm.; S. J. R.; E. J. G.)

HURDY-GURDY, a musical instrument, a kind of squat fiddle with the strings sounded not by a bow but by the rosined rim of a wooden wheel turned by a handle at the tail end of the instrument. The tunes are made on one string, or on a pair of strings, stopped by means of short wooden jacks pressed sideways against the string or strings (*i.e.*, from below as the hurdy-gurdy hangs from its carrying sling) by the fingers of the left hand. Further strings, up to four in number, are not stopped and sound a drone. Described as *organistrum*, the instrument is first mentioned in the 10th century by Bishop Odo of Cluny. It was then a church instrument, played by two men, one turning, the other fingering.



BY COURTESY OF THE HORNIMAN MUSEUM, LONDON

FRENCH HURDY-GURDY (ABOUT 1750), LUTE-SHAPED, WITH GUARD REMOVED TO SHOW MECHANISM. IN THE HORNIMAN MUSEUM, LONDON

During the 13th century, one-man forms of the instrument, called symphonia, appeared and were used in secular music. These remained in use here and there in Europe up to the middle of the 20th century, played either by folk musicians or by beggars, notably in central France, where the *vielle à roue* (wheel fiddle) gained a fresh lease of popular life through the pastoral fashions cultivated during the reign of Louis XIV. The Swedish *nyckel-harpa* has similar stopping mechanism but is played with a bow. Because of the hurdy-gurdy's handle-operated wheel and its association with street musicians, the term is sometimes mistakenly applied to mechanical instruments such as the barrel organ (*q.v.*).
(A. C. Ba.)

HURGRONJE, CHRISTIAAN SNOUCK (1857–1936), Dutch orientalist noted for his studies of Arabic and of Islam, was born at Oosterhaut on Feb. 8, 1857. After completing his studies in theology and oriental languages he went to Arabia, where he stayed for several years, and to other parts of the near east. The result of these travels was his work *Mekka*, 2 vol. (1888–89). He refused a nomination as professor of Arabic at Cambridge university in succession to Robertson Smith and also nominations in Germany and at Leiden, preferring to continue his studies on Islam in the Netherlands Indies (1889–1906), where for several years he was counselor to the government in Islamic affairs. In 1893–94 he published *De Atjehers*, which was translated into English in 1900. He returned to the Netherlands in 1906, where he accepted the chair of Arabic at the University of Leiden; in 1907 he was nominated counselor for Indian and Arabian affairs to the Dutch and the Netherlands Indies government. Among his other works are *Nederland en de Islam* (1911) and *Verspreide Geschriften* (1923 *et seq.*). He died on June 26, 1936.

HURLEY, PATRICK JAY (1883–1963), U.S. politician, soldier and diplomatist, was born on Jan. 8, 1883, in Indian territory, now Oklahoma. In 1908 he began the practice of law in Oklahoma. After serving as colonel in the American expeditionary force during World War I, Hurley was prominent in Republican party politics during the 1920s, serving as secretary of war in the

Hoover administration (1929–33). On U.S. entrance into World War II, Hurley, promoted to brigadier general, went to the far east as Gen. George C. Marshall's personal representative to examine the possibility of relieving U.S. troops on Bataan. During the remainder of the war, Hurley served in various diplomatic capacities as President Roosevelt's personal representative. As U.S. ambassador to China in 1944–45, Hurley, in the interest of intensifying the Chinese war effort, attempted vainly to reconcile the Kuomintang government and the Communist faction; his mission was a failure and he resigned his post in Nov. 1945 after some controversy with the administration. He died on July 30, 1963, in Santa Fe, N.M. (W. R. E.)

HURLING. An outdoor stick and ball game somewhat akin to hockey and lacrosse (*qq.v.*) and long recognized as the national pastime of Ireland. There is considerable reference to hurling (*iomáin* in Gaelic) in the oldest Irish manuscripts; the heroes of the ancient tales were all expert hurlers. The stick used is called a hurley, *camán* in Gaelic, and *camáns* in relief decorate some monuments to 15th-century chieftains. Hurling was for long a communal game played between neighbouring clans or rival parishes with unlimited numbers of players on either side. Boughs of stripped wood bent to the form of a bow were used as goal posts. Games were often played for heavy money stakes.

An association to revive and standardize hurling, the Gaelic Athletic association, was founded in Thurles, County Tipperary, in 1884, and by mid-20th century there were more than 2,000 clubs in Ireland. County, provincial and all-Ireland championships are played.

Method of Play.—The stick, resembling a hockey stick except that the head is shorter and wider, is made of young pliable ash, 3 ft. long and 3½ in. wide in the oval-shaped striking blade. The width of the blade enables the ball to be hit overhead from man to man as well as along the ground. Each team consists of 15 players. The average pitch, or field, is 150 yd. long and 90 yd. wide. The goals at each end have posts 16 ft. high and 21 ft. apart with a crossbar 8 ft. above the ground. One point is scored by hitting the ball over the opposing crossbar, at any height between the posts. A goal, scored by driving the ball under the crossbar, is equal to three points. The ball, or *slitter*, is of cork, wound with wool and leather covered. It may be caught in the hand before hitting but not thrown or lifted; it may also be juggled or carried on the blade of the stick, or may be hit from left or right. (P. D. M.)

BY COURTESY OF BORD FAILTE EIREANN

HURLING TEAMS FROM CORK AND WEXFORD, IRELAND, BATTLE FOR THE CHAMPIONSHIP BEFORE A CAPACITY CROWD OF 20,000 SPECTATORS IN DUBLIN'S CROKE PARK

HURLSTONE, WILLIAM YEATES (1876–1906), English pianist and composer of chamber works esteemed at the beginning of the 20th century. Born in London on Jan. 7, 1876, he was a pupil of Sir Charles Stanford at the Royal College of Music. His piano concerto (1896) and *Variations on a Swedish Air*, for orchestra (1904), were enthusiastically received. His chamber works, produced between 1897 and 1899, include a violin and piano sonata and a piano quartet. His *Fantasy Quartet* won the first W. W. Cobbett award for chamber music. He died in London on May 30, 1906, having the previous year been appointed professor of counterpoint at the Royal College of Music.

See *William Hurlstone*, ed. by Katherine Hurlstone (1949). (P. M. Yo.)

HURON. This French epithet, meaning "bristle head" or "ruffian," was applied to a group of Indian tribes calling themselves Wendat, whence Wyandot. At the time of their discovery by Jacques Cartier in 1534 they were settled in agricultural villages near the St. Lawrence river. The family, the matrilineal clan, the larger clan groupings called phratries and the tribal confederacy were the main social and political units. Political leaders were selected by the matrons. The Hurons belonged to the Iroquoian linguistic family but were bitter enemies of the Iroquois, with whom they competed in the fur trade. Before the arrival of Samuel de Champlain in 1603 the Iroquois had driven part of the Hurons from the St. Lawrence river westward into Ontario, where kindred tribes seem to have been already resident.

About 1590 four of these groups, the Bear, Cord, Rock and Deer people, established a confederacy which included also a number of smaller or dependent tribes. The confederacy numbered perhaps 20,000 persons. The Hurons received the French as friends and the Jesuit missionaries made many converts; but in 1648–50 Iroquois invasions destroyed the confederacy, thousands of Hurons being killed, others taken captive or forced to settle among their conquerors and the remnants driven west. These fragments drifted back and forth between Michigan, Wisconsin, Ontario, Ohio and Quebec, in alliance or conflict with many tribes, some of them also victims of the Iroquois.

At mid-20th century there remained about 500 Huron at Lorette-ville in Quebec and 900 Wyandot in northeastern Oklahoma.

See also CANADA: *Native Peoples;* IROQUOIS.

HURON, LAKE, named by the French from the Huron Indians, the second largest of the Great Lakes of North America, is bordered on the west by the state of Michigan, U.S., and on the north and east by the province of Ontario, Can. The lake roughly has the form of a wide crescent convex to the northeast, with Georgian bay lying outside the crescent in that direction. The lake is 247 mi. long from northwest to southeast, and its maximum width is 101 mi. The surface area of the lake, including Georgian bay, is 23,010 sq.mi., and the area of its drainage basin, excluding lake surface, is 49,610 sq.mi. The mean annual precipitation in the area is 31 in. The mean height of the lake above sea level is 581 ft., the same as that of Lake Michigan, with which it is joined at its northwestern extremity by the Straits of Mackinac. The deepest point in the lake, 750 ft., is 169 ft. below sea level. Currents in the lake generally are slight and variable, the most consistent movement of water being a slow drift from the northwest toward the outlet at the south end. (For comparisons with the other Great Lakes, a discussion of their origins, connections, utilizations, etc., *see* GREAT LAKES, THE.)

History.—Huron was the first of the Great Lakes to be discovered by Europeans. Samuel de Champlain and Étienne Brulé, traveling up the Ottawa and Mattawa rivers, reached Georgian bay in 1615. Brulé traversed the North channel to the St. Marys river in 1618. A Jesuit mission, named Ste. Marie, was established among the Huron Indians at the Wye river (southeastern corner of Georgian bay) in 1638. Iroquois Indians destroyed the mission and wiped out most of the Huron nation in 1649. After that the centre of French activities was shifted northwestward to the set-

tlement at Sault Ste. Marie on the river connecting Lakes Superior and Huron. Father Jacques Marquette established a mission at St. Ignace on the Straits of Mackinac in 1671.

Meanwhile Louis Jolliet, returning eastward from the Sault in 1669, had traveled by canoe down Lake Huron, through St. Clair river and lake and the Detroit river, and discovered Lake Erie. Robert Cavelier de la Salle's ship the "Griffin," sailing westward from Niagara, traversed Lake Huron in 1679. A fort was built on the St. Clair river in 1686 by Daniel Greysolon, Sieur Dulhut. British penetration of the lower lakes developed strongly in the mid-1700s. Major Robert Rogers with 200 rangers captured Detroit for the British in 1760 and took Michilimackinac on the Straits of Mackinac in 1761. At the close of the Revolutionary War the boundary between the United States and Canada was drawn through Lake Huron from its south end to the St. Marys river. The fort on Mackinac Island, overlooking the Straits of Mackinac, was captured by the British in the War of 1812 and reoccupied by U.S. troops at the close of the war.

Physiography.—Inflow into Lake Huron is received from Lake Superior via the St. Marys river (73,700 cu.ft. per second), from Lake Michigan and from numerous streams draining the adjacent lands. The discharge of the lake, through the St. Clair river at its south end, averages 177,500 cu.ft. per second. When strong winds blow from the east or northeast, over the expanse of Georgian bay and eastern Lake Huron, they develop high seas which run athwart the main course of traffic through the lake.

Resistant Niagaran Dolomite rock forms the north shore of the lake for 40 mi. eastward from the Straits of Mackinac, and also forms the southern and western shores of the chain of islands and of Saugeen peninsula, which separate the main body of the lake from Georgian bay. Dundee and other limestones underlie the south shore of Lake Huron from the straits southeastward to Thunder bay, and an unusually pure phase of the limestone, quarried at Calcite and Rogers City, Mich., is the principal source of flux material for the steel industry of the lower lakes.

There is evidence that the surface of Lake Huron was approximately 400 ft. below its present level when the margin of the last continental glacier retreated and permitted the lake to drain from the northeastern corner of Georgian bay to the Mattawa and Ottawa river valleys of Ontario. Uplift of the land has since raised that outlet area and caused the lake to rise and discharge down the St. Clair river.

The principal mineral resources of the region are the widely distributed sand and gravel; petroleum, limestone and salt in the lower peninsula of Michigan; nickel ores, mined near Sudbury, Ont.; and uranium, found mainly near Blind River, Ont.

Harbours and Commerce.—The average season of navigation on Lake Huron is from mid-April to mid-December in the north and from early April to late December in the south. The most important traffic on the lake is the through commerce between Lake Erie and Lakes Superior and Michigan, but large tonnages of limestone are loaded at Rockport and Rogers City, Mich., along the west coast of Lake Huron. Other harbours, important in local trade, include: in Michigan, Cheboygan, near the Straits of Mackinac; Alpena, on the southwestern shore of Thunder bay; Bay City, at the head of Saginaw bay; and Harbor Beach, 60 mi. N. of the head of the St. Clair river; and, in Ontario on Georgian bay, Collingwood, Midland, Tiffin, Port McNicoll and Depot Harbor. *See* GEORGIAN BAY; MACKINAC, STRAITS OF.

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HURONIAN: *see* PRECAMBRIAN TIME.

HURRIANS, a people who played an important role in the history and culture of the near east during the 2nd millennium B.C. Little was known of them to modern scholars until, in the course of the first half of the 20th century, archaeological research and a gradually increased understanding of the Hurrian language helped to trace the zone of their expansion. Even so, many aspects of their early history and provenance remained uncertain, constituting some of the most arduous problems of the historiography of the area.

The earliest recorded presence of demonstrably Hurrian onomastic elements (personal and place names) goes back to Mesopotamian records of the late 3rd millennium, notably those of the 3rd dynasty of Ur; these point uniformly to the area east of the Tigris and the mountain region of Zagros as the Hurrian habitat and to gradual penetration of Mesopotamia proper. From then on, and especially during the early 2nd millennium, there is scattered evidence of a westward spread of Hurrians. An inscribed Hurrian tablet of northern Mesopotamian provenance, apparently dating from the Old Akkadian period, was published in 1948; some religious poems in Hurrian from Mari (Tell el Hariri) on the middle Euphrates belong to Hammurabi's time; and Alalakh (Tell Atchana) in northern Syria was considerably hurrianized in the 18th century B.C. An even greater westward migration must have taken place after 1700 B.C., probably issuing from the area between Lake Van and the Zagros. When the records become abundant, *c.* 1500 B.C., there is evidence of Hurrian dominance or presence over a wide area. This Hurrian wave was probably set in motion by the intrusion of Indo-Iranians from the north into the region of the later Iran and is connected with the approximately contemporary incursions of Kassites into Babylonia and perhaps of Hyksos into Egypt. There is every indication that Hurrians overthrew the Assyrian dynasty of Shamshi-Adad I and Ishme-Dagan I and subsequently dominated Assyria. East of the Tigris the flourishing commercial centre of Nuzi was a basically Hurrian community, as is shown by the proper names of its inhabitants and various other Hurrian linguistic elements in its records. Hurrian influence prevailed in many communities of Syria. Hurrian names predominate at Alalakh; and Ugarit has yielded, besides its Canaanite records, Hurrian religious texts in alphabetic cuneiform, a conventional syllabic Sumero-Hurrian vocabulary and a short Hurrian-Akkadian bilingual document. Hurrians likewise occupied large sections of eastern Asia Minor, thereby becoming eastern neighbours and later partly dependents of the Hittites.

Yet the Hurrian heartland during this period of maximum expansion was northern Mesopotamia, the country then known as Hurri, where the political units were dominated by dynasts of Indo-Iranian origin. In the 15th century B.C. these principalities and their dependencies ranging from the Iranian mountains to Syria were united into a state called Mitanni or (in Mesopotamian records) Hanigalbat, under the leadership of an Indo-Iranian warrior caste named *maryannu*, which, like the royal names (*e.g.*, Artatama, Shaushshatar), has a clearly Indo-European etymology. Mitanni, with its capital Washshukanni, warred especially with Thutmose III of Egypt for the possession of Syria. During the reign of Amenhotep III of Egypt friendly relations prevailed; an extensive letter from the Hurrian king Tushratta to this Pharaoh is the longest extant Hurrian text. In the middle years of the 14th century B.C., after the political decline of Egypt under the Pharaoh Ikhnaton, the resurgent Hittite empire under Suppiluliumas I defeated Mitanni and reduced Tushratta's son Mattiwaza to vassaldom, while Assyria under Ashur-uballit I seized the opportunity to reassert its independence. In spite of political subjection, the continued Hurrian ethnic and cultural presence in Syria and in the Cilician region (Kizzuwatna) exerted a strong influence on the Hittite empire.

The carvings at Yazilikaya suggest that the official pantheon of the empire was thoroughly hurrianized through the inclusion and syncretization of Hurrian deities, especially Teshub and Hebat; Hurrian cultic texts were found at the capital site of Hattusas (Bogazkoy); Hittite queens had Hurrian names; and Hurrian mythology appears in Hittite epic poems. Moreover, the Indo-Iranian overlords of Mitanni had introduced horse breeding and chariot warfare into the near east, and Mitannian specialists in this line were employed by the Hittites at Hattusas.

The principality of Hayasha in the Armenian mountains was another Hittite dependency; Suppiluliumas, in a famous treaty with its ruler Huqqanas, warns him against certain incestuous family relations which seem to have been originally current among the Hurrians under a fratriarchal system, also attested in traces at Nuzi. This hinterland region provided the last stronghold for Hurrian ethnic identity. The people of the Haldian (Khaldian)

kingdom of Urartu during the 9th–7th centuries B.C. spoke a language definitely akin to Hurrian. Everywhere else Hurrians appear to have spent themselves in the latter part of the 2nd millennium B.C.; before modern discoveries only such meagre traces as the brief mentions of "Horites" in the Pentateuch remained as uninstructive witnesses of their forgotten greatness. Yet the typically Hurrian "Armenoid" physical type had left its lingering imprint on the racial features of the near east.

Language.—The Hurrian language, once called improperly Mitannian or Subarian (after Subartu, an old cuneiform name for regions north of Sumer and Akkad), is attested chiefly in four varieties of cuneiform: Old Akkadian; Babylonian; specifically Hurrian; and consonantal Ugaritic. Continuous texts, mostly from Mari, from the Amarna archives in Egypt (Tushratta's letter), from Bogazkoy and from Ugarit, are supplemented by onomastic materials, glosses and loan words from many sites, notably Nuzi and Alalakh. Combinatory analysis, especially of the long continuous text of the Tushratta letter, has permitted considerable penetration into the language, which is neither Indo-European nor Semitic. The grammatical structure is dominated by a profusion of suffixes, and the verbal system is particularly complicated. There is a basic distinction of transitive and intransitive forms and constructions; the full transitive expression is conceived in a passive sense, with the object of the action in a "subject case," while the doer takes on the form of the "agent case," so that "and my brother requested a wife" is expressed as *šeniwwuš-an ašti šaruša* "by my brother and" (*šena* "brother," *-iwwu-* "my," *-š* agent suffix, *an* "and") "a wife" (*ašti* subject case without suffix) "was requested" (*šaruša*). These characteristics suggest that Hurrian may have an affinity not only with Urartaean but with modern Georgian and related languages on the Caucasus.

See also HITTITES.

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HURRICANE, a tropical storm, originally in the West Indies only, but a term now applied to this type of storm in other parts of the world. The name is derived from the word *huracan* of the Arawak-speaking Indians of the West Indies. It is also used to designate a wind of force 12 on the Beaufort scale (*q.v.*), that is, a wind of more than 75 m.p.h.

The hurricane season lasts roughly from June to October. In midseason, Aug. and Sept., hurricanes develop mainly near or to the east of the Lesser Antilles. Early and late in the season, in June and from the latter part of September onward, the area with most frequent formation is the western Caribbean. The Gulf of Mexico also is a breeding ground for hurricanes, as is the Pacific just off the Central American coast. In the Atlantic-Gulf region the mean hurricane frequency is seven per year; it is reasonable to assume that about the same number form in the eastern Pacific, but the information is quite uncertain in that area. In individual years the frequency has ranged irregularly from 2 to 21 in the Atlantic. However, when considering frequency in terms of decades, a definite cycle is apparent. Hurricane frequency was high from 1890 (roughly the start of the record) to 1910, low from 1910 to 1930 and high from 1930 to the late 1950s.

After formation, most hurricanes move northwest, gradually turning more directly north as they move out of the tropics. The United States intercepts all hurricanes moving northward in the Gulf, and since the land mass extends farther east with increasing latitude, it also intercepts many hurricanes moving northward on the ocean side of Florida. Some of the most extensive damage suffered from hurricanes has been sustained in New England. This damage has resulted partly from the wind, especially the effect of wind upon the sea near coasts, but also from floods following heavy rains in the mountainous sections of New England.

See TROPICAL STORM; *see* also references to "Hurricane" in the Index volume. (H. RL.)

HURST, JOHN FLETCHER (1834–1903), U.S. Methodist Episcopal bishop and educator, was born in Salem, Md., on Aug. 17, 1834. He graduated at Dickinson college, Carlisle, Pa., in 1854, taught for two years and then went to Germany to study at Halle. On his return to the U.S. he was engaged in pastoral work, and from 1867 to 1871 taught Methodist mission institutes in Germany. In 1871 he became professor of historical theology at Drew Theological seminary, Madison, N.J., of which he was president from 1873 till 1880, when he was made a bishop. He died at Bethesda, Md., on May 4, 1903.

Bishop Hurst, by his devotion, recovered the endowment of Drew Theological seminary, lost by the failure in 1876 of Daniel Drew, its founder. The American university (Methodist Episcopal) at Washington, D.C., for postgraduate work, of which he was chancellor from 1891 till 1902, was the outcome of his labours to improve the quality of Methodist scholarship. Besides translating and revising many important works he published *A History of Rationalism* (1865; rev. ed., 1901); *Life and Literature in the Fatherland* (1875), brilliant sketches of Germany; *Indika: the Country and People of India and Ceylon* (1891); *History of the Christian Church* (1897–1900); and edited the *History of Methodism* (1902–04), a co-operative work.

HUSAIN IBN ALI (*c.* 1854–1931), amir of Mecca from 1908 to 1916 and king of Hejaz from 1916 to 1924, was the son of Ali ibn Mohammed of the Aun line of Hashemites (*q.v.*), to which line the Meccan amirate had passed in 1827. He was brought up in Bedouin surroundings, and although he spent much of his life in Constantinople, he never lost his affection for the desert. Reputedly sagacious and modest, he appeared, at the beginning of his amirate, to be bent on forwarding Turkish interests in Arabia. But in 1913 he began to assert his independence by opposing the extension of the Hejaz railway to Mecca.

When World War I broke out Husain entered into negotiations with the British, which culminated in the Arab revolt in June 1916. In October he proclaimed himself "king of the Arab countries," though he was formally recognized only as king of Hejaz. At the Versailles peace conference (1919) he was represented by his third son, Faisal, but refused to ratify the treaty as a protest against the mandatory regimes imposed on Syria, Palestine and Iraq. Subsequently his domestic policy was marked by ever increasing avarice and reaction, while he sowed the seeds of future trouble by deliberately courting the enmity of Ibn Saud. In March 1924, while on a visit to Trans-Jordan, he proclaimed himself caliph, but war with Ibn Saud was imminent, and the Wahhabi attack on At Ta'if in September found him unprepared. On Oct. 5 he abdicated and proceeded to Aqaba. In July 1925 the British conveyed him to Cyprus, where he lived till 1930. He died at Amman in 1931.

Husain had four sons: Ali, Abdullah, Faisal and Zaid. Ali succeeded his father on Oct. 3, 1924, as second king of Hejaz, but abdicated on Dec. 10 of the following year. Abdullah (*see* ABDULLAH IBN HUSAIN) became king of Jordan, Faisal (*see* FAISAL I), king of Iraq.

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HUSAIN IBN TALAL (1935–), Hashemite king of Jordan from 1953, was born in Amman on Nov. 14, 1935. A direct descendant of the prophet Mohammed (*see* HASHEMITES), he is a son of King Talal and grandson of King Abdullah (*see* ABDULLAH IBN HUSAIN), who was murdered before his eyes in 1951. Husain was educated in England at Harrow school and the Royal Military academy, Sandhurst, and succeeded his father, who was declared mentally ill in 1952, being crowned on May 2, 1953. Vigorous and receptive of new ideas, he shared the nationalist emotions of his generation of Arabs, but in trying to give them expression he opened his country to powerful Egyptian and other extraneous influences. In 1956 he dismissed the commander in chief of his Arab legion, Glubb Pasha (*see* GLUBB, SIR JOHN BAGOT), and in the same year abrogated Jordan's treaty with Britain, thereby forfeiting the annual British financial subsidy. It was only by a display of great personal courage that in April

1957 he foiled a plot to dethrone him engineered by his pro-Egyptian commander in chief, Abu Nawar. On this and on later occasions he was compelled to purge his army of disloyal elements.

From 1957 Husain obtained generous subsidies from the United States. In 1958 he countered the Egyptian union with Syria by federating Jordan with Iraq, but the federation was dissolved the same year after the revolution in which his cousin Faisal II of Iraq was murdered. Husain's policies incurred the hostility of Egypt, but over a number of years he survived the dangers engendered by intermittent campaigns of highly adverse propaganda directed from Cairo.

His marriage to Princess Dina Abdul Hamid al-Aun having been dissolved, he married on May 25, 1961, an English girl, Antoinette Gardiner, known thereafter as Muna al-Husain. An heir, Abdullah, was born on Jan. 30, 1962.

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HUSBAND AND WIFE, LAWS CONCERNING. This article deals principally with the effect of marriage on the legal relations between husband and wife, both concerning personal and property rights. The methods by which the matrimonial relationship is constituted and dissolved is discussed in the articles on MARRIAGE, LAW OF and DIVORCE. The powers, duties and rights of parents concerning their children are discussed in the article CHILDREN, LAWS CONCERNING.

The Principle of "Unity."—The English common law treated husband and wife as a "unity" and the personality of the wife as "merged" in that of her husband. To some extent this answered medieval social needs but the principle was still expounded by William Blackstone (*q.v.*) in the 18th century and adopted by the American colonies, who retained it after the Revolution. It is comparable to the rule of the earlier Roman law according to which the wife was, in the marriage with manus, subject to the *patria potestas* or control of the husband (*see* ROMAN LAW). In Rome, just as later in England, the United States and elsewhere, the equality of husband and wife was eventually accepted. Yet the principle of unity has not quite vanished nor is it likely ever to do so entirely, for marriage implies a household community. Inroads on the unity rule were originally intended to preserve the wife's property for her next of kin and not to let it go to the husband. In the propertied classes this policy was followed centuries before the notion of the equality of the sexes was seriously defended.

Personal Relations.—Husband and wife owe each other a duty to cohabit; *i.e.*, to create and to maintain what the German and Swiss civil codes call a "community of life." The common law imposes on the spouses a duty to give each other "mutual society and affection." Husband and wife are, as an Australian judge once put it, linked together by a "mass of indefinable rights and duties . . . conveniently gathered under the word 'consortium.'" This general rule derives its meaning from the way it is translated into practice by statutes or by the courts, as, for example, in the French and Swiss civil code provisions holding that the spouses owe each other fidelity and assistance and that they are mutually liable to co-operate for the welfare of their community and to give care and guardianship to the children. Thus, by virtue of the consortium they are under a duty to share a home, the husband (and occasionally the wife) is under a duty to earn a living and to support the other spouse and the children (*see* ALIMONY), the wife must manage the household and look after the children and the spouses owe each other marital intercourse.

Equality.—If the spouses differ on a matter affecting their matrimonial life, *e.g.*, where they are to live, the older rule was that the husband decided. This was the law under the common-law tradition and on the European continent. The provision of the French civil code that the husband owed his wife protection and she owed him obedience was repealed in 1938, but in France, as also in Switzerland, he remains the head of the family, although he must exercise this power in the interest of the family (husband, wife and children). Even so, in both countries it is he who determines the location of the home, and in French law the wife may refuse to share it only in exceptional cases of moral or physical danger to herself or the children, in which case the judge determines her residence. In other countries the modern postulate of equality of the sexes has led to more radical changes. In the German Federal Republic (*see* GERMAN LAW: *Law of Domestic Relations*) a law of 1957, taking account of the constitutional requirement of equality, abrogated an earlier provision by which the husband had the power to decide all questions concerning the conjugal life and, in particular, to determine the matrimonial home. The English court of appeal decided in 1949 (*Dunn* v. *Dunn*) that, in determining the matrimonial home, the spouses had equal rights and the husband had no casting vote; in the event of a difference of opinion, the more reasonable view, as decided by a judge, must prevail. In practice the principle of equality is limited by the difference in the natural, and therefore the social, functions of the sexes; for instance, it is regarded as reasonable for the family to live near the husband's place of work, since normally he is the breadwinner. By changing his job or trade he can thus in fact play the main part in deciding where the home should be. In all matters concerning the custody, upbringing and education of the children, husband and wife have completely equal rights, a rule established in England by statute in 1925. This rule also holds in the United States where, however, in general the husband still primarily determines the home and, if the wife does not follow him, she is prima facie guilty of desertion unless he abused his right. In the 1960s laws by which the husband could prevent his wife from doing paid work outside the house were continuing to disappear. Inequality survives in most countries in that the wife must take her husband's name. By the new German law of 1957 she may add her own name to that of her husband.

Enforcement.—The right to consortium normally gives rise to only two directly enforceable claims, namely, financial support (alimony or maintenance) and, sometimes, possession and custody of the children. In many countries there exists a right, based on the canon law, to obtain a court order for the "restitution of conjugal rights," but such decrees cannot be enforced through committal to prison or attachment of property; the English court of appeal held in 1891 (*Regina* v. *Jackson*) that neither spouse may enforce cohabitation by physical coercion. Personal, as distinguished from property, rights can as a rule be enforced only indirectly, usually in divorce or separation proceedings, and the right to determine the home becomes relevant when a court has to decide whether either spouse has deserted the other. The conjugal community occupies lawyers mainly when it is disorganized or breaking up; the mutual rights of husband and wife usually emerge in proceedings between the spouses arising from a matrimonial crisis.

The right of consortium may, however, also affect third parties. According to English law the husband or the wife may be entitled to damages against third parties who, by enticing the other spouse, have interfered with the consortium. The husband is also entitled to compensation against a third party who, for example, by negligently causing personal injury, has deprived him of his wife's consortium and services, but the wife has no corresponding right. In some states of the U.S., actions for alienation of affection and other heart-balm actions have been abolished by statute.

Survival of the Unity Rule.—In some respects the principle of unity still survives. Whereas in most countries a wife can have a nationality independent of that of her husband and in many countries, among them most of the United States, she can also have a separate legal domicile, English and Scots law take the view that the wife's domicile follows that of the husband, so that he can change it without her consent. This rule, still prevailing in the early 1960s, has the advantage that the same law applies to the personal estates of both spouses.

At common law the spouses could generally not be forced, nor were they even allowed, to give evidence for or against each other, but in England this rule has been abolished by statute, completely in civil and to some extent in criminal proceedings. Communications between the spouses cannot give rise to an action or prose-

cution for defamation nor can either spouse be forced to reveal them in a court. Husband and wife cannot be guilty of conspiracy with each other, or, as long as they cohabit, of stealing one another's property, unless it is taken when either spouse is deserting or leaving, or about to desert or leave, the other.

Property and Liabilities.—All modern systems of matrimonial property law are a compromise seeking to reconcile the stability of the household community, the interests of the families (kinship groups) of both spouses (especially in regard to land and investments) and the principle of equality of the sexes (which dominates legislation even where it is not expressed in the constitution). There are two types of system: "community" (where the whole or part of the property of husband and wife is common by operation of law) and "separation" (where each spouse retains what he or she has on marriage or acquires during wedlock). In practice each actual system has some features of both types; the emphasis depends on economic policy and social mores.

The Anglo-American Common Law.—At common law the husband acquired on marriage all the chattels (movable property) of his wife; since she could not own such personal property, whatever she purported to acquire during wedlock became his property. She retained her property in leasehold land and intangible assets such as debts, shares and similar investments, but she had no power to dispose; this power, including the power to sell and to appropriate the proceeds and to collect debts for his own benefit, together with the right to the income (rent, interest, etc.), vested in the husband. Freehold land remained her own and neither she nor her husband had the right to dispose of it alone, but by a number of devices they were able to dispose of it jointly. Moreover, he was entitled to the income and if there was issue and if he survived her, this usufructuary right was extended until his death (tenancy by "curtesy"), although the land itself went upon her death to her heir-at-law. Marriage had no effect on the husband's property, except that if the wife survived him she had under certain conditions a right to the income for her life of all freehold land that had at any time been in his legal possession (seisin) during the marriage, a right known as "dower" (*q.v.*) which could be easily taken away ("barred") by the husband through certain legal techniques. Curtesy and dower have been abolished in England but still survive in many states in the United States. Being unable to dispose of property, a married woman was at common law also incapable of entering into a binding contract in her own name, but she was capable of acting as her husband's agent and, on the whole, he was liable for all contracts she entered into in the course of her normal duties as a housewife. She was unable to commit torts (*see* TORT) but her husband was jointly liable with her. She was incapable of making a will. She could sue and be sued in court only jointly with her husband.

Property and Status.—Since the common law debarred a married woman from disposing of property and therefore also from making contracts, it linked two quite different problems, namely, the effect of marriage on the property of the spouses and the legal status of a married woman. Equality of status, including full contractual capacity, is not incompatible with a system under which the husband has the power to dispose of his wife's property interests, as, for example, in French law (as it has been since the amendments of the civil code in 1938 and 1942) and in the Spanish-inspired laws of the eight "community of property" states in the United States (Arizona, California, Idaho, Louisiana, Nevada, New Mexico, Texas and Washington).

The Rule of Separation of Property.—In England and in the rest of the United States, equality of status and capacity in the law of contract, tort, property and civil procedure resulted from separation of property of husband and wife. Community of property has never been the law either in England or in the majority of U.S. states. When the husband's common-law rights were abolished, separation took their place and, hence, equality of the spouses.

The evolution of separate property, which is today complete in England, Scotland and in the U.S. noncommunity states, began in the 16th and 17th centuries when lawyers tried to meet the needs of the incipient capitalist economy. When investment in assets other than freehold land became common, the need arose for preserving for a married woman's family (kinship group), including her children, such assets as devolved upon her by will or gift on the part of her father or other members of the family. Hence courts of equity (*q.v.*) intervened so as to exclude the husband's common-law right to appropriate and to dispose of such assets. If assets were given expressly by will or, for instance, by marriage settlement, to trustees for a married woman's separate use, courts of equity would enforce the trustees' obligation to apply and dispose of these assets as directed by the testator or settlor; *i.e.*, to hold them for the wife's separate use and not to hand them over to her husband. Thus there came into being the wife's separate estate in equity, the first and decisive breach in the common law of matrimonial property. Such property might be given to the husband himself as a trustee and he would be liable in equity to hold it for his wife's separate use; he might himself make a gift to his wife and act as a trustee for it. Yet in equity marriage was never held to be an implicit declaration of trust on the husband's part. The benefit of a separate estate was thus confined to the women of those classes who could afford, and were accustomed, to enter into express transactions drafted by lawyers, such as wills and settlements.

Concerning her separate estate, from the 16th century a married woman could enter into contracts and other transactions and could dispose *inter vivos* (to another living person) or by will. For her and her family's protection, however, it became common to subject such property to "restraints on alienation and anticipation," thus making it impossible for her to dispose *inter vivos* of the substance or future income. Such restraints on alienation, though generally void, were upheld when attached to a gift to a married woman for her separate use. Equity thus sharpened the common-law inequality between the sexes, besides adding a further inequality between the women of the propertied and those of the working and lower-middle classes.

Modern Legislation.—Legislation passed in the 19th and 20th centuries in the U.S. noncommunity states and in England was designed to overcome both inequalities. In England this legislation started in 1857; the trend was strengthened by J. S. Mill's *Subjection of Women* (1869) and led to the Married Women's Property acts of 1870 and 1882. The act of 1882 has been largely superseded by the Law Reform (Married Women and Tortfeasors) act, 1935, and a supplementary statute of 1949 which abolished restraints on alienation and anticipation. The effect of these statutes was to abrogate completely the husband's rights in his wife's property (even in the absence of a separate estate in equity), to give her complete equality of status and capacity in matters of contract, tort, property and procedure, to introduce separation of property and to abolish all rules by which a husband was liable for his wife's debts or liabilities except where she acts as his agent. This is also the law in the U.S. noncommunity states, in the Canadian provinces except Quebec and in the Australian states. Moreover, in England, by legislation passed in 1925 and 1952, the widow's right to inherit her husband's estate on intestacy was put on a par with the widower's right to inherit his wife's estate, and the law of intestacy was changed so as to make the estate of the first dying spouse devolve upon the surviving spouse in the great majority of all cases of intestacy. (*See* also INTESTATE SUCCESSION; SCOTS LAW: *Intestate Succession.*)

Mitigation of Separation Rule.—Nevertheless, the law takes some account of the household community and of the mingling of incomes, assets and liabilities which normally results from it. In England the courts are authorized by statute to allocate assets between the spouses and often use this power to divide equally between them the proceeds of assets acquired by means of their earnings and savings, without inquiring how far either contributed the money with which the asset was bought. The courts have also used this discretion to protect a deserted wife against being evicted by her husband from premises of which he is the legal owner or tenant. The spouses can sue each other in tort, but the court can stay the proceedings if neither spouse would derive any substantial benefit from them. The court can also in its discretion deal with tort actions in which either spouse asserts property rights

against the other. Although the spouses can enter into contracts with each other and sue each other on them, the courts are reluctant to assume that they intended to make legal contracts when entering into the daily, ordinary household arrangements between husband and wife. A married woman continues to bind her husband by contracts entered into in the course of her household duties, provided they live together or he has deserted her. In the law of income tax and in the law of social security, the incomes of the spouses are aggregated for many purposes. All this is broadly true of the United States.

Community Systems.—In all those countries (with the exception of the U.S.S.R.) in which a community of property results from marriage, the husband administers the common property and disposes of it, subject to an obligation to pay due regard to the interests of the wife. This is the case in the U.S. community states, in Quebec, in South Africa and Southern Rhodesia, in France, in Spain and in Latin America. However, the extent to which the spouses' assets are common property varies. In Quebec and South Africa the community comprises all assets except those expressly exempted from it; in the U.S. community states it comprises what the spouses have acquired during marriage by work or thrift; in France it comprises all movable property and all land that the spouses have acquired during marriage out of earnings or savings (*i.e.*, land not owned by either at the time of the marriage or given to, or inherited by, either during marriage), a provision reflecting the habits of a peasant community and laid down by the Code Napoléon of 1804. In all community countries marriage contracts and settlements are common, especially among the wealthier classes in the towns who wish to adopt systems of separation. In some countries, *e.g.*, in Switzerland and formerly in Germany, there is no community by operation of law, but the husband administers and enjoys the income of certain assets of his wife, although not normally those acquired with her own earnings. (*See* COMMUNITY PROPERTY.)

Community of Surplus.—In recent years some countries, notably Denmark, Finland, Iceland, Sweden and Norway, and (in a different form) since 1957, the German Federal Republic, have tried to combine the advantages of separation with those of community. They all provide that property remains separate, but that, on dissolution of the marriage by death or divorce or on separation of the spouses, either their aggregated net assets (as in Scandinavia), or the surplus of their aggregated net assets at that time over the aggregated net assets at the time of the marriage (as in the German Federal Republic) is equally divided between the spouses or between the surviving spouse and the estate of the predeceased spouse. The earnings and savings of both thus inure for the benefit of both equally. The good housewife who, without contributing to the family property through earnings has augmented it by her thrift, gets her due share in the aggregate. This "community of surplus" is widely considered as the fairest and most adequate solution to the problem of matrimonial property in an industrialized and urbanized society. (*See* also WOMEN, LEGAL POSITION OF.)

See also references under "Husband and Wife, Laws Concerning" in the Index volume.

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HÜSEYIN RAHMI GÜRPINAR (1864–1944), Turkish novelist, was a prolific writer who skilfully depicted Istanbul middle and lower-middle class society. Born in Istanbul in 1864, the son of a general, he was educated privately and at the School of Political Science. He retired from the civil service in 1908 and thereafter, apart from a short spell as a member of parliament, lived a solitary life on Heybeli Island in the Sea of Marmara. He was a disciple of Ahmed Midhat rather than of the French-inspired school of writers but soon developed an independent style. He wrote over 30 novels, a number of short stories and a few unsuccessful plays, and translated several French novels. He is at his best in reproducing dialogue and his work is valuable to the student of Istanbul life and language at the turn of the century.

See O. Spies, *Die türkische Prosaliteratur der Gegenwart* (1943). (F. I.)

HU SHIH (1891–1962), Chinese historian, philosopher and diplomat, called the father of China's literary renaissance, was born in Shanghai in 1891, the son of a magistrate in Formosa who died in 1895. His ancestral home was in Hui-chou, Anhui province. Precocious as a child, Hu Shih began early to study the classics, mainly through the sacrifice and encouragement of his widowed mother. In 1904–10 he attended school in Shanghai, where he displayed independence of judgment by publishing, at the age of 15, articles in the living tongue of the people instead of the ancient classical style, in which, however, he was fully competent. In 1910 he passed the examinations held in Peking for study in the United States under the newly established Boxer Indemnity fund. He entered Cornell university and in 1914 received his A.B. degree. At the 25th reunion of his class he was named its most distinguished member. In 1917 he received his doctorate at Columbia university, where he was much influenced by the pragmatism of John Dewey. While yet a student in the university he published suggestions for language reform that were echoed by like-minded scholars in China. In 1916, for example, he resolved never to write poetry except in the spoken language.

The year 1917, when he returned to China to teach philosophy in the Peking National university, marks the beginning of the literary renaissance that flourished until the Japanese invasion in 1937 (*see* CHINESE LITERATURE). The movement was hailed by younger writers, teachers and students in all parts of the country, and hundreds of periodicals arose to establish the spoken language as a suitable literary medium. Though the work of Hu Shih has been compared to that of Wycliffe and Dante in creating for England and Italy their respective national languages, he himself has described it as the culmination of a long evolutionary process in which Chinese novels and dramas had earlier set the pattern. The movement did not stop, however, with language reform; it went on to the revaluation and reorganization of China's entire cultural and social heritage. Hu Shih led the way by championing, in the new medium, neglected figures in Chinese history, and by applying the most rigorous historical methods to the study of ancient texts and to the authorship and development of China's great novels. His numerous articles in Chinese, written with kindliness and great clarity, have been brought together in several collections. Two English works may be mentioned: *The Development of the Logical Method in Ancient China* (1928) and *The Chinese Renaissance* (1934). Among his books in Chinese are: "A History of Chinese Philosophy" (ancient period), "The Philosophy of Tai Tung-yuan" and "My Life to the Age of Forty." Except for an interval (1928–30) when he taught in Shanghai, he continued at the Peking National university, where he later became dean of the college of arts. For nearly four years he was China's ambassador to the United States, returning to his university in 1946 to be chancellor. After the establishment of the Communist regime he lived in New York city, continuing his researches in history and philosophy. In 1957 he was appointed one of China's representatives in the United Nations.

In 1958 he returned to Formosa (Taiwan) to engage in writing and to direct China's leading scholarly organization, the Academia Sinica, where he died on Feb. 24, 1962. (A. W. H.)

HUSKISSON, WILLIAM (1770–1830), English statesman and financier, and a leading advocate of the principles of free trade, was born at Birch Moreton, Worcestershire, on March 11, 1770. He went to Paris at the age of 13 in the care of his uncle, physician to the British embassy in Paris, and there witnessed the French Revolution. In Jan. 1793 he was employed by Henry Dundas (afterward Lord Melville) as a clerk. His abilities were so marked that in 1795 he was appointed undersecretary for war. Huskisson sat in parliament for Morpeth (1796–1802), Liskeard (1804–07), Harwich (1807–12), Chichester (1812–23) and Liverpool (1823–30). He was secretary to the treasury under William Pitt (1804–05) and the duke of Portland (1807–09) and was vice-chairman of the Bullion committee in 1810. As a close friend of

George Canning he resigned from the cabinet in 1809, rejoining Lord Liverpool's administration in 1814. He took a prominent part in the corn law debates of 1814 and 1815, and in 1819 was a member of Peel's finance committee and an able advocate of the resumption of cash payments. In 1821 he was a member of the committee appointed to inquire into the causes of the agricultural distress, and the proposed relaxation of the corn laws embodied in the report was due to his strenuous advocacy.

Huskisson was appointed president of the board of trade and treasurer of the navy in 1823, and shortly afterward he received a seat in the cabinet. In the same year he was returned for Liverpool as successor to Canning, and as the only man who could reconcile the Tory merchants to a free trade policy. Among the more important legislative changes with which he was principally connected were the reform of the navigation acts, admitting other nations to a full equality and reciprocity of shipping duties; the repeal of the labour laws; the reduction of the duties on manufactures and on the importation of foreign goods, and the repeal of the quarantine duties. He became increasingly uneasy about the operation of the corn laws, and in accordance with his suggestion Canning in 1827 introduced a measure on the corn laws proposing the adoption of a sliding scale to regulate the amount of duty. A misapprehension between Huskisson and the duke of Wellington led the duke to propose an amendment, the success of which caused the abandonment of the measure by the government. After Canning's death (1827), Huskisson accepted the secretaryship of the colonies and leadership of the house of commons under Lord Goderich, offices which he continued to hold in the new cabinet formed by the duke of Wellington in 1828. After succeeding with great difficulty in inducing the cabinet to agree to a compromise on the corn laws, Huskisson resigned office in May 1828 because of a difference with his colleagues in regard to parliamentary reform and the disfranchisement of East Retford. On Sept. 15, 1830, he was accidentally killed by a locomotive engine while present at the opening of the Liverpool and Manchester railway.

See C. R. Fay, *Huskisson and His Age* (1951). (A. Bri.)

HUSS (Hus), **JOHN** (*c.* 1370–1415), Bohemian religious reformer after whom the Hussite movement was called (*see* Hussites), came of a peasant family and took his name from his birthplace, Husinec, a village near Prachatice in southern Bohemia not far from the Bavarian frontier. He entered the University of Prague *c.* 1390 and became dean of the philosophical faculty in 1401. The university was undergoing a period of struggle against foreign, chiefly German, influence and intense rivalry between, on the one hand, the foreign masters, who upheld nominalism (*q.v.*) and were regarded as enemies of reform, and, on the other, the strongly nationalist Czech masters, who inclined to the realist philosophy and were enthusiastic readers of the philosophical writings of John Wycliffe (*q.v.*), a bitter critic of nominalism. Huss studied these works and later Wycliffe's theological writings, which were brought into Bohemia early in the 15th century by Huss's friend, Jerome (*q.v.*) of Prague. He became increasingly influenced by their underlying principles, although he never accepted their extreme implications, and was particularly impressed by Wycliffe's proposals for reform of the clergy. The clerical estate in Bohemia owned about one-half of all the land, and the great wealth of the higher clergy aroused jealousy among the poor priests who had ample reason to attack their superiors for corruption, especially simony. The Bohemian peasants, who were far enough advanced socially to make their complaints felt, also attacked the church as one of the heaviest land taxers. There was thus a large potential support for any reform movement at a time when the authority of Rome was discredited by schism (*see* Papacy: *The Great Schism, 1378–1417*). Attempts at reform had been made by King Charles IV, and Wycliffe's works were the chosen weapon of the national reform movement founded by Jan Milic of Kromeriz (d. 1374), a wealthy prelate who had deliberately embraced poverty that he might preach return to the simplicity of the primitive church.

In 1391 Milic's pupils founded the Bethlehem chapel in Prague, where public sermons were preached in Czech in the spirit of Milic's teaching. From 1402 Huss was in charge of the chapel, and, while he continued active work for the philosophical faculty and in 1404 also began to lecture in the theological faculty, he became increasingly absorbed in public preaching, attaining a reputation equal to that of Milic himself. These activities brought him into great disfavour with highly placed churchmen, but for six years he was protected both by the archbishop of Prague, Zbynek (Sbinko) Zajic of Hasenburg, and also by King Wenceslas (Vaclav) IV, who was infuriated at Pope Boniface IX's approval of his deposition from the imperial throne and glad of any opportunity to reduce the wealth and influence of the church. Huss's support of Wycliffe's teachings, however, armed the opponents of Milic's movement with a powerful weapon, since these doctrines were already denounced as heresy, of which Huss was unsuccessfully accused before the archbishop in 1408.

Also in 1408 Huss's teacher, Stanislav of Znojmo, senior Czech member of the theological faculty, was accused for defending Wycliffe's attack on the dogma of transubstantiation and summoned to appear before the Roman curia, where he was forced to recant. Huss took his place as the leader of reform, and, on the question of papal obedience, unhesitatingly quarreled with the archbishop when the latter opposed the Council of Pisa (1409), summoned to dethrone the rival popes and to reform the church. The archbishop excommunicated Huss, but the king, for political reasons, supported him. When the foreign masters, who carried a majority in university affairs, supported the archbishop, Wenceslas IV broke their power by reforming the university statutes to give the Czechs a permanent majority (Jan. 18, 1409). At this, most of the foreign scholars left Prague and took their complaints to Rome. Huss was elected rector of the reformed university. The archbishop relaxed his opposition when the Council of Pisa elected yet a third pope, Alexander V.

This controversy, however, created a breach between Huss and Archbishop Zbynek and prevented his promotion to the degree of doctor, to which his greatest work, the commentary *Super iv sententiarum*, fully entitled him. The archbishop now abandoned Huss to his enemies, who in 1410 obtained from Alexander V a bull ordering the burning of Wycliffe's heretical works, forbidding further preaching at the Bethlehem chapel and refusing recognition to any appeal. The archbishop postponed publishing the bull, hoping that Huss would withdraw. But not only did Huss revere Wycliffe, he also realized that Wycliffe was only a pretext, and that what was at stake was the fate of the Bethlehem chapel, in which he had now preached according to Milic's teaching for eight years. Accordingly, when the archbishop published the bull at the synod in 1410, Huss, backed by many of his colleagues and pupils, solemnly appealed to the pope against it. Zbynek retaliated by announcing his excommunication and burning Wycliffe's books. He was ultimately forced by increasing coercion from the king to promise Huss his support before the Roman curia, but he then died suddenly in 1411 and leadership of Huss's enemies passed to the Holy See itself.

In 1412 the case of Huss's heresy, which had been tacitly dropped, was brought to life again by a new dispute over the sale of indulgences which had been issued by the antipope John XXIII to finance his campaign against Gregory XII. Their sale in Bohemia aroused general indignation but had been approved by the king, who, as usual, shared in the proceeds. Huss publicly denounced the indulgences before the university and refused to retract even after the execution, by royal order, of three men who had protested against them. He also held a disputation in the university in support of certain theses of Wycliffe's that had been condemned by the theological faculty and adopted the revolutionary principle that the faithful are not bound to obey papal commands that conflict with the laws of Christ. In October the papal legate published his solemn excommunication in the synod, and the king ordered Huss to leave Prague. He spent the next two years in the country, where he found powerful protectors, enthusiastic audiences and leisure for much writing in both Latin and Czech. He believed that the papacy would never recover from the struggle between the rival popes, and that, like Wycliffe, he would be able to live out his days in peace.

But in 1414 a council to discuss church unity, reform and questions of heresy was summoned at Constance, territory now ruled by Sigismund, Wenceslas IV's half-brother, who, seeking support for his claim to his brother's Bohemian kingdom, came to terms with Huss's enemies and helped them to tempt him out of his own country. (*See* also CONSTANCE, COUNCIL OF; COUNCIL: *Council of Constance.*) Sigismund invited Huss to Constance "to justify himself before all men," and, while Huss was chary of accepting the word of a king already noted for his perfidy, John XXIII threatened Wenceslas IV with a crusade against him as a protector of heretics. Noblemen of Huss's party sought to obtain an imperial safe-conduct; Sigismund promised this, but, after Huss had already left Bohemia, sent a document that amounted to no more than an ordinary passport. Huss had foreseen this but would not risk embroiling his own country in war on his account. Shortly after arriving in Constance he was, with Sigismund's tacit consent, arrested and placed in close confinement, from which he never emerged.

All that earnest intervention by the Bohemian nobles could obtain for Huss was three public hearings, at which he was allowed to defend himself and succeeded in refuting some of the charges against him. The council urged him to recant and save his life, some members giving an insecure promise of mitigation of the life imprisonment prescribed by canon law. But to the majority of the council Huss was a dangerous heretic fit only for death. When he refused to recant he was solemnly sentenced on July 6, 1415, and burned at the stake.

There has been much dispute as to the extent of Huss's dependence on Wycliffe. Czech scholarship in the 20th century has shown that, although he agreed fundamentally with Wycliffe's tenets, he was equally influenced by native reforming trends. At Constance he refused to submit to the council's demand that he disavow Wycliffe entirely, and, undoubtedly, he did support the doctrine of predestination and advocate the supremacy of biblical authority. During his exile in 1412–14 he substituted for his popular preaching in Prague a series of writings in Czech, which have since become classics of Czech literature (*see* CZECHOSLOVAK LITERATURE) and equally important in the history of the Czech language (*see* CZECH LANGUAGE), since he developed a new and simpler orthography. Among these works are his *Vyklad viery, desatera a patere* ("Exposition of the Faith, of the Ten Commandments and of the Lord's Prayer") and *Knizky o svatokupectvi* (1413; *On Simony,* Eng. trans. by M. Spinka, 1953). In the latter, having little hope of eliminating simony through either ecclesiastical or secular authorities, he appeals to the local congregations. His more numerous Latin writings include his commentary on the *Sentences* of Peter Lombard (*Super iv sententiarum*), a series of lectures delivered between 1407 and 1409; and his treatises on indulgences and on the church, the last written to justify his disobedience to Rome and defining the church as a body of the elect. In this last work he was strongly influenced by Wycliffe. To Huss are also ascribed three hymns.

See also references under "Huss, John" in the Index volume.

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HUSSAR, originally the name of a soldier belonging to a corps of light horse raised by Matthias Corvinus, king of Hungary, in 1458 to fight against the Turks. The hussar was the typical Hungarian cavalry soldier, and, in the absence of good light cavalry in the regular armies of central and western Europe, the name and character of the hussars gradually spread into Prussia, France, etc. Frederick the Great sent Maj. H. J. von Zieten to study the work of this type of cavalry in the Austrian service, and Zieten so far improved on the Austrian model that he defeated his old teacher, General Baranyai, in an encounter between the Prussian and Austrian hussars at Rothschloss in 1741. The typical uniform of the Hungarian hussar was brilliantly coloured and was followed, with modifications, in other European armies. It consisted of a busby or a high, cylindrical cloth cap, jacket with heavy braiding and a dolman or pelisse, a loose coat worn hanging from the left shoulder. Several hussar regiments of the British army were converted from light dragoons in the 19th century. The name survived into the Korean War when the 29th British Commonwealth brigade group, embarking from England in Oct. 1950, included the 8th Royal Irish hussars as the tank unit.

(LN. MS.)

HUSSERL, EDMUND (1859–1938), philosopher, the father of phenomenology (*q.v.*), was born of Jewish parents at Prossnitz (Prostejov) in Moravia on April 8, 1859. To complete the mathematical studies that he had begun in German universities, he went to Vienna in 1884, where, under the influence of Franz Brentano, he discovered that his real bent was for philosophy. In 1887 he joined the Lutheran Church. He taught philosophy as *Privatdozent* at Halle from 1887, then as professor at Göttingen from 1901 and at Freiburg im Breisgau from 1916 to his retirement in 1928. He died at Freiburg on April 27, 1938.

The phenomenological method, discovered by Husserl about 1896 as a new philosophical approach to describe and define the genuine essence (*eidos*) of conscious data, was presented for the first time in his *Logische Untersuchungen,* 2 vol. (1900–01). In that work he applies this method primarily to the more formal meanings of logic and mathematics. Intentionality of the consciousness (*i.e.,* the necessary relation of every conscious act to a meaningful object) is emphasized as being the universal law of awareness; as the source and root of the content and value of all knowledge, he maintains the absolute priority of the intuition.

In *Ideen zu einer reinen Phänomenologie,* book i (1913), phenomenological description is presented as the necessary propaedeutic method to begin authentic philosophical inquiry about every intentional meaning whatsoever. To grasp the meaning of the "intentionally given" in its purity, phenomenological "reduction" is necessary; reduced to meaning as such, the world to be explained in philosophy is not the existing world supposed by the natural attitude, but an infinite multitude of meaningful data, unified by the universal structures by which these data belong to the world. Phenomenology has to describe the basic meanings and structures by "intentional analysis" of them; *i.e.,* an analysis of their meaning as such. Such an analysis has to respect the necessary relation act-object of all consciousness; consequently the "noetical" (act) and "noematical" (object) aspects of every intentional datum must be analyzed correlatively. Transcendental phenomenology, the theory of the universal constitution of all meaning by the transcendental ego, is nothing else than the metaphysical background required by the intentional analysis. Phenomenology at this stage claims to be a universal and transcendental philosophy, as in the *Cartesianische Meditationen* (Fr. trans., *Méditations cartésiennes,* 1931) and in "Die Krisis der europäischen Wissenschaften und die transcendentale Phänomenologie," *Philosophia,* i (1936).

Husserl's descriptive method and his theories about intentionality and intuition exercised wide influence on philosophy, especially in Germany (Max Scheler, Martin Heidegger) and in France (Jean-Paul Sartre, Maurice Merleau-Ponty), and also on psychology (Ludwig Binswanger, F. Buytendijk). In 1939 his manuscripts (about 40,000 pages) were brought together to form the *Archives-Husserl* at Louvain. Much of this material has been published in the collection *Husserliana,* directed by H. L. van Breda (1950 ff.).

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HUSSITES, followers of the Bohemian religious reformer John Huss (*q.v.*), whose martyrdom linked his name with a movement actually older than himself. After his death many knights and nobles published a formal protest, refusing obedience to the Council of Constance (1414) and offering protection to those persecuted for their faith (*see* CONSTANCE, COUNCIL OF; COUNCIL:

Councils of the Western Church: Council of Constance). The movement's chief supporters were Jakoubek of Stribro (d. 1429), Huss's successor as preacher at the Bethlehem chapel in Prague, who gave the movement the communion chalice as its badge, signifying that its use had for centuries been common to all the faithful and only recently gradually reserved to the priesthood; Vaclav Koranda, leader of the Taborite (or extreme Hussite, named for Tabor, their stronghold, south of Prague) priests; and Jan Zelivsky, who organized the extreme reform party in Prague. Zelivsky was overthrown by his political enemies in 1422 and executed along with several of his followers. The Hussites broke with Rome by administering Holy Communion to the laity in both kinds (*i.e.*, under the forms of both bread and wine; the doctrine supporting this was called Utraquism) and by using a Czech liturgy. Under King Wenceslas (Vaclav) IV the movement had spread widely. However, in 1419 he died and was succeeded by a bitter enemy of the Hussites, his half brother Sigismund (*q.v.*), king of the Romans and of Hungary.

The Hussites would have acknowledged Sigismund had he allowed them the Four Articles of Prague which Jakoubek had formulated: (1) freedom of preaching; (2) communion in both kinds; (3) poverty of the clergy and expropriation of church property; (4) the punishment of notorious sinners, especially prostitutes. In 1420, however, Sigismund, having failed to get possession of Prague, published a bull of Pope Martin V proclaiming a crusade against the Hussites. The Hussite union, which now included the municipalities of Prague and other cities and the chief military power of Bohemia, deposed Sigismund and repelled two crusading attacks against Prague. Another crusade from Germany in the next year met a shattering defeat at Zatec, before Sigismund, from his second kingdom of Hungary, could launch an attack which was put to flight by the Hussites under Zizka early in 1422.

Prince Vitold of Lithuania at the Hussites' invitation now assumed the Bohemian crown, sending his nephew, Zikmund Korybut, as his representative to Bohemia, where, though not universally acknowledged, he kept the peace for some time; in 1427, however, he opened negotiations with Sigismund and was forced to leave the country. In that year another crusade, led by the English cardinal Henry Beaufort, was so heavily defeated at Tachov that no further attack was attempted for four years. The Hussites, now led by Prokop (*q.v.*) the Great, embarked in Silesia, Lusatia and Slovakia on a more revolutionary political program set forth in manifestoes that reached even Spain and England. European universities (including Cambridge) declared against them with little effect, and Pope Martin V organized the greatest crusade yet launched but did not live to see its ignominious flight at Domazlice in 1431.

The Hussites won these victories largely because they truly felt themselves to be the "warriors of God" of their own battle hymn and to be fighting to preserve the very existence of the Czech people, surrounded on three sides by an overwhelming German majority. Many Hussite soldiers had learned their trade in the civil wars of 1394–1405 or in the ceaseless fights between Poland and the Teutonic knights. Among them was John Zizka (*q.v.*), inventor of the "war wagon fortress" which won most of the Hussite successes in their critical early period. The best of these soldiers were also statesmen, who were able to keep the movement united against the internal quarrels that became more dangerous as the movement grew.

At first Prague took the lead, joined by the cities to which the country folk had fled for refuge; then the fortress town of Tabor was founded in 1420, soon joined by other towns and by many of the lesser nobility. Antagonism arose between Prague and Tabor, particularly when the Taborite priests broke with Prague by introducing a form of service that anticipated the later Calvinist liturgy and by opposing not only union with Prague but also any restoration of the Bohemian monarchy. Tabor, going far beyond the Four Articles, thus estranged Zizka, who organized a new left-wing brotherhood of his own, a movement that was nicknamed "the Orphans" after his death in 1424. The two movements worked in uneasy harmony. Zizka and Prokop as leaders of the centre party staked everything on co-operation with Prague and scotched extremist deviations such as the Adamite movement, suppressed by Zizka in 1421. Due to the efforts of statesmanlike leaders and of members of the university, who did much to keep the war on a humane and mainly defensive basis, peace between the parties was maintained till the end of the war.

Since the death of Wenceslas IV there had been no ruler capable of exercising sovereign power, but, as a working basis for settled government, the provincial diet, now meeting regularly on the initiative of the estates and much changed in composition, formed a sort of substitute. Besides the nobles, whose monopoly it had formerly been, the diet now included many knights and, above all, representatives of the towns upon which the war bore most heavily. Later it included representatives of the army, whose word carried so much weight that what had begun as a religious reform ended close to a military dictatorship, which proved especially dangerous when, after victories in the field, peace negotiations were begun.

These began in 1431, when the Council of Basel agreed to negotiate with the Hussites on an equal basis (which Pope Martin V had persistently refused). A Hussite delegation, led by Prokop and including leading theologians of Prague and of the brotherhoods, and the Oxford Lollard master Peter Payne, spent three months in Basel in 1433 discussing the Four Articles.

The council then sent a mission to Prague, which advised the granting of communion in both kinds, since this might split the Hussite ranks; it did so effectively since the nobles were willing to make peace on these terms—the so-called first *Compactata* (Compacts of Prague) which had been agreed on in Nov. 1433—while the brotherhoods were not. The two parties came to blows and at Lipany, in 1434, the nobles, with a mercenary force partly financed from Basel, defeated the brotherhoods' troops. Even this disaster, however, failed to fulfill the hopes of the council; the seat of the negotiations was transferred to Prague, and Jan Rokycana, leader of the Hussite majority, proved as unyielding as Prokop, who had fallen at Lipany. Two years later (July 1436) the Hussites obtained a peace treaty, confirming the *Compactata*, that ensured all the principal gains of the war: communion in both kinds, the expropriation of church lands (which broke the economic power of the Roman Church) and an independent Bohemian church under Jan Rokycana as its elected archbishop. Even Sigismund, now emperor, was compelled to confirm an extensively democratized constitution for Bohemia and, though Pope Pius II denounced them in 1462, the *Compactata* remained in force for two centuries. Even the Catholics admitted them as the law of the land in 1485, and thus ensured religious peace till the suppression of Bohemian Protestantism in 1620, which saw the eventual victory of the Counter-Reformation and of absolute monarchy. In the country districts only did a few insignificant Protestant remnants survive during 150 years of systematic persecution until religious toleration was achieved toward the end of the 18th century. *See* also references under "Hussites" in the Index volume.

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HUTCHESON, FRANCIS (1694–1747), British philosopher, the exponent of the moral-sense theory in ethics, was born on Aug. 8, 1694, at Drumalig in County Down, the son of a Presbyterian minister. From 1710 to 1716, he studied philosophy, classics and theology at Glasgow university. He then opened a private academy in Dublin, where he made many friends among the clergy of the established church. In 1729 he returned to Glasgow as professor of moral philosophy. In spite of being accused in 1738 before the Glasgow presbytery for holding that the standard of moral goodness was the promotion of the happiness of others and that we could have a knowledge of good and evil without and prior to a knowledge of God, Hutcheson enjoyed a well-deserved popularity. He died in Glasgow in 1747.

Ethics.—Hutcheson wrote on all the major branches of philosophy, but is important chiefly for his ethical writings. His theory was propounded in his *Inquiry Into the Original of Our Ideas of Beauty and Virtue*, in two treatises (1725; rev. ed., *Inquiry Concerning Beauty, Order, Harmony and Design* and *Inquiry Concerning Moral Good and Evil*, 1726); and in *An Essay on the Nature*

and Conduct of the Passions, With Illustrations Upon the Moral Sense (1728). Later works were *Philosophiae moralis institutio compendiaria, ethices, et jurisprudentiae naturalis elementa continens* (1742) and the posthumous *System of Moral Philosophy*, 2 vol. (1755). Opposing Hobbes and Bernard de Mandeville, he closely followed the 3rd earl of Shaftesbury, especially as regards the analogy between beauty and virtue, the functions assigned to the moral sense, the position that the benevolent feelings form an original and irreducible part of our nature and the unhesitating adoption of the principle that the test of virtuous action is its tendency to promote the general welfare. According to Hutcheson, man has a variety of senses, internal as well as external, reflex as well as direct, the definition of a sense being "any determination of our minds to receive ideas independently on our will, and to have perceptions of pleasure and pain" (*Essay on the Nature and Conduct of the Passions*, §1). Without exhaustively enumerating these "senses," he specifies, besides the five external senses, (1) consciousness, by which each man has a perception of his own mind; (2) the sense of beauty; (3) a public sense, or *sensus communis*, "a determination to be pleased with the happiness of others and to be uneasy at their misery"; (4) the moral sense, or "moral sense of beauty in actions and affections, by which we perceive virtue or vice, in ourselves or others"; (5) a sense of honour or praise and blame; (6) a sense of the ridiculous. Of these "senses" the "moral sense" is the most important. It is implanted in man and pronounces immediately on the character of actions and affections, approving those which are virtuous and disapproving those which are vicious, because the Author of Nature "has made virtue a lovely form to excite our pursuit of it, and has given us strong affections to be the springs of each virtuous action." Hutcheson's use of the term "moral sense" and his failure to couple it invariably with the term "moral judgment" tends to obscure the part played by deliberation.

But though Hutcheson usually describes the moral faculty as acting instinctively and immediately, he does not confound the moral faculty with the moral standard. The criterion of right action is for him, as for Shaftesbury, its tendency to promote the general welfare of mankind. He thus anticipates the utilitarianism of Jeremy Bentham even in the use of the phrase "the greatest happiness for the greatest number" (*Inquiry Concerning Moral Good and Evil*, §3). But since intuition has no possible connection with an empirical calculation of results, Hutcheson in adopting such a criterion practically denies his fundamental assumption. His most distinctive ethical doctrine is the "benevolent theory" of morals by which he opposes Hobbes. He maintains not only that benevolence is the direct source of many of our actions, but also that it is the only source of those actions of which, on reflection, we approve. Actions which flow from self-love only are morally indifferent, though in so far as a man may justly regard himself as a part of the rational system and may thus "be, in part, an object of his own benevolence," the "personal virtues" may be regarded as fitting objects of moral approbation. Hutcheson inconsistently declares that while self-love merits neither approbation nor condemnation, the satisfaction of the dictates of self-love is one of the very conditions of the preservation of society. In the *Synopsis metaphysicae* (*see* below), he holds that will is determined by motives in conjunction with our character and habit of mind, and that the only true liberty is the liberty of acting as we will, not the liberty of willing as we will.

The prominence given by Hume and Adam Smith to the analysis of moral action and moral approbation, with the attempt to distinguish between the respective province of the reason and that of the emotions in these processes, is undoubtedly due to the influence of Hutcheson. To a study of Shaftesbury and Hutcheson we might probably attribute Hume's unequivocal adoption of the utilitarian standard. Objections to Hutcheson's system were made by John Balguy in *The Foundation of Moral Goodness* (1727–28); by the dissenter John Taylor (1694–1761) in *An Examination of the Scheme of Morality Advanced by Dr. Hutcheson* (1759); and, most notably, by Richard Price (*q.v.*) in his *Review of the Principal Questions and Difficulties in Morals* (1758). (*See* ETHICS, HISTORY OF.)

Epistemology and Logic.—Hutcheson's most important work apart from the ethical writings was the *Metaphysicae synopsis ontologiam et pneumatologiam complectens* (1742; 2nd ed., *Synopsis metaphysicae*, etc., 1744). Both his epistemology and his logic are interesting mainly as a link between Locke and the Scottish school. With Locke he rejects the doctrine of innate ideas (*see*, for instance, *Inquiry Concerning Moral Good and Evil*, 1 *ad fin.*, and §4; *cf. Synopsis*, pars i. cap. 2); but he modifies Locke's doctrine and anticipates Thomas Reid when he states that the ideas of extension, figure, motion and rest "are more properly ideas accompanying the sensations of sight and touch than the sensations of either of these senses"; that the idea of self accompanies every thought; and that the ideas of number, duration and existence accompany every other idea whatsoever (see *Essay*, art. 1; *Synopsis*, pars i. cap. 1, pars ii. cap. 1). Like Locke, Hutcheson also depreciates the importance of the so-called laws of thought, distinguishes between the primary and secondary qualities of bodies, asserts that we cannot know the inmost essences of things though they excite various ideas in us and assumes that external things are known only through the medium of ideas (*Synopsis*, pars i. cap. 1). He accounts for our assurance of the reality of externals by referring it to a natural instinct (*Synopsis*, pars i. cap. 1). Of the correspondence between our ideas of the primary qualities of things and the things themselves God alone is the cause, having effected it through a law of nature.

Hutcheson diverges from Locke in his account of the idea of personal identity, which he appears to have regarded as made known to us directly by consciousness. Generally, he speaks as if we had a direct consciousness of mind as distinct from body (*see*, for instance, *Synopsis*, pars ii. cap. 3), though in the posthumous *System of Moral Philosophy* he expressly states that we know mind as we know body "by qualities immediately perceived though the substance of both be unknown" (bk. i, ch. 1). Other points in which he supplemented or departed from Locke are: the distinction between perception proper and sensation proper, which is not explicitly worked out; the imperfection of the ordinary division of the external senses into five; the limitation of consciousness to a special mental faculty; and the disposition to refer on disputed questions of philosophy not so much to formal arguments as to the testimony of consciousness and our natural instincts. The last point suggests the "common-sense philosophy" of Reid.

The short *Logicae compendium* contains a large proportion of psychological matter. The author distinguishes between the mental result and its verbal expression (idea as distinct from term; judgment as distinct from proposition), constantly employs the word "idea" and defines logical truth as *convenientia signorum cum rebus significatis* ("a concord of the signs with the things signified"), thus implicitly repudiating a merely formal view of logic.

Aesthetics.—Hutcheson is one of the earliest modern writers on aesthetics. He maintains that the special sense by which we perceive beauty, harmony and proportion is a *reflex* sense, presupposing sight and hearing. Beauty is also perceived in universal truths, in the operations of general causes and in moral principles and actions. Thus, the analogy between beauty and virtue, a favourite topic with Shaftesbury, is seen to be prominent in Hutcheson also.

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HUTCHINS, ROBERT MAYNARD (1899–), U.S. educator and critic of overspecialization and lack of balance in the college curriculum and the failure of colleges and universities to maintain and enlarge the intellectual tradition of the western world. He was born in Brooklyn, N.Y., on Jan. 17, 1899. After two years at Oberlin college, Oberlin, O., he served in the ambu-

lance service of the U.S. army, 1917–19, and the Italian army, 1918–19. He received the degrees of A.B. (1921) and LL.B. (1925) from Yale where he later (1927) became dean of the law school. In 1929, at the age of 30, he was elected president of The University of Chicago, and was chancellor 1945–51. He was appointed associate director of the Ford foundation (1951) and became president of the Fund for the Republic in 1954. He became a centre of controversy by insisting that since World War I there has been confusion about the purposes of higher education, with consequent overemphasis upon athletics, social life and specific vocational training, and use of hours spent in class as a measure of a student's education. His criticisms and proposals have been vigorously debated and widely accepted. His interests in educational reform are part of his broader concern with the improvement of American society. His vigorous defense of nonconformity and protest as having been essential to the growth of that society and his analysis of education in the United States as drifting toward specialization and pragmatism are presented in his published lectures, including *The Higher Learning in America* (1936), *Education for Freedom* (1943), *The Conflict in Education* (1953), *University of Utopia* (1953) and *Some Observations on American Education* (1956). His other publications include books and articles on education and *Freedom, Education, and the Fund: Essays and Addresses, 1946–1956* (1956). He became chairman of the board of editors of *Encyclopædia Britannica* (1943) and editor in chief of *Great Books of the Western World* (1952).

(R. W. Tr.)

HUTCHINSON, ANNE (*c.* 1600–1643), American religious enthusiast and one of the founders of Rhode Island, was born in Lincolnshire, Eng., the daughter of a clergyman, Francis Marbury, and according to tradition, a cousin of John Dryden. She married William Hutchinson, and in 1634 emigrated to Boston, Mass. Although her orthodoxy was suspected and for a time she was not admitted to the church, she soon organized meetings among the Boston women, among whom her exceptional ability and her services as a nurse had given her great influence. At these meetings, which were soon attended even by some of the ministers and magistrates, she discussed and commented upon recent sermons and gave expression to her own theological views. She asserted that she, John Cotton (*q.v.*) and her brother-in-law, the Rev. John Wheelwright, were under a "covenant of grace," that they had a special inspiration, a "peculiar indwelling of the Holy Ghost," whereas the other ministers of the colony were under a "covenant of works." Anne Hutchinson, according to Winthrop a woman "of a ready wit and bold spirit," was, in fact, voicing a protest against the legalism of the Massachusetts Puritans, and was also striking at the authority of the clergy in an intensely theocratic community. As a result the entire colony was divided into factions. Mrs. Hutchinson was supported by Gov. Sir Henry Vane, Cotton, Wheelwright and the great majority of the Boston church; opposed to her were Deputy Gov. John Winthrop, the Rev. John Wilson of the Boston church and all of the country magistrates and churches. The strength of the parties was tested at the general court of election of May 1637, when Winthrop defeated Vane for the governorship. Cotton recanted, Vane returned to England in disgust, Wheelwright was tried and banished. Mrs. Hutchinson was tried by the general court chiefly for "traducing the ministers," and was sentenced to banishment; later she was tried before the Boston church and formally excommunicated. With William Coddington and others she established a settlement on the island of Aquidneck (now Rhode Island) in 1638. Four years later, after the death of her husband, she settled on Long Island sound near what is now New Rochelle, N.Y., and was killed by the Indians in Aug. 1643, an event regarded in Massachusetts as a manifestation of divine providence. Anne Hutchinson and her followers were called "Antinomians," rather as a term of reproach than with any reference to her doctrinal theories, and the controversy in which she was involved is known as the "Antinomian controversy."

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HUTCHINSON, JOHN (1674–1737), English writer who held fanciful theories about the Hebrew language and the interpretation of the Bible, was born at Spennithorne, Yorkshire. After being privately educated in mathematics and mechanics he made experiments and wrote books on biblical and scientific subjects (collected edition, 12 vol., 1748–49) while earning his living as a family steward and then (1728) as riding purveyor to the master of the royal horse. He died in London on Aug. 28, 1737. His *Moses's Principia* (1724–27), a commentary on the account of the Creation and the flood in Genesis, asserts that "the Hebrew language was form'd by God," and that the Bible had always been misinterpreted by ignorant scholars who did not understand the true meaning of Hebrew words. He claimed that revelation and his own observations disproved Sir Isaac Newton's theories. His followers, called Hutchinsonians, were attacked in 1756 for their sermons decrying reason and natural religion.

HUTCHINSON, SIR JONATHAN (1828–1913), English surgeon and pathologist, whose principal work was in the study of syphilis, was born on July 23, 1828, at Selby, Yorkshire. He entered St. Bartholomew's hospital and gained a reputation as a skilful operator and a scientific inquirer. He was Hunterian professor at the Royal College of Surgeons (1879–83) and in 1889 was president of the college. His lectures on neuropathogenesis, gout, leprosy, diseases of the tongue, etc., as well as his studies in syphilis, were full of original observations. He was the founder of the London Polyclinic or Post-graduate School of Medicine and the promoter of the New Sydenham society for the publication of translations of important foreign medical treatises. He published several volumes on his own subjects and was editor of the quarterly *Archives of Surgery*. Hutchinson was knighted in 1908 and died at Haslemere on June 26, 1913.

HUTCHINSON, THOMAS (1711–1780), colonial legislator, jurist and royal governor of the province of Massachusetts, was born in Boston on Sept. 9, 1711, the son of a wealthy merchant. He graduated from Harvard college in 1727 and for several years thereafter devoted himself to business. In 1737 he began his public career as a member of the Boston board of selectmen, and a few weeks later he was elected to the general court of Massachusetts Bay, of which he was a member, save for one brief interval, until 1749. He consistently contended for a sound financial system, and vigorously opposed inflationary monetary policies.

His first trip to England was in 1740 when he represented Massachusetts in a boundary dispute with New Hampshire. He was a member of the Massachusetts council, 1749–66, was chief justice of the superior court of the province, 1760–69, was lieutenant governor, 1758–71, and from 1771 to 1774 was governor. In 1754 he was a delegate from Massachusetts to the Albany convention, and, with Benjamin Franklin, was a member of the committee appointed to draw up the Albany plan of union. Though he recognized the legality of the Stamp act of 1765, he considered the measure inexpedient and impolitic and urged its repeal, but his attitude was misunderstood. He was considered by many to have instigated the passage of the act, and in Aug. 1765 a mob sacked his Boston residence and destroyed many valuable manuscripts and documents. He was acting governor at the time of the Boston Massacre in 1770, and it was his order that removed the British troops from the town. Throughout the pre-revolutionary disturbances in Massachusetts he was the representative of the British ministry, and though he disapproved of some of the ministerial measures, he felt impelled to enforce them and necessarily incurred the hostility of the Whig or patriot element.

In 1774, upon the appointment of Gen. Thomas Gage as military governor, Hutchinson went to England and acted as an adviser to George III and the British ministry on American affairs, uniformly counseling moderation. During these years he completed his *History of the Colony and Province of Massachusetts Bay* (new ed., 3 vol., 1936). Hutchinson died at Brompton, later part of London, on June 3, 1780.

See J. K. Hosmer, *Life of Thomas Hutchinson* (1896).

HUTCHINSON, a city of south-central Kansas, U.S., and seat of Reno county, 40 mi. N.W. of Wichita. Established on the north bank of the Arkansas river in 1871 by C. C. Hutchinson, who was originally sent to Kansas as an Indian agent for the federal government, Hutchinson began developing with the arrival of the Santa Fe railroad in 1872, the year of the city's incorporation.

In Sept. 1887 thick beds of salt were discovered there, which led to the development of a major industry. The city sits atop what are reputedly some of the world's richest salt deposits, which are mined, processed and shipped to markets in all parts of the U.S. Hutchinson is also a principal primary hard wheat market, with a grain storage capacity of approximately 35,000,000 bu. It is centred in one of the middle west's richest oil fields, and its petroleum production, banking, transportation, flour milling, building products, farm-machinery manufacturing and wholesale grocery business are important factors in the economy of the area.

Hutchinson is the site of the annual Kansas State fair and several important athletic tournaments. The State Industrial reformatory is located there. Hutchinson junior college, founded in 1928 as a senior high school, is operated as a part of the public-school system. For comparative population figures *see* table in KANSAS: *Population.* (R. W. RI.)

HUTTEN, PHILIPP VON (also known as URRE or UTRE) (*c.* 1511–1546), last German captain general of Venezuela, was born in Königshofen, Franconia, about 1511. A relative of the humanist poet and satirist Ulrich von Hutten, he was among the band of German adventurers who sailed to Venezuela under Georg Hohermuth, or George of Spires, to conquer and rule that land in the interest of the house of Welser of Augsburg, who had been granted a concession by Charles V in 1528. The party landed at Coro in Feb. 1535 and Hutten accompanied Hohermuth on his expedition into the interior in search of treasure. After the death of Hohermuth in Dec. 1540 he became captain general. Soon after this event he embarked on a tragic expedition of exploration into the interior, returning after five years to find that a Spaniard, Juan de Carvajal, had been appointed governor in his absence. He and his traveling companion, Bartholomew Welser the younger, were seized and executed in 1546.

His letters, "Zeitung aus India Junkheer Philipps von Hutten," were published in *Meusel's Historisch-litterarisches Magazin* (1785).

See G. Arciniegas, *Germans in the Conquest of America* (1943). (U. S. L.)

HUTTEN, ULRICH VON (1488–1523), German knight and humanist, famed as a patriot, satirist and vigorous supporter of Luther's cause, was born on April 21, 1488, at the castle of Steckelberg, near Fulda, in Hesse, the eldest son of a poor but not undistinguished knightly family. He led a restless, adventurous life. Early destined to be a monk because of his frailty and feeble health, he fled from the Benedictine house at Fulda in 1505, and visited university after university in an effort to satisfy his burning thirst for learning. Between 1505 and 1508 he studied at Cologne, Erfurt (where the contact with Crotus Rubianus and Eobanus Hessus was particularly fruitful), Frankfurt an der Oder and Leipzig. He suffered shipwreck on the coast of Pomerania in 1508, was robbed and stripped of his possessions the following year in Greifswald by the servants of people who at first befriended him, and barely escaped, half-starved, frozen and penniless, in the dead of winter, to Rostock. From there he wandered through Germany to Italy, suffered at the hands of both sides in the siege of Pavia (1512), returned to Germany and enjoyed the patronage of Archbishop Albert of Mainz (*q.v.*).

In 1515 his cousin Hans von Hutten was murdered by Ulrich, duke of Württemberg. This event, and the impact on him of the Reformation, shaped the future course of Hutten's life. He sought revenge on Ulrich in literary satire and invective, using the literary talent already developed at Erfurt and employed against his treacherous benefactors at Greifswald (*Querelae*, 1510). For the rest of his life he carried on a fight against tyrannical and reactionary forces, both as gallant soldier and humanistic satirist. He pursued his own private quarrel against Duke Ulrich, and allied himself in this connection with Franz von Sickingen (*q.v.*); he espoused the claims of the knightly order (*Ritterstand*) against the growing power of the German princes; he supported Luther and attacked the papacy, particularly for its inroads on the German economy; as a humanist he attacked the obscurantism of the older universities that resisted the spread of the "new learning"; as a patriot, for whom the *Germania* of Tacitus represented an ideal, he conjured up visions of a new united Germany. His activities did not endear him to established authority. He was dismissed from the court of Archbishop Albert and rebuffed by the emperor Charles V. On the defeat of Sickingen's cause he fled to Basel, where Erasmus (with whom he had earlier been friendly) refused to have anything to do with him. He found better treatment at the hands of Huldreich Zwingli in Zürich, and, with his help, spent his last days on the island of Ufenau on the Lake of Zürich. There he died, his intellect still keen, his body riddled with syphilis, a poverty-stricken refugee, on Aug. 29(?), 1523.

Hutten is a literary figure of considerable importance. If in his espousal of the cause of the *Ritterstand* he looked back to the middle ages, as a writer he looked forward, taking up the cause of the humanists and employing their new-found literary forms in the service of his vendettas, both private and public. He achieved greatness as a satirist. Employing biting satire and merciless invective, he wrote Latin dialogues modeled on Lucian, attacking general abuses and the pretensions of princes (*Nemo*, 1512–18; *Aula*, 1518), denouncing the claims of the papacy and tyrannical institutions (*Phalarismus*, 1516, *Vadiscus*, 1520), glorifying and attempting to inspire a new German national spirit (*Inspicientes*, 1520, *Arminius*, 1524), and depicting his own personal misfortunes (*Fortuna*, 1519, *Febris*, 1519). He wrote an *Ars versificandi* (1511) and a treatise on syphilis (*Morbus Gallicus*, 1519). He was the main contributor to the second volume of the *Epistolae Obscurorum Virorum* (1515–17), the famous attack on monkish life and letters, and his satire is harsher and more bitter, though not necessarily more effective, than that of the first volume. After 1520 he wrote in German, changing his motto ("The die is cast") from *Jacta est alea* to *Ich hab's gewagt*, and produced satirical dialogues in German (*Gesprächsbüchlein*, 1521). His last days were overshadowed by his dispute with Erasmus.

Hutten is a considerable writer and a keen patriot, whose restless life reflects the turbulent age in which he lived. The figure of Hutten as a warrior of freedom fighting for the Reformation in Germany has been much romanticized by his fellow Germans, and has often been given literary treatment, notably by C. F. Meyer, *Huttens letzte Tage* (1871).

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HUTTER, LEONHARD (1563–1616), German Lutheran theologian, born at Nellingen, near Ulm, began to lecture at Jena in 1594, and in 1596 became professor of theology at Wittenberg, where he died on Oct. 23, 1616. Hutter was a champion of Lutheran orthodoxy, as set down in the confessions and embodied in his own *Compendium locorum theologicorum* (1610; reprinted 1863). He was called "Luther redonatus."

In reply to Rudolf Hospinian's *Concordia discors* (1607), he wrote *Concordia concors* (1614), defending the formula of Concord, which he regarded as inspired. His *Irenicum vere christianum* is directed against David Pareus (1548–1622), of Heidelberg, who had pleaded for a reconciliation of Lutheranism and Calvinism; his *Calvinista aulopoliticus* (1610) was written against the "damnable Calvinism" which was becoming prevalent in Holstein and Brandenburg. Another work, based on the formula of Concord, was entitled *Loci communes theologici*. Karl von Hase used his name as the symbol of orthodoxy in his *Hutterus redivivus* (1827).

HUTTON, JAMES (1726–1797), Scottish geologist who formulated the basic theory that geologic phenomena can be explained in terms of observable geologic processes, was born in

Edinburgh on June 3, 1726. He qualified as a doctor of medicine, studying in Edinburgh and Paris, but turned to practical agriculture, in which he made many improvements. In 1768 he retired, and from then until his death (in Edinburgh on March 26, 1797) he devoted himself to scientific pursuits.

Hutton conceived larger ideas than were entertained by the mineralogists of his day. He desired to trace the origin of the various minerals and rocks and thus to arrive at some clear understanding of the history of the earth. In 1785 he communicated his views to the recently established Royal Society of Edinburgh in a paper entitled "Theory of the Earth, or an Investigation of the Laws Observable in the Composition, Dissolution, and Restoration of Land Upon the Globe," published in the society's *Transactions*. Hutton's work was little recognized until the publication of John Playfair's *Illustrations of the Huttonian Theory* (1802; facsimile reprint with introduction by G. W. White, 1956), a lucid exposition of the postulate that the processes that have been at work on the earth in the past are the same as those now in operation.

The same volume of the *Transactions* in which his "Theory of the Earth" appeared contained also a "Theory of Rain," which was read to the Royal society in 1784. His other works include: *Dissertations on Different Subjects in Natural Philosophy* (1792), in which he discussed the nature of matter, fluidity, cohesion, light, heat and electricity, and *An Investigation of the Principles of Knowledge, and of the Progress of Reason From Sense to Science and Philosophy*. His closing years were devoted to the extension and republication of his *Theory of the Earth*, of which two volumes appeared in 1795. A portion of the manuscript of a third volume was edited by A. Geikie in 1899.

For an evaluation of Hutton's contributions to geologic theory *see* GEOLOGY: *Development of the Science: 18th-Century Advances*. (A. GEI.; X.)

HUXLEY, ALDOUS LEONARD (1894–1963), British author, chiefly remarkable for his acute and far-ranging intelligence, his graceful style and (more especially in his earlier novels and stories) for his mocking and, at times, outrageous humour, was born at Godalming, Surrey, on July 26, 1894, the third son of Leonard Huxley and grandson of Thomas Henry Huxley. He was educated at Eton and at Balliol college, Oxford.

Though best known as a novelist, Aldous Huxley was also a prolific writer of essays, biography, drama and verse. *Crome Yellow* (1921) established him as one of the most witty and intelligent writers of his generation; in this, as in his subsequent novels, the characters are employed primarily as mouthpieces for the expression of contrasted ideas and opinions, a device borrowed from Thomas Love Peacock. *Antic Hay* (1923), the most high-spirited and least didactic of the novels, is a malicious and amusing satire on the literary and bohemian coteries of the time; *Those Barren Leaves* (1925) and *Point Counter Point* (1928) are in similar vein, though marked by a growing seriousness. Huxley's deep distrust of current trends in politics and applied science found expression in *Brave New World* (1932), a pessimistic vision of utopia in striking contrast with the optimistic fantasies of H. G. Wells.

In later life Huxley became increasingly drawn to Hindu philosophy and mysticism, and a number of works reflect this preoccupation, notably *The Perennial Philosophy* (1946). His other works include: essays, *Do What You Will* (1929); poems, *The Cicadas* (1931); novels, *Eyeless in Gaza* (1936), *Ape and Essence* (1949); biography and history, *Grey Eminence* (1941), *The Devils of Loudun* (1952); and *The Doors of Perception* (1954), a study of the hallucinogenic drug mescaline. He died on Nov. 22, 1963, at Los Angeles, Calif. (B. J. B.)

HUXLEY, ANDREW FIELDING (1917–), British physiologist, who shared the 1963 Nobel prize for physiology and medicine with Alan Lloyd Hodgkin and Sir John Carew Eccles (*qq.v.*) for researches on "the ionic mechanisms involved in excitation and inhibition in the peripheral and central portions of the nerve cell membrane."

Huxley, born in Hampstead, London, on Nov. 22, 1917, was the son of Leonard Huxley by his second wife and thus the half-brother of Sir Julian and of Aldous Huxley and a grandson of T. H. Huxley. He was educated at University College school, Westminster school and Trinity college, Cambridge, of which he was a fellow in 1941–60 and a director of studies in 1952–60. During World War II he did research for the antiaircraft command (1940–42) and for the admiralty (1942–45). He was demonstrator (1946–50), assistant director of research (1951–59) and reader in experimental biophysics (1959–60) in the department of physiology at Cambridge university. He became Jodrell professor of physiology, University college, London, in 1960.

Like those of his intimate collaborator, Hodgkin, Huxley's researches were concerned largely with the physicochemical analysis of the fundamental phenomena involved in the excitation in a peripheral nerve fibre (and in conduction of excitation along it). The properties of the surface membrane of the fibre are intimately concerned in the excitatory ionic interchange between the external fluid and the protoplasm of the fibre, and thus with the fall or reversal, during excitation, of the electrical polarization shown by the membrane when at rest.

Apart from the researches directly mentioned in the Nobel citation, Huxley has made contributions of fundamental importance to knowledge of the process of contraction by a muscle fibre. (H. H. DA.)

HUXLEY, SIR JULIAN SORELL (1887–), English biologist, philosopher, educator and author who had a great influence in the modern development of embryology, systematics, behaviour and evolution. The son of Leonard Huxley and the grandson of Thomas Henry Huxley, he was born June 22, 1887, at London. He was educated at Eton and at Balliol college, Oxford. Some of his most important positions were those of assistant professor at Rice institute, Houston, Tex. (1913–16); fellow, New college, Oxford (1919–25); professor, King's college, University of London (1925–27); secretary of the Zoological Society of London (1935–42); and director general of the United Nations Educational, Scientific and Cultural organization (1946–48). He was an officer of many scientific societies, several of which he organized. He was elected a fellow of the Royal society in 1938. Huxley was author, co-author or editor of many important books, including *The Individual in the Animal Kingdom* (1912); *Religion Without Revelation* (1927); *The Science of Life* (1931); *Problems of Relative Growth* (1932); *The Captive Shrew and Other Poems of a Biologist* (1932); *The Elements of Experimental Embryology* (1934); *The New Systematics* (1940); *The Uniqueness of Man* (1941); *Evolution, the Modern Synthesis* (1942); *Touchstone for Ethics, 1893–1943* (1947); *Soviet Genetics and World Science* (1949); *Evolution as a Process* (1954); and *Toward a New Humanism* (1957).

Huxley was a leader in relating science to human social life and to religion. His versatility of interests, combined with scientific scholarship, philosophical penetration and communication with the public, constitute his noteworthy contributions to modern culture. (A. E. E.)

HUXLEY, THOMAS HENRY (1825–1895), English biologist whose speculations on philosophy and religion led him to a powerful advocacy of the principle of agnosticism, was born on May 4, 1825, at Ealing, the seventh child of George Huxley, a schoolmaster. "Physically . . . I am the son of my mother so completely . . . that I can hardly find any trace of my father in myself, except an inborn faculty for drawing, . . . a hot temper, and that amount of tenacity of purpose which unfriendly observers sometimes call obstinacy." (*Life*, i, 3.) When his father moved to Coventry about 1835, young Henry was left to his own devices. His great desire to be a mechanical engineer ended in his devotion to "the mechanical engineering of living machines." At the age of 17, with his elder brother James, he commenced regular medical studies at Charing Cross hospital, and on graduating in 1845 published his first paper on the hitherto unrecognized layer in the inner sheath of hairs, subsequently known as Huxley's layer.

Having obtained the qualification of the Royal College of Surgeons, Huxley sought and received an appointment in the Royal Navy; according to books kept on board Nelson's old ship "Victory," he was posted for duty to Haslar hospital. Huxley's chief at

Haslar, Sir John Richardson, a well-known arctic explorer and naturalist, recognized his ability and procured for him the post of surgeon in H.M.S. "Rattlesnake," which was about to set out for surveying work in Torres strait, between north Australia and Papua. By the time the ship was paid off at Chatham in Nov. 1850, Huxley had made a profound study of the surface life of the tropical seas. His important paper "On the Anatomy and the Affinities of the Family of Medusae" was printed by the Royal society in its *Philosophical Transactions* (1849). Huxley united the hydroid polyps with the Medusae to form a class, the Hydrozoa, in which the body consisted of two layers comparable with the ectoderm and endoderm formed during the development of higher animals.

Huxley was elected a fellow of the Royal society in 1851, and in the following year received the society's royal medal and was elected to the council.

In anatomical studies, his views differed sharply from the accepted notions of Richard Owen, the leading comparative anatomist in Great Britain. Owen was a disciple of Georges Cuvier, and adopted largely from him the deductive explanation from idealistic conceptions of anatomical facts, to which he added the transcendental "archetypal" theory of Lorenz Oken. Huxley would have none of either view, for his methods were purely inductive. He would not hazard any statement beyond what the facts revealed, and Herbert Spencer, whose acquaintance he made in 1852, was unable to convert him to belief in evolution in its widest sense (*Life*, i, 168). At about the same time, in his first interview with Charles Darwin, Huxley expressed his belief "in the sharpness of the line of demarcation between natural groups" and was received with a humorous smile (*Life*, i, 169).

In July 1854, after leaving naval service earlier that year, Huxley became lecturer in natural history at the School of Mines, and in 1855 naturalist to the geological survey. His most important published work at this period was the Croonian lecture of 1858 on "The Theory of the Vertebrate Skull," in which, by his inductive method, he completely demolished the idealistic views of the origin of the skull held by Richard Owen. This finally disposed of the "archetype," and may be said to have liberated the English anatomical school from the deductive method.

In 1859 Darwin's *The Origin of Species* was published. This was a momentous event in the history of science, and not least for Huxley, who found in Darwin's theory an intelligible hypothesis on which to base a study of evolution. At the Oxford meeting of the British Association for the Advancement of Science in 1860, Huxley's defense of evolution against the attacks of Bishop Samuel Wilberforce (*q.v.*) resulted in a victory for science over obscurantism. (*See* also DARWIN, CHARLES ROBERT; DARWINISM.) Owen, who could not break with orthodoxy, asserted that man was clearly marked off from other animals by the anatomical structure of his brain. This statement was inconsistent with known facts, and was effectually refuted by Huxley in various papers and lectures, summed up in 1863 in *Man's Place in Nature*. In 1881 he asserted that if the hypothesis of evolution "had not existed, the palaeontologist would have had to invent it" (*Essays*, iv, 44). In 1892 he wrote: "The doctrine of evolution is no speculation, but a generalization of certain facts . . . classed by biologists under the heads of Embryology and of Palaeontology" (*Essays*, v, 42).

Meanwhile, Huxley had been drawn into paleontological research. His numerous memoirs on fossil fishes established many far-reaching morphological facts. The study of fossil reptiles led to his demonstration of the fundamental affinity of reptiles with birds as one group, under the title of Sauropsida. His *Lessons in Elementary Physiology* (1866) and *Anatomy of Vertebrated Animals* (1871) were masterpieces of exposition in these subjects. He also proposed a rearrangement of the zoological regions into the primary divisions—Arctogaea, to include the land areas of the northern hemisphere, and Notogaea for the remainder.

From 1870 onward Huxley was more and more drawn away from scientific research by the claims of public duty. Between 1862 and 1884 he served on no less than ten royal commissions. From 1871 to 1880 he was a secretary of the Royal society, and from 1883 to 1885 its president; while from 1870 to 1872 he served as a member of the newly constituted London school board. During his brief period of activity in this last position, he probably made a deeper impress on the foundations of national elementary education than any other man. He made war on the scholastic methods which wearied the mind in merely taxing the memory; the children were to be prepared to take their place worthily in the community. Physical training was to be the basis of the curriculum; domestic economy, at any rate for girls, was insisted upon, and for all some development of the aesthetic sense by means of drawing and singing. Reading, writing and arithmetic were the indispensable tools for acquiring knowledge, and intellectual discipline was to be gained through studying the rudiments of physical science. He insisted on the teaching of the Bible, partly for its standing as a great literary heritage, partly because he was "seriously perplexed to know by what practical measure the religious feeling, which is the essential basis of conduct, was to be kept up, in the present utterly chaotic state of opinion in these matters, without its use" (*Essays*, iii, 397), and also because it was "the most democratic book in the world."

In 1872 the School of Mines was moved to South Kensington, and Huxley had, for the first time, appliances for teaching beyond the lecture room. Up to this time he had been able to bring his influence to bear upon his pupils by oral teaching only; but now he was able to design a laboratory course enabling the student to examine for himself the things described in lectures. His system of instruction, for classes of elementary teachers, in the general principles of biology indirectly affected the teaching of the subject throughout the country. In 1892 he was made a privy councilor.

The later years of Huxley's life were mainly occupied with contributions to periodical literature on subjects connected with philosophy and theology. The only approach to certainty which he admitted lay in the order of nature. "If there is anything in the world which I do firmly believe in, it is the universal validity of the law of causation, but that universality cannot be proved by any amount of experience." (*Essays*, ix, 121.) The assertion that "There is only one method by which intellectual truth can be reached, whether the subject-matter of investigation belongs to the world of physics or to the world of consciousness" (*Essays*, ix, 126) laid him open to the charge of materialism, which he vigorously repelled.

From 1880 onward Huxley was occupied in a campaign against orthodox beliefs. In 1885 he formulated "the perfect ideal of religion" in a passage which has become famous: "In the 8th century B.C. in the heart of a world of idolatrous polytheists, the Hebrew prophets put forth a conception of religion which appears to be as wonderful an inspiration of genius as the art of Pheidias or the science of Aristotle. 'And what doth the Lord require of thee, but to do justly, and to love mercy, and to walk humbly with God' " (*Essays*, iv, 161). Two years later he was writing: "That there is no evidence of the existence of such a being as the God of the theologians is true enough" (*Life*, ii, 162). He never really advanced beyond the recognition of "the passionless impersonality of the unknown and unknowable which science shows everywhere underlying the thin veil of phenomena" (*Life*, i, 239), though he insisted that "atheism is on purely philosophical grounds untenable" (*Life*, ii, 162). In its place he put forward the principle of agnosticism (*q.v.*) which involved the subordination of belief to evidence and reason (*Life*, ii, 221).

Huxley's personal creed was a kind of scientific Calvinism. He finally defines that which, "since the second century, has assumed to itself the title of Orthodox Christianity" as a "varying compound of some of the best and some of the worst elements of Paganism and Judaism, moulded in practice by the innate character of certain people of the Western world" (*Essays*, v, 142). He did not omit, however, to do justice to "the bright side of Christianity," and was deeply impressed with the life of St. Catherine of Siena. He contrasted the moral with the aesthetic sense, which he declared to be intuitive, and, in the Romanes lecture for 1893 (Oxford), defined "law and morals" to be "restraints upon the struggle for existence between men in society." Apparently he thought that the moral sense in its origin was institutional and in its development utilitarian. "The cosmic process has no sort of relation to moral ends" (*Essays*, ix, 83); "of moral purpose I

see no trace in nature. That is an article of exclusive human manufacture" (*Life*, ii, 268). The cosmic process gives rise to what is evil in man's moral life, and in the long run will get the best of the contest, and "resume its sway" when evolution enters on its downward course (*Essays*, ix, 45). Huxley's health broke down completely in 1885. In 1890 he moved from London to Eastbourne, where, after a painful illness, he died on June 29, 1895.

In 1855 Huxley had married Henrietta Anne Heathorn, whom he had met during one of the visits of the "Rattlesnake" to Sydney, Austr. Their eldest son, Leonard (1860–1933), was a classical scholar and writer on scientific, educational and literary subjects. Leonard Huxley's eldest son, Julian (1887–), achieved fame as a biologist and writer on science and philosophy and was knighted in 1958; another son, Aldous (1894–1963), also became a well-known writer.

Bibliography.—Huxley's own works include: *Scientific Memoirs*, 5 vol. (1898–1903); *Collected Essays*, 9 vol. (1898); *Diary of the Voyage of H.M.S. "Rattlesnake,"* ed. by Julian Huxley (1935). *See* also L. Huxley, *Life and Letters of Thomas Henry Huxley*, 2 vol., 1st ed. (1900), 3 vol., 2nd ed. (1903); T. H. and Julian Huxley, *Evolution and Ethics* (1947); P. Chalmers Mitchell, *Thomas Henry Huxley, a Sketch of His Life and Work* (1900); E. Clodd, *Thomas Henry Huxley* (1902); J. R. Ainsworth Davis, *Thomas Henry Huxley* (1907); W. Irvine, *Apes, Angels, and Victorians* (1955). (G. DE B.)

HUYGENS (latinized Hugenius), **CHRISTIAAN** (1629–1695), Dutch mathematician, astronomer and physicist, was the founder of the wave theory of light. He was born at The Hague on April 14, 1629. In 1655, Huygens, working with his brother Constantijn on the improvement of the telescope, hit upon a new method of grinding and polishing lenses. The immediate results of the clearer definition obtained were the detection of a satellite of Saturn and the resolution of Saturn's rings into their true form. Huygens was also in 1656 the first effective observer of the Orion nebula; he delineated the bright region still known by his name and detected the multiple character of its nuclear star. His application of the pendulum to regulate the movement of clocks sprang from his experience of the need for an exact measure of time in observing the heavens. The invention dates from 1656. On June 16, 1657, Huygens presented his first "pendulum-clock" to the estates-general; and the *Horologium*, containing a description of the requisite mechanism, was published in 1658.

In 1663 he was elected a fellow of the Royal Society, and delivered before that body in Jan. 1669 a clear and concise statement of the laws governing the collision of elastic bodies.

Huygens had before this time taken up residence in France. In 1665 Jean Colbert, on behalf of Louis XIV, made him an offer too tempting to be refused, and from 1666 to 1681 his stay at the Bibliothèque du Roi was only interrupted by two short visits to his native country. His *magnum opus* dates from this period. The *Horologium oscillatorium* (1673) contained many original discoveries, as well as the first successful attempt to deal with the dynamics of a system. This remarkable treatise also included the determination of the true relation between the length of a pendulum and the time of its oscillation; the invention of the theory of evolutes; the discovery that the cycloid is its own evolute; the ingenious although practically inoperative idea of correcting the "circular error" of the pendulum by applying cycloidal cheeks to clocks. The theorems on centrifugal force in circular motion with which it concluded helped Sir Isaac Newton to formulate his law of gravitation.

In 1681 he returned to Holland. He then spent six years on the production of lenses of enormous focal distance, which, mounted on high poles and connected with the eyepiece by means of a cord, formed what were called aerial telescopes. Three of his object glasses, of respectively 122, 170 and 210 ft. focal length, are in the possession of the Royal society. He also succeeded in constructing an almost perfectly achromatic eyepiece, still known by his name. But his researches in physical optics constitute his chief title deed to immortality. He developed the wave theory of light which had already been adopted by Robert Hooke in 1665; he assumed that all the points of a wave front originate secondary waves, the aggregate effect of which is to reconstitute the primary disturbance at the subsequent stages of its advance, thus accomplishing its propagation; so that each primary wave front is the envelope of an indefinite number of secondary undulations. This resolution of the original wave is the well-known principle of Huygens, and by its means he was able to prove the fundamental laws of optics and to assign the correct construction for the direction of the extraordinary ray in uniaxial crystals. These investigations, together with his experiments on polarization, are recorded in his *Traité de la lumière*, composed in 1678 and published at Leiden in 1690.

Huygens died at The Hague on June 8, 1695, bequeathing his manuscripts to the University of Leiden.

See also references under "Huygens, Christiaan" in the Index volume.

HUYGENS, CONSTANTIJN (1596–1687), the most versatile man of letters and science in the Dutch Renaissance, was born at The Hague on Sept. 4, 1596. There were greater diplomats, scholars, poets, musicians and scientists (his son, Christiaan, was one of them), but he alone made notable contributions in all these fields. He was secretary to three princes of Orange in succession, and his diplomatic service had previously taken him to Venice (1619) and twice to England (1618, 1621–23) where he met John Donne and Francis Bacon and was knighted by James I. He knew seven languages, and his translations of Donne witness to his understanding of his language and poetry. He also spoke at least three Dutch dialects, so that the aristocratic Marinist was also at ease with the bargees near Hofwijck, his country seat. Among his writings, at one extreme stand *Batava Tempe, dat is 't Voorhout van 's-Gravenhage* (1621), the virtuosity of which cannot obscure his affection for his birthplace, and *Costelyck Mal* (1622), a merciless satire of the ostentatious finery of the townswomen which offended his puritanical Calvinism; at the other stand *Scheepspraet* (1625) in the language of the lower deck, and *Trijntje Cornelis* (1653), an earthy farce written with the relish of the man in the street, who is its subject. *De Uytlandighe Herder* (1622), like *'t Voorhout*, praises the countryside, but here Huygens voices his Calvinistic patriotism, writing from London like an exiled psalmist.

Huygens, the wit and connoisseur of words, is at his best in some of the *Sneldichten*. These epigrams are of mixed quality, as might be expected from a man who regarded the making of rhymes and even of poetry as "a small pastime; an accompaniment, I readily admit, to a better occupation." Hence the title of his collection of moral emblems, *Otia of Ledighe Uren* (1625) and the name *Korenbloemen* (1658 and 1672) given to his collected poems. Cornflowers are, by his definition, pleasant little flowers that spring up amidst the wheat produced by his daily labours.

Three works are purely autobiographical: *Dagwerck* (1639), recording his married life; *Hofwijck* (1651), about his life in his country residence (*see* also Jakob Cats's *Zorgh-vliet*); and *Cluyswerck* (1683), describing his latter years in The Hague where he died on March 28, 1687.

Bibliography.—*De gedichten van C. Huygens*, ed. by J. A. Worp, 9 vol. (1892–99); *De briefwisseling van C. Huygens*, ed. by J. A. Worp, 5 vol. (1911–17). *See* A. G. H. Bachrach, *Sir Constantijn Huygens and Some Trends in the Literature and Art of 17th Century England and Holland* (1953); R. L. Colie, *"Some Thankfulnesse to Constantine": a Study of English Influence Upon the Early Works of C. Huygens* (1956). (P. K. K.)

HUYSMANS, the name of three Flemish painters, who matriculated in the Antwerp guild in the 17th century.

Jacob Huysmans (1633?–1696) was born at Antwerp. He went to England toward the close of the reign of Charles II, and competed with Peter Lely as a fashionable portrait painter. Among the portraits executed by him are those of Queen Catherine of Braganza and Izaak Walton. He died in London in 1696.

Jan Baptist Huysmans (1654–1716) was born and died in Antwerp. There are several of his paintings in the museums of Antwerp, Brussels and Munich, representing southern landscapes with figures and cattle.

His elder brother, Cornelius Huysmans (1648–1727), was born at Antwerp and educated by Gaspar de Wit and Jacob van Artois. Cornelius is the only master of the name of Huysmans whose talent was largely acknowledged. He received lessons from

two artists, one of whom was familiar with the Roman art of Nicolas Poussin, while the other inherited the scenic style of the school of Rubens. He combined the two in a rich, highly coloured style, seldom attempting anything but woodside views with fancy backgrounds, half Italian, half Flemish. He first practised at Malines, where he married in 1682. From 1706 to 1717 he lived at Antwerp, and then returned to Malines, where he died on June 1, 1727. According to Walpole, he also visited England. Though most of his pictures were composed for cabinets rather than for churches, he sometimes emulated van Artois in the production of large sacred pieces, and for many years his "Christ on the Road to Emmaus" adorned the choir of Notre Dame of Malines.

HUYSMANS, CAMILLE (1871–), Belgian Socialist writer and statesman, was born at Bilzen, in Belgian Limbourg, on May 26, 1871. After graduating in Germanic philology at Liège, he became a professor, first at the liberal *collège* at Ypres, then at the Atheneum at Ixelles (a suburb of Brussels) and the Université Nouvelle in Brussels. From 1904 till 1921 he was secretary general of the Labour and Socialist International bureau in Brussels. He wrote in *Le Peuple* and other Socialist papers, and, after World War I, started the Flemish *Volksgazet* in Antwerp. Elected to the chamber of deputies in 1910, he sat first for Brussels, then for Antwerp, where he became mayor (1933) and director of the fine arts department. From June 1925 to Nov. 1927 he was minister of education; and in 1936 he was elected president of the chamber of deputies. During World War II he was in London, where he served as vice-chairman of the Belgian parliamentary consultative committee. On returning to Belgium, he was prime minister from Aug. 2, 1946, to March 12, 1947, and minister of education from 1947 to June 1949. From April 1954 to May 1958 he served again as president of the chamber. His publications include: *Soixante-cinq années de domination bourgeoise* (1905); *La Révolution de 1830* (1905); *L'Affiliation des syndicats* (1907); and *Études sur les assurances sociales* (1913). He also re-edited two novels by Charles de Coster, *Stéphanie* (1926) and *Tyl Uilenspiegel* (1927), as well as a Flemish dramatic work of the 18th century, *Don Juan en de vier jaargetyden* (1928), and the *Werken* of M. de Swaen (1928). (JE. D.)

HUYSMANS, JORIS-KARL (1848–1907), French novelist, and one of the most individual yet representative writers of the late 19th century, was born in Paris on Feb. 5, 1848. The only son of a French mother and a Dutch father, he was christened Charles Marie Georges, but when he began writing he adopted what he took to be the Dutch form of two of these names. In 1866 he entered the ministry of the interior, where he remained for 32 years, writing many of his novels on official notepaper and in official time. For a few months before the Franco-German War he also made a show of studying law in his spare time, and lived with a soubrette in a liaison described in his first novel, *Marthe* (1876). His experiences during the war itself, which he spent partly in hospitals suffering from dysentery and partly under fire in the besieged capital, inspired the short story "Sac au dos" (1877, revised 1880) and an unfinished novel, *La Faim*. His first published work, however, was not a novel but a collection of highly coloured prose poems, *Le Drageoir à épices* (1874), reminiscent of Baudelaire and Aloysius Bertrand.

Huysmans then came under the influence of the three contemporary masters of the French novel, Edmond de Goncourt, who inspired *Marthe;* Zola, to whom he dedicated *Les Soeurs Vatard* (1879), an uneventful story of working-class life centred on a bindery in which Huysmans had inherited a half-share; and Flaubert, to whom *En Ménage* (1881), described by its author as a little *Éducation sentimentale*, was a kind of funeral tribute. At this time Huysmans was regarded as one of the most promising members of Zola's Médan group of naturalist writers, and his "Sac au dos" was generally judged the best, after Maupassant's "Boule de Suif," of the group's collection of war stories, *Les Soirées de Médan* (1880). But, like the other members of the group, he soon broke away, asserting his independence in a series of novels too individual in content and violent in style to be classed as naturalist literature.

The first was *À Vau-l'Eau* (1882), the tragicomic story of the culinary and sexual misfortunes of a humble civil servant called Folantin. It was followed in 1884 by *À Rebours*, the account of the more esoteric and aesthetic adventures of a richer and more cultured Folantin, the Duc Jean Floressas des Esseintes, a character who owed something to the eccentric Robert de Montesquiou. *En Rade* (1887), about a married couple's uncomfortable stay in a dilapidated château, combined naturalistic descriptions of rural life with imaginative dream sequences. In *Là-Bas* (1891), Huysmans attempted a more ambitious formal experiment, interweaving a story of 19th-century satanists with a life of the medieval satanist Gilles de Rais (*q.v.*). He also introduced an obviously autobiographical hero called Durtal who was to reappear in his last three novels: *En Route* (1895), an account of Huysmans-Durtal's return to the Catholic Church in a retreat at a Trappist monastery (Notre-Dame d'Igny); *La Cathédrale* (1898), a monumental study of Notre-Dame de Chartres, with a thin story attached; and *L'Oblat* (1903), which told of the expulsion of the monks from the Benedictine abbey (Ligugé, near Poitiers) in the neighbourhood of which Huysmans had lived as an oblate or lay monk from 1899 to 1901.

His major novels have considerable historical significance in that they epitomize the successive phases of the aesthetic, spiritual and intellectual life of late 19th-century France. Thus *À Vau-l'Eau* is permeated with the pessimism of the postwar years and the ideas of the period's favourite philosopher, Schopenhauer; *À Rebours*, which Arthur Symons aptly called "the breviary of the Decadence," expresses the tastes of a whole generation of artists and writers; *Là-Bas* tells of the occultist revival that took place in France in the 1880s; and *En Route* epitomizes the Catholic revival of the '90s which witnessed the conversion of such writers as Paul Claudel, Francis Jammes and Ferdinand Brunetière.

The chief interest and importance of Huysmans' novels, however, lies in their autobiographical quality. Written in an intensely personal, tormented style which bears only a superficial resemblance to the Goncourt brothers' *écriture artiste*, and centred on a vacillating, anguished character who may change his name and social status but is always recognizable as a self-portrait, they tell the story of a protracted spiritual odyssey. In each novel the hero tries to achieve happiness in some form of spiritual and physical escapism: humble contentment and a bachelor's lodgings; artificial pleasures and an aesthete's "refined Thebaid": country life and a decaying château; satanism and a bell-ringer's eyrie; monastic life and a Trappist abbey; provincial life and a cathedral city; and, finally, semimonastic life and a secluded village. Each novel ends on a note of disappointment and revolt, until at last, in *L'Oblat*, Huysmans and his hero admit that escapism is not only futile but wrong, and that one should suffer the trials of life willingly as an expiation of one's sins and the sins of others. Huysmans also expounded his hard-won belief in the value of suffering in a hagiographical work, *Sainte Lydwine de Schiedam* (1901), and exemplified it in his courageous behaviour during the months of pain which preceded his death from cancer of the mouth on May 12, 1907, in Paris.

Huysmans was also one of the most perceptive and sensitive art critics of his time, bringing both contemporary and long-dead artists to the public's attention. His collection of *salons*, *L'Art Moderne* (1883), won him the title of "inventor of Impressionism" from Felix Fenéon (1861–1944); *Certains* (1889) considered such artists as Gustave Moreau, Degas, Cézanne and Whistler; *Trois Primitifs* (1905) included a masterly essay on Matthias Grünewald. His last book was a study of piety and commercialism at Lourdes entitled *Les Foules de Lourdes* (1906).

Among Huysmans' works in English translation are *Against Nature* (*À Rebours*) and *Down There* (*Là-Bas*), both in many editions; *Marthe* (1948 and 1958); *The Cathedral* (1922); *The Crowds of Lourdes* (1925); *Downstream* (*À Vau-l'Eau*) (1952); *En Route* (1920); *The Oblate* (1924); and *Saint Lydwine of Schiedam* (1923).

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HUYSUM, JAN VAN (1682–1749), Dutch painter of still

life and landscapes, was born at Amsterdam on April 15, 1682, and died in his native city on Feb. 8, 1749. He was the son and pupil of Justus van Huysum, who is said to have been expeditious in decorating doorways, screens and vases. His pictures of flowers and fruit, in oil and water colours, were finished in every detail and highly prized during his lifetime. He also painted landscapes with Arcadian scenery. His work may be seen in many European galleries.

HUYTON-WITH-ROBY, an urban district (1895) in the Huyton parliamentary division of Lancashire, Eng., 6 mi. E. of Liverpool. Pop. (1961) 63,089. Though Hitune and Rabil were mentioned in Domesday, the town was not of much importance until its rapid growth as a dormitory area for Liverpool. Preeminently residential, it has industries making cables, hosiery-knitting machines, foodstuffs, vacuum flasks and metal goods. George Stephenson's Liverpool-Manchester railway, which was laid down in 1830 and is probably the second oldest in England, runs through the town.

HVAR (Ital. Lesina), an island in the Adriatic sea forming part of Dalmatia, Croatia, Yugos. Pop. (1961) 12,132. It has an area of 112 sq.mi. and is the longest island in the Adriatic (43 mi. long and from 2 to 5 mi. broad). The island is rocky, the highest hill rising to 2,054 ft. The warm and equable climate lends itself to the successful growing of grapes, olives, figs, dates and locust beans. A popular Dalmatian tourist resort, Hvar also has industries which include the making of rosemary essence and liqueurs, beekeeping, boatbuilding, fishing and marble quarrying. Hvar, the capital (1953 pop. 1,770), and Starigrad (Cittavecchia) are the chief towns and seaports.

Hvar has been a Roman Catholic bishopric since 1145. The island is famous as the home of the two Slav poets, the lyricist H. Lucić (d. 1553) and the more famous P. Hekterović (d. 1572), a democratic noble, several centuries ahead of his time, who devoted his genius to the writing of national songs. Hvar was already inhabited in Neolithic times and possesses Cyclopean walls. In 385 B.C. a Greek colony built a city on the site of the present Hvar and called it Paros (or Pharos). In 228 B.C. Demetrius, the lieutenant of the Illyrian queen Teuta, betrayed the island to the Romans. The Slavs, fleeing from the Avars, settled on the island in the 7th century. Throughout the middle ages and in modern times it has remained purely Slavonic. Since the end of World War I Hvar has belonged to Yugoslavia. (V. De.)

HVIEZDOSLAV: *see* Országh, Pavol.

HWANG HO: *see* Yellow River.

HWICCE, the inhabitants of one of the subkingdoms of Anglo-Saxon England which coincided with the medieval diocese of Worcester, whose bishops sometimes used the title *episcopus Hwicciorum*. It therefore included Worcestershire, Gloucestershire and southwest Warwickshire. The Hwicce have left their name in Wychwood forest, once a much greater stretch of woodland than now. The southern part of their territory was acquired from the Britons by the West Saxons after Ceawlin's victory at Dyrham in 577; archaeological evidence and that of place names suggest that the northern part was settled by Anglian peoples from the east. It is probable that the whole area was united and brought under Mercian power by the agreement between Penda (afterward king of Mercia) and Cynegils of Wessex after the battle of Cirencester in 628. Its first recorded local rulers, Eanfrith and Eanhere, are mentioned shortly before 675. Osric, king of the Hwicce, appears in the last decade of the 7th century; he and his brother Oswald are shown by a charter to have been subject to Aethelred, king of Mercia (674–704). Also subject to the king of Mercia was Osric's successor, Oshere, whose four sons, Aethelheard, Aethelweard, Aethelberht and Aethelric, followed him and also ruled under Mercian overlords. In Offa's reign (757–796) three brothers, Eanberht, Uhtred and Aldred, ruled jointly as subkings, but after *c.* 780 the royal title seems to have been given up. The district remained under Mercian control until the end of that kingdom between 877 and 883. No genealogy of its kings survived, and it is improbable that they traced their descent to Woden. Osric and Oswald founded the monastery of St. Peter at Gloucester. Osric is said to have founded a nunnery at Bath. (D. Wk.)

HYACINTH (Jacinth), one of the most popular of spring garden flowers (Liliaceae or lily family). It was in cultivation prior to 1597, at which date it is mentioned by the herbalist John Gerard. By the middle of the 18th century about 50 single-flowered varieties and nearly 100 double-flowered ones were described as a selection of the best from the catalogues of two celebrated Dutch growers. One of the Dutch sorts, called La Reine de Femmes, a single white, is said to have produced from 34 to 38 flowers in a spike, and on its first appearance to have sold for 50 guilders a bulb; while one called Overwinnaar, or Conqueror, a double blue, sold at first for 100 guilders, Gloria Mundi for 500 guilders and Koning Saloman for 600 guilders.

ROCHE

HORTICULTURAL FORM OF COMMON HYACINTH (HYACINTHUS ORIENTALIS)

The original of the cultivated hyacinth, *Hyacinthus orientalis,* a native of Greece and Asia Minor, is by comparison with these an insignificant plant, bearing on a spike only a few small, narrow-lobed, washy blue flowers, resembling in form those of the common English bluebell. So great has been the improvement effected by the florists, and chiefly by the Dutch, that the modern hyacinth would scarcely be recognized as the descendant of the original. The spikes are long and dense, composed of a large number of flowers; spikes produced by strong bulbs not infrequently measure six to nine inches in length and from seven to nine inches in circumference, with the flowers closely set from bottom to top. Size of the individual flowers and the breadth of their recurving lobes have been much increased, and the colours have gained in brilliancy and depth.

The cultivation of hyacinths is easy, for the purchased bulbs already contain a well-developed flower bud and sufficient nourishment to ensure flowering the following spring, even when grown in pebbles and water. The bulbs, which need a winter chilling, should be planted in late autumn for bloom the following spring. Any ordinary garden soil will do, but if it is enriched with well-rotted manure the results are improved. The manure should be put at the bottom of the hole and covered with an inch of soil, for no manure should directly touch the bulb. Bulbs should be planted five or six inches deep and spaced eight to ten inches apart. In severe climates the beds should be covered with a winter mulch of straw or strawy manure, which should be removed in early April in the U.S. (earlier in England).

Most of the older varieties of hyacinth were single flowered and among the most fragrant of all garden flowers. The fad for double-flowered sorts, of which many were developed, led to a coincident loss of fragrance. Most modern varieties are again single flowered and their fragrance is generally superb. The single-flowered sorts produce more regular and symmetrical spikes of blossom, the flowers being closely set and more or less horizontal, whereas in most of the double sorts the bells are distant and pendent, so that the spike is loose and by comparison an ineffective display.

Originally blue, the hyacinth can now be had in white, pink, mauve and various shades of blue from pale to porcelain. The Roman hyacinth (*H. orientalis albulus*) is less hardy than the common sort and has two or three flower stalks to each plant. The other species of *Hyacinthus* (perhaps 29), native to the Mediterranean region and Africa, are of little horticultural interest.

For other plants with "hyacinth" in their names, *see* Grape Hyacinth; Scilla; Water Hyacinth. (N. Tr.)

HYACINTH or Jacinth, in mineralogy, a variety of zircon (zirconium silicate) of yellowish-red colour, used as a gem stone. Hyacinth is not a common mineral. It occurs, with other zircons, in the gem gravels of Ceylon, and very fine stones have been found as pebbles at Mudgee, N.S.W. Most of the gems known in trade

as hyacinth are only garnets, generally the deep orange-brown hessonite or cinnamon stone. The stones known as Compostella hyacinths are simply ferruginous quartz from Santiago de Compostella, Sp. For composition and characters *see* ZIRCON.

(L. J. S.; X.)

HYACINTHUS, in Greek legend, a young man (parentage variously given) of Amyclae in Laconia. According to the general story, which is probably late and composite, his great beauty attracted the love of Apollo, who killed him accidentally when teaching him to throw the discus (quoit); others say that Zephyrus (or Boreas) out of jealousy deflected the quoit so that it hit Hyacinthus on the head and killed him. According to the representation on the throne of Apollo at Amyclae he was translated into Heaven with his virgin sister Polyboea. Out of his blood there grew the flower called *hyacinthos* (perhaps a fritillary; not our hyacinth), the petals of which were marked with the mournful exclamation *AI, AI* ("alas"). It was also said to have sprung from the blood of Ajax, son of Telamon.

The death of Hyacinthus was celebrated at Amyclae by the second most important of Spartan festivals, the Hyacinthia, which took place in the Spartan month Hyacinthius. What month this was is not certain. Arguing from Xenophon (*Hellenica*) we get May; assuming that the Spartan Hyacinthius is the Attic Hecatombaion, we get July; or again it may be the Attic Scirophorion, June. At all events the Hyacinthia was an early summer festival. It lasted three days, and the rites gradually passed from mourning for Hyacinthus to rejoicings in the majesty of Apollo. This festival is clearly connected with vegetation, and marks the passage from the youthful verdure of spring to the dry heat of summer and the ripening of the grain.

There can be little doubt that Hyacinthus is a pre-Hellenic god. His name is not Greek. The precise relation that he bears to Apollo is obscure. The supposed "tomb of Hyacinthus," which forms the base of the monument of Apollo at Amyclae, described by Pausanias, may be taken as evidence of his subordination to the greater god. Into the "tomb" at Amyclae were put offerings for the hero, before gifts were made to the god. This and the taboo on cereals during the first part of the Amyclean festival suggest an underworld vegetation deity whose death is mourned like that of Adonis. Sir James Frazer suggests that he may have been regarded as spending the winter months in the underworld and returning to earth in the spring when the "hyacinth" blooms. With the growth of the hyacinth from his blood should be compared the oriental stories of flowers springing from the blood of Attis (*q.v.*) and from that of Adonis (*q.v.*).

HYADES, "the rainy ones," a group of five stars in the head of the constellation Taurus, the bull. In Greek mythology they were maidens, sisters of the Pleiades (*q.v.*), who nursed the infant wine-god Dionysus and as a reward were placed among the stars. According to another version, they lamented so bitterly the death of their brother Hyas while hunting that Zeus, out of compassion, changed them into stars. Their name is derived from the fact that their rising at the same time as the sun was supposed to presage rain. The Romans derived the name from *hys* ("pig") and translated it by *suculae* ("piglets").

HYATT, ALPHEUS (1838–1902), U.S. zoologist and paleontologist who achieved eminence in the study of invertebrate fossil records, was born at Washington, D.C., on April 5, 1838. He studied at Harvard (1858–62) under Louis Agassiz and in 1863 served as a volunteer in the Civil War, attaining the rank of captain. In 1867 he was appointed curator of the Essex institute at Salem, Mass., and in 1870 became professor of zoology and paleontology at the Massachusetts Institute of Technology (resigned 1888) and custodian of the Boston Society of Natural History (curator in 1881). In 1886 he was appointed assistant for paleontology in the Cambridge museum of comparative anatomy, and in 1889 was attached to the United States geological survey as paleontologist. Hyatt rose to foremost rank among U.S. investigators in the field of invertebrate paleontology. He was a founder and editor (1867–71) of the *American Naturalist* and was the chief founder of the American Society of Naturalists, acting as first president in 1883. He also took a leading part in establishing the marine biological laboratories at Annisquam and Woods Hole, Mass. Hyatt died at Cambridge on Jan. 15, 1902.

His works include *Observations on Polyzoa* (1866); *Fossil Cephalopods of the Museum of Comparative Zoology* (1867); *Revision of North American Porifera* (1875–77); *Genera of Fossil Cephalopoda* (1883); *Larval Theory of the Origin of Cellular Tissue* (1884); *Genesis of the Arietidae* (1889); and *Phylogeny of an Acquired Characteristic* (1894). He wrote the section on Cephalopoda in Karl von Zittel's *Paläontologie* (1900), and his valuable study on the fossil pond snails of Steinheim, "The Genesis of the Tertiary Species of Planorbis at Steinheim," appeared in the *Memoirs* of the Boston Natural History society in 1880.

HYBLA, the name of three towns in Sicily of the pre-Greek Sicels or Siculi. Originally the most important was Hybla Maior, near modern Melilli, where numerous Sicel tombs have been found, about 4 mi. S.W. of Megara Hyblaea (*q.v.*). It was this Hybla that was famous for its honey. Another Hybla, known as Hybla Minor or Geleatis, is probably represented by the modern Paternò on the southern slopes of Mt. Etna, with its conspicuous medieval castle. Various remains have been found, especially tombs of the Sicel period; there are also Roman remains, two arches of a bridge, remains of baths, cisterns, etc. The third, less important, was Hybla Heraea on the site of the modern Ragusa.

See T. J. Dunbabin, *The Western Greeks*, p. 144 (1948).

HYBRIDISM. A hybrid or mongrel is the offspring of a cross between dissimilar parents; *e.g.*, belonging to different species or to very distinct races, varieties or breeds. Such crosses used to be regarded as something base and evil, hence the word "hybrid" is derived from a Greek word meaning "insult" or "outrage." In genetics, any individual heterozygous for one or more genes or chromosome structures is, however, called a hybrid (*see* HEREDITY). In this wider sense, almost all individuals of sexually reproducing organisms, including man, are hybrids, because their parents usually differ in several genes. Hybridism is a corollary to sexual reproduction. Only where self-fertilization is the rule (as in wheat) can many individuals be homozygous or "pure" (*i.e.*, carrying like genes for any certain character) and, hence, nonhybrid.

Hybridism is biologically very important because it permits accumulation in natural populations of sexually reproducing organisms of hereditary variability. This variability may be compared to a store of raw materials from which evolutionary changes are built. Yet, hybridization of forms which possess genetic systems adapted to different environments or living conditions results in emergence of disharmonious and ill-adapted types. Hybridism is in general favourable on lower levels of evolution but unfavourable on higher levels.

Hybrid Vigour or Heterosis.—Customs and laws which forbade inbreeding (marriage of close relatives) have existed in many countries since antiquity. Their biological justification lies in the fact that the offspring of matings of close relatives are frequently inferior in vigour to crossbred individuals. The extent of the deterioration of the viability produced by inbreeding varies in different organisms. In maize, no inbred lines equal crossbred strains in vigour or yield. In man, inbreeding is generally deleterious, yet marriages of brothers and sisters practised in some royal families of Egypt and Peru allegedly led to no undesirable results. Many plant species reproduce mostly or exclusively by self-fertilization, which is the closest possible form of inbreeding. Crossing of inbred lines is followed in the immediate offspring by hybrid vigour or heterosis; *i.e.*, by restoration of the vigour lost during inbreeding. The extent of heterosis is, as expected, proportional to the degree of harmfulness of inbreeding in the same species or race (*see* INBREEDING).

To account for the observed effects of inbreeding and crossing, G. F. Shull (1908) and D. F. Jones (1917) postulated that normally crossbred strains carry unfavourable recessive genes in heterozygous condition, covered up by their more favourable dominant alleles. In different lines different unfavourable recessives become homozygous because of inbreeding. Intercrossing of the inbred lines results, therefore, in the deleterious recessives becoming again concealed by heterozygosis, hence the restored vigour in the hybrid. A proof of this hypothesis was obtained two

to three decades after its formulation, chiefly through genetic analysis of natural populations of *Drosophila* (*q.v.*) flies. Almost every individual in such populations carries deleterious recessive genes, often recessive lethals, concealed in heterozygous condition. In the homozygous condition recessive lethals often cause the death of an organism in an early stage of development. There is no doubt that human populations are comparable in this respect to populations of *Drosophila* flies; at any rate, numerous hereditary defects appear much more frequently in the offspring of consanguineous marriages than in marriages between persons not known to be related.

The surprising fact that deleterious recessive genes accumulate in natural populations of organisms is explained very simply. Mutations occur in all organisms, and most mutations are known to be unfavourable to their carriers. Unfavourable dominant and semidominant mutants are rapidly eliminated by natural selection. The fate of the unfavourable recessives depends upon the reproductive biology of the organism in question. Where self-fertilization or mating of close relatives is the rule (as in wheat and many other plants), the recessive defects become homozygous and are eliminated soon after their appearance by natural selection. In such organisms inbreeding is not deleterious and outbreeding is not accompanied by heterosis. Where consanguineous matings are rare, unfavourable recessive mutants are protected, or "sheltered," from natural selection by their dominant alleles, and, therefore, are allowed to accumulate in the populations. Here inbreeding is deleterious and heterosis clearly pronounced.

Heterosis is taken advantage of in plant and animal breeding. The development of hybrid corn in the United States is a striking application of the modern science of heredity to agriculture. Hybrid corn is the first generation hybrid between two inbred lines of maize. The average increase in yield in hybrid corn, compared to the open-pollinated varieties (from which the inbred lines giving rise to the hybrid were obtained), is between 15% and 20%, and some increases up to 35% have been recorded.

G. Dahlberg (1938) surmised that the increase of the average stature of the human populations observed in many countries for more than a century may be due, in part, to heterosis. Inhabitants of sparsely populated country districts may be somewhat inbred. The development of communications and increasing population densities led to wide intercrossing of human strains, to increased hybridity and to heterosis.

Isolating Mechanisms.—Hybridization of species of sexually reproducing organisms is restricted or prevented by a variety of isolating mechanisms. The simplest of these is geographic isolation—related forms inhabit different territories and their meeting and mating are hindered or excluded by their separation. Geographic isolation prevents the interbreeding not only of distinct species but of races and colonies of the same species as well. Human races were geographically isolated before the advent of civilization and even now the fusion of races is hindered somewhat by separation.

Reproductive isolation is the common name for isolating mechanisms other than geographic isolation. Complete reproductive isolation indicates distinction of species, but its rudiments may occur even between races. The principal kinds of reproductive isolation are as follows.

Ecological Isolation.—Representatives of different species may lack the opportunity to hybridize because, though they share the same geographic area, they occupy different habitats and seldom or never come in contact. Thus, some pairs of related plant species in England differ in that one member occurs only on soils with high and the other with low lime content.

Seasonal Isolation.—Related species may have different and nonoverlapping breeding or flowering seasons.

Sexual or Psychological Isolation.—When sexually mature representatives of related species occur in the same milieu, matings between individuals which belong to the same species occur more readily than those between different species. Absolute aversion from copulation with individuals of foreign species is very common; on the other hand, instances are known where distinct species which do not normally occur together intercross readily if artificially placed next to each other. Causes which make interspecific matings repugnant are diverse. Differences in specific scents are undoubtedly important in many insects. Differences in songs may play an important role among birds. The courtship techniques are more or less fixed within a species but different between species. In many spiders, insects, mollusks, fish and birds courtship develops into highly complex rituals which make species recognition secure. In some instances the psychological barriers to crossing can be overcome by conditioning and training.

Mechanical Isolation.—Differences in the structures of the genitalia or of other body parts which play a role in the sexual act may prevent normal coitus and sperm delivery. This is particularly true among insects and other arthropods with chitinous genitalia. Differences in the flower structures and scents among species of plants are analogues of the mechanical and sexual isolations on the animal level.

Incompatibility of the Sex Cells.—Failure of hybridization may be caused by spermatozoa of one species not being normally viable in the sexual ducts of another, or not being attracted to the foreign egg cells. Failure of the pollen of one species to develop pollen tubes on the stigma or in the style of another is a very important isolating mechanism in higher plants.

Hybrid Inviability.—The development of the organism produced by the union of sex cells of different species may be abnormal, and terminate in death at any stage of the life cycle. Yet, some species hybrids (*e.g.*, the mule) are not inferior in bodily vigour to the parental species, and may even exhibit the phenomenon of heterosis. The death of the hybrids is sometimes caused by relatively minor disturbances, the proper treatment of which may allow the hybrids to survive. Thus, some plant hybrids can be brought to maturity by excising the embryos from the seeds and cultivating them for a time on artificial media.

Hybrid Sterility.—Species hybrids often fail to produce mature sex cells (*e.g.*, the mule), or these sex cells give rise to poorly viable offspring in the next generation. Sterility of a hybrid is not necessarily an accompaniment of constitutional weakness—some weak hybrids are fertile and some vigorous ones sterile. Causes underlying hybrid sterility fall into at least two categories: chromosomal sterility (attributable to differences in the gene arrangements in the chromosomes of the parental species) and genic sterility (produced by the gene composition of the hybrid).

It should be understood that species are kept apart in nature by different isolating mechanisms or combinations of isolating mechanisms. Thus, sexual isolation is important in species of *Drosophila* flies but not among species of toads. Hybrid sterility is not necessarily a mark of species distinction; hybrids between some unquestionably good species are fertile (*e.g.*, between mallard and pintail ducks). Any reproductive isolating mechanism has, however, the same biological end effect: prevention of hybridization, and consequently of gene exchange, between species.

See also ANIMAL BREEDING; PLANT BREEDING; and references under "Hybridism" in the Index volume.

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HYDASPES, BATTLE OF THE. This battle was fought on the left (*i.e.*, eastern) bank of the Hydaspes (Jhelum) river in 326 B.C. between Alexander the Great of Macedonia and Porus, ruler of the territory between the Jhelum and the Chenab (anc. Acesines) rivers, in what is now northeastern Pakistan. (For the events leading up to the engagement and the composition of Alexander's army, *see* ALEXANDER III, the Great.) When the Macedonians arrived at the right bank of the Hydaspes they found Porus and his army drawn up on the opposite bank. The summer rains were beginning and the river was thought to be then unfordable. Nevertheless Alexander decided to keep Porus constantly on the alert; on successive nights, noises and signs of activity were made at various points along the bank. Every night Porus would hurry to discover if a crossing had been started; eventually he relaxed his vigilance. The fact of provisions being

stocked and other preparations by the Macedonians persuaded him that no crossing would be attempted during the rainy season.

In the meantime Alexander found, about 17 mi. upstream, a suitable fording place where a thickly wooded island lay near the opposite bank. The boats, which had been brought in sections from the Indus, were assembled there; Craterus with part of the army was posted on the right bank opposite Porus with instructions to cross only when the opposite bank was clear of elephants. Other detachments of mercenaries were posted along the right bank.

On the night chosen for fording the Hydaspes a violent storm drowned all the sounds of embarking of the army, said by Arrian to number 6,000 infantry and 5,000 cavalry. When in the morning Porus learned that troops had arrived on his side of the river, he sent his son with a small contingent which Alexander defeated; Porus' son was killed.

The dispositions of the two armies were as follows: Porus had 200 of his elephants drawn up in the centre with gaps between them; behind them and in line with the gaps, the infantry, and more infantry extending beyond the elephants on each wing; his cavalry were on the flanks with chariots in front. According to Arrian his force numbered about 4,000 cavalry and 30,000 infantry. Alexander had a picked cavalry group drawn up on the right, including the *agema* of the Companions and a battalion under Coenus, both screened by mounted archers. The heavy infantry was in the centre, consisting of a portion of the phalanx (the rest was with Craterus) including the *agema*, the hypaspists on the right under Seleucus and light infantry on either wing.

Alexander's cavalry was untrained to face elephants and could therefore be used only against Porus' cavalry, leaving the infantry to deal with the elephants. His first aim was to draw Porus' left-wing cavalry away from the infantry (and from the elephants); he therefore moved to the right with part of his cavalry against Porus' left-wing cavalry, sending round the mounted archers against the left of Porus' infantry. Coenus with the rest of the cavalry, first making a feint toward Porus' right, swung around behind Porus' right wing. Porus' cavalry turned left to meet Alexander; Coenus took them in the rear and when they reformed Alexander charged them, driving them back toward their infantry. Porus then sent round the cavalry from his right wing and turned his infantry and elephants against Alexander's cavalry. At this point Seleucus led the Macedonian infantry against the elephants and encircled them, while Alexander defeated the cavalry which had come round from the Indian right wing. The elephants, breaking out from the circle of Macedonian infantry, trampled Macedonians and Indians indiscriminately, and eventually backed riderless into the Indian ranks. The Macedonian phalanx, advancing with interlocked shields, routed the enemy, supported by the mercenaries and the rest of the force under Craterus which had at last crossed the river. There are no reliable figures for the losses on either side.

Alexander confirmed Porus in his kingdom and founded on either bank of the Hydaspes the cities of Nicaea and Bucephala.

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HYDATID, the cyst stage (fluid-filled sac containing larvae) of the tapeworm *Echinococcus*, a parasite of man and other mammals. *See* TAPEWORMS; PARASITOLOGY: *Tapeworms*.

HYDE, the name of an English family that attained great distinction and influence during the 17th century, descended from Robert Hyde of Cheshire. The children of Lawrence, Robert Hyde's third son, included Henry, father of Lord Chancellor Clarendon (*see* CLARENDON, EDWARD HYDE, 1st Earl of). Sir Lawrence Hyde, who was attorney general to Anne of Denmark, and Sir Nicholas Hyde (d. 1631), chief justice of the king's bench. Sir Nicholas was an undistinguished lawyer who entered parliament in 1601 and later abandoned the opposition for the court party. He prepared the duke of Buckingham's defense in the projected impeachment of 1626, became chief justice in 1627 and was one of the judges who condemned Sir John Eliot in 1629.

Sir Lawrence, the attorney general, had 11 sons, including Robert (1595–1665), a prominent royalist member of the Long parliament, who gave refuge to Prince Charles after the battle of Worcester (1651), was knighted at the Restoration and became chief justice of the king's bench in 1663; Alexander (1598–1667), who became bishop of Salisbury; and Edward (1607–59), theologian and writer.

The two surviving sons of Lord Chancellor Clarendon were Henry (1638–1709), 2nd earl of Clarendon, and Lawrence, earl of Rochester (*q.v.*). His daughter Anne (1637–71) was the first wife of James, duke of York (afterward James II). Anne was born near Windsor on March 12, 1637. She was in exile with the royalists after 1649 and became maid of honour to the princess of Orange in 1654. During this period she met the duke of York, whom she married privately, on Sept. 3, 1660. The marriage had considerable political repercussions and was a great embarrassment to Clarendon. Anne, who became a secret convert to Roman Catholicism in 1670, died on March 31, 1671; her two surviving children, Mary and Anne, succeeded in turn to the throne.

HYDE, CHARLES CHENEY (1873–1952), U.S. authority on international law, was born in Chicago, Ill., on May 22, 1873. He was educated at Yale (A.B., 1895; A.M., 1898) and Harvard law school (LL.B., 1898). After engaging in private practice, and teaching at Northwestern university law school, Chicago, Hyde was appointed to the Hamilton Fish professorship of international law and diplomacy at Columbia university, New York city, which he occupied from 1925 to 1945.

He was a member of the panel known as the Permanent Court of Arbitration at The Hague, an editor of the *American Journal of International Law*, president of the American Society of International Law and a member of the Institut de Droit International. As solicitor for the U.S. department of state, he was responsible for drafting, in 1923, what became a model treaty of commerce and navigation. His private practice included the representation of several governments.

Hyde's major treatise, *International Law Chiefly as Interpreted and Applied by the United States* (1922; rev. ed., 1945), was often cited by courts and international tribunals. Richly documented, it became the standard work mirroring the United States approach. For the future he concluded that the price of peace might prove to be the gradual and ultimate vesting of all military power in some international security organization. He died in New York city, Feb. 13, 1952. (J. N. HE.)

HYDE, DOUGLAS (also known as DUBHGHLAS DE HÍDE, the Irish form of his name, and as "An Craoibhín Aoibhinn," a pen name) (1860–1949), Irish scholar and writer and first president of Eire, was born at Frenchpark, County Roscommon, on Jan. 17, 1860, and educated at Trinity college, Dublin, where he graduated in 1884. He became the first professor of modern Irish in University college, Dublin, when it was founded in 1909 and held the chair until his retirement in 1932. He published many works of scholarship, of which the most important are *The Love Songs of Connacht* (1893) and *A Literary History of Ireland* (1899), but academic work was for him only one aspect of the struggle for the preservation and extension of the Irish language, in which he was the outstanding figure from 1893, when he founded the Gaelic league, until 1922, when the setting up of the Irish Free State accorded Irish an equal status with English. During this period he avoided political activity and in 1915 resigned the presidency of the Gaelic league, which he had held since its foundation, when it became clear that it had become a separatist organization. He was a member of the senate of the Irish Free State for a short time and, in 1938, when a new constitution created the office of president of Ireland, Hyde was the unanimous choice of all parties and was elected unopposed for a seven-year term. He vacated the presidency in 1945 and died in Dublin on July 12, 1949.

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HYDE, a market town and municipal borough (1881) in the Stalybridge and Hyde parliamentary division of Cheshire, Eng., 7½ mi. E. of Manchester. Pop. (1961) 31,741.

Standing on the Peak Forest canal and on the Tame, which divides it from Lancashire, it has grown up with the establishment of the cotton industry, though the Hyde family held the manor as early as the reign of John. Besides the staple cotton trade there are heavy and light engineering and factories for making rubber, leather, leather cloth, hats, paper, ice cream, etc., and there are coal mines in the vicinity. Werneth Low, on the edge of the Pennines, 1½ mi. S., was bought by the borough as a war memorial.

HYDE DE NEUVILLE, JEAN GUILLAUME, Baron (1776–1857), French diplomat and statesman of the Restoration, a devoted Legitimist, was born at La Charité-sur-Loire (Nivernais) on Jan. 24, 1776, of an English family which had emigrated with the Stuarts after the rebellion of 1745. From 1793 he was an active agent of the exiled Bourbon princes. He took part in the royalist rising in Berry in 1796 and, after the *coup d'état* of 18 Brumaire (Nov. 9, 1799), tried to persuade Napoleon Bonaparte to recall the Bourbons. After an accusation of complicity in the Infernal Machine conspiracy (1800–01), subsequently retracted, Hyde de Neuville went to the United States (1806), returning after the first Bourbon Restoration (1814).

Hyde de Neuville's mission from Louis XVIII to induce the British government to transfer Napoleon to a safer place of exile than Elba was cut short by Napoleon's return to France in March 1815. Under the second Restoration he was ambassador at Washington from 1816 to 1822. In 1823 he was made ambassador to Lisbon, but his action at the time of the *coup d'état* of Dom Miguel (April 30, 1824) was disapproved in Paris and he was recalled in 1825. He opposed the policy of the comte de Villèle's cabinet in the chamber as deputy for Nièvre and, in 1828, became minister of marine in the vicomte de Martignac's moderate administration. During the ministry of Jules de Polignac (1829–30) he was again in opposition, being a firm upholder of the charter of 1814, but after the revolution of July 1830 he entered an all but solitary protest against the exclusion of the legitimate line of the Bourbons from the throne and resigned his seat, to retire to his house at Lestang (Cher). He died in Paris on May 28, 1857. His *Mémoires et souvenirs* were compiled from his notes by his nieces, the vicomtesse Pauline de Bardonnet and the baronne Isabelle Laurenceau (3 vol., 1888–92; Eng. ed., abridged, 2 vol., 1913).

HYDE PARK, a township and unincorporated village of Dutchess county, N.Y., U.S., is located on the east side of the Hudson river about 80 mi. N. of New York city and includes the land that formerly comprised the estate where Pres. Franklin Delano Roosevelt was born and is buried. Part of the estate, including the Roosevelt family home and the graves of the president and his wife, is a national historic site. Adjacent to this is the Franklin D. Roosevelt library, containing more than 30,000 books, a museum, the president's papers and the papers of many of his contemporaries and associates. It also houses collections of material on U.S. history and politics from 1910 to 1945, U.S. naval history and New York colonial history.

The township, established in 1821, may have taken its name from an estate called after Edward Hyde, Viscount Cornbury, governor of New York (1702–08). The Frederick W. Vanderbilt mansion, constructed on this property in 1898, and the Vanderbilt estate are now a national historic site and arboretum. The village was originally named Stoutenburg's Landing after the first white settler, who arrived in 1741. It is chiefly a residential village. (E. M. A.)

HYDERABAD, a former princely state of India, a successor to the Muslim sultanates of Berar, Bijapur, Bidar and Golconda. (For geography and prehistory *see* Deccan.) In 1951 its area was 82,168 sq.mi. and its population 18,655,108. On Nov. 1, 1956, it was divided among the states of Andhra Pradesh, which took the Telangana districts; Mysore, which took the Kannada-speaking districts; and Bombay.

Nizam ul-Mulk (Mir Qamr ud-Din), though a Muslim, succeeded to the responsibilities, north of the Krishna and Tungabhadra rivers, of both the former Bahmani and Vijayanagar rulers and their successors, and it is a tribute to the dynasty's government that the Hindu subjects made no effort to evict the Muslim aristocracy by allying themselves to the Marathas, to Mysore or to the European powers. Mir Qamr ud-Din became viceroy of the Deccan in 1713 under the emperor Farrukhsiyar. With the title Asaf Jah, he became virtually independent in 1724. The British and French participated in the war of succession that followed his death in 1748. With the help of the marquis de Bussy-Castelnau and French troops, Salabat Jang, the third son, gained the throne, leasing the Northern Circars (*see* Circar) to the French. Nizam Ali, a younger brother, deposed Salabat Jang in 1761 and threatened the Carnatic. The British acquired a nominal title to the Circars in 1765, repulsed the Hyderabad forces, took Nizam Ali under their protection and recovered possession of the Circars. After temporarily siding with Haidar Ali (*q.v.*) in 1767, the nizam accepted British ascendancy in the treaty of Masulipatnam (1768) and from 1778 a British resident and subsidiary force were installed in the nizam's dominions. In 1795 Nizam Ali Khan lost territories, including parts of Berar, to the Marathas. Turning to the French, he incurred Lord Wellesley's displeasure, and the subsidiary force or "contingent" was increased. The nizam's territorial gains as ally of the British against Tipu Sultan in 1792 and 1799 were ceded to the British to meet the cost of that force. Surrounded by territory owned by or dependent upon the British, except on the west, his own independence was confirmed. As ally in the second and third Maratha wars he gained land in Berar, but the nizam Nasir ud-Daula was obliged in 1853 to assign Berar to the East India company to pay for the contingent. In 1860 the nizam's adherence to the British during the Indian mutiny was rewarded, and in 1912 Berar was leased permanently to British India on advantageous terms. In 1918 Nizam Mir Osman Ali was given the title "His Exalted Highness." The government of India retained the right to intervene in case of misrule. Though peaceful, Hyderabad was regarded as a backward state, but cultural and economic development made strides in its last years. In the legislative assembly set up in 1946 the Muslims, though only 15% of the population, had a majority over the Hindu representatives.

On partition of the Indian subcontinent in 1947 the Muslims naturally looked toward Pakistan, but the nizam elected to "resume" independent status. On Nov. 29, 1947, he signed a standstill agreement with India to last one year, and Indian troops were withdrawn. But Hyderabad raised difficulties about contributions to defense; banned Indian currency; attempted to appoint agents in foreign countries and to obtain a loan from Pakistan; and failed to improve the political position of Hindu inhabitants. The Razakars, an irregular army under Kasim Razvi, pledged to secure Muslim supremacy in the Deccan, harried border villages. India insisted upon accession of Hyderabad to India but the nizam appealed to King George VI. On Sept. 13, 1948, Indian troops entered the state, the Razakars were dispersed, the nizam capitulated on the 17th and the state's accession to India was achieved. After a period of military and provisional civil government, during which much of the nizam's legislation was abrogated, a popular ministry and legislature were set up in March 1952, Osman Ali becoming *rajpramukh*. Berar had been merged with Madhya Pradesh.

From 1943 Communists had created disorder. Subsequently they allied themselves to the Razakars, and between 1948 and 1952 they defied normal administration in the backward Telangana districts. The government of India, however, employing armed police and forces from Madras and Madhya Pradesh, subdued these insurgent elements before reorganization in 1956.

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HYDERABAD, a city and district located in Andhra Pradesh state, India. The city, capital of the state and once capital of the former Nizam's dominions, is situated on the river Musi, a tributary of the Krishna, with Golconda 5 mi. to the west, and the city and cantonment of Secunderabad 6½ mi. to the northeast. Pop. (1961) 1,251,119 including suburbs and cantonment. It was

PAUL POPPER LTD.

VIEW OF HYDERABAD SHOWING THE CHAR MINAR WITH FOUR MINARETS AT FAR RIGHT

founded in 1589 by Mohammed Kuli, fifth of the Qutb Shahi kings. The Char Minar, or four minarets, a stately rectangular building built in 1591 and 180 ft. high, stands in the centre of the old city with four roads radiating from its base. The Ashur Khana (1594), a ceremonial building, the Gosha Mahal (palace), the Jamma Masjid and the Mecca mosque, a sombre building designed after a mosque at Mecca, are the other principal buildings of the Qutb Shahi period, though the mosque was only completed in the time of Aurangzeb. The city proper was surrounded by a stone wall with 13 gates, finished in the time of the first nizam, who made Hyderabad his capital. The wall was demolished for the city's improvement and extension. There are several palaces built by various nizams, the Falaknuma palace being the finest. The former British residency stands in a large park on the left bank of the Musi. The bazaars round it are picturesque. Five bridges cross the Musi, the most notable of which is the Purana Pul (old bridge) of 23 arches, built in 1593, which withstood the flood in 1908, when the river swept away all the other bridges. The four bridges built after the flood are the Naya Pul (the new bridge), the Chaderghat bridge, the Musallam Jung bridge and the railway bridge. Modern buildings are the Osmania university, the high court, the Osmania general hospital, the city college, the Asafia state library, the state archaeological museum and art gallery. The Salar Jung museum contains rare works of art. The Osman sagar, the Himayat sagar, the Hussain sagar and Mir Alam tank are the chief reservoirs in and around the city. The Hussain sagar (area 4 sq.mi.) is older than Hyderabad city and was built in 1562 in the reign of Ibrahim Qutb Shah.

The Osmania university, founded in 1918, is unique among Indian universities in that Urdu was the medium of instruction from its inception, English being taught as a compulsory second language. After the merger of the state into the Indian union English took the place of Urdu as a medium of instruction. The university has a number of component colleges.

Hyderabad is also a great centre of trade and commerce. Cloth mills and cigarette, match and glass factories are located there. The city is linked to Secunderabad by the bund (embankment) across the Hussain sagar which carries a fine road. It is well served by rail and road. Air services operating from the Begumpet airport link it with all the major cities of India.

HYDERABAD DISTRICT (area 2,988 sq.mi.; pop. [1961] 2,062,995) was formed after the accession of Hyderabad to India from parts of the nizam's *sarf-i-khas* or private estate and other privilege areas. There are more than 200 large- and small-scale industries in the district, including textile mills and match, glass and clay works. (S. AH.)

HYDERABAD, a city and cantonment, *taluka*, district and division in the Sind region of West Pakistan. The city, administrative headquarters of the district and division, lies 90 mi. E.N.E. of Karachi on the most northerly hill of a limestone ridge, called Ganjo Takkar, which runs parallel to the Indus along its left (east) bank for about 14 mi. It is separated from the major ridge in the south by a gap of about a mile. The cantonment is northwest of the city. Pop. (1961) 416,441, including the cantonment. The old town is congested, but the modern outskirts with their many gardens give it a beautiful appearance. The newly developed areas include One Unit colony, the Barrage colony, Shah Latifabad and Hyderabad Industrial Trading estate. Across the Indus lies the University of Sind, founded in 1947 and moved to Hyderabad in 1951. The mile-long Shahi Bazar is the chief business centre of the city, Sadar Bazar that of the cantonment area. The principal roads are Thandi Sarak (Gidu road), connecting the city with Gidu Bandar on the Indus; Risala road; Station road; Tilak incline, the fashionable shopping centre; and Jail road. Important old buildings include the remains of the burnt-brick fort (1768), Homestead hall (1905), Collector's Kutchery and Circuit house (1912) and, on the northern part of the hill, the beautiful tombs of the Talpur rulers and the Kalhoras. The municipal garden is the only important park. One of the most interesting features of the city are the *badgirs* (wind-catchers) that are fixed on the house tops to catch the sea breezes which blow from the southwest throughout the hot season. Shamsul Ulama Mirza Qaleech Beg has been an outstanding literary figure of Sind, and Noor Mohammed and Hassan Ali Effendi were great social workers. Important literary associations include the Sindhi Adabi board, Sind Adabi Sangat, Theosophical society, Writers guild, Halqai Arabab-e-Shaoor and Bazme Ilm-o-Adab.

Great development of industry has occurred since independence, with glass and soap works, hosiery, textile and oil mills, sweets, vegetable ghee, cement, leather and shoe factories. With good rail and road connections, Hyderabad is the most important commercial centre of the region. It is on the main line from Karachi to Peshawar and is connected by rail with Indian railways through the border towns of Khokhropar and Munabao (across the frontier).

The city, named in memory of the Prophet's son-in-law, Hazrat Ali, also called Haider, was founded by Ghulam Shah Kalhora, the saintly ruler of Sind, in 1768. With the Indus in the west and the Fuleli in the east, it was very suitably situated for a fortified capital town. On the site of the present fort is supposed to have stood the ancient town of Neran-Kot, which submitted to the Muslim general Mohammed ibn Kasim in A.D. 711. Hyderabad was made the capital of Sind by the Talpurs who succeeded the Kalhoras but who for a short period (1783–89) had their capital at Khudabad near Hala. Hyderabad remained the capital of Sind till 1843 when, after the battle of Miani, it was surrendered to the British and the capital was transferred to Karachi. On the separation of Karachi from Sind in 1948 Hyderabad became the capital of the province of Sind. When separate provinces in West Pakistan were abolished, it was made the headquarters of a division.

HYDERABAD DISTRICT has an area of 4,969 sq.mi. and a population (1961) of 1,285,711. It consists of a vast alluvial plain along the left (east) bank of the Indus. Forests fringe the river, and avenues of trees line the canals in an otherwise monotonous landscape. The principal crops are millet, rice, oilseeds, cotton and wheat, which are dependent on irrigation, mostly from government canals. The district has a few well-established cottage factories. Hala (pop., 1951, 9,481), 30 mi. N. of Hyderabad city, is famous for glazed pottery and tiles (made from Indus clay and powdered flint), lacquerware and *susi* (striped cotton cloth); Nasarpur (17 mi. N.E.) specializes in the weaving of *khes* (cotton blankets), *susis* and *angochas* (lengths of cotton cloth). There are about 200 leather-processing and leather-goods enterprises in the district. The most important historical site is Bhitshah, a village about 4 mi. E. of Hala, containing the tomb of Shah Abdul Latif, the poet and Sufi saint, who died in 1753. It is a cultural centre.

HYDERABAD DIVISION comprises Hyderabad, Tatta, Dadu, Thar-parkar and Sanghar districts. In 1961 it had an area of 35,998 sq.mi. with a population of 3,288,000. The rainfall is low and precarious. The whole of the cultivated area is irrigated.

(K. S. AD.)

HYDNOCARPUS, an Indo-Malayan genus of trees of the family Flacourtiaceae. The seeds of some species are a source of hydnocarpus or chaulmoogra oil, which has some therapeutic effec-

tiveness in some forms of leprosy (*q.v.*) but is of questionable or no value in others. Chaulmoogra oil and its purified derivatives as chemotherapeutic agents have been largely replaced by antibiotics. (N. TR.)

HYDRA, in Greek legend, the offspring of Typhon and Echidna, a gigantic monster with nine heads (the number is variously given), the centre one being immortal. Its haunt was the marshes of Lerna by Argos. The destruction of this hydra was one of the 12 "labours" of Hercules (*q.v.*), which he accomplished with the assistance of Iolaus. Finding that as soon as one head was cut off two grew in its place, they burned out the roots with firebrands, and at last severed the immortal head from the body, and buried it under a rock. The arrows dipped by Hercules in the poisonous blood or gall inflicted fatal wounds.

HYDRA (anc. HYDREA, mod. Gr. IDHRA), an island of Greece lying in the Aegean sea about 4 mi. off the southeast coast of Argolis and forming with the neighbouring island of Dhokos the Bay of Hydra. The greatest length from southwest to northeast is about 11 mi., and the area is 18 sq.mi.; it is a rocky and treeless ridge with hardly a patch of arable soil. The highest point, Mt. Ere, is 1,958 ft. In former times the island was thickly wooded, as its Turkish name Tchamliza ("the place of pines") shows. It was once well watered (hence the designation Hydrea from Gr. *udor*, "water"), but it is now wholly dependent on the rain supply, and sometimes water has to be brought from the mainland. This change may be due in part to earthquakes, which are frequent. Pop. (1961) 2,766.

Hydra, the chief town, pop. (1961) 2,546, near the middle of the northern coast, on a very irregular site, has handsome white houses and clean, narrow streets. There are three other small ports on the north coast: Mandraki, Molos, Panayia; but almost all the population of the island is collected in the town, which has a bishop, a local court, numerous churches and a high school. Cotton and silk weaving, tanning, sponge fishing and shipbuilding are carried on. The island forms part of Attica *nomos* (department).

Hydra was of no importance in ancient times. In the 17th century it began to be settled by large numbers of refugees from Turkish rule on the mainland, chiefly Albanians, who were soon active in the reviving commerce of the Peloponnese. After the abortive insurrection of 1770, Hydra received a further influx of refugees; and the inhabitants, too numerous for their island to support them, took increasingly to seafaring, at first in the Aegean islands, but later as far as Alexandria, Constantinople (Istanbul), Trieste and Venice, and eventually to France and even America. The Turks left them in peace, though requiring them to provide ships and sailors for the Turkish fleet. In 1821, at the outbreak of the Greek War of Independence, the population of the island was nearly 30,000 and it could boast a fleet of 115 ships of over 100 tons. Together with the neighbouring islands of Spetsai and Psara, Hydra was able to put its merchant navy at the disposal of the insurgents. Its leading families, notably that of Lazaros Konduriotis (reputedly worth £2,000,000), enthusiastically sacrificed their fortunes to the national cause; and Hydriote sea captains such as Andreas Miaoulis commanded ships of the Greek navy in many successful encounters with the Turkish fleet.

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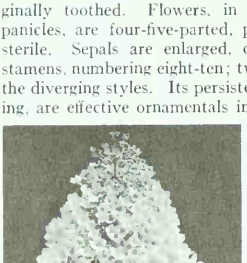
HYDRA, in zoology, the name for several small, tentacled polyp animals, members of the class Hydrozoa, phylum Coelenterata; common genera include *Hydra*, *Chlorohydra* and *Pelmatohydra*, which are all members of the family Hydridae. They are found in fresh waters throughout the world. Their bodies, or columns, which may attain up to one-half inch in length, bear five or six tentacles, which, when extended, may be up to twice as long as the column. Hydras may be whitish, pink, gray, brown or green, the green (*Chlorohydra viridissima*, for example) being the result of the presence of green algae in their gastric cells. Hydras attach to the substrate by a pedal disc, and the mouth, at the free end of the body, is surrounded by the tentacles.

Hydras may be found on submerged pond weeds, sticks, dead leaves and stones and may move about slowly by gliding on a surface or by somersaulting. They sometimes are seen hanging from the smooth surface film of quiet water. In temperate zones, with the onset of cold weather, many hydras enter a sexual phase in which ovaries and testes appear on the column. The sexes are usually separate, although hermaphroditic species are known. After fertilization the eggs develop a tough, resistant coat, which allows many of them to withstand periods of drying and freezing. With the return of favourable living conditions, small hydras emerge from the eggs. Commonly a new hydra is formed as an asexual bud on each adult hydra every two to four days throughout the spring and summer months. The food of hydras consists of small crustaceans (water fleas, copepods) and insect larvae such as the wrigglers of mosquitoes. These are captured by stinging with the nematocysts of the tentacles and are subsequently carried to the mouth and swallowed.

Hydras are common laboratory animals; they have been mass cultured and have provided much insight into biochemistry, embryology, regeneration, nematocyst development and migration of nematocysts through tissues. *See* COELENTERATA; HYDROZOA.

See also N. J. Berrill, "The Indestructible Hydra," *Sci. Amer.*, 197(6):118 (Dec. 1957); P. Brien, "The Fresh-Water Hydra," *Amer. Scient.*, 48:461–475 (1960); H. M. Lenhoff and W. F. Loomis, *The Biology of Hydra and of Some Other Coelenterates* (1961). (C. HA.)

HYDRANGEA is a genus of shrubs of the saxifrage family embracing about 80 species, distributed in North and South America and Asia. The simple leaves are opposite, petioled and marginally toothed. Flowers, in corymbiform cymes or cymose panicles, are four-five-parted, perfect, marginally sterile, or all sterile. Sepals are enlarged, often dentate; petals are small; stamens, numbering eight-ten; two-celled capsule opening between the diverging styles. Its persistent flower clusters, erect or climbing, are effective ornamentals in borders and arbours.



J. HORACE MCFARLAND

PEEGEE HYDRANGEA (HYDRANGEA PANICULATA GRANDIFLORA)

Hydrangea flowers are white or coloured. The colours, pink or blue, depend upon the presence of aluminum in the floral buds before opening. In those plants growing in basic soil the flowers are pink; in acid soil they are clear blue. The blue colour may be maintained by adding a soluble aluminum sulfate to the soil. Conversely, the pink colour may be maintained by adding lime to the soil.

Hydrangea is propagated by suckers, parts of older plants or cuttings. Cuttings are obtained in summer from young stems of plants grown under glass. Rooted cuttings may be cultivated in pots or in beds of rich, well-drained, loamy soil, with frequent watering. Partial shade is desired for foliage; sunlight stimulates flowering. In the fall or in early spring, the stems are pruned back to a few pairs of buds. For winter protection the plants may be lifted from beds for storage in cool cellars; otherwise, the stems may be tied together within straw or burlap and the plants covered with boughs; or the beds may be boarded along sides and filled with light earth. Seeds, seldom if ever used, should be planted in the fall in boxes under a scant soil cover.

H. petiolaris, native to Japan, is a luxuriant vine, with pure white, fragrant flowers, climbing by roots. *H. arborescence*, var. *grandiflora* (hills of snow), an American species, is renowned for its mostly sterile white flower clusters up to 7 in. across. Its rhizomes and roots contain a diuretic principle. Frequently cultivated in northern gardens is *H. paniculata*, var. *grandiflora* (Peegee hydrangea), with panicles of flowers up to 12 in. long, changing to pink and russet in the autumn. *H. macrophylla*, of greenhouses or gardens, bears blue or pink flowers. (O. LA.)

HYDRASTIS, a genus comprising two species of plants of the Ranunculaceae family, one species occurring in Japan and the other in eastern North America, known as golden seal or orangeroot.

The native species is a low perennial herb that sends up, in early spring, from a thick yellow rootstock a single radical leaf and a simple hairy stem that is two-leaved near the apex and terminated by a single greenish-white flower bearing many stamens and 12 or more pistils in a head, the two-ovuled pistils becoming crimson, fleshy, berrylike in fruit. The rootstocks are gathered in the wild and under cultivation for the alkaloid hydrastine used in medicine. (J. M. BL.)

HYDRATE, in chemistry, a liquid or solid compound containing combined water. In some cases the crystalline character of a solid hydrate depends on this water which is present. Common examples of hydrates are the well-known sodium compounds: Glauber's salt (*q.v.*), which is decahydrated sodium sulfate, $Na_2SO_4.10H_2O$; washing soda, which is decahydrated sodium carbonate, $Na_2CO_3.10H_2O$; and borax, which is sodium pyroborate, $Na_2B_4O_7$, with five or ten molecules of water. Blue vitriol, $CuSO_4.5H_2O$, the pentahydrated copper sulfate, is another common example.

The alums owe their characteristic crystalline form partly to the presence of combined water; for example, potash alum, $KAl(SO_4)_2.12H_2O$, crystallizes in well-defined octahedra, which crumble into powder on removing the water. Acids and bases also form hydrates. $Ba(OH)_2.8H_2O$, hydrated barium hydroxide, is a well-crystallized substance. Sulfuric acid and hydrochloric acid combine with water to form hydrates, and since certain of these are stable only at comparatively low temperatures they are termed cryohydrates.

A remarkably stable solid hydrate is chloral hydrate, $CCl_3CH(OH)_2$, produced by adding water to liquid chloral (*q.v.*). In this substance the added water has probably become hydroxide of constitution, so that this hydrate may be regarded as a connecting link between the loosely knit hydrates and the true hydroxides (*q.v.*). (G. T. M.; X.)

HYDRAULIC LIME: *see* CEMENT.

HYDRAULIC POWER TRANSMISSION: *see* POWER TRANSMISSION.

HYDRAULICS: *see* MECHANICS, FLUID.

HYDRAULICS, APPLIED. Applied hydraulics is a branch of engineering which applies principles of fluid mechanics and hydraulics to the economic development of water supply. Although problems associated with utilization of other liquids such as oils are sometimes included in applied hydraulics, this article will deal with the subject in the narrower sense.

Some system of storage usually must be provided for a water supply, involving dams, diversion works, spillways and energy dissipaters (stilling basins). Water must be conveyed to its point of utilization and some system must be provided for drainage of used or excess water away from the point of utilization. Proper control of the water involves hydraulic machinery and measuring devices throughout. Special hydraulics problems have to do with river engineering and coastal engineering. Frequently model studies can be used to advantage in the design and construction of hydraulic structures. Each of these subjects is treated briefly in the following article. Not considered in this article, however, is the fact that the usefulness of applied hydraulics is frequently conditioned or limited by social, economic and political considerations (*see* WATER RIGHTS).

WATER

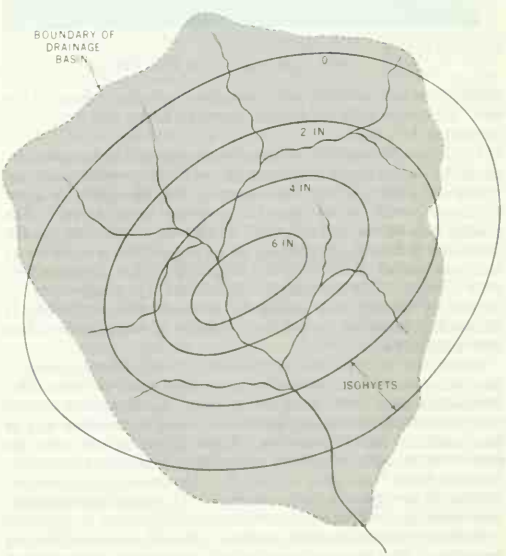
Use.—The more common uses of water are domestic, industrial, agricultural (including irrigation), power (both hydroelectric and condensing water for steam plants), sanitation, navigation, flood control, recreation and maintenance of marine life. One or more of these purposes may be the primary reason for using water at a specific location. Consideration, however, must also be given to each of these uses to ensure that one or more of them is not denied to some other hydraulic project.

Multipurpose projects are those that involve one or more of the foregoing purposes. Basically, multipurpose projects are designed and operated so that the combined use of the water provides maximum benefits for all concerned. Usually this requires a compromise for at least some of the interests, since the water must be handled in different ways for different purposes. In the operation of a reservoir, for example, a maximum available storage space is required for flood control, whereas for hydroelectric power and irrigation projects the reservoir should be full.

Examples of multipurpose projects include the St. Lawrence seaway, the Tennessee Valley authority, the Damodar valley in India, the Columbia basin project in Washington, the Colorado-Big Thompson project in Colorado and the Missouri river project in north-central United States. In many projects, flood control is the primary purpose (*see* FLOOD). The U.S. army corps of engineers is charged with the primary responsibility of designing and building flood-control works along individual rivers and in metropolitan areas of the United States. The bureau of reclamation does similar work in the utilization of water on the arid lands of western United States.

Supply.—The principal factors involved in the utilization of a water supply are its quantity, quality and location. The existing situation with respect to these factors must be related to the needs of the project. The quantity of the water is expressed in terms of discharge—the volume rate of flow—and in terms of total volume over a period of time. Knowledge of the minimum, maximum and average values are needed if the project is to operate successfully under varying conditions. The quality of water involves its chemical composition, for example, its hardness or mineral content; its bacterial content; materials such as sediment in suspension; temperature; and reliability. The location of the water involves both its placement on the surface of the earth and its elevation or depth.

A study of the hydrologic cycle (*see* HYDROLOGY; WATER SUPPLY AND PURIFICATION) reveals the source and disposition of water diverted and utilized in applied hydraulics. The principal source of a water supply is precipitation. Water is also obtained from deep underground sources and from the ocean. Rainfall may be available directly as surface runoff or indirectly as ground water (*q.v.*). Snowfall is not immediately available but is later released as melt from snowbanks or glaciers, and in turn may become either surface flow or ground water. The deep underground water is that which is not replaced by seepage from the surface of the earth



BY COURTESY OF MAURICE L. ALBERTSON

FIG. 1.—ISOHYETAL MAP

but rather has been trapped during geologic processes.

Precipitation frequently must be analyzed in the hydraulic design of a project. Factors considered are the rate and total amount of rainfall over a period of time ranging from a few hours to several years. Both the maximum and minimum are significant. An isohyetal map (fig. 1) is used to show the amount of rainfall over a given area during a period of two days. (For maximum rates of rainfall, *see* RAINFALL.)

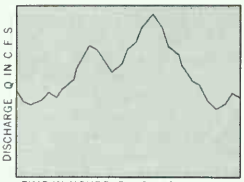


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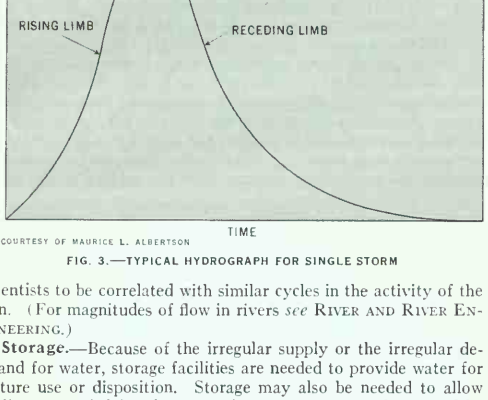
FIG. 2.—TYPICAL HYDROGRAPH

The hydrograph (fig. 2) is a chart that shows the variation in cubic feet per second (c.f.s.) of the depth of flow Q, or the discharge in a river or stream. It is used by the hydraulic engineer to indicate the variations in runoff with which he must contend. These may be caused by daily fluctuations due to variations in barometric pressure, evapo-transpiration and temperature, which affects both snow melt and ground-water flow. The surface runoff from a single storm creates a hydrograph similar to the one in fig. 3. Other variations are seasonal and are related to evapotranspiration, availability of ground water and precipitation, average daily temperature and seasonal movement of air masses. Long-range cycles of precipitation and runoff are claimed by some



BY COURTESY OF MAURICE L. ALBERTSON

FIG. 3.—TYPICAL HYDROGRAPH FOR SINGLE STORM

scientists to be correlated with similar cycles in the activity of the sun. (For magnitudes of flow in rivers *see* RIVER AND RIVER ENGINEERING.)

Storage.—Because of the irregular supply or the irregular demand for water, storage facilities are needed to provide water for future use or disposition. Storage may also be needed to allow sediment carried by the water in a stream to settle out. The storage may be for a short period of time to compensate for the variations in hourly consumption by a metropolitan area, or for as long as a period of several years to provide water during a possible drought. The storage in Lake Mead (32,000,000 ac.ft.), created by Hoover dam on the Colorado river, for example, is intended, if necessary, to last over a period of many years of less than average flow.

Water can be stored above or below ground. Above ground it may be stored in reservoirs, channels, valleys such as that of the Mississippi river, or in snow and glaciers. Underground storage may result from natural seepage of rain water or runoff as well as from artificial water spreading. Water spreading not only increases the quantity of ground water but in some cases is used to dissipate floods from small watersheds. Important factors to consider in the storage of water are losses due to seepage and evaporation as well as possible significant changes in quality.

Surface reservoirs must be carefully planned as to location and operation. The storage capacity with respect to water-surface elevation in the reservoir must be determined together with a mass curve, the variation of accumulated runoff over a period of time. In the design and operation of a reservoir, plans also must be made for the disposition of sediment that is carried in with the water. This sediment can completely fill a reservoir in a few years if it is introduced in sufficient quantities. Coarse sediment settles out at the entrance to the reservoir where the water is slowed and its sediment-carrying capacity reduced. The finer materials, which may take many days to settle, are usually carried as a dense submerged current under the reservoir along the old channel, and deposited at the bottom of the reservoir. An example of the effect of sediment deposits is Elephant Butte reservoir in New Mexico the capacity of which was decreased by 16% during the period 1915–40 by sediment deposited from the upstream watershed at the rate of 1,600 tons per square mile per year.

Reservoirs may be operated singly or in combination. Furthermore, in multipurpose projects their use must be considered in connection with the various needs of possibly conflicting operations. Obtaining maximum efficiency of operation is a complicated procedure, so complicated in fact that electronic computers are used to integrate all the variables to be considered.

HYDRAULIC WORKS

Dams.—The creation of a reservoir usually requires construction of a dam to impound and store water, either temporarily or for longer periods of time, for use while stored or for later release and use. Low dams are used to divert water from one conveyance system, such as a river, into another. The basic problems involved in the design and construction of a dam are the stability of the dam; the seepage of water around, through, or under the dam; the disposition of floodwaters; protection against waves and sudden drawdown; and foundation support for the dam. Stability of the dam involves its vertical weight, the pressure of the water upstream, the pressure of the silt upstream, the pressure of the ice upstream, uplift pressure under the dam, the foundation materials and seismic forces from vibrations such as explosions and earthquakes. Seepage takes place through all dams to a greater or lesser extent. It is only when the seepage is of such quantity as to waste the water or to endanger the safety of the dam that it becomes of major concern. The failure of most dams is due to flood flows for which there has not been provided adequate spillway capacity for passing the flood flow over, around or through the dam. (For a fuller discussion of the construction and operation of dams, *see* DAM.)

Spillways and Outlet Works.—Nearly all types of dams and control works that require release of water involve a spillway or outlet works of some kind. A spillway is a structure which permits the water to pass around, over, through or under a dam or other structure safely, in desired quantities and at the desired time. This water may be floodwater that cannot be stored in the reservoir or it may be water stored under normal conditions that is released for use downstream.

The crest of the overfall type of spillway is shaped like the underside of the jet of water that flows over a weir (*q.v.*). The water, after leaving the spillway, flows into a stilling basin downstream from the dam where its kinetic energy is dissipated.

The morning-glory or shaft spillway is usually located in the reservoir upstream from the dam. The water flows radially inward over a rounded crest down a shaft to a pipeline that passes through, under or around the dam.

Side-channel spillways accumulate the water over a spillway crest upstream from the dam and carry it into a tunnel or chute around the end of the dam.

Spillways that siphon water over the top of a dam are advantageous for drops in elevation of 50 ft. or less. Because of the siphoning action it is possible to obtain a much greater discharge for a given size opening or passageway.

The flow (Q) over a spillway crest is represented by the equation $Q = KLH^{3/2}$ in which K is the coefficient of flow (approximately 4), L is the length of the spillway crest and H is the height of the water in the reservoir above the spillway crest.

Outlet works are used to discharge water through a dam at a level lower than the crest of a spillway and are thus under greater

pressure than an ordinary spillway, the head sometimes reaching hundreds of feet. The water, after passing through the outlet, is discharged into a stilling basin. Various types of gates and regulating valves control the rate of flow.

Energy-Dissipation Systems.—In order to protect the banks and beds of a stream or river against erosion and to reduce waves, surges and water spray, kinetic energy of the initial high-velocity flow in the spillway or outlet works must be dissipated. Kinetic energy can be dissipated by shear resistance and pressure resistance (fig. 4). A boundary along which water is flowing will create a resistance to the flow that results in a reduction in kinetic energy (fig. 4[A]), which is converted to turbulence and heat. Furthermore, energy can be dissipated in either the vertical or horizontal direction or in a combination of both. The hydraulic jump (fig. 4[B]) is based upon the momentum principle. Dissipation of

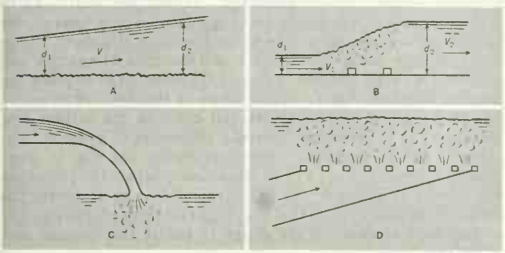


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FIG. 4.—METHODS OF DISSIPATION OF KINETIC ENERGY, *d* BEING DEPTH AND *V*, VELOCITY, SHOWING (A) CHANNEL RESISTANCE, (B) HYDRAULIC JUMP, (C) DOWNWARD INTO POOL, (D) UPWARD THROUGH MANIFOLD STILLING BASIN

energy in the direction vertically downward is shown in fig. 4(C), while the manifold stilling basin (fig. 4[D]) dissipates energy vertically upward.

Conveyance and Diversion Systems.—Conveyance systems, in the form of natural or man-made waterways or conduits, are used to transport water from point of origin, diversion or storage to point of further storage, utilization or waste, while diversion works are for the purpose of diverting water from storage or from one conveyance system into another. Such diversion works can consist of a simple head gate that releases stored water into the conveyance system or of a complex combination of a diversion dam with control gates, sluice gates and head gates. The control gates on the diversion dam are intended to pass floodwaters and to control the elevation of the water upstream in order to divert the desired quantity into the conveyance system. Sluice gates are mounted at a much lower level in order to wash any sand or other sediment away from the head gates. This prevents sediment from entering the head gates of the conveyance system.

Immediately downstream from the head gates is usually a device for ejecting or removing any undesirable sediment that may have entered the conveyance system. This ejector usually flushes such sediment back into the main channel. Usually near the head gate is also located a device, such as a Parshall flume, for measuring the water diverted into the conveyance system.

Closed conduits such as pipes and tunnels are often used for conveying water from one point to another. The pipes may consist of cast iron, steel, concrete, clay or wood stave. Penstocks are a special type of pipes that convey water into hydroelectric turbines. The design of an economic closed conduit depends in part upon the resistance to flow (*see* MECHANICS, FLUID). In some flow systems the boundary resistance is of major importance, whereas in others the energy losses due to fittings, bends, gates, valves, etc., called minor losses, are of primary importance.

Measurement of flow in closed conduits is usually accomplished by means of measuring flow pressures with a Pitot tube, Venturi meter, orifice meter, flow nozzle or other device and computing the rate and volume of flow from the pressure values thus obtained. (*See* MECHANICS, FLUID: *Applications: Fluid Meters*).

Water hammer, a pressure wave that travels through the water with the speed of sound, must be considered in any closed conduit where automatic and sudden stoppages of flow are apt to occur. If the pressure generated is of sufficient magnitude, it can burst the conduit. Although water hammer is frequently thought to be the noise associated with the sudden closure of a water faucet on a water line such as that in a home, the noise created in such cases is caused by the conduit or pipe, actuated by a water hammer, striking some other object such as a wall.

Some closed conduits operate partially full so that there is air above the liquid. This air may be at atmospheric pressure or at some modified pressure. Under these conditions the problems of analysis and design are the same as for flow in an open channel.

Examples of closed conduits include domestic water-supply systems, cross-country lines for natural gas and other petroleum products, industrial and agricultural water supplies and pipelines for chemical and industrial processes.

Open channels include flow of water in natural channels such as rivers and in artificial channels such as canals, flumes and aqueducts. The type of boundary may be rigid or it may be alluvial so that sand or gravel is moved along the bed. (For the method of analyzing flow in open channels, *see* MECHANICS, FLUID: *Applications: Flow of Liquids in Open Channels.*)

Associated with diversion and conveyance systems are regulating and control structures such as gates and valves to control the flow, measuring devices to measure the amount of water being diverted and delivered to the consumer, turnouts to deliver water, wasteways to dispose of excess water, checks to maintain the water in the canal at a higher level for delivery at small discharges, dividers to divide the flow into certain proportions regardless of the amount of the total flow and locks to permit vessels to go from one level to another.

Protective structures are also necessary on conveyance systems. These include automatic spillways to dispose of unexpected flows automatically without damage to the structures; overchutes to carry excessive drainage water such as storm runoff over canals; culverts to carry excess water under canals; bridges and aqueducts to carry vehicular and pedestrian traffic as well as water over canals or natural drainage systems; drain inlets which permit a small amount of surface drainage to enter the canal; and sand traps and settling basins which collect excess sediment.

Drainage Systems.—Often a drainage system is employed in connection with hydraulic projects to transport waste or excess water safely and economically to a river or other point of disposition. This drainage water may be flowing over the surface of the ground or underground. Surface water usually consists of storm water or excess and waste water from irrigation, industrial and domestic sources. Surface water must be taken around, over, under or through the main conveyance system. This is usually done through overchutes and culverts or under bridges and aqueducts.

Subsurface drainage involves ground water and water that has leaked into the earth through porous media. Such drainage is usually accomplished by means of systems of tile piping laid underground or by open trenches, ditches and cuts that intercept the subsurface water and dispose of it. (*See* LAND RECLAMATION.)

HYDRAULIC MACHINERY

To serve its purposes a hydraulic project must have machinery. Machinery to control and regulate flow usually consists of gates or valves. Pumps are used to add energy to the flow while turbines subtract energy from the system by converting it into other forms such as mechanical or electric energy.

Gates.—Gates may be designed to operate under low heads of only a few feet or high heads of several hundred feet. They may be operated manually or automatically. Low-head gates are usually associated with spillways and canals while high-head gates are usually to be found with outlet works and penstocks for dams and hydroelectric plants.

A radial or Taintor gate is a segment of a cylinder at the centre of which is the pivot for the gate. One of the least expensive as well as one of the simplest to operate, it is used for control gates on dams, head gates, control gates and checks in canals, and sluice gates.

The leaf gate consists of a sliding plane located in a conduit perpendicular to the direction of flow. Leaf gates that are hinged along one edge are for low head only, while the sliding or vertical-lift gates are designed for both low and high heads. For low heads the sliding or vertical-lift gate simply slides along a seat since the friction is not too great to be overcome by a hoisting mechanism. For high heads, however, it is necessary to have wheels on the gate or wheels fixed in the seat so that the sliding friction is reduced. Otherwise the friction would be so great that the gates could not be raised or lowered.

For the crests of dams and other types of diversion works flashboards and needles are sometimes used. Flashboards are horizontal boards and needles are vertical boards. Both are placed across the flow in order to increase the elevation of the water surface, usually for diversion purposes. Stop logs are usually planks or logs that slide into vertical grooves on the side of a canal or flume in order to close a flow passage either temporarily or permanently.

Valves.—Valves are associated with closed conduits and usually are designed for high-head conditions. Outlet works associated with discharge at a low level behind a dam or the discharge of water into a hydroelectric plant are usually controlled by valves. The most common type of valve is the needle valve. The interior part of the valve is composed of two streamlined sections, one of which is rigid and remains fixed, the other being movable so that it can move into the opening. A modification of this valve is the tube valve, which has the movable portion at the downstream end cut off in order to simplify its operation. A further simplification of the needle valve is the hollow-jet valve, which has the movable portion upstream and the casing, as well as the interior, cut off downstream. This valve discharges directly into the atmosphere rather than into a conduit downstream. Perhaps the simplest of valves for high-head installation is the Howell-Bunger valve, consisting of a cone facing upstream that moves into the cylindrical valve chamber to close off the flow. This type of valve discharges radially outward into the atmosphere and greatly aids energy dissipation but increases spray.

The cylinder gate is similar in some respects to the tube valve except that it operates in a vertical direction and is customarily used to release water from a reservoir.

Butterfly valves are most commonly used to control the flow from a penstock into a hydroelectric turbine because of the very small energy loss through the valve. When the valve is open the butterfly leaf is simply a streamlined disk parallel to the flow. To close the valve, the butterfly leaf is turned 90° so that it is perpendicular to the flow, shutting it off.

Pumps and Turbines.—Pumps and turbines (*see* PUMP; TURBINE: WATER) are similar in design and operation except that the water flows in one direction for the pump and in the opposite direction for the turbine. The purpose of the pump is to increase the kinetic energy or the potential energy of the water in the system. Some of the largest pumps ever built were for Grand Coulee dam, Washington. These operate with 65,000 h.p. at 200 r.p.m. to deliver 1,350 c.f.s. of water against a head of 310 ft. Centrifugal pumps can be combined in multiple stages in order to pump against extremely high heads. One of the highest heads for which a pump was ever built was 8,600 ft.; delivery rate was 875 gal. per minute (g.p.m.).

The Francis-type turbine corresponds to the centrifugal pump and the Kaplan-type turbine to the propeller pump. Some of the largest Francis-type turbines are the 115,000-h.p. turbines for Hoover dam, Arizona-Nevada, which operate at 180 r.p.m. with a head of 510 ft. At Grand Coulee dam there are 150,000-h.p. turbines operating at 120 r.p.m. with a head of 330 ft. At the Marne plant in Italy is a Kaplan turbine for 7,320 h.p. under 105 ft. of head. Francis turbines have been used for heads greater than 1,000 ft.

COASTAL ENGINEERING

Hydraulics problems associated with coastal engineering involve the design, operation and maintenance of docks, harbours, beaches, estuaries and navigation channels. Natural phenomena that complicate this work are waves, surges, tides, littoral currents, scour and deposition of sediment, and salt-water intrusions. Salt-water intrusions into fresh-water bays and river estuaries frequently cause difficulty if this water is being used for industrial, agricultural or domestic consumption. Tides result in a fluctuation of water-surface elevation along a coast varying from a few inches to many feet. To overcome these complications various types of protective devices have been developed, including breakwaters, groins, spur dikes, jetties and sea walls. Long dikes or walls built perpendicular or parallel to the shore protect it against waves and erosion by waves. (*See* BREAKWATER; JETTY; TIDES.)

MODELS

In hydraulic engineering great use is made of model systems by the operation of which the characteristics of similar but larger hydraulic systems can be predicted. Models are built: (1) to study the general appearance and the relative proportions of the various features as they will be in the prototype structure; (2) to study the flow pattern (magnitude and direction of velocity and acceleration) over, through or around the object; (3) to study the pressure distribution and resulting forces on the object or its parts; (4) to determine flow capacities and calibrate the various flow passages; (5) to determine hydraulic efficiencies of hydraulic machinery; (6) to determine mechanical-energy loss due to shear drag and pressure drag; (7) to determine whether the prototype will operate as intended; (8) to determine ways of improving the design of the prototype so that it will operate more effectively; (9) to find ways of changing the design to reduce the eventual cost of the prototype.

The chief advantages of a model are that, by its use, the purposes and objectives of a hydraulic project can be attained more economically, quickly, simply, conveniently and completely.

The principal disadvantage of a model is the fact that complete similarity in the model is sometimes difficult or impossible to obtain. Consequently, in some cases only partial or approximate answers can be obtained by means of a model.

Models have been used for most of the hydraulic structures and systems discussed in this article. They are also commonly used to study naval vessels, aircraft and various types of hydroelectric machinery, as well as pipes, rivers, harbours and hydraulic structures such as dams, spillways and stilling basins.

See also AQUEDUCT; CLIMATE AND CLIMATOLOGY; DOCK; ELECTRIC POWER; GROUND WATER; HARBOURS; HYDROMECHANICS; IRRIGATION; LAND RECLAMATION; SEWAGE DISPOSAL; SEWER DESIGN AND CONSTRUCTION; WATER TRANSPORT, INLAND; WAVES AND SHORE CURRENTS. *See* also references under "Hydraulics, Applied" in the Index.

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HYDRAZINE is a colourless liquid which solidifies at 1.8° to 2.0° C. and boils at 114.5° C. Having the chemical formula of N_2H_4, it belongs to a group of hydrogen-nitrogen compounds known as the hydronitrogens and was first prepared by T. Curtius (1887).

Hydrazine is a powerful reducing agent and is used in the silvering of mirrors and the formation of metal films on glass and plastics. It is used as a corrosion inhibitor to remove dissolved oxygen from boiler waters. A mixture of hydrazine, water and methyl alcohol was used by the Germans in World War II as a rocket- and jet-propulsion fuel.

Anhydrous hydrazine is miscible in all proportions with water, methyl and ethyl alcohols. It forms a high boiling azeotrope with water containing 68.5% N_2H_4 and boiling at 120.5° C. (771 mm. pressure). Care must be taken in the storage of anhydrous hydrazine and its aqueous solutions, since these absorb moisture and carbon dioxide and react chemically with oxygen of the atmosphere. Hydrazine solutions and vapour are toxic. Hydrazine vapour mixed with air is inflammable. Aqueous solutions of

hydrazine are more weakly basic than ammonia.

Preparation.—It may be obtained by the reduction of nitrosoamines, nitramines and the nitrosohydroxylamine sulfonates and by the thermal, photochemical or electrical decomposition of ammonia. It is produced technically from aqueous ammonia (or urea) by oxidation with hypochlorite in the presence of gelatin or glue (Raschig process). This process is operated at temperatures between 160° and 180° C. under pressure to yield a dilute reaction liquor containing about 2% N_2H_4.

Concentration is effected by fractional distillation to give a product marketed as 85% or 100% hydrazine hydrate, $N_2H_4.H_2O$. Further concentration to anhydrous hydrazine must be accomplished by dehydration with barium oxide or caustic soda. The anhydrous material is also obtained by treating hydrazine sulfate with liquid ammonia (A. W. Browne).

Salts.—Hydrazine forms two series of salts, $N_2H_4.HX$ and $N_2H_4.2HX$, where HX represents a monobasic acid. Best-known salts are the sparingly soluble sulfate, $N_2H_4.H_2SO_4$, the mono- and dihydrochlorides, $N_2H_4.HCl$ and $N_2H_4.2HCl$, and the mononitrate, $N_2H_4.HNO_3$. The mononitrate has found application as a high explosive and as an ingredient of high-explosive compositions. The bromide $N_2H_4.HBr$ is used as a soldering flux. Double salts such as the chlorides, $N_2H_4.HCl.MCl_2$, and the sulfates, $(N_2H_4)_2.H_2SO_4.MSO_4$, are also known. The copper compound, $(N_2H_4)_2.H_2SO_4.CuSO_4$, has interesting algaecidal and fungicidal properties and has found application as an agricultural fungistatic material. Compounds containing co-ordinated hydrazine, *i.e.*, hydrazinates, have been prepared, for example, $ZnCl_2.2N_2H_4$ and $Co(N_2H_4)_3SO_4$.

Organic Hydrazines.—Derivatives of hydrazine have been prepared in which one, two, three and even four of the hydrogen atoms are replaced by alkyl, cycloaliphatic and/or aryl radicals. The simple alkyl hydrazines such as methylhydrazine, $CH_3N_2H_3$, and dimethylhydrazine, $(CH_3)_2N_2H_2$, are prepared from the amines and chloramine by a modification of the Raschig process. Phenylhydrazine, $C_6H_5N_2H_3$, was discovered by E. Fischer in 1877 and was employed by him in his classical researches on sugar; it is used along with other organic derivatives of hydrazine to detect organic substances containing carbonyl groups (*see* Aldehydes and Ketones; Carbohydrates) since it condenses with these to form hydrazones and azines with the elimination of water.

Acid hydrazides, $RCON_2H_3$, are obtainable by the action of hydrazine on acid chlorides or esters. Best known are the hydrazine derivatives of carbonic acid such as semicarbazide, $CO(NH_2)(N_2H_3)$; carbohydrazide, $CO(N_2H_3)_2$; bi-urea, $(-NHCONH_2)_2$; and aminoguanidine, $C(NH)(NH_2)(N_2H_3)$. The latter substance is obtained in the form of its salts by condensation of cyanamide with hydrazine.

Organic derivatives of hydrazine find application in analytical chemistry (dithizone), as biologically active substances (isonicotinic acid hydrazide in the treatment of tuberculosis) and as chemical intermediates, for example, in the production of specialty fuels, plastics and resinous substances, photographic chemicals and as blowing agents for the manufacture of foam rubber.

For additional information on the hydronitrogens *see* Nitrogen and Ammonia.

Bibliography.—H. Wieland, *Die Hydrazine* (1913); L. F. Audrieth and B. A. Ogg, *The Chemistry of Hydrazine* (1951); C. C. Clark, *Hydrazine* (1953). (L. F. A.)

HYDRAZOIC ACID (Hydrogen Azide), a compound of hydrogen and nitrogen. It is a colourless liquid, boiling at 37° C., and is sensitive to shock, exploding violently but with a limited radius of action. The acid has a characteristic odour, said to resemble that of a damp cellar, and the vapour causes headache and attacks the mucous membrane. Its salts, which are called azides, and its organic derivatives are also explosive but to a lesser extent. The acid (HN_3) and its derivatives present many points of theoretical interest, but the only derivative of commercial importance is lead azide. This is used as an initiating explosive in detonators and percussion caps and is in some ways superior to mercuric fulminate, especially in being less sensitive to moisture.

Organic derivatives of hydrazoic acid were the first to be known and resulted from the discovery of the aromatic diazo compounds by P. Griess. He found in 1866 that the perhalides of these are converted into azides by ammonia.

$$C_6H_5.N_2.Br_3 + NH_3 \longrightarrow C_6H_5N_3 + 3HBr$$

The acid itself was first prepared by T. Curtius in 1890 by the alkaline hydrolysis of benzyl azide; he found that after acidification the acid could be separated by distilling in steam. The first preparation from inorganic materials was by J. Wislicenus in 1892; he used nitrous oxide on sodium amide at about 200° C.

$$NaNH_2 + N_2O \longrightarrow NaN_3 + H_2O$$

A number of other methods are known, mostly using hydrazine as starting material. This reacts with nitrous acid to give hydrazoic acid, but there are many side reactions so that a useful yield is obtained only under carefully regulated conditions. The anhydrous acid can be prepared from its aqueous solution, which is less explosive than the pure acid, by repeated fractional distillation, but the best method is to warm the pure sodium salt with stearic acid, condense the acid at −40° C., and distill it under reduced pressure between −50° and −80° C.

The chemical behaviour can be roughly summarized by saying that the radical N_3 behaves like a halogen, so that the salts resemble the chlorides and the free acid hydrogen chloride. In aqueous solution, however, it is only a weak acid and of approximately the same strength as acetic acid.

Structure.—The constitution of the azide group N_3 which is covalently linked to hydrogen in the acid and to carbon in the organic derivatives, and which exists as an anion in the salts, was a matter of controversy for many years. The first formula proposed (I) was that of Emil Fischer in 1878 and this was accepted until J. Thiele and A. Angeli pointed out in 1911 that the straight chain formula (II) could be held to give a better explanation of certain reactions.

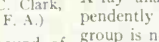
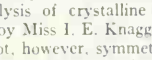
(I) (II) $-N=N\equiv N$

A decision was impossible at that time. The demonstration that the cyclic formula (I) is incorrect could only be reached when methods became available whereby the actual positions of the atoms in a molecule could be determined. This was first done for the azide ion in sodium and potassium azides by S. B. Hendricks and L. Pauling in 1925, and the result was confirmed later by the Raman spectrum of the ion in solution. The three nitrogen atoms lie in a straight line and the ion is symmetrical about the central atom. The ion must be written $N\rightleftharpoons N\rightleftharpoons N$, or with dots representing valency electrons as . It resembles in structure the cyanate ion, $\bar{N}=C=O$ or and the structure of the potassium cyanate crystal is almost identical with that of potassium azide.

For the covalently linked azide group a straight chain structure is established beyond doubt by the electron diffraction of methyl azide studied by L. O. Brockway and Pauling in 1933 and by the X-ray analysis of crystalline cyanuric azide carried out independently by Miss I. E. Knaggs and E. W. Hughes in 1935. The group is not, however, symmetrical about the central atom as in the ion; the molecule can be represented as below, the figures showing the distances in angstrom units:

$$H_3C\ 1.47\ N\ 1.24\ N\ 1.10\ N$$

Such a structure cannot be represented by a single formula based on the older views of valency. The original Thiele-Angeli formula (II above) must be rejected because it involves pentacovalent nitrogen, a state not known in any other compound of the element. The alternatives are $R-N=N\rightleftharpoons N$ and $R-N\leftarrow N\equiv N$, which can be written

 and 

These must be excluded as they stand because they imply much higher molecular electric moments than those observed and because the bond lengths do not fit the experimental results. The structure must be taken to be a resonance hybrid (*see* RESONANCE, THEORY OF) of these two straight chain formulas, a view which is supported by the known heats of formation of phenyl azide and of ethyl azidoacetate. Such a conclusion can be reached only when the existence of resonance is realized and it is thus easy to see why in the earlier part of the century the controversy could not be settled. The azide group is one of the few where, using conventional formulas, no one formula can be written even as an approximation.

Derivatives.—The organic derivatives of hydrazoic acid can be divided into two classes, the alkyl and aryl azides in which the group is attached to a hydrocarbon radical, and the acyl azides which contain the group $-CO.N_3$. Apart from reactions which involve its breakdown, the behaviour of the azide group in all these recalls that of a halogen atom, a further justification for its description as a pseudohalogen. Thus methyl azide, a liquid boiling at 20° C. and somewhat less explosive than the acid, is hydrolyzed by alkalies to methyl alcohol and the alkali azide, while phenyl azide resists such hydrolysis. The aryl azides, which are considerably more stable, show a variety of addition reactions with compounds containing a reactive methylene group and with ethylenic and acetylenic unsaturated compounds. These have been much studied and lead to derivatives of 1,2,3-triazoline.

The acyl azides are derivatives of carboxylic acids and are best obtained by the action of the acid chloride on sodium azide. They resemble acid chlorides in many ways and, though the majority are reasonably stable, certain of them are among the most explosive compounds known; for example the diazide of carbonic acid detonates if gently rubbed with a glass rod. The important reaction of the acyl azides is the Curtius rearrangement which occurs when they decompose in solution. Nitrogen is lost and the resulting radical rearranges to an isocyanate by an intramolecular process (*see* MOLECULAR REARRANGEMENTS).

$$R.CO.N_3 \rightarrow N_2 + R.CO.N. \longrightarrow R.NCO$$

Since the isocyanate can be hydrolyzed to a primary amine, the reaction is useful for effecting the change $R.COOH \longrightarrow R.NH_2$.

(T. W. J. T.)

HYDRIDES. Chemical compounds in which one or more hydrogen atoms are attached to a metal or metalloid (metallike) atom are called hydrides. Compounds of this class have interesting applications because of their high hydrogen content; some are useful as rocket fuels and as hydrogen sources for filling balloons and others are of prime importance in nuclear fusion processes. The term hydride is also applicable to metallic phases whose composition may vary within narrow limits; *e.g.*, palladium hydride which has the approximate composition Pd_2H. It is used loosely to include solid solutions of hydrogen in metals and all compounds of hydrogen with single elements, including ammonia, NH_3, and even water, H_2O.

All metals are capable of dissolving small amounts of hydrogen, particularly at high temperatures or on melting. Those metals which form true hydrides are likewise capable of dissolving small amounts of hydrogen prior to hydride formation. These solutions of hydrogen in metal are quite different from hydrides and this term is not properly used to describe them.

It is well known that the hydrogen penetration of many metals causes a weakening or embrittling referred to as hydrogen embrittlement. Hydrogen diffuses with great rapidity through several heated metals such as palladium, iron and nickel; it reacts with palladium and about 40 metals to form compounds most of which are brittle. These compounds dissociate on stronger heating, giving back the metal and hydrogen gas. The volume of hydrogen which is taken up by some metals is quite remarkable. Thus titanium hydride, TiH_2, is a metallic-appearing compound which contains 1,620 times its volume of hydrogen. This hydrogen is released by heating to red heat or by reaction with strong acids. The hydrogen atoms in titanium hydride are more tightly packed together than in solidified pure hydrogen at its freezing point.

Hydrides of many of the metals capable of dissolving hydrogen in small amounts are known to exist even though they cannot be formed by reaction of the metal with hydrogen. Such hydrides must be made by indirect syntheses and decompose on heating.

Four types of hydrides have been recognized under a classification based on the type of chemical bond involved:

1. Saline or saltlike: hydrides in which hydrogen is present as an anion H^- similar in size to the fluoride ion F^-. In these compounds hydrogen displays its family resemblance to the halogens: fluorine, chlorine, etc. Saline hydrides are physically similar to corresponding fluorides except that they react vigorously with water giving off large volumes of hydrogen. This property renders them useful as light, portable sources of hydrogen. Examples of primary saline hydrides are sodium hydride, NaH, and calcium hydride, CaH_2. Examples of complex saline hydrides are lithium aluminum hydride, $LiAlH_4$, and sodium borohydride, $NaBH_4$, both of which are chemicals of commerce used as reducing agents.

2. Metallic (formerly termed interstitial): alloylike hydrides which possess some of the characteristics of metals such as lustre and strong electrical conductivity. They tend, however, to be more brittle and sometimes harder than the metals from which they are made. These compounds are regarded as intermediate in nature between salts and alloys. The hydrogen is probably closely associated with two electrons and therefore resembles the anionic form found in saline hydrides. The metal may be regarded as a cation of maximum charge which has given one of its electrons to hydrogen and shares one or more electrons with other metal ions such that the assemblage is immersed in a "sea" of such electrons. Metallic hydrides have also been regarded as made up of protons (positive hydrogen ions H^+), and metal atoms in an electron sea. The lustre and electrical conductivity are attributed to the relative freedom of electron movement in the hydride. Examples are titanium hydride, TiH_2; lanthanum dihydride, LaH_2; thorium dihydride, ThH_2, and a higher hydride, Th_4H_{15}; and uranium hydride, UH_3. Metallic hydrides are generally not reactive toward water unless the finely divided metals themselves are reactive. Thus palladium hydride does not react appreciably with water whereas uranium hydride does.

3. Dimeric or polymeric: hydrides in which hydrogen is presumed to have formed a connecting bridge between metal or metalloid atoms. Classical examples are furnished by the numerous hydrides of boron; *e.g.*, diborane, $H_2BH_2BH_2$ (whose formula is so written to indicate the two bridging hydrogen atoms); pentaborane, B_5H_9; decaborane, $B_{10}H_{14}$; etc. Such hydrides burn with evolution of considerably more energy than provided by carbonaceous fuels and are of interest as high-energy fuels for rockets. Aluminum and possibly copper and beryllium hydrides belong in the polymeric category. All of these hydrides are nonconductors and may be solid, liquid or gaseous. All are thermally unstable and some explode on contact with air or moisture.

4. Covalent-volatile: hydrides in which the bonds are evidently normal covalent bonds without strong residual affinities. Examples are: silane, SiH_4; arsine, AsH_3; germane, GeH_4; aluminum borohydride, $Al(BH_4)_3$; and digermane, Ge_2H_6. These hydrides are volatile, thermally unstable and usually possess a strong odour. Some are exceptionally toxic, *e.g.*, AsH_3, and others may ignite on contact with air or moisture, *e.g.*, $Al(BH_4)_3$.

The above classification is not rigid and in some cases the distinctions made are a matter of degree, *e.g.*, $LiBH_4$ and $Al(BH_4)_3$, rather than of intrinsic differences. Many families of compounds, such as chlorides, for example, may be similarly differentiated. The reason for the existence of the four categories may be interpreted on the basis of three properties of the metal atom: ionization potential (a measure of the ease with which the atom may lose an electron), number of bonding electrons and number of unfilled energy levels. Two other factors are also involved: the cohesive energy (a measure of the cohesiveness of a metal) and the radius of the metal atom and ion.

Hydrides may also be classed as primary or binary, *i.e.*, one metal and hydrogen such as BaH_2, or as secondary, double or

TABLE I.—*Properties of Primary Hydrides (Selected From Literature)*

Formula	Description	Density g./c.c. (liquid or solid)	Reaction with humid air and water at room temperature		Heat of formation (kg.cal./mol. H_2)	Approximate dissociation pressure of MH_n in cm. of mercury (T = ° K.)	
			Air	Water		200° C.	500° C.
LiH	white cubic crystals resembling NaCl. LiH melts with marked expansion at 686° C., others undetermined	0.778	mod. slow	rapid	−42	$\log P = -9337/T + 10.131$	
NaH		1.36	rapid	violent	−27	$\log P = -5700/T + 2.5 \log T + 2.956$	
KH		1.43	inflames	violent	−28	$\log P = -5870/T + 2.6 \log T + 2.895$	
RbH		2.60	inflames	violent	−24	$\log P = -5680/T + 10.80$	
CsH		3.41	inflames	violent	−20	$\log P = -5900/T + 10.79$	
CaH_2	white crystals, ortho.	1.9	mod. fast	rapid	−46	$\log P = -7782/T + 8.07$	
SrH_2	crystals, ortho.	3.27	mod. fast	rapid	−42	$\log P = 10,400/T + 10.1$	
BaH_2	crystals, ortho.	4.15	rapid	rapid	−41	$\log P = 6,450/T + 7.20$	
LaH_3	metallic gray powder	—	rapid	rapid	−30 ($LaH_{2.78}$)	—	—
CeH_3	metallic black powder	5.4	pyrophoric	slow	−31 ($CeH_{2.7}$)	—	—
TiH_2	metallic powder, cubic	3.75	none	none	−20	$\log P = -10,630/T + 3.6$	
ZrH_2	metallic powder, tet.	5.47	none	none	−39	$10/ZrH_{1.92}$	$-100/ZrH_{1.92}$
HfH_2	metallic powder, tet.	11.7	none	none	—	—	—
ThH_2	metallic powder, tet.	9.19	very slow	slow	—	$\log P = -7,700/T + 8.54$ (ThH_2)	
VH	metallic powder, tet.	5.1	none	slow	—	76 (VH_4)	76 (VH_3)
NbH	metallic powder, ortho.	7.64	slow or none	none	—	76 ($NbH_{0.8}$)	76 (NbH_4)
TaH	black metal, ortho.	15.2	none	none	—	—	76 (TaH_2)
UH_3	black powder, cubic	10.5	pyrophoric	moderate	−21	$\log P = -4500/T + 8.28$	
PuH_3	black powder	—	very slow	none	−4.4	250 ($PuH_{2.8}$)	very high
PdH	black powder, cubic	10.5	very slow	none	−17.7	91 ($PdH_{0.6}$)	?
CuH	brown powder, hex.	6.4	rapid	slow	+5(?)	irreversible	
BeH_2	white powder	0.57	slow	slow	—	irreversible above 250° C.	
MgH_2	white powder, tet.	1.42	mod. rapid	mod. rapid	—	irreversible in part	
ZnH_2	white powder	—	—	—	—	irreversible above 25° C.	
B_2H_6	colourless gas, foul odour	liq. 0.44 (−112° C.)	explosive	moderate	+8.7	irreversible decomposition above 50° C.	
B_4H_{10}	colourless gas, foul odour	liq. 0.59 (−70° C.)	explosive	slow	—	irreversible decomposition	
B_5H_9	colourless gas, foul odour	liq. 0.61 (0° C.)	burns	rapid	—	irreversible decomposition	
$B_{10}H_{14}$	colourless needles, rhombic	0.94	very slow	very slow	—	irreversible decomposition	
AlH_3	white microcrystal. (etherate $AlH_3 \cdot Et_2O$)	1.1 app.	slow	moderate	—	irreversible decomposition above 100° C.	
Ga_2H_6	colourless liquid m.p. −21.4° C.	—	—	—	—	unstable at 100° C.	
InH_3	brown powder	—	—	—	—	unstable at 80° C.	
SiH_4	colourless gas, foul odour	b.p. −112° C.	explosive	rapid	−5.9	irreversible decomposition above 500° C.	
Si_2H_6	colourless gas, foul odour	b.p. −14.5° C.	explosive	rapid	—	irreversible decomposition above 400° C.	
GeH_4	colourless gas, foul odour	liq. 1.53 −142° C.	none	none	—	irreversible decomposition	
Ge_2H_6	colourless liquid	liq. 1.98 (−109° C.)	flashes	slow	~−6	—	
$(GeH)_x$	brown powder	—	slow	slow		irreversible decomposition at 100° C.	
$(GeH_2)_x$	yellow powder	—	rapid	slow		irreversible decomposition at 120° C.	
SnH_4	gas	—	—	slow			
PbH_4	gas, very unstable	b.p. −13° C.	instant	?			
PH_3	colourless, gas, poisonous	liq. 0.74 (−90° C.)	pyrophoric	very slow	+4		
AsH_3	colourless gas, poisonous	b.p. −55° C.	moderate	very slow	+28.6		
SbH_3	colourless gas, poisonous	liq. 2.26 (−25° C.)	rapid	very slow	+23.2		
BiH_3	gas	b.p. −22° C. (unstable)	slow	very slow	+2.2	unstable at 25° C	

drides are summarized in Table I and Table II which have been compiled from many sources. The heats of formation (col. 6) are rounded off and for the most part are for compositions less than stoichiometric (whole-number ratio of atoms). Where these compositions are known they are indicated in parentheses. Note that in Table I heats of formation are given per molecule of hydrogen contained and in Table II per molecule of compound.

In most cases solid binary hydrides decompose before melting. An exception is lithium hydride which may be melted under hydrogen at 688° C. with a small change in dissociation pressure and electrical conductivity but a large increase in volume. The solid secondary hydrides usually melt at or slightly above the decomposition temperature; *e.g.*, $LiAlH_4$ about 150° C., $LiBH_4$ about 280° C. Some, such as $Be(BH_4)_2$ and $Al(BH_4)_3$, show less ionic and more covalent character and melt well below the temperature of rapid decomposition.

The covalent hydrides show normal melting points for the most part. Metallic hydrides are all decomposed before melting, although at the melting point of the metal considerable hydrogen may be reabsorbed.

Saline binary hydrides are insoluble in conventional solvents, including liquid ammonia. They dissolve in fused halides, carbides and, in the case of the alkali hydrides (not LiH), in fused hydroxides. These hydrides are somewhat denser than the parent metals. The metallic hydrides, which are less dense than the parent metals, show typical metallic solubilities, the solvent metal either increasing or decreasing the hydrogen content. Metallic hydrides are wet by mercury and may disperse therein (F. H. Spedding, 1944; A. R. Ubbelohde, 1950). No general rules are formulated concerning solubility of other classes of hydrides.

complex, *i.e.*, containing more than one metal or metalloid and hydrogen, such as $NaBH_4$. The term double hydride is best applied to compounds or solid solutions of hydrides in each other such as $ZrNiH_3$ or $CaH_2.xBaH_2$ where the hydrogen is not necessarily associated with only one of the metal atoms. Various atoms or groups may be substituted in part for hydrogen giving substituted hydrides such as dimethyl aluminum hydride, $(CH_3)_2AlH$; dichloroaluminum hydride, Cl_2AlH; sodium trimethoxyborohydride, $NaB(OCH_3)_3H$; etc.

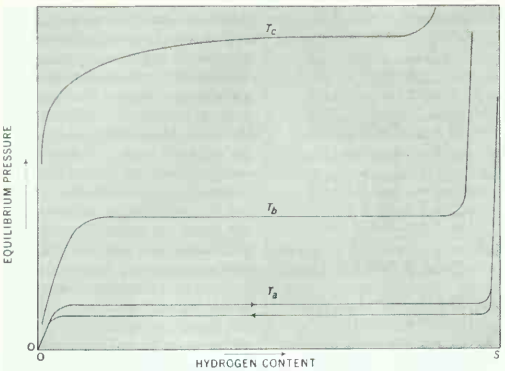
General Properties of Hydrides.—Lithium borohydride reacts vigorously with water, yielding approximately 4 l. of hydrogen per gram of borohydride. (Half of this hydrogen comes from the water.) Advantage has been taken of this property of several hydrides in the design of portable hydrogen generators for military purposes or use in remote areas. All of the hydrides are reducing agents and several find widespread use for this reason. Thermal dissociation to the metal and hydrogen may be utilized, in the case of volatile hydrides, as a means of depositing metal films or preparing pure metals for use in transistors, etc.

Properties of a number of hydrides are summarized in Table II.

Dissociation of Hydrides.—The thermal dissociation of binary saline and metallic hydrides is generally reversible, whereas

TABLE II.—*Properties of Selected Secondary Hydrides*

Formula	Description	Decomposition temperature (*in vacuo*)	Reaction with humid air and water		Heat of formation kg.cal./mol.	Appreciably soluble in
			Air	Water		
$LiBH_4$	white crystals, d = 0.666, ortho.	280° C.	rapid	vigorous	−44.1	diethyl ether lower amines
$NaBH_4$	white crystals, d = 1.07 cubic	350° C.	slow	slow	−43.8	ice water water
KBH_4	white crystals, d. = 1.18, cubic	—	very slow	very slow	−58	isopropylamine liquid ammonia
$LiAlH_4$	white microcrystals, d = 0.94	120° C.	rapid	violent	−24.1	diethyl ether tetrahydrofuran methyl Cellosolve
$(CH_3)_3NBH_3$	white crystals, d = 0.813	150° C.	slow	very slow	—	water
$Al(BH_4)_3$	colourless liquid, b.p. 45° C. d = 0.54	20° C. (very slow) vapour stable at 60° C.	explosive	explosive	−72	lower ethers (forms etherates)
$Mg(BH_4)_2$	white powder	above 200° C.	very slow	violent	—	lower ethers
$Be(BH_4)_2$	colourless crystals, v.p. 8 mm. 25° C	above 200° C.	explosive	explosive	—	lower ethers (forms etherates)
$NaBH(OCH_3)_3$	white powder	above 150° C.	rapid	vigorous	—	lower amines
$(CH_3)_2SiH_2$	colourless gas, b.p. −20° C.	above 150° C.	very slow	slow	—	[ethers]
$(SiH_3)_2O$	colourless gas, b.p. −15.2° C.	—	slow	slow	—	[ethers]
$(CH_3)_3GaBH_4$	liquid m.p. 1.5° C.	below 25° C.	rapid	violent	—	[ethers]
$Th(BH_4)_4$	white crystals, d = 2.50	over 200° C.	slow	rapid	—	ethyl ether



RELATION BETWEEN EQUILIBRIUM PRESSURE AND HYDROGEN CONTENT AT VARIOUS TEMPERATURES. ISOTHERMS ARE IN ORDER OF INCREASING TEMPERATURE T_a, T_b, T_c. S IS LIMITING HYDROGEN CONTENT, USUALLY AN INTEGER. NOTE: HORIZONTAL PORTIONS (PLATEAUS) BECOME SHORTER AS TEMPERATURE INCREASES AND DISAPPEAR AT SOME HIGHER TEMPERATURE CALLED THE CRITICAL TEMPERATURE (NOT SHOWN)

polymeric, covalent and secondary hydrides usually decompose irreversibly on heating. Reversible dissociation implies a pressure- and temperature-dependent equilibrium between hydrogen and the solid phases (figure) whereas irreversible dissociation implies only a more or less characteristic decomposition temperature where evolution of hydrogen first becomes noticeable (Tables I and II). In the case of reversible dissociation, the relation of temperature, pressure and hydrogen content has been found somewhat complicated by the fact that at certain magnitudes of these three variables a phenomenon known as hysteresis occurs. This is illustrated by isotherm T_a in the figure where the arrows indicate direction of changing hydrogen content. Thus when hydrogen is being absorbed, the equilibrium pressure at a given temperature may be higher than when the hydrogen is being desorbed during the measurement.

The reversible dissociation of hydrides is found to follow, over short temperature intervals, the relation: $\log P = -A/T + b$ where P is dissociation pressure, T absolute temperature and A and b are constants. A more general relation (C. E. Messer, 1953) is: $\log P = \log P_{\frac{1}{2}} + 2\log\left(\frac{n}{S-n}\right) + W/T\left(\frac{2n}{S} - 1\right)$ where $P_{\frac{1}{2}}$ and W are constants, n is the hydrogen-to-metal ratio and S is a parameter which varies slightly with T. It will be observed in curves T_a, T_b and T_c of the figure that over certain regions of composition the equilibrium pressure is independent of composition. Values of dissociation pressures in such plateau regions are more meaningful than in those regions near the limiting composition where the pressure changes rapidly with composition. A similar interpretation of the curves shown based on hydrogen-hydrogen-lattice site interaction rather than on phases has been suggested (R. M. Barrer, 1948; J. R. Lacher, 1937; A. Harasima *et al.*, 1947; G. Libowitz, 1957).

The dissociation pressure of saline deuterides is usually greater than that of corresponding hydrides at a given temperature (E. F. Sollers and J. L. Crenshaw, 1937).

Reactions and Uses.—In general the chemical behaviour of the saline primary hydrides is similar to that of the metal element. These hydrides all burn vigorously in air and react rapidly with water and less rapidly with alcohols, according to the equation:

$$MH + HOH \longrightarrow MOH + H_2 \text{ or } MH_2 + 2H_2O \longrightarrow M(OH)_2 + 2H_2$$

The hydrogen so evolved is not in as active a condition as that evolved by the parent metals (*e.g.*, sodium) with water, and primary saline hydrides are correspondingly less active reducing agents than the metals. At elevated temperatures where dissociation occurs, the binary saline hydrides show reducing properties. Potassium hydride reduces carbon dioxide to potassium formate at 225° C. (H. Moissan, 1902). Calcium hydride reduces refractory oxides to metals (titanium, zirconium, uranium, etc.) at about 900° C. (F. M. Perkin, 1907; P. P. Alexander, 1936) where it is slightly dissociated, and reduces sulfates to sulfides (W. E. Caldwell and F. C. Krauskopf, 1930). Sodium hydride is a condensing agent for Claisen and related condensations (V. L. Hansley, 1940). It has been used as a hydrogenation catalyst (A. M. Muckenfuss, 1935).

Sodium, calcium and lithium hydrides have been used for generation of hydrogen by reaction with water. Sodium hydride in molten sodium hydroxide has been used for removing oxide scale from iron and steel.

In general the saline secondary hydrides are powerful reducing agents. Lithium aluminum hydride (discovered by H. I. Schlesinger and A. E. Finholt, 1947) has been widely used for the reduction to alcohols of such compounds as organic acids, esters, anhydrides, amides, nitriles, aldehydes, ketones, etc. (W. G. Brown and R. F. Nystrom, 1947). Examples of such reactions are the following:

$$NaH + CH_2(COOC_2H_5)_2 \rightarrow H_2 + NaCH(COOC_2H_5)_2$$

$$NaBH_4 + 4(CH_3)_2CO \rightarrow [(CH_3)_2CHO]_4NaB \xrightarrow{2H_2O} 4(CH_3)_2CHOH + NaBO_2$$

$$2LiAlH_4 + 4CH_3CH_2COOCH_3 \rightarrow (CH_3CH_2CH_2O)_4LiAl +$$

$$(CH_3O)_4LiAl \xrightarrow[8HCl]{aq.} 2LiCl + 2AlCl_3 + 4CH_3CH_2CH_2OH + 4CH_3OH$$

$$LiAlH_4 + 2CH_3CN \rightarrow (CH_3CH_2N)_2LiAl \xrightarrow[4HCl]{aq.} 2CH_3CH_2NH_2 + LiCl + AlCl_3$$

$$LiAlH_4 + 4CH_2{=}CH{-}CH_2I \longrightarrow 4CH_2{=}CH{-}CH_3 + [LiAlI_4]$$

The solubility of lithium aluminum hydride in ethers or ether-benzene mixtures greatly increases its utility. Compounds such as quinones, Schiff bases, disulfides, acetylenes, aromatic condensed ring systems, nitrocompounds, alkyl halides, alkylhalosilanes, epoxides, sulfonic acids, sulfonylhalides, pyridine derivatives, etc., have been reduced. Carbon to carbon double bonds are unaffected unless conjugated with a carbonyl and phenyl group. Lithium borohydride is a similar but less powerful and versatile reducing agent. It is, however, soluble both in ethers and in primary amines which latter react with lithium aluminum hydride. Sodium borohydride (Schlesinger and H. C. Brown, 1945) has been used in aqueous solution for the reduction of aldehydes and ketones to alcohols (S. W. Chaikin and W. G. Brown, 1949). Sodium trimethoxyborohydride has also been used for the latter reductions (I. Sheft, 1944) and lithium tri-*t*-butoxyaluminum hydride for reduction of acid chlorides to aldehydes (H. C. Brown, 1956). Sodium borohydride in aqueous solution reduces many metal ions to free metals or borides. The reaction of this hydride with water is catalyzed by nickel or cobalt salts (presumably via the colloidal metals or borides) and by boric acid (H. R. Hoekstra, 1945). The latter combination has been used for hydrogen generation. Lithium borohydride reacts vigorously with water, often inflaming. If the reaction is adiabatic, nearly 14 l. of steam and hydrogen at 100° C. may be produced by 1 g. of the hydride.

Diborane and other dimeric and polymeric hydrides are, for the most part, active reducing agents. Diborane is exceptionally reactive and frequently yields substitution as well as reduction products. Aluminum hydride when freshly prepared acts in the same general fashion as lithium aluminum hydride. Both diborane and aluminum hydride have been decomposed thermally to produce coatings of boron and aluminum on heated objects. Aluminum has been electrodeposited from an ethereal solution of aluminum chloride containing aluminum hydride (D. E. Couch, 1951; A. Brenner, 1956).

The metallic hydrides react, in general, as expected from the independent properties of their components. The hydrogen obtained via aqueous attack is reactive at least in part and will effect reductions comparable to those obtained by dissolving metals in dilute acids. The hydrogen obtained by thermal dissociation is highly active as in the case of the saline hydrides. Several of the

metallic hydrides are hydrogenation catalysts; *e.g.*, TiH_2, Pd_2H, ZrH_2. Metallic hydrides find uses in powder metallurgy and for the preparation of metal sponge.

Most of the covalent hydrides are relatively mild reducing agents. The instability of many members of this class makes their study difficult. Bismuth, lead and tin have been deposited in specular form by decomposition of the hydrides at or above room temperature (F. Paneth, 1925). Germanium hydrides have been studied in greater detail (C. A. Kraus, 1949).

Preparation.—The most general method for preparing binary hydrides was first described in 1811 (J. L. Gay-Lussac, L. J. Thénard). It consists of heating a metal in pure hydrogen until absorption occurs, then cooling slowly. All of the binary saline and metallic hydrides may be prepared in this way, although agitation of the reaction mixture is required in the case of sodium and potassium hydrides and hydrogen at high pressure is required for magnesium hydride. Beryllium hydride has not been prepared by this method. Nearly all of the binary hydrides may be made by the action of atomic hydrogen, generated in a glow discharge, upon the metals or metal alkyls, etc. (Paneth, 1922; Schlesinger, 1931; E. Pietsch, 1933). This method is claimed to yield hydrides of tin, lead, bismuth, polonium, gallium, beryllium, thorium, silver, gold, thallium, tantalum, copper and boron.

Reduction of metal oxides or halides at high temperature by calcium, calcium hydride, magnesium or aluminum in the presence of hydrogen has been used to prepare many hydrides; *e.g.*, LiH, CaH_2, ZrH_2, TiH_2 (Alexander, 1936). This method may be employed even for thermolabile volatile hydrides, *e.g.*, B_2H_6, if these are removed rapidly from the reaction zone by a stream of hydrogen (D. T. Hurd, 1949).

Hydrogen evolved at the cathode during electrolysis of aqueous solutions is also active and has been reported to combine with many cathode metals. This method is useful for the preparation of most metallic hydrides but is obviously unsuited to the preparation of water-reactive types. Many metals which do not form true hydrides may be supersaturated with hydrogen when used as cathode metals, mechanical disintegration sometimes occurring as a result. The plating of metals at potentials where hydrogen is also discharged usually leads to absorption of hydrogen. Thus freshly deposited chromium contains many times its own volume of hydrogen.

Hydrolysis of borides, silicides, germanides by water, aqueous acids or nonaqueous acids, *e.g.*, ammonium bromide prepared with liquid ammonia, has been used for the preparation of boranes, silanes and germanes (F. Jones, 1878; A. Stock, 1917; Hurd, 1947). Copper hydride has been made by reduction of aqueous copper sulfate solutions with hypophosphite (A. Wurtz, 1844).

One of the most elegant and versatile methods of preparing hydrides involves the use of alkali metal hydrides as starting reagents (Schlesinger, Finholt and H. C. Brown, 1946). Lithium aluminum hydride is prepared by reacting finely powdered lithium hydride with aluminum chloride in ethereal solution. Sodium borohydride is prepared without a solvent by reacting sodium hydride with methyl borate at 260° C. An excess of methyl borate yields sodium trimethoxyborohydride. In each case the product is leached away from the insoluble by-product:

$$4LiH + AlCl_3 \rightarrow 3LiCl + LiAlH_4$$
($NaAlH_4$, $LiGaH_4$, B_2H_6 similarly)

$$4NaH + B(OCH_3)_3 \rightarrow 3NaOCH_3 + NaBH_4$$

From these two hydrides many others may be prepared by metathetical reactions; *e.g.*:

$$NaBH_4 + LiCl \xrightarrow{\text{amine}} NaCl + LiBH_4$$

$$3NaBH_4 + AlCl_3 \xrightarrow{\text{heat}} 3NaCl + Al(BH_4)_3$$

$$3NaBH_4 + 4BF_3 \xrightarrow{\text{ether}} 3NaBF_4 + 2B_2H_6$$

$$NaBH_4 + SnCl_4 \xrightarrow{\text{aq.}} [NaBCl_4] + SnH_4$$

$$LiBH_4 + (CH_3)_4NF \xrightarrow{\text{water}} LiF + (CH_3)_4NBH_4$$

$$LiAlH_4 + MX_n \xrightarrow{\text{ether}} LiAlX_4 + MH_n$$
(B_2H_6, AlH_3, SiH_4, GeH_4, SnH_4, AsH_3, SbH_3, etc., similarly)

$$LiAlH_4 + MR_n \rightarrow LiAlH_3R + MH_n$$
(BeH_2, MgH_2, ZnH_2, CdH_2, HgH_2 similarly)

The latter two equations are schematic; X represents halogen, R represents an alkyl group (*e.g.*, methyl) and M is a metal or metalloid atom. Borohydrides of titanium, thorium, etc., have been prepared from the halides and aluminum borohydride (Hoekstra and J. J. Katz, 1948). Aluminohydrides and galliohydrides have been prepared by reacting alkali metal hydrides with the respective alkyls, and several borohydrides may be prepared directly from diborane; *e.g.*:

$$NaH + B(C_2H_5)_3 \rightarrow NaBH(C_2H_5)_3$$

$$ZnH_2 + B_2H_6 \rightarrow Zn(BH_4)_2$$

$$2Ga(CH_3)_3 + 3B_2H_6 \xrightarrow{-45^\circ} 2(CH_3)_2GaBH_4 + 2B_2H_5CH_3$$

The preparation and structure of many substituted boron hydrides, especially amino derivatives, have been studied (A. B. Burg, 1950), including such compounds as $Na_2HB(CH_3)_2$, $[(CH_3)_2PBH_2]_3$, $(CH_3)_3PBH_3$, etc. Borazole, $B_3N_3H_6$, is the parent substance of a number of related compounds (Schlesinger, 1950). *See* also ADSORPTION; BORON; HYDROGEN; SILICON.

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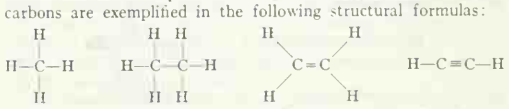
HYDROCARBON, in chemistry, a compound that contains only the elements carbon and hydrogen. Hydrocarbons are one of the most important groups in organic chemistry for three reasons: (1) they form a logical first step in the study of organic chemistry since they contain only two kinds of atoms and can be related systematically to other more complicated molecules; (2) they are available in very large quantities (*e.g.*, in natural gas and petroleum); (3) they are widely used in industry (*e.g.*, as fuels, lubricants, solvents, plastics, rubbers).

In the hydrocarbons, except for free radicals such as triphenylmethyl, carbon always has a completed valence of 4 and hydrogen has a valence of 1. Thus, in the structural formula for any hydrocarbon there are four bonds attached to each carbon atom (joining that carbon atom either to other carbon atoms or to hydrogen atoms) and one bond attached to each hydrogen atom. The joining of two atoms by one valence bond of each is described as a single bond. When two carbon atoms are joined by two valence bonds from each atom, the joining is called a double bond; three such bonds make a triple bond. The valences and bonds of hydrocarbons are exemplified in the following structural formulas:



The two-dimensional representation above is commonly used since it is adequate for most purposes. The molecules themselves, however, are in general three-dimensional with the valence bonds of the carbon atom being arranged as if directed toward the corners of a regular tetrahedron. In some cases the three-dimensional

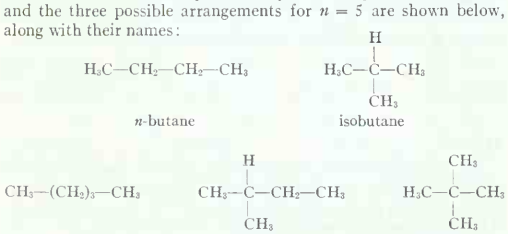
characteristic can lead to alternative spatial arrangements of the atoms, and the determination of these configurations is of considerable importance. (*See* also CHEMISTRY: *Organic Chemistry: Representation of the Structure of Organic Compounds.*)

Inasmuch as extremely different properties are associated with the single, double and triple bonds, it is conventional to make a subdivision of hydrocarbons on the basis of bond type. Those hydrocarbons that contain only single bonds are known as saturated hydrocarbons; those containing double or triple bonds are called unsaturated hydrocarbons. It is generally found that the atoms may be rotated more or less freely about single bonds but not about double or triple bonds. In the case of a double bond, there are two alternative arrangements of the atoms about the bond. For example, the following cis and trans configurations exist for 2–butene:

In the cis configuration, the methyl groups are on the same side of the double bond, whereas in the trans arrangement they are on opposite sides. With the triple bond, the configuration is linear and hence there is no possibility at this point for more than one structure. (*See* also ISOMERISM; STEREOCHEMISTRY.)

Nomenclature.—Hydrocarbon nomenclature, because of the large number of compounds involved and the overlapping of the identifiable characteristics of the compounds, always has been inexact. Many of the unsystematic names still used once had significance, but this significance often has largely disappeared although the names remain. For example, in the early era of organic chemistry saturated hydrocarbons were considered relatively inactive and hence were called paraffins (from Lat. *parum affinis*, meaning little activity). Although the name paraffin hydrocarbon is still commonly used, it is now known that paraffins are reactive under certain conditions, and they are more correctly identified by their systematic name of alkanes. For much the same reasons, the group of hydrocarbons still commonly called olefins is more correctly known as alkenes, and the acetylenes have the chemical name of alkynes. Trivial (common) names of individual compounds arose from the origins of the materials, from properties that they possessed or from whims of the investigators who first prepared the compounds. Sometimes a name takes on several different meanings. Thus paraffin has the significance discussed above and also is used to designate a group of waxy hydrocarbons obtained from petroleum.

General Structure.—*Saturated.*—It is in some ways convenient to start a discussion of hydrocarbons by considering the generalized molecular formula for them as C_nH_{2n+x}, where n is the number of carbon atoms in the molecule and x is an integer that may take on such values as $+2$, 0, -2 or -4. When $x = 2$, the structures are those of paraffin hydrocarbons. Thus CH_4 corresponds to methane, C_2H_6 to ethane, C_3H_8 to propane, etc. The number of ways in which the carbon atoms can be arranged in these molecules increases rapidly with n. When $n = 1$, 2 or 3, there is only one possible acyclic arrangement. At $n = 4$ there are two, at $n = 7$ there are nine, while at $n = 20$ there are more than 300,000. The two possible acyclic arrangements for $n = 4$ and the three possible arrangements for $n = 5$ are shown below, along with their names:



Saturated hydrocarbons of three or more carbon atoms also can be arranged in a cyclic manner; since they have two less hydrogen atoms than acyclic paraffins, their generalized molecular formula is C_nH_{2n}. They are called cycloparaffins, cycloalkanes, cyclanes or naphthenes. The latter name is commonly used in petroleum chemistry since these compounds are obtained in the naphtha fraction of petroleum.

Compounds such as *n*-butane and *n*-pentane or isobutane and isopentane and the related compounds that can be formed from them by adding a $—CH_2—$ group into the molecule are said to be members of a homologous series. (In hydrocarbon nomenclature, the prefix normal, abbreviated as *n*, indicates a straight chain; the prefix iso, sometimes abbreviated as *i*, indicates a one-carbon branch at the end of a straight chain; and the prefix neo indicates that at least one carbon atom is attached directly to four other carbon atoms. Considerable care should be exercised with the use of these abbreviations since iso is sometimes used in a much broader sense and the abbreviation nor also will be found; the latter is used to denote a simpler precursor of the material to which it is prefixed.) The usefulness of the homologue concept is based on the fact that there is only a gradual change in properties between adjacent members in such a series, and these properties tend to approach a limit as the number of carbon atoms increases. Consequently the behaviour of large groups of hydrocarbons can be predicted by determining the properties of a few homologues in each group. This generalization can be applied, however, only with a certain amount of care, but on the whole it is extremely useful.

In most cases, the boiling point, melting point and density increase as the number of carbon atoms increases and the boiling point decreases as the number of branch chains increases. Under standard conditions of temperature and pressure (25° C. and 760 mm.), normal hydrocarbons of 1 to 4 carbon atoms are gases, those with 5 to 17 carbon atoms are liquids and those with 18 and more carbon atoms are solids. The molecular weights of hydrocarbons range from 16.043 for methane to several million for certain heavy synthetic polymers.

Unsaturated.—When $x = 0$ hydrocarbons have the formula C_nH_{2n}. It is apparent by referring back to the structural formulas of the paraffins that molecules corresponding to C_nH_{2n} can be obtained by removing two atoms of hydrogen from a molecule of a paraffin and then joining together the two carbon atoms from which the hydrogen atoms have been abstracted. If the two carbon atoms involved are not adjacent to one another, *e.g.*, at opposite ends of the chain, then this procedure leads to the cycloalkanes (*see* above). If, however, the hydrogen atoms are removed from adjacent carbon atoms, then this introduces a double bond and leads to compounds variously called olefins, alkenes or in general unsaturated compounds. The simplest member here is ethylene, C_2H_4. This process of hydrogen abstraction can, of course, be repeated with x decreasing by 2 for each pair of hydrogen atoms abstracted. In this way a great profusion of compounds results. For the special case $x = -2$ there is the possibility of removing all four hydrogen atoms from adjacent carbon atoms, thus giving a triple bond and leading to the acetylene (alkyne) structure; or two double bonds may be formed, thus leading to the dienes, or diolefins.

It is also possible to remove the four atoms of hydrogen so as to form a ring compound containing one double bond, that is, a cycloalkene, cycloolefin or cyclene, or to form a compound containing two rings; that is, a bicyclo compound. Cyclic acetylenes, called cycloacetylenes or cycloalkynes, and cyclic diolefins also are known.

(*See* also PARAFFIN HYDROCARBONS; OLEFIN; ACETYLENE.)

Aromatic.—It is thus possible to continue abstracting two atoms of hydrogen at a time and, particularly as n increases, to build up increasingly complex structures. One noteworthy class of more complicated, cyclic unsaturated hydrocarbons consists of the aromatics. Here again the name is of historical significance only and is based on the fact that the first members examined happened to be odorous.

The first member of the aromatic series is benzene (*q.v.*),

C_6H_6. Its structural formula is represented by a ring of six carbon atoms, each carrying one hydrogen atom. In order to distribute the carbon valences, the structure is often written with alternate single and double bonds between the carbon atoms. However, benzene does not display the reactivity usually associated with an unsaturated compound and instead is a relatively inert material in which all carbon atoms are equivalent; also, no differences can be found among the hydrogen atoms. The accepted concept is that in six-membered ring systems of this type interactions occur that tend to equalize all the carbon-to-carbon bonds (*see* RESONANCE, THEORY OF) while also increasing stability.

In fig. 1 the second formula for benzene is one often used to indicate this type of ring since its use avoids the need for locating the double bonds.

The higher aromatics may be considered as being derived from benzene by the addition of side chains or by the fusing of one or more additional benzene rings. A few derivatives are shown in fig. 1. One word of caution should be given about these formulas. It is common practice in organic chemistry to write structural formulas with the hydrogen atoms omitted; it is understood that hydrogen atoms are to be imagined wherever they are needed to bring the valence of carbon to four. However, hexagonal rings that represent unsaturated compounds, such as those in fig. 1, are quite different from this usage and are always to be interpreted as shown in that figure. If it is desired to write an abbreviated structure for a saturated compound, *e.g.*, cyclohexane,

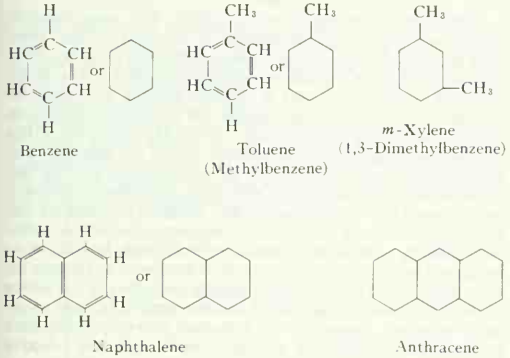


FIG. 1

then a similar hexagon is used but the capital letter S is printed within the hexagon to indicate that it is a saturated structure and not an aromatic.

Terpenes.—The terpenes (*q.v.*) comprise a number of naturally occurring hydrocarbons. Turpentine, perhaps the best-known example, is composed principally of α- and β-pinene.

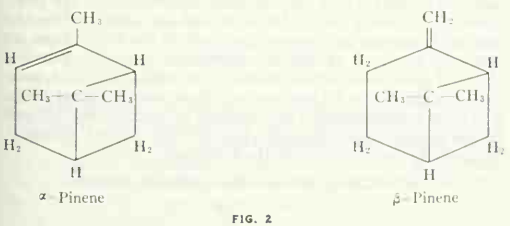


FIG. 2

Light Absorption.—Most hydrocarbons are colourless; that is, they do not absorb light in the visible spectrum. However, if enough double bonds are introduced into the compound or if they are introduced in certain arrangements, then absorption shifts into the visible and the compound becomes coloured. Two interesting examples of coloured hydrocarbons are azulene, the compound that

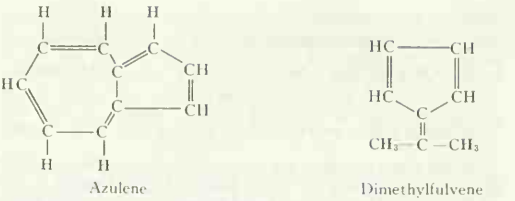


FIG. 3

produces the blue colour in certain essential oils, and dimethylfulvene (orange). Azulene has the same molecular formula, $C_{10}H_8$, as naphthalene but consists of a seven-member ring and a five-member ring instead of two six-membered rings. Dimethylfulvene, whose molecular formula, C_8H_{10}, is the same as that of colourless *m*-xylene, is a derivative of cyclopentadiene, which also is colourless.

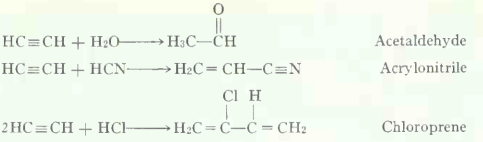
Synthesis.—Hydrocarbons have been synthesized in an enormous number of ways. In the laboratory the aim is generally to secure a pure product with some specific structure. The methods employed often involve establishing, by known synthetic methods, the correct arrangement of the carbon atoms for the desired structure but with atoms other than hydrogen or perhaps with some extraneous groups present in the molecule. Then in subsequent operations these extraneous parts of the molecule are removed so that finally the desired hydrocarbon is secured.

A number of hydrocarbons can be made from nonhydrocarbon sources, and several such syntheses are carried out commercially. It is possible, for example, to form compounds of a number of the metals with carbon and then to decompose these carbides with water or acid to yield a variety of hydrocarbons. Large quantities of acetylene are produced in this way from calcium carbide. Coal can be converted into liquid hydrocarbons in two ways. In one, coal is combined directly with hydrogen to form a liquid mixture rich in hydrocarbons. In the other, the coal is first burned to form carbon monoxide and then the carbon monoxide is reacted with hydrogen to form a mixture of materials; the reaction conditions can be controlled so that the product ranges from a mixture composed only of hydrocarbons to mixtures of oxygenated compounds. Since one hydrocarbon can be transformed into another, these syntheses have in principle made the whole range of hydrocarbons available. Because of high costs, however, these syntheses are economically attractive only in very special circumstances.

Natural Sources.—In nature the great sources of hydrocarbons are natural gas and petroleum, coal tar, and natural rubber in that order. Of considerably lesser importance are the essential oils. The two chief sources, natural gas and petroleum, differ in that natural gas consists mainly of hydrocarbons of low molecular weight while petroleum in general contains larger proportions of hydrocarbons of high molecular weight.

Methane (*q.v.*) is the predominant constituent of natural gas and is easily obtained from it in a state of substantial purity. Its primary use is as a heating fuel since it is inexpensive and convenient to use. Relatively small amounts are chlorinated to produce chlorinated solvents, while large amounts are converted to acetylene by exposure for a short time to a high temperature. This transformation can be effected either by passing the methane over a highly heated refractory or by controlled combustion with a limited amount of oxygen so that the reaction $4CH_4 + 3O_2 \rightarrow 2C_2H_2 + 6H_2O$ takes place. With careful control of the conditions, about 30% of the carbon originally present in the methane can be converted to acetylene.

Acetylene in turn has become an important chemical. Its use in the oxyacetylene torch is well known. As a chemical intermediate, it is the raw material for the preparation of acetaldehyde, vinyl esters (chloride, acetate, etc.), acrylonitrile, chloroprene and many other important products. All of these derivatives are formed by the addition of the proper chemical reagent to the acetylene molecule:



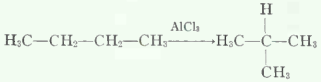
In the above reactions, the emphasis in general is on the triple bond of the acetylene and on the ability of other reagents to add to this bond. The triple bond also confers a relatively high degree of acidity to the hydrogen atoms adjacent to it; in consequence, acetylene forms metallic salts (often explosive), which in turn have been used for the synthesis of many other acetylene derivatives.

Following methane, the next higher-boiling paraffin hydrocarbons in natural gas are ethane and propane. Both materials are used as fuels and are decomposed by heat to yield the olefins ethylene and propylene. For butane and higher paraffin hydrocarbons, petroleum is the source.

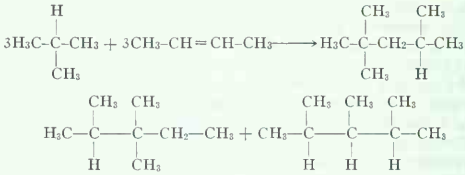
Petroleum Refining.—The operations of the petroleum and petrochemical industries, the major processors of hydrocarbons, are based on a consideration of the properties of the hydrocarbons involved as they relate to product demands. In the production of gasoline, for instance, the operation of the internal-combustion automobile engine is a determining factor. In the gasoline engine, a mixture of hydrocarbons and air is first sucked into the combustion chamber. This mixture is next compressed to about one-tenth its original volume and then is ignited by a spark. In consequence, a good gasoline must be able to withstand the increase in pressure and temperature during compression without igniting, and then when it is ignited by the spark it must burn smoothly and cleanly without detonation (knock). In the diesel engine, on the other hand, air is introduced first into the cylinder and is compressed to about one-twentieth its original volume. Diesel fuel is then sprayed as a liquid into this heated, compressed air. Here it is imperative that the fuel (1) ignite as soon as possible after it enters the cylinder and (2) burn smoothly and completely. Thus the requirements for these two types of engine are somewhat opposed since in the gasoline engine the fuel should resist ignition except when acted upon by a powerful source like a spark or flame while in the diesel engine the fuel should ignite very readily. In the case of continuous combustors such as those used in jet engines and furnaces, the need is for a fuel that burns cleanly without decomposing into sooty deposits. Here the ignition properties of the hydrocarbon fuels are less critical since a flame is continuously present. The materials that are actually produced as engine fuels represent compromises dictated by economics. In all cases proper mechanical design of the combustion device itself materially improves the performance of many fuels.

Gasoline.—As fuels for the internal-combustion automobile engine, hydrocarbons rank in the following order: paraffin hydrocarbons with considerable chain branching, extremely good; aromatics, good; olefins, fair; straight-chain paraffins, poor. As diesel fuels, the straight-chain paraffins are among the best and the higher aromatic hydrocarbons are among the poorest.

In order to produce the maximum possible amount of high-quality gasoline (*q.v.*) the refiner subjects hydrocarbons to a number of chemical and physical actions. Portions of the crude petroleum that boil at temperatures higher than the boiling point of gasoline are cracked thermally or catalytically to bring them into the gasoline range. In thermal cracking the material is subjected to a temperature of about 1,000° F. (538° C.) at elevated pressures. This has the effect of breaking larger molecules into smaller olefins and paraffins and some aromatics. In this thermal process the change is largely one of simple cleavage of molecules and consequently the gasoline is relatively poor in branched structures and in aromatics. In catalytic cracking, the feed is passed over a catalyst (commonly alumina silica) at around 900° F. (482° C.) under a few pounds of pressure. In this case extensive rearrangement and dehydrogenation take place so that both branched structures and aromatics are found in abundance. The cracking processes work on a wide boiling fraction of the crude; certain other processes that are almost if not actually chemical processes have been developed that are applied to relatively narrow fractions. For example, in order to secure isobutane for alkylation, large quantities of normal butane are isomerized by passing the material over an aluminum chloride type of catalyst:

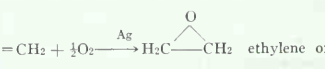


In relation to gasoline production, alkylation refers to the reaction between isobutane and an olefin in the presence of an acidic catalyst to give branched-chain paraffins. Thus when isobutane is reacted with 2-butene a mixture of saturated hydrocarbons particularly rich in 2,2,4-, 2,3,3- and 2,3,4-trimethylpentane is produced. In practice, the proportions of the products vary and are not equal.



Production of Aromatics.—The refiner also uses catalytic processes to increase the production of aromatics. These processes generally involve taking a selected fraction from the crude and passing it over a platinum-containing catalyst. The initial feedstock is selected so that it contains suitable precursors for making benzene, toluene, the xylenes and the other aromatics up through about the 10-carbon range. Under the conditions of this reaction, the rings containing 5 carbon atoms are enlarged to 6, and hydrogen is split off from the 6-carbon rings to give the aromatic nucleus. In this process very large quantities of hydrogen are produced and in consequence the further processing of this hydrogen has become an important subsidiary operation of petroleum refining. The lower aromatic hydrocarbons, in addition to being used as gasoline components, have been used as solvents for many years. Coal tar distillates originally served as the sole source of these materials, but petroleum sources came to be used as demand increased. In general, the aromatics are recovered by such processes as extractive or azeotropic distillation and selective freezing.

Olefins.—As indicated above, very large quantities of the lower olefins—*e.g.*, ethylene, propylene, butylene—are available from the petroleum refining industry and also are made deliberately by pyrolysis of selected paraffin hydrocarbons. These olefins have become the basis for the extensive modern petrochemical industry. From the standpoint of the chemistry involved, it can be seen that most uses of olefins take advantage of the double bond in the molecule to react it with other chemical reagents. In a few cases, however, the double bond is left intact and use is made of the fact that the hydrogens on a carbon atom next to the double bond are unusually reactive. In the case of ethylene (*q.v.*), the principal chemical derivatives include ethanol from the addition of a molecule of water to the double bond; ethylene oxide by direct oxidation using a silver catalyst; ethylbenzene by reaction with benzene in the presence of aluminum chloride; and various polymers. Typical ethylene reactions are the following:



When water is added to the double bond of propylene the product is isopropyl alcohol, which in turn is used to produce a great many derivatives. The hydrogen atoms in the methyl group of propylene are activated by the presence of the double bond and advantage is taken of this fact to react propylene at an elevated

temperature with chlorine so that the reaction that occurs is chlorination of the methyl group rather than addition to the double bond (the latter predominates at low temperatures):

$$H_3C{-}CH{=}CH_2 + Cl_2 \xrightarrow{\text{hot}} H_2C(Cl){-}CH{=}CH_2 + HCl$$

allyl chloride

$$H_3C{-}CH{=}CH_2 + Cl_2 \xrightarrow{\text{cold}} H_3C{-}CH(Cl){-}CH_2(Cl)$$

propylene dichloride

Allyl chloride was used in the key step to the first commercial synthesis of glycerol (*q.v.*). Oxygen also will attack the methyl group of propylene at elevated temperatures over an appropriate catalyst such as copper oxide. In this case, acrolein is produced:

$$H_3C{-}CH{=}CH_2 + O_2 \longrightarrow HC(=O){-}CH{=}CH_2 + H_2O$$

acrolein

This reaction serves as the basis for another commercial synthesis of glycerol.

The butylenes undergo reactions similar to those already described for ethylene and propylene. In addition, butylene can be dehydrogenated to give butadiene:

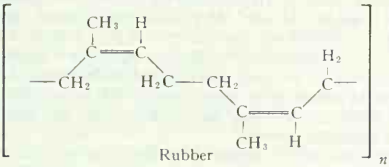
$$H_3C{-}C{\equiv}C{-}CH_3 \longrightarrow H_2C{=}C{-}C{=}CH_2 + H_2$$

butadiene

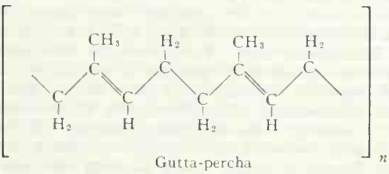
Dehydrogenation is commonly carried out with other hydrocarbons. Ethylbenzene, for example, is dehydrogenated to give styrene. Both butadiene and styrene are used in the production of plastics and synthetic rubbers.

(*See* also PETROLEUM: *Refining of Petroleum.*)

Heavy Polymers.—The polymers of hydrocarbons of high molecular weight deserve special mention. The two best-known examples that occur in nature are rubber and gutta-percha. These two hydrocarbons have very high molecular weights and consist of linear multiples of the following basic units:



Rubber



Gutta-percha

FIG. 4

It will be observed that the only significant difference in these two formulas is the arrangement of the carbon atoms at the double bond. In rubber, the chain or backbone of the molecule enters and leaves the double bond on the same side. The gutta-percha chain, however, enters and leaves on opposite sides. This difference in structure causes the one material to be rubber and the other a horny plastic.

For a number of years processes have been available by which a large number of olefin molecules can be joined together to give high molecular weight hydrocarbon polymers with useful mechanical properties. Ethylene, for example, can be made to combine with itself to produce polyethylene. Similarly, styrene can be polymerized to give polystyrene, and three parts of butadiene can be condensed with one part of styrene to give synthetic rubber. In a later development called stereospecific polymerization, the polymers synthesized closely resemble the corresponding natural ones. In the case of rubber and gutta-percha, for example, it is possible to start with isoprene (2-methylbutadiene) and prepare a polymer that is rubberlike, although decidedly inferior to natural rubber, and that structurally resembles a mixture of the units found in natural rubber and gutta-percha along with certain other structures.

However, recently it has been found possible to control the polymerization of isoprene so as to secure the same ordered structure that is found in natural rubber, thereby producing the so-called synthetic natural rubber. This stereospecific polymerization is carried out with either a lithium or an aluminum-titanium catalyst. Similarly, starting with butadiene, stereospecific polymers have been produced that correspond to natural rubber with the exception that the methyl groups are missing from the chain. The structure of stereospecific polymerized propylene may be visualized as follows:

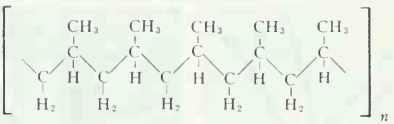


FIG. 5

While there are no double bonds in the molecule, nevertheless every other carbon atom does carry one methyl group and one hydrogen atom. If the backbone chain of this polypropylene is visualized as a long zigzag in a plane, then these hydrogen and methyl groups lie above and below the plane of the backbone. The possibility thus exists that successive methyl groups may be distributed randomly on either side of the plane or they may be arranged systematically so that all lie on the same side of the plane or alternate between sides. Thus optimum properties are produced.

See also separate articles on many of the compounds mentioned, *e.g.*, ETHANE; PROPANE; and references under "Hydrocarbon" in the Index volume. (T. W. E.)

HYDROCELE, the medical term for any collection of fluid other than pus or blood in the neighbourhood of the testis or cord. The fluid is usually serous. Hydrocele may be congenital or arise in the middle-aged without apparent cause. The hydrocele appears as a rounded, fluctuating translucent swelling in the scrotum, and when greatly distended causes a dragging pain. It may be treated and cured by surgical procedures.

HYDROCEPHALUS is a condition, either developmental or acquired, in which there is an abnormal accumulation of the body fluids within the skull. The congenital form is often associated with other developmental anomalies of the spine and spinal cord. The acquired variety usually results from some inflammatory disease such as meningitis but may occur also as a result of tumours and other obstructions. The immediate cause of hydrocephalus is some interference with the circulation of the fluids in and around the brain. Two varieties are often mentioned, internal and external. In the former the ventricles of the brain become more or less distended with cerebrospinal fluid, which compresses the brain and interferes with its function. In the latter fluid accumulates in the arachnoid spaces on the outer aspect of the brain; this also compresses the brain.

The two varieties are frequently combined. In most instances the condition is progressive, associated with enlargement of the head and separation of the sutures and fontanels of the skull; mental retardation also results. The shape of the face and head, sometimes referred to as Marshall Hall's facies, is characteristic.

When a fetus is afflicted with this disorder, the size of the head may cause serious complications of labour. The condition, however, can be recognized during the prenatal period by X-rays and other diagnostic means, and the situation handled satisfactorily as far as the mother is concerned.

No medical or radiologic treatment is of benefit, except in those cases in which the condition results from a radiosensitive tumour.

Various methods of surgical treatment have been tried, with a certain amount of success, especially by the use of a "valve" to drain the excess fluid directly into the blood stream.

(F. L. A.; X.)

HYDROCHARITACEAE, a family of chiefly aquatic plants belonging to the order Hydrales (Butomales) and including such commonly cultivated aquarium plants as the water weed or water thyme (*Elodea*), eelgrass (*Vallisneria*), frogbit (*Hydrocharis* and *Limnobium*) and water soldier (*Stratioides*). The plants are rooted in mud, sometimes becoming free-floating. The leaves are diverse; they are either basal and wholly submersed or with blades emersed, or bladeless and borne in whorls along the stem and wholly submerged.

The flowers are enclosed in a spathelike structure in the leaf axils, regular, usually unisexual with the sexes on different plants, rarely in the same flower. The male flowers number one to several in a spathe, the female ones are usually solitary. The perianth is in two or one series, the outer series three, rarely two, green, not

(A) HUGH SPENCER; (B) MILO WILLIAMS

TWO SPECIES OF HYDROCHARITACEAE: (A) EELGRASS (VALLISNERIA); (B) WATERWEED (ELODEA OR ANACHARIS)

overlapping, the inner three, two or none, overlapping in bud and petallike, often borne on an elongate tubelike extension of the receptacle (hypanthium). The number of stamens may range from three to many. The ovary is inferior (below the perianth and stamens) and is one-celled with several seeds on the ovary wall. The fruit is leathery.

This is a family of plants of diverse habit held together by the inferior ovary, spathelike involucre and elongate tubelike receptacle and parietal placentation.

See John Hutchinson, *Families of Flowering Plants*, vol. ii, pp. 22–32 (1926–34); H. L. Mason, *Flora of the Marshes of California*, pp. 119–123 (1957). (H. L. Mn.)

HYDROCHLORIC ACID AND HYDROGEN CHLORIDE.

Hydrogen chloride, a compound containing the elements hydrogen and chlorine, is a gas under ordinary conditions. The name hydrochloric acid was formerly applied to both the gas and its solution in water, but later practice favours the restriction of the term hydrochloric acid to the aqueous solution.

Hydrogen chloride and hydrochloric acid, like coal tar, were considered troublesome waste products before they became industrially important. In the 19th century manufacturers of soda ash, under attack because of the noxious fumes discharged from their chimneys, worked out a process for converting it into liquid form; the resultant hydrochloric acid was dumped at sea until a method was found for utilizing it in the manufacture of chlorine, which was much in demand for bleaching.

Hydrochloric acid is present in the digestive juices of the human stomach. Excessive secretion of the acid causes gastric ulcers; a marked deficiency of it impairs the digestive process and is sometimes the primary cause of deficiency anemias. (*See* Gastric and Duodenal Ulcer; Anemia.)

The acid was first mentioned by Johann Rudolf Glauber in 1648, while the gas was first prepared by Joseph Priestley in 1772. The composition of hydrogen chloride was elucidated by Sir Humphry Davy in 1810. Having first shown that chlorine is an element, Davy demonstrated that hydrogen chloride contains only hydrogen and chlorine, for, on causing the gas to react with sodium and potassium, he obtained only hydrogen and the chloride of the metal. Previously the gas, then known as muriatic acid, was assumed by Claude Louis Berthollet and Antoine Lavoisier to contain oxygen.

Preparation.—Hydrogen chloride may be formed by the combination of chlorine and hydrogen with no change in volume: $H_2 + Cl_2 \rightarrow 2HCl$. The reaction is accompanied by the evolution of 22 kilocalories of heat per gram mole of HCl and the compound is stable, being only 0.2% decomposed at 1,550° C. A mixture of hydrogen and chlorine may be kept at room temperature without apparent reaction. Exposure to sunlight causes an explosive reaction that also occurs when the gases are heated to 250° C. The reaction appears to be hastened by moisture. With well-dried gases it has been found that only 80% reacts in ten minutes at 450° C. A stream of burning hydrogen continues to burn with a steady flame in chlorine and vice versa. The reaction may be brought about also by igniting the two gases after they are brought together in a blow torch.

Hydrogen chloride is prepared both on a laboratory and on an industrial scale by the reaction of a chloride, generally that of sodium, with concentrated sulfuric acid. At moderate temperatures only half of the hydrogen from the sulfuric acid reacts, hydrogen chloride is evolved and a residue of sodium bisulfate remains: $NaCl + H_2SO_4 \rightarrow NaHSO_4 + HCl$. At a temperature of 500° C., two molecules of hydrogen chloride per molecule of sulfuric acid may be obtained, the residue being sodium sulfate (salt cake), $2NaCl + H_2SO_4 \rightarrow Na_2SO_4 + 2HCl$. This reaction, which was employed in the Le Blanc process for the manufacture of sodium carbonate (*see* Alkali Manufacture), provided more hydrogen chloride than could be utilized as hydrochloric acid and much of it was consumed in producing chlorine. With the advent of cheaper chlorine the relative positions of chlorine and hydrochloric acid were reversed and considerable hydrochloric acid thereafter was made from chlorine.

Hydrogen chloride is produced by the hydrolysis of some chlorides. Phosphorus trichloride hydrolyzes completely at room temperature ($PCl_3 + 3H_2O \rightarrow H_3PO_3 + 3HCl$) to phosphorous acid and hydrogen chloride. At elevated temperatures magnesium chloride is hydrolyzed by steam ($MgCl_2 + H_2O \rightarrow MgO + 2HCl$). A convenient way to prepare hydrogen chloride gas in the laboratory is to drop concentrated hydrochloric acid into concentrated sulfuric acid. Hydrogen chloride is also a by-product of the chlorination of many organic substances and this has become an important source.

Hydrochloric acid is prepared by dissolving gaseous hydrogen chloride in water. The solubility of the gas is less at higher temperatures and consequently provision must be made to remove the considerable amount of heat produced when the gas dissolves. Because of the corrosive nature of the acid, ceramic or glass apparatus is commonly used. Tantalum is the most resistant of the metals to corrosion in the presence of hydrochloric acid and, although expensive, is employed to some extent. Pure hydrochloric acid is colourless. The yellow colour of some commercial products is caused by iron and other impurities. Hydrochloric acid is usually marketed as a solution containing 28%–36% hydrogen chloride by weight (18–22 Baumé), commonly known as concentrated hydrochloric acid. The concentration of hydrochloric acid may be approximately calculated by subtracting 1.00 from its specific gravity and multiplying the remainder by 200. For example, hydrochloric acid of specific gravity 1.10 contains $200 \times .10 = 20\%$ by weight of HCl. Anhydrous liquid hydrogen chloride in steel cylinders is available, but because the vapour pressure is about 50 atm. at ordinary temperatures, heavy and expensive containers are required and the use of hydrogen chloride in this form is limited.

Properties.—Hydrogen chloride has a molecular weight of 36.460. It is a colourless gas of strong odour, weighing 1.639 gr. per litre at 0° C. and 1 atm. The boiling point is −85° C., the freezing point −114° C., the critical temperature is 52° C. and critical pressure 90 atm. Deuterium chloride (DCl) has similar properties but its boiling point is 3° lower and its freezing point

1° lower. The heat capacity at constant pressure at T° Kelvin is $6.70 - 0.84 \times 10^{-3}T$ cal. per g. mole. At 25° C. the free energy is −22.690 cal./mole, the entropy 44.5 cal./mole/degree. The gas is very soluble in water; at 20° C. water will dissolve 477 times its own volume of hydrogen chloride. Because of its great solubility the gas fumes in moist air, forming a mist of hydrochloric acid. The solubility does not follow Henry's law. While at 20° C. hydrogen chloride at 760 mm. pressure is in equilibrium with a solution 42% HCl by weight, the pressure is less than 0.1 mm. over a 15% solution. The solution of one mole (36.460 g.) of gaseous hydrogen chloride in a large amount of water is accompanied by the evolution of 17.63 kilocalories of heat. At 1 atm. a solution 20.24% by weight HCl has the maximum boiling point 110° C., and boils without change in composition. On boiling acids of either greater or less strength than the constant boiling mixture, the composition of the liquid approaches 20.24%. Since the composition of the constant boiling, or azeotropic, mixture depends upon the atmospheric pressure, it is not considered a chemical compound. However, at low temperatures solid hydrates of hydrogen chloride may be crystallized from the concentrated solution. Although liquefied hydrogen chloride and solutions of the gas in nonpolar liquids are extremely poor conductors of electricity, the aqueous solution is a good conductor. At 25° C., the equivalent conductance of 0.1 normal hydrochloric acid is 389.8, and the limiting equivalent conductance 426.1 reciprocal ohms. Thus, hydrochloric acid is a strong electrolyte. The extensive dissociation in aqueous solution is attributed to the formation of a hydrated hydrogen (hydronium) ion, $HCl + H_2O \rightarrow H_3O^+ + Cl^-$, this reaction being essentially complete in dilute solution.

Gaseous hydrogen chloride reacts with active metals and their oxides, hydroxides and carbonates to produce chlorides. With ammonia gas it forms fumes of ammonium chloride, $NH_3 + HCl \rightarrow NH_4Cl$. These reactions occur readily only in the presence of moisture. Completely dry hydrogen chloride is very unreactive. The reactions of hydrochloric acid are those of the hydrogen and chloride ions, both probably hydrated in solution. Some of the reactions of hydrochloric acid that may be attributed to the hydrogen ion are: reactions with metals in which hydrogen gas is displaced; *e.g.*, with zinc $(Zn + 2H^+ + 2Cl^- \rightarrow H_2 + Zn^{2+} + 2Cl^-)$; with oxides or hydroxides that are neutralized with the formation of water; *e.g.*, with calcium hydroxide $[Ca(OH)_2 + 2H^+ + 2Cl^- \rightarrow Ca^{2+} + 2Cl^- + 2H_2O]$; with salts of weak acids in which the weak acid is displaced; *e.g.*, with iron sulfide $(FeS + 2H^+ + 2Cl^- \rightarrow Fe^{2+} + 2Cl^- + H_2S)$. Some of the many uses of hydrochloric acid as a laboratory reagent, *e.g.*, the preparation of metallic chlorides, hydrogen sulfide, sulfur dioxide and carbon dioxide, and the use of a standardized solution of hydrochloric acid in the volumetric determination of alkalis, are suggested by the examples above.

Exposure to as little as 0.1% by volume hydrogen chloride gas in the atmosphere may cause death in a few minutes, but concentrations of 0.001% to 0.005% may be tolerated for several hours without injury. Concentrated hydrochloric acid causes burns and inflammation of the skin, but dilute acid is relatively harmless. Chloride ion is, of course, harmless, being normally present to the extent of 0.25% in human blood and 0.1% to 0.2% as hydrochloric acid in the gastric juices.

The chloride ion is colourless, extremely stable in solution and only oxidized to chlorine by very strong oxidizing agents such as manganese dioxide, dichromate ion and permanganate ion. With manganese dioxide the reaction is: $MnO_2 + 2Cl^- + 4H^+ \rightarrow Mn^{2+} + Cl_2 + 2H_2O$. This and similar reactions also consume hydrogen ions and hence take place more readily in strongly acid solution.

The limiting equivalent conductance of the chloride ion in water at 25° C. is 76.3 reciprocal ohms. In crystals the chloride ion has a radius of 1.81 Å. Chlorides of the alkalis and alkaline earths possess the ionic type of crystal, with high melting points and low volatility. Passing toward the less metallic elements, the chlorides become more volatile and the bonding tends toward the covalent type. Sodium chloride boils at 1,465° C., magnesium chloride at 1,418° C., aluminum chloride at 180° C., and silicon chloride at 57° C. Chlorides are, with the exception of silver, mercurous, lead, cuprous and palladous chlorides, soluble in water. The chlorides of nonmetallic elements are, however, generally completely hydrolyzed in water, and many metallic chlorides such as aluminum chloride cannot be recovered in anhydrous condition from solution. On removal of water, hydrogen chloride formed by partial hydrolysis is also lost, hydrolysis becomes complete and only the oxide or hydroxide is obtained. A few chlorides such as bismuth chloride hydrolyze to insoluble basic chlorides; *e.g.*, BiOCl.

The chloride ion enters into many complex ions (*see* Coordination Compounds); *e.g.*, chloroplatinate ($PtCl_6^{2-}$) and chlorourate ($AuCl_4^-$). Chloroplatinic acid, H_2PtCl_6, finds application in analytical chemistry because its potassium salt is one of the least soluble salts of that metal. The solubility of cuprous chloride in hydrochloric acid, of gold in aqua regia and a number of other reactions are attributed to the formation of stable complex chloride-containing ions. For the same reasons, oxides that dissolve with great difficulty in other acids of equal strength dissolve readily in strong hydrochloric acid. Iron rust (ferric oxide) is readily dissolved by hydrochloric but not by sulfuric or nitric acid. This reaction accounts for the industrial use of hydrochloric acid to clean the surface of iron or steel preparatory to tinning. In industry large amounts of hydrochloric acid also are used in preparing both organic and inorganic chlorides. (For chlorides of industrial significance *see* Chlorine.)

Analytical.—Hydrochloric acid may be quantitatively determined by titration with a standard base or by the measurement of the amount of chloride present. For dilute solutions the concentration of hydrogen ions is also an adequate measure of the total acid (HCl) present. The chloride ion is determined gravimetrically by precipitation as silver chloride, which is dried and weighed. It may be determined volumetrically by titration with a standard silver nitrate solution using potassium chromate as indicator (Mohr method); or by the addition of an excess of standard silver nitrate solution and titration of the excess silver ion by standard thiosulfate solution with ferric ion as indicator (Volhard method). Qualitatively, chloride ion is distinguished from bromide and iodide ions by the white colour of silver chloride, silver bromide and silver iodide being yellow; also, silver chloride is soluble in dilute ammonium hydroxide while the other two are not. A chloride also forms volatile brownish-red chromyl dichloride (CrO_2Cl_2) when heated with a dichromate and concentrated sulfuric acid; neither bromides nor iodides react in this way.

See also references under "Hydrochloric Acid and Hydrogen Chloride" in the Index volume.

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HYDROCORTISONE: *see* Hormones, Vertebrate.

HYDROCYANIC ACID, also known as prussic acid or hydrogen cyanide, is a highly volatile, colourless, extremely poisonous liquid. It was discovered in 1782 by C. W. Scheele, who obtained the compound from Prussian blue. Hydrocyanic acid (HCN) and its compounds are used for many chemical processes, including fumigation; the caschardening of iron and steel; electroplating; and the concentration of ores. The acid is employed in the preparation of acrylonitrile, which is used in the production of acrylic fibres, synthetic rubber and plastics. In some states of the U.S. the legal method of inflicting capital punishment is by dropping pellets of cyanide into sulfuric acid, thus releasing hydrocyanic acid gas, which causes death when inhaled. Cyanides are the salts of hydrocyanic acid. In variable but generally small proportions hydrocyanic acid is widely distributed among plants in the form of glycosides; *i.e.*, in combination with sugars. Amygdalin, which is present in bitter almonds, is an example of such glycosides; it yields hydrocyanic acid upon hydrolysis.

Toxic Action.—Hydrocyanic acid is highly toxic because it inhibits cellular oxidative processes. Acute poisoning from hydrocyanic acid or the cyanides is manifested by dizziness, nausea,

staggering and loss of consciousness. Death ensues rapidly if lethal quantities are absorbed through ingestion of the cyanides or through the inhalation of HCN gas in sufficient amounts. In sublethal poisoning recovery is usually complete within a few hours and there are no permanent aftereffects. In sublethal doses the CN radical is rapidly detoxified by the body through combination with sulfur to form nontoxic sulfocyanides. Man can withstand 50–60 parts of HCN per 1,000,000 parts of air for one hour without serious consequences, while exposure to concentrations of 200–500 parts per 1,000,000 parts of air for 30 minutes is usually fatal.

First-Aid Treatment for Cyanide Poisoning.—Carry patient to fresh air and have him lie down and keep warm. Call a physician. Treatment must begin immediately since the poison acts rapidly. If the patient is breathing, break a vial of amyl nitrite in a cloth and hold lightly over the nose for not more than 15 to 20 seconds, or have him inhale aromatic spirits of ammonia. Repeat every five minutes for 25 minutes if necessary. If the patient has stopped breathing give artificial respiration until breathing starts; then administer amyl nitrite as above.

If cyanides have been swallowed and the patient is conscious give one pint of 5% sodium thiosulfate solution (or soapy water or mustard water) by mouth every 15 minutes until vomiting occurs. Never give anything by mouth to an unconscious person. *p*-Aminopropiophenone, administered orally, also is an antidote.

Pest Control.—The use of hydrocyanic acid for the control of insect and other pests became widespread after D. W. Coquillet first employed the compound in 1886 for the control of scale insects on citrus trees in California. Hydrocyanic acid is used extensively as a fumigant for the control of insects in stored goods, of household and agricultural pests and of insect and rodent pests occurring in ships and railway cars, and for a variety of other purposes. The liquid is available in steel cylinders for shipment over long distances. A product consisting of hydrocyanic acid absorbed in wood-pulp disks or in granular diatomaceous earth in sealed tins is also available.

Periodic general fumigation of flour mills has become common practice in the U.S. Liquid in cylinders is used for this purpose. It is sprayed at each floor from special spray nozzles attached to a permanent piping system or to rubber hose reaching all parts of the floor. The liquid is ejected with compressed air. This method of application is also utilized in the fumigation of other large buildings and ships. The most effective and economical method of flour-mill fumigation consists of injecting the liquid into the various machines, thus producing the highest concentration of the fumigant at the sources of infestation. An elaborate, permanent machinery piping system forms an essential part of this method.

The pressure of demand for effective measures directed at the prevention of insect damage to stored goods led to the development of vacuum fumigation technique. Specially constructed large cylindrical or rectangular airtight chambers are used for this purpose. The commodities to be fumigated are introduced into the chamber on special trucks, the chambers are sealed tight and evacuated and the hydrocyanic acid is then injected in the form of vapours. The doses required may vary, according to the commodities fumigated and the magnitude of the load, between 1½ and 3 lb. or more per 1,000 cu.ft. of space.

A convenient method for fumigating dwelling houses and commercial establishments of moderate size utilizes disks of wood pulp impregnated with liquid hydrocyanic acid. The disks are contained in sealed metal cans that are opened with a special cutter just before fumigation begins. The disks are scattered evenly throughout the building on heavy paper placed on the floor.

The introduction of calcium cyanide made possible the satisfactory solution of a number of difficult pest-control problems. The mode of action of this product depends upon its reaction with the moisture in the atmosphere, generating vapours of hydrocyanic acid. In the finely ground form it is an effective agent for the destruction of burrowing animals such as rats, rabbits, ground hogs, etc. It is also one of the best fumigants for the control of ants and termites in their nests. A granular form is best suited for this purpose; it is applied on the walks in a thin layer in quantities corresponding to ⅛ to ¼ oz. per 1,000 cu.ft. of space. Application is begun an hour after sunset and the house is allowed to remain closed overnight. The temperature within the house should be rising and preferably between 15° and 21° C. (60° and 70° F.) and the air should be calm. Several applications at weekly intervals are recommended. An important use of calcium cyanide is in the fumigation of grain in storage, for which a granular form of the product is used. It is applied to the grain at a controlled rate by a special device at the time the grain is run into the bin. A dosage of 10 to 20 lb. per 1,000 bu. of wheat gives satisfactory control of insects without damage to the grain. (*See* also FUMIGATION.)

Casehardening.—Casehardening, or surface hardening, of iron or steel articles by immersion in a fused cyanide bath came into general use, especially in the United States and Canada, after the process was introduced in 1910. The bath material usually consists of 60% sodium cyanide mixed with other salts such as sodium carbonate or sodium chloride. It is fused in mild steel or chromium-steel pots and the temperature is raised above 760° C. The cyanide gradually decomposes and the resulting carbon combines with the metal and penetrates into it. The rate of penetration of carbon into mild steel is about 0.01 in. per hour and about 50% greater when nickel steel is used. Casehardening usually implies a case depth of 0.015–0.060 in.; cases of smaller depth, in some instances only 0.005 in. thick, are produced for surface hardening. Sodium cyanide is added to heat-treating baths to prevent decarburation of the treated pieces. A concentration of 10% is usually regarded as sufficient for this purpose, but lower or higher concentrations may be used in connection with low and high carbon steels. (*See* also SURFACE HARDENING: *Carbonitriding and Cyaniding.*)

Electroplating.—A solution containing the double cyanide of sodium and silver, $NaAg(CN)_2$, or the corresponding potassium salt, and a molecular excess of the alkali cyanide is used for electroplating metal articles with silver. After its surface has been thoroughly cleaned, the article to be plated is suspended in the solution so that it hangs a few inches from a sheet of silver. The article to be plated is made the cathode, the silver the anode and a direct current is passed through at a rate of three amperes per square foot of surface. As electrolysis proceeds, the silver anode gradually dissolves, and an equal quantity of the metal is deposited out of the solution upon the surface of the article. The concentrations of the double salt commonly used correspond to two ounces to four ounces of silver per imperial gallon. The solution improves with use. Plating with gold, gold-silver or gold-copper alloys is done in a similar way. Cyanide solutions are also used in deposition of copper, zinc, brass and cadmium, more especially on iron. (*See* also ELECTROPLATING.)

Flotation.—In the flotation process of ore concentration, metal sulfides are separated by bubbling air through a vigorously agitated water suspension of the ore containing a little oil or other flotation agents. The metal sulfides rise with the froth and are obtained in a concentrated form by collecting the froth. G. E. Sheridan and G. G. Griswold discovered in 1922 that the addition of a small amount of sodium cyanide to the suspension of ore, previously made faintly alkaline with soda ash (sodium carbonate), prevents the flotation of zinc and iron sulfides without affecting that of lead and copper sulfides. By making use of this effect the sulfides of zinc and iron may be separated from those of lead and copper. The iron and zinc sulfides may be separated by a second treatment in more strongly alkaline solution, the zinc alone floating. (*See* also METALLURGY: *Ores and Ore Treatment: The Flotation Process.*)

Sodium and calcium cyanides are used extensively in extracting gold and silver from their ores. (*See* CYANIDE PROCESS.)

Physical and Chemical Properties.—Hydrocyanic acid boils at 25.7° C. and freezes to a snowlike, white mass melting at −14.9° C. It is highly volatile even in the frozen condition. The dielectric constant of hydrocyanic acid is the second highest known, indicating the strongly polar character of its molecule. In this respect the compound bears a great resemblance to water, and

like water it is a strongly ionizing solvent. The abnormally high heat of evaporation of the liquid is also ascribable to the highly polar character of the molecule. Hydrocyanic acid is miscible in all proportions with water and most organic solvents. The vapours of hydrocyanic acid are combustible and mixtures with air containing 7%–40% acid by volume are explosive. The products of combustion are carbon dioxide and nitrogen.

The elements in the molecule of hydrocyanic acid may be combined in one of two possible ways, H—C≡N or H—N=C, designated respectively as the normal (nitrile) and the iso (carbylamine) forms. The fact that both methyl cyanide, CH_3—CN, and methyl isocyanide, CH_3—NC, result from the reaction of hydrocyanic acid with diazomethane, CH_2N_2, would seem to indicate that both forms exist in liquid hydrocyanic acid, possibly in a state of dynamic equilibrium (*see* TAUTOMERISM). Evidence indicates that the molecules of normal structure largely predominate in the liquid. The dissociation constant of hydrocyanic acid in aqueous solution at 18° C. is 1.3×10^{-9} or $2\frac{1}{6}$ that of carbonic acid, which is itself a weak acid. The degree of acidity developed in aqueous solution is, for this reason, too small to affect the colour of most indicators. The vapours of hydrocyanic acid react with remarkable rapidity, nevertheless, with solutions of alkalies, which can therefore serve effectively for the elimination of the compound from a stream of air containing hydrocyanic acid.

Polymerization of Hydrocyanic Acid.—Hydrocyanic acid in the pure form is stable and can be kept unchanged almost indefinitely in sealed glass containers. The acid gradually polymerizes in the presence of minute amounts of substances of basic character such as ammonia, sodium cyanide, etc. The polymer is a black solid of approximately the same empirical composition as hydrocyanic acid. Polymerization is accompanied by the evolution of considerable heat and is greatly accelerated as the temperature rises. For this reason the polymerization of comparatively large quantities, which may cause a great rise in temperature with a consequent rise in pressure, may result in an explosion. The addition of small quantities of a strong acid (*e.g.*, phosphoric acid), or of compounds giving rise to acids by gradual reaction with water, effectively stabilizes the commercial acid.

Chemical Behaviour.—Hydrocyanic acid cannot be esterified directly. Its esters, R—CN (*i.e.*, the nitriles), are usually obtained through the interaction of an alkali metal cyanide with an organic halide or sulfate. Methyl cyanide can, for example, be prepared by heating methyl iodide with an alcoholic solution of potassium cyanide according to the equation: $KCN + 1CH_3 \rightarrow CH_3CN + KI$. The fact that nitriles, R—CN, may be prepared through the dehydration of the amides of the corresponding acids, R—$CONH_2$, definitely demonstrates that these compounds are normal cyanides, R—C≡N. The reaction of organic halides with silver cyanide or mercuric cyanide leads to the formation of isonitriles, R—N=C, which differ in their properties from normal nitriles. Hydrocyanic acid combines with aldehydes and ketones in the presence of small quantities of substances of basic character, such as potassium cyanide or amines, generally at room temperature, forming cyanohydrins. Acetaldehyde cyanohydrin (lactonitrile) results, for example, from the reaction of acetaldehyde with hydrocyanic acid: $CH_3CHO + HCN \rightarrow CH_3CH(OH)CN$.

Hydrocyanic acid is capable of reacting with ethylene oxide under pressure in the presence of a basic catalyst at a moderately high temperature to form ethylene cyanohydrin:

$$CH_2—CH_2O + HCN \rightarrow HOCH_2CH_2CN$$

This compound is readily dehydrated on distilling in the presence of certain catalysts to acrylonitrile, CH_2=CHCN. This is the basis of one of the technical preparations of the latter compound, which has assumed great importance. Acrylonitrile, together with butadiene, is used in the preparation of the acrylic type of synthetic rubber. In the polymeric form it is used for the manufacture of an important synthetic fibre; another synthetic fibre is made from the copolymer of acrylonitrile and vinyl chloride. (*See* also PLASTICS: *Acrylic Resins.*)

Preparation.—*Laboratory Method.*—A convenient method of obtaining hydrocyanic acid in the laboratory is to add a cold mixture of 100 c.c. concentrated sulfuric acid and an equal volume of water slowly to 100 g. of coarsely granular potassium cyanide in a large flask connected to two U-tubes filled with anhydrous calcium chloride. The vapors emerging from these U-tubes are condensed by passing downward through a condenser and then are collected. Brine cooled to −10° C. is circulated through the jacket of the condenser. A fully anhydrous product is made by adding phosphorus pentoxide to the liquid thus prepared, shaking for a short period and distilling once more.

Commercial Cyanide Method.—Hydrocyanic acid is made commercially from sodium cyanide in a continuous manner by bringing together a 23% aqueous sodium cyanide solution and concentrated sulfuric acid in a lead-lined generator and condensing and collecting the vapours evolved. The sulfuric acid is kept slightly in excess over the cyanide in the course of the reaction. The residual hydrocyanic acid in the liquid, which forms 20% of the total, is recovered by boiling the solution, the vapours being condensed after a partial enrichment in a special "cooler." Hydrocyanic acid of 97.5%–98% strength is made from the combined crude condensate by fractional distillation. Large quantities of the acid are also prepared from commercial calcium cyanide by a similar process.

Synthesis by Controlled Oxidation of a Hydrocarbon-Ammonia Mixture.—There are two commercially successful processes of synthesizing hydrocyanic acid. In one, the acid is formed when a mixture of methane and ammonia, containing an insufficient amount of oxygen for complete combustion, is passed through a glowing platinum gauze. The reaction giving rise to the compound may be expressed as $2NH_3 + 2CH_4 + 3O_2 \rightarrow 2HCN + 6H_2O$. Leonid Andrussow, who discovered this method, developed it into a successful technical process. Methane and ammonia are mixed in the approximate ratio 11:10 and sufficient air is added to the mixture to give an oxygen content of about 15.5%. The mixture is passed through two or more layers of incandescent platinum iridium gauze with 3% to 5% iridium. The gauze is constructed of 0.16-mm. wire. The several layers of the gauze, resting on a special support, are held between ceramic rings inside a short tube, the whole constituting the converter. The cold gases enter the converter usually at a linear velocity of 103 cm. per second, emerging at a temperature of 1,000°–1,030° C. at a little over 500 cm. per second. The heat generated by the reaction is sufficient to maintain the gauze at the desired temperature. The gases emerging from the converter may be passed through sodium hydroxide solution after being cooled sufficiently. The hydrocyanic acid is quantitatively absorbed and may be recovered as sodium cyanide. Alternatively, the ammonia is removed by scrubbing with dilute acid and the hydrocyanic acid is absorbed in cold water in special towers and recovered by distillation. Of the total ammonia fed into the converter approximately 63% is utilized in the formation of hydrocyanic acid and 10% to 20% is lost by complete combustion. Platinum losses resulting from catalyst deterioration amount to about 1 g. per metric ton of hydrocyanic acid produced.

Aliphatic hydrocarbons other than methane are capable of undergoing the reaction. Methane receives preference, however, since higher hydrocarbons tend to deposit carbon and cause what is known as spotting of the catalyst. This results in loss of efficiency and a greater rate of deterioration of the gauze.

Synthesis by Dehydration of Formamide.—In this commercial synthesis, formamide is dehydrated in the vaporized condition by passing it, in admixture with a large proportion of ammonia, over an aluminum phosphate catalyst heated to 360° C. The reaction expressing the change is $HCONH_2 \rightarrow HCN + H_2O$. The original formamide-ammonia mixture contains 3%–5% of formamide. Dehydration is carried out at atmospheric pressure and proceeds very rapidly. The hydrocyanic acid formed is absorbed in sodium hydroxide solution and may be recovered as sodium cyanide.

Metallic Cyanides.—The cyano group or radical (CN) behaves in many respects like an element and, when combined with metals, gives the metallic cyanides, which resemble the metallic halides. This resemblance is particularly marked in the case of alkali metal salts. The radical shows a marked power, on the

other hand, of forming complex salts such as potassium ferrocyanide, $K_4Fe(CN)_6$. In these compounds, usually one metal atom forms part of the complex cyanide anion. For example, potassium ferrocyanide dissociates into the potassium cations, K^+, and ferrocyanide anions, $Fe(CN)_6^{4-}$. Ferrous ions, Fe^{2+}, and cyano ions, CN^-, are present in the solution in such minute quantities, in this instance, that ordinary analytical tests fail to reveal their presence; and the stability of the complex is such that the addition of a mineral acid yields the corresponding free ferrocyanic acid, $H_4Fe(CN)_6$. This behaviour is common to many, but not by any means all, of these complex salts. Some, like potassium zinc cyanide, $K_2Zn(CN)_4$, are easily decomposed by acids with the liberation of hydrocyanic acid.

The tendency to form complex cyanides is most marked in the metals of Group VIII and contiguous metals. Most complex cyanides are of the following types: $K[R(CN)_2]$, where R is Cu, Ag, Au; $K_2[R(CN)_4]$, in which R is Zn, Cd, Hg, Ni, Pd, Pt; $K_4[R(CN)_6]$, where R is Cr, Mn, Fe, Co, Ru, Os, Ir; $K_3[R(CN)_6]$, where R may be Cr, Mn, Fe, Co, Rh or Ir; and $K_4[R(CN)_8]$, where R is Mo or W.

Sodium Cyanide.—The two commercially most important salts of hydrocyanic acid are sodium cyanide and calcium cyanide. Sodium cyanide is prepared in a pure form, analyzing 96%–98% NaCN, by the Castner process, which utilizes the reaction of metallic sodium with ammonia and charcoal. A less pure form of the compound is made from hydrocyanic acid.

In the Castner process, metallic sodium is melted with charcoal in a steel vessel and dry ammonia is blown into the liquid, while the temperature is gradually raised to 600° C.; the mass is finally heated to about 850° C. in order to complete the conversion of the last remaining portion of sodium cyanamide into cyanide. The molten mass is filtered through iron turnings, after being cooled to some extent, and is cast in molds in the form of spheroids of convenient size. The reaction proceeds in three steps: sodium amide is the first product, $2Na + 2NH_3 \rightarrow 2NaNH_2 + H_2$; the amide reacts rapidly with charcoal, forming sodium cyanamide, $2NaNH_2 + C \rightarrow Na_2CN_2 + 2H_2$; and this finally combines with an additional atom of carbon to form sodium cyanide, $Na_2CN_2 + C \rightarrow 2NaCN$.

In the preparation with hydrocyanic acid, the acid is absorbed in aqueous sodium hydroxide solution of such strength that a saturated solution of sodium cyanide (45% by weight) is produced. The use of an excess of acid is avoided, since otherwise a dark product is obtained because of the polymerization of the free acid. The solution is evaporated *in vacuo* to a paste, which is centrifuged to give a product containing 10% water. The remaining water is removed by drying this product on heated trays *in vacuo*. The dried powder, which analyzes 90%–92% NaCN, is compressed into rectangular cakes of convenient size.

Sodium cyanide is a colourless, poisonous solid crystallizing in the cubic system. It forms a dihydrate, $NaCN \cdot 2H_2O$, which crystallizes in large colourless plates decomposing above 34.7° C. Sodium cyanide is soluble in water, alcohol and anhydrous ammonia; it melts at 563.7° C.

In aqueous solution sodium cyanide is partially hydrolyzed to hydrocyanic acid and sodium hydroxide: $NaCN + H_2O \rightarrow NaOH + HCN$. When aqueous solutions of sodium cyanide are heated, hydrolysis of the cyano group takes place at an appreciable rate and ammonia and sodium formate result: $NaCN + 2H_2O \rightarrow HCOONa + NH_3$. This reaction also takes place at ordinary temperatures, although at an extremely slow rate.

Calcium Cyanide.—This salt acquired considerable commercial importance since the introduction of its preparation from cyanamide: a mixture of 10 parts commercial calcium cyanamide, 8 parts common salt and 0.5–1 part calcium carbide is fed into an electric furnace of the arc-resistance type with conducting hearth and a single suspended graphite electrode. Alternating current passing through the charge heats this to 1,200°–1,400° C., and the fused mass overflows to a pan in which an internally water-cooled rotating drum picks up a thin layer of the melt. The cyanide is thus chilled rapidly in the form of a thin sheet that breaks into flakes as it is scraped off and collected. The product analyzes more than 45% $Ca(CN)_2$ and contains impurities derived from the coal and coke used in the manufacture of cyanamide and from the salt. Calcium cyanide is formed through the combination of calcium cyanamide with carbon. The carbon is present in the commercial product in the required amount because of its mode of formation from carbide: $CaC_2 + N_2 \rightarrow CaCN_2 + C$. Rapid cooling of the fused cyanide is essential to prevent reversion to cyanamide, which takes place rapidly between 400° and 700° C.

Calcium cyanide in the pure form is a white, poisonous powder that melts at 640° C. ± 30° C., when heated rapidly, to a clear liquid. The melt soon becomes turbid and finally solidifies as it reverts to calcium cyanamide. An important property of calcium cyanide is its reaction with atmospheric moisture, which takes place according to the equations:

$$Ca(CN)_2 + H_2O \rightarrow Ca(OH)CN + HCN$$
$$Ca(OH)CN + H_2O \rightarrow Ca(OH)_2 + HCN$$

The reaction takes place rapidly if the cyanide is finely ground and the relative humidity is in excess of 35%. It forms the basis of the use of calcium cyanide as a fumigant.

Heavy Metal Cyanides.—The simple cyanides of heavy metals are insoluble in water, with the notable exception of mercuric cyanide. Cuprous, silver and zinc cyanides have acquired some commercial importance.

Cuprous cyanide, CuCN, the only stable cyanide of copper, is made by adding a solution of sodium cyanide to one of cuprous chloride in saturated aqueous sodium chloride. It is soluble in solutions of alkali metal cyanides. The complex salts obtained through the combination of cuprous cyanide with alkali cyanides are used in the electrodeposition of copper on iron. Cuprous cyanide is also important as a reagent for the introduction of the CN radical into aromatic compounds by reaction with aromatic diazo compounds.

Silver cyanide, AgCN, separates as a white flocculent precipitate when hydrocyanic acid is added to an aqueous solution of a soluble silver salt. It dissolves in sodium cyanide solution, forming the complex salt $NaAg(CN)_2$, which is used in the electrodeposition of silver.

Zinc cyanide, $Zn(CN)_2$, may be prepared by adding hydrocyanic acid to a solution of zinc acetate in water. It separates as white crystals that dissolve in solutions of alkali cyanides, with the formation of a complex cyanide.

Complex Salts.—Potassium ferrocyanide, $K_4Fe(CN)_6$, together with the corresponding sodium salt, finds wide use in the preparation of Prussian blue in the dye industry for the fixation of aniline black dyes and in the casehardening of iron by the "cementation" process. It may be prepared through the reaction of ferrous sulfate and potassium cyanide in aqueous solution. It is obtained more economically from commercial calcium cyanide. Commercial calcium cyanide is dissolved in water and treated with the calculated quantity of ferrous sulfate. To the filtered solution potassium chloride is added, thus precipitating the nearly insoluble potassium calcium ferrocyanide, $K_2CaFe(CN)_6$; this is filtered, washed and then boiled with the required quantity of aqueous potassium carbonate solution. The solution is filtered and concentrated by boiling in cast-iron vessels, and the salt is allowed to crystallize during 14 days on wires or strings suspended in the liquid. The sodium salt may be prepared similarly by the use of sodium chloride and sodium carbonate in the process in place of the potassium salts.

Potassium ferricyanide, $K_3Fe(CN)_6$, is prepared by oxidizing potassium ferrocyanide in aqueous solution electrolytically or with chlorine. Electrolysis is carried out in diaphragm cells with nickel electrodes. Potassium ferricyanide crystallizes out from the anode liquor on cooling, and the mother liquor is replenished with fresh ferrocyanide and returned to the cell. The reaction may be represented ionically as follows: $Fe(CN)_6^{4-} \rightarrow Fe(CN)_6^{3-} + e$; $H_2O + e \rightarrow OH^- + \frac{1}{2}H_2$.

Oxidation with chlorine is carried out by conducting gaseous chlorine into a cold 10% solution of ferrocyanide. The reaction is represented by the equation: $2K_4Fe(CN)_6 + Cl_2 \rightarrow 2K_3Fe-$

$(CN)_6 + 2KCl$. The passage of chlorine is discontinued when the conversion of the ferrocyanide is just completed. The solution is evaporated to the crystallizing point, a little caustic potash is added to eliminate the small amount of Prussian green formed, which is precipitated as ferric hydroxide and removed by filtration. The ferricyanide is recovered by crystallization in an 85%–90% yield. Potassium ferricyanide, used in combination with hypo, is a common photographic chemical (Farmer's reducer).

Iron cyanide blues form an important group of pigments. They may be prepared directly through the interaction of ferric salts with alkali ferrocyanides or of ferrous salts with alkali ferricyanides in neutral or acid solution. They are amorphous substances containing variable quantities of combined water. Depending upon the procedure followed in their preparation, soluble or insoluble varieties may be produced. The soluble types, which may be represented by the formula $K_2Fe[Fe(CN)_6]aq$. and contain a maximum of four molecules of water, may be prepared by mixing cold neutral solutions of ferric chloride and potassium ferrocyanide, the latter being used in excess. Insoluble blues conform to the formula $Fe_4[Fe(CN)_6]_3aq$. and contain a maximum of 10–11 molecules of water. They are formed when an excess of a ferric salt solution is added to a neutral or slightly acid solution of potassium ferrocyanide. Five main varieties of iron blues are recognized in commerce: Prussian blue, Paris blue, bronze blue, milori blue and steel blue. In chemical composition they are nearly identical. Milori blue is a special quality, showing a bright colour and a reddish tint. It is distinguished by exceptional softness and is largely used for printing inks.

Detection and Estimation.—The presence of hydrocyanic acid in an aqueous solution may be demonstrated by a variety of methods; one that is most commonly employed depends upon the conversion of the acid into Prussian blue; one or two drops of moderately concentrated sodium hydroxide solution and of freshly made ferrous sulfate solution are added to the liquid, and the whole is boiled. The liquid is cooled and acidified and a drop of ferric chloride solution is added; a precipitate of Prussian blue then forms if hydrocyanic acid was present in the original solution.

One of the more satisfactory methods for the quantitative determination of hydrocyanic acid is titration of the acid in the form of its alkali metal salt with standard silver nitrate solution; a few drops of 10% potassium iodide solution is used as an indicator. The end point is reached when a permanent opalescence is observed in the solution; at this point the reaction $2NaCN + AgNO_3 \rightarrow NaAg(CN)_2 + NaNO_3$ is just complete. It can be seen that every formula weight of silver nitrate used is equivalent to two formula weights of hydrocyanic acid.

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HYDRODYNAMICS, the branch of hydromechanics which deals with the motion of fluids (*see* MECHANICS, FLUID).

HYDROELECTRIC POWER GENERATION: *see* ELECTRIC POWER: *Generation.*

HYDROGEN is a gaseous element usually assigned to the first group of the periodic system. The hydrogen atom is the lightest of all atoms in weight; it consists of a nucleus with one unit of positive charge and one electron.

Hydrogen is present in almost all animal and vegetable matter, in compounds in which it is joined to carbon and other elements. In the form of hydrocarbons, it is a constituent of petroleum and coal and is contained in all acids. Some authorities believe that hydrogen compounds are more numerous than those of any other element, although until recently the precedence of carbon was generally accepted.

On the weight basis, hydrogen is the ninth most abundant element; the hydrogen content of the earth, including air and terrestrial waters as well as the earth's crust, is 0.9%. Hydrogen is found in the free state in gases from volcanoes and fumaroles, and occluded in salt deposits, rocks and meteorites. It occurs in many stars, in comets and in the upper atmosphere. Spectroscopic examination indicates that hydrogen constitutes the bulk of the outer atmosphere of the sun; during total eclipse it is observed in the form of protuberances of incandescent gas reaching as far as 300,000 mi. into space.

The chemical atomic weight of hydrogen is 1.00797. Natural hydrogen as it occurs in combined form in water is a mixture of two isotopes: hydrogen proper, also referred to as light hydrogen or protium (symbol H, ^1H or H^1), and deuterium or heavy hydrogen (symbol ^2H, H^2 or D). (*See* also DEUTERIUM AND TRITIUM). These two isotopes are present in the ratio of 5000:1 and have the chemical atomic weights of 1.0079 and 2.0142 respectively. Their nuclei are called proton and deuteron respectively. A third isotope of hydrogen, tritium (symbol ^3H, H^3 or T), occurs in nature only in minute amounts but can be produced artificially. It is radioactive and has a half-life of 12.5 years.

History.—It appears that Theophrastus Paracelsus in the 16th century had handled hydrogen, since he found that an inflammable gas was evolved when a metal was dissolved in an acid. However, hydrogen was then confused with other inflammable gases such as hydrocarbons and carbon monoxide. In 1766 Henry Cavendish showed that hydrogen, then called "inflammable air," phlogiston or the inflammable principle, was distinct from other combustible gases by measuring its density and the amount of gas evolved from a given amount of acid and metal. J. Warltire noticed in 1776 that water was formed when hydrogen was burned. In 1781 Cavendish confirmed this observation and Antoine L. Lavoisier coined the name hydrogen (Greek for "maker of water"). In 1929, on the basis of earlier theoretical work by P. M. Dennison, Karl F. Bonhoeffer and Paul Harteck showed that ordinary hydrogen is a mixture of two kinds of molecules, orthohydrogen and parahydrogen. In 1931 Harold C. Urey, Ferdinand G. Brickwedde and George M. Murphy discovered the heavy hydrogen isotope. Tritium was first prepared by Lord Rutherford, Marcus L. E. Oliphant and Harteck by the bombardment of deuterophosphoric acid with fast deuterons in 1935.

Uses of Hydrogen.—The first industrial use of hydrogen was the inflation of balloons by Jacques A. C. Charles in 1783. The barrage balloons used in England during World War II were filled with hydrogen. Hydrogen is used as fuel gas in the oxyhydrogen flame (*see* FLAME) in the production of synthetic gems, for melting and working of silica or quartz and of platinum, for lead burning and for autogeneous welding and cutting. However, in the latter application, hydrogen was being replaced by acetylene.

Hydrogen is the reducing agent in the manufacture of metallic tungsten and molybdenum and in the production of spongy iron for use in powder metallurgy. A hydrogen atmosphere is employed in the pouring of special castings, in the manufacture of magnesium, in the annealing of metals and for the cooling of large electric motors. Large quantities of hydrogen are used in the synthesis of ammonia, of methyl alcohol, in the Fischer-Tropsch synthesis (*see* below) and in the hydrogenation of various organic chemicals (*e.g.*, benzene, phenol, naphthalene) and of vegetable and animal oils and fats (in the production of margarine and vegetable shortening) and of coal (in the conversion to petroleumlike material). During World War II the major portion of Germany's petroleum requirement was produced by the latter process. Hydrogen is used to reduce aldehydes, fatty acids or esters to the corresponding alcohols and to manufacture hydrogen chloride and bromide. A number of petroleum refining processes are carried out in the presence of hydrogen, but usually in these processes more hydrogen is formed than consumed. Liquid hydrogen is used in the laboratory to produce extremely low temperatures. Regarding the use of hydrogen in the hydrogen bomb, *see* ATOMIC ENERGY.

Production of Hydrogen.—Hydrogen is prepared in the laboratory by the interaction of zinc and dilute acid, usually in Kipp's apparatus, according to the equation $Zn + 2H^+ \rightarrow Zn^{2+} + H_2$ or by the electrolysis of a dilute acid or alkali according to the equations: $2H^+ + 2e^- \rightarrow H_2$, or $2Na^+ + 2e^- \rightarrow 2Na$ and

$2Na + 2H_2O \rightarrow 2Na^+ + 2OH^- + H_2$. Hydrogen, used for the first time industrially for inflating a balloon, was prepared by reacting iron with sulfuric acid. With the military use of balloons a great many methods for producing hydrogen were devised that could be operated in the field and required relatively light raw material and equipment. After the advent of aircraft and the availability of helium as a balloon gas, these methods lost their importance, although some of them (*e.g.*, the reaction between water and calcium hydride, the hydrolith process) were used during World War II to inflate weather balloons.

The steam-methanol process based on the decomposition reaction $CH_3OH + H_2O \rightarrow 3H_2 + CO_2$ was also used by the armed forces for producing hydrogen in portable equipment. On an industrial scale, large amounts of hydrogen are produced by the reaction of steam and spongy iron at 650° C., $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$. The iron is recovered by reducing the iron oxide with water gas (*q.v.*), a mixture of hydrogen and carbon monoxide, $Fe_3O_4 + 2H_2 + 2CO \rightarrow 3Fe + 2H_2O + 2CO_2$. The cheapest source of hydrogen is water gas, from which carbon monoxide is removed by the water gas shift reaction $CO + H_2O \rightleftarrows CO_2 + H_2$ in the presence of a catalyst such as iron oxide containing some chromium oxide. In order to reduce the amount of carbon monoxide present at equilibrium, an excess of steam is used and the reaction is carried out at the lowest temperature, 400°–500° C., at which the reaction velocity is sufficiently high. The carbon dioxide thus formed is then washed out by water or another aqueous solution. The residual carbon monoxide is removed by scrubbing with a cuprous chloride solution or by repeating the water gas shift reaction or by reduction to methane.

By the interaction of methane (or other hydrocarbons) and steam ($CH_4 + 2H_2O \rightleftarrows CO_2 + 4H_2$ and $CH_4 + H_2O \rightleftarrows CO + 3H_2$) in the presence of a suitable catalyst (nickel) at 800°–900° C., a mixture of hydrogen, carbon monoxide and carbon dioxide is obtained. It is then treated as water gas. Hydrogen can also be recovered from water gas or coke oven gas by low temperature fractional distillation since its boiling point (−252° C.) is much lower than that of carbon monoxide (−191° C.) or of nitrogen (−195° C.). Thermal decomposition of hydrocarbons over heated brick is convenient for producing hydrogen when hydrocarbon gases are readily available (*e.g.*, refineries) and when the purity of hydrogen is unimportant. The purest hydrogen (99.9%) is obtained by electrolysis of alkaline water in cells specially built to permit separation of the hydrogen and oxygen, the yield being approximately 7 cu.ft. of hydrogen per kilowatt hour. Hydrogen is a by-product in the electrolytic manufacture of caustic alkali and chlorine (*q.v.*), in the butyl alcohol-acetone fermentation and in the refining of petroleum naphthas over platinum and similar catalysts to motor gasoline and to aromatic hydrocarbons.

Orthohydrogen and Parahydrogen.—Hydrogen gas under normal conditions consists of molecules, each of which contains two atoms. The nuclear magnets (spins) of both protons are oriented in the same direction in orthohydrogen molecules. In parahydrogen molecules these magnets are oriented in opposite directions. Ortho molecules rotate with odd rotational quantum numbers, para molecules with even. Normally, conversions do not occur between ortho and para molecules, and orthohydrogen and parahydrogen can be regarded as two distinct modifications of hydrogen. The equilibrium between orthohydrogen and parahydrogen can be readily established in the presence of catalysts. The equilibrium concentration of parahydrogen depends on the temperature as shown by the following figures:

−253.1° C.	99.82%
−223.1° C.	76.89%
−193.1° C.	48.39%
−153.1° C.	32.87%
0° C.	25.13%

Thus essentially pure parahydrogen can be produced by bringing hydrogen into contact with charcoal at the temperature of liquid hydrogen, while orthohydrogen cannot be prepared directly since the equilibrium concentration of parahydrogen does not fall below 25%, the amount present in normal hydrogen. Parahydrogen differs from normal hydrogen in its physical properties, but the two kinds of hydrogen are identical in chemical properties. Parahydrogen can be kept at room temperature without appreciable conversion for months. At elevated temperatures, under the influence of electric discharges or in the presence of metals and paramagnetic substances, parahydrogen is converted to normal hydrogen.

Atomic Hydrogen.—When hydrogen molecules are exposed to excessive heat, *e.g.*, contact with a white hot tungsten filament (Irving Langmuir, 1914), to an electric discharge (Robert W. Wood, 1921; Bonhoeffer, 1924), or to an electric arc, they dissociate into atoms. The atoms thus formed have a short lifetime that depends on the pressure (*e.g.*, 0.3 sec. at a pressure of 0.5 mm.Hg). Platinum, nickel and other metals destroy the activity of atomic or active hydrogen by catalyzing the recombination of the atoms. Atomic hydrogen reacts even at room temperature with hydrocarbons (except methane), causing dehydrogenation, cracking and, in the unsaturated hydrocarbons, hydrogenation.

It combines with sulfur, tellurium, phosphorus, arsenic, lithium, sodium, chlorine, bromine and other elements and reduces metallic oxides. Atomic hydrogen forms hydrogen peroxide with oxygen, a reaction which has found industrial application. The heat of recombination of the hydrogen atoms is utilized in arc welding.

Physical Properties.—Hydrogen is an odourless, colourless and tasteless gas. It is the lightest chemical element, has the highest heat conductivity and the highest coefficient of diffusion of all the gases. It diffuses through porous substances such as clay and has the unique property of diffusing through rubber and, at elevated temperatures, through quartz and silica. It also diffuses through the metals of the nickel, palladium and platinum groups; diffusion is accompanied by the dissolution of hydrogen. The diffusion of hydrogen through a palladium thimble is used in the laboratory to purify hydrogen. The standard electrode potential of hydrogen is zero according to a generally accepted convention.

Chemical Properties.—Hydrogen has chemical properties similar to those of the elements of Groups I and VII of the periodic systems. Combined with the electronegative halogens, hydrogen resembles the alkali metals since it forms positive ions on dissolution in water. In its compounds (hydrides) with the electropositive alkali metals, hydrogen behaves as an electronegative element, attracting an extra electron to form a negative ion. This ion is discharged at the positive anode on electrolyzing the molten hydride. In volatile hydrides hydrogen forms a nonionic covalent bond. The bond in all gaseous hydrogen halides except hydrogen fluoride is similar. All compounds of hydrogen are univalent.

Under proper conditions, hydrogen combines directly with most of the lighter elements and many of the heavier elements. The reaction with fluorine to form hydrogen fluoride is very violent, even at −252° C. Mixtures of hydrogen and chlorine can react with explosive violence on irradiation or under the influence of a spark. Mixtures of hydrogen and oxygen react at a measurable rate only above 300° C. Such mixtures containing 4% to 94% hydrogen can ignite or explode when heated to 550°–600° C. or brought into contact with a catalyst, spark or flame. Especially violent is the explosion in detonating gas containing oxygen and hydrogen in the proportion 1:2. In air or oxygen, hydrogen burns with a nonluminous flame. With bromine, iodine, the alkali metals, alkaline earths, sulfur, etc., hydrogen reacts at elevated temperatures. Nitrogen and hydrogen form ammonia under pressure

Some Properties of Normal Hydrogen and Parahydrogen

Density at 0° C., 760 mm. pressure	0.08988 g./l.
Buoyancy in air	1.203 g./l.
Melting point: normal hydrogen	−259.24° C.
parahydrogen	−259.28° C.
Boiling point: normal hydrogen	−252.78° C.
parahydrogen	−252.87° C.
Critical temperature	−239.91° C.
Critical pressure	12.8 atm.
Critical density	0.0310 2 g./ml.
Specific heat	
gas at const. vol. 20°–100° C.	2.35 cal./g.
liquid at const. vol. −257.4° C.	1.77 cal./g.
solid at const. vol. −260.4° C.	0.536 cal./g.
Heat of evaporation	108.1 cal./g.
Heat of fusion	14.0 cal./g.
Heat conductivity at 0° C.	0.000413 cal./cm. sec. ° C.
Coefficient of expansion	0.00366
Pressure coefficient	0.0036627
Molecular diameter	2.5×10^{-8} cm.
Heat of dissociation	102.72 kg. cal./mol.
Heat of combustion, 20° C., 1 atm.	68.351 kg. cal./mol.
Ionization potential	13.527 v.

above 300° C. in the presence of a suitable catalyst. Carbon and hydrogen combine in the electric arc to form acetylene and they also form various other hydrocarbons in the presence of a catalyst at moderate temperatures. The dissolution of hydrogen by palladium and other metals is accompanied by the formation of hydrides. Hydrogen reduces the oxides of most metals, and some metallic salts, to the metals, especially at elevated temperatures and pressures. The reduction of an aqueous solution of a metallic salt (*e.g.*, palladium chloride) by hydrogen corresponds to the reverse reaction as it occurs in the dissolution of metals in acids. Which of these two reactions will occur depends on the standard electrode potential of the metals involved. All metals that have positive potentials measured on the hydrogen scale can displace hydrogen ions from a solution according to the general reaction $M + H^+ \rightarrow M^+ + \frac{1}{2}H_2$ while metals with negative potentials will be produced by reducing the corresponding metallic ions with gaseous hydrogen. In the presence of nickel or platinum catalysts, hydrogen combines with unsaturated organic compounds (*see* HYDROGENATION) and reduces certain oxygenated organic compounds to compounds containing less or no oxygen (*see* OXIDATION AND REDUCTION). Under high pressure and temperature, coal and similar material can be converted into petroleumlike products by catalytic hydrogenation.

With carbon monoxide, hydrogen forms a great variety of products depending on the pressure, temperature and catalyst used. Thus the product can be methane, methyl alcohol, a mixture of various alcohols or of hydrocarbons. The latter two processes were originated by Franz Fischer and Hans Tropsch in 1925. In a variation of these processes, in the oxo process, a mixture of hydrogen and carbon monoxide is reacted with olefins to form aldehydes.

Compounds.—Hydrogen ions (*q.v.*), H^+, are present in solutions of acids and are responsible for their characteristic properties such as sour taste, neutralization of bases, dissolution of base metals accompanied by evolution of hydrogen and colour changes with certain dyes (*e.g.*, blue litmus to red). In aqueous solutions of hydrogen ions, protons are not present as such but are associated with water molecules forming hydronium ions $(H_3O)^+$. Since water is dissociated to a certain extent into hydrogen and hydroxyl ions (*see* HYDROXIDE) according to $H_2O \rightarrow H^+ + OH^-$ water is amphoteric; *i.e.*, it can either lose or take up a hydrogen ion and thus can act as an acid or a base. With other elements hydrogen forms three types of compounds (*see* HYDRIDES): saltlike compounds (*e.g.*, hydrides of alkali metals and alkaline earths); volatile compounds (*e.g.*, water H_2O, ammonia NH_3, phosphine PH_3, hydrocarbons, hydrogen halides); and metallike hydrides (*e.g.*, hydrides of palladium, titanium and zirconium). Besides the compounds already mentioned the following compounds of hydrogen are the most common: hydrogen peroxide (*q.v.*) H_2O_2, hydrazine (*q.v.*) N_2H_4, hydrazoic acid HN_3, hydrogen sulfide H_2S (*see* SULFUR), hydrogen fluoride H_2F_2 (*see* FLUORINE), hydrocyanic acid (*q.v.*) or prussic acid HCN and hydrogen chloride HCl (*see* HYDROCHLORIC ACID AND HYDROGEN CHLORIDE). With carbon, hydrogen forms a very large number of compounds, the hydrocarbons. All these hydrogen compounds have important technical applications. Hydrogen is present in a great variety of compounds, formed by three or more elements, such as acids, bases (*see* HYDROXIDE), compounds containing combined water (*see* HYDRATE) and in almost all organic compounds.

Analysis.—The hydrogen content of a gas is often determined by admixing a known amount of oxygen and measuring the contraction that is caused by the formation of liquid water when the gas is brought into contact with a glowing filament or with a spark. In the presence of other combustible gases, the hydrogen is determined by reacting it with hot copper oxide according to $H_2 + CuO \rightarrow Cu + H_2O$. Other methods that are used for determining the purity of hydrogen and the amount of hydrogen present in other gases are based on measuring density, refractive index, the masses of the components (by the mass spectrograph) and the thermal conductivity.

See also references under "Hydrogen" in the Index volume.

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(A. Fs.)

HYDROGENATION is the addition of molecular hydrogen to a multiple linkage in the presence of a catalyst. Hydrogenolysis is a special case of hydrogenation in which the addition of hydrogen results in cleavage of the bond.

Few reactions, if any, have served chemists in all branches of organic chemistry so extensively as have catalytic hydrogenation and hydrogenolysis. These processes have vastly enlarged the world's supply of edible fats and soap and have upgraded the quality of gasoline as well as opening a new source of supply.

The basic problem in the synthesis of edible fats is summed up (from Carleton Ellis, *Hydrogenation of Organic Substances* [p. 36], copyright 1930, D. Van Nostrand Co., Inc., Princeton, N.J.) as follows:

"For years the dream of the oil chemist was to find a solution to the problem of converting oleic acid into stearic acid, or olein into stearin, simply by the addition of hydrogen, so as to make valuable hard fats from relatively cheap raw material. Superficially the problem looked simple. Oleic acid is the next-door neighbor of stearic acid, apparently differing only in having a little less hydrogen than stearic acid has in its constitution. Only a trifling amount of hydrogen, less than 1 per cent, is required to transform oleic into stearic acid.

"But the problem was far from simple, as oleic acid stubbornly resisted the invasion of hydrogen into its structure to any material extent under the earlier methods of hydrogen addition, and not until later years, with the discovery of effective hydrogen carriers or catalyzers, has it become possible to bring about this conversion economically with large yields so as to warrant commercial exploitation in an extensive way."

Although the first synthetic edible fats were produced in France in the late 1860s, the industrial importance of the hydrogenation process dates from 1897, when Paul Sabatier discovered that the introduction of a trace of nickel as a catalyst facilitated the mixture of hydrogen with the molecules of carbon compounds.

The manufacture of gasoline by the hydrogenolysis of coal was originated in Germany during World War I by Friedrich Bergius.

Methods.—Several methods are used for carrying out hydrogenation reactions. In the presence of very active catalysts, such as platinum and palladium, and easily hydrogenated material, such as olefins, ketones, aldehydes, or nitro compounds, the reactions can be carried out at a pressure of 1 to 4 atmospheres and at a temperature up to 80° C. For other hydrogenations much higher pressures are used and the reactions are carried out in autoclaves which can withstand high pressures and temperatures.

Low-Pressure Hydrogenation.—This method can be effected in an apparatus consisting of a shielded reaction bottle and a shaker mechanism. The reaction bottle is attached to a hydrogen reservoir. The progress of the reaction is followed by noting the pressure drop.

High-Pressure Hydrogenation.—In the laboratory this process is usually carried out in a steel rocking autoclave which can withstand a pressure of 400 atm. at a temperature of 400° C. The autoclave, fitted with a pressure gauge, is mounted in an electrical heating jacket, the temperature of which is controlled by means of a thermocouple and an electrical control system. The compound, alone or in solution, is agitated with the catalyst and hydrogen at elevated pressure.

Catalysts.—The catalysts most commonly used for low-pressure hydrogenation are platinum oxide, supported palladium and Raney nickel. These catalysts are easily prepared and have high activity at low temperatures and pressures. They catalyze the hydrogenation of a variety of functional groups. For high-pressure hydrogenations copper chromite and nickel supported on kieselguhr are the catalysts most extensively used. The choice of a catalyst depends on the functional group to be hydrogenated and, in the case of polyfunctional groups, on the desired selectivity of hydrogenation.

Variables Affecting Hydrogenation.—One of the primary

factors that determine the ease with which a catalytic hydrogenation can be effected is the nature of the functional group to be reduced. There are however, in addition, several external factors such as:

Temperature and Pressure.—In general an increase in temperature causes an increased rate of hydrogenation. For the hydrogenation of most functional groups there is an optimum temperature for the reaction. At temperatures much below this point, the reaction is usually too slow to be practical. Neither is it desirable to conduct the hydrogenation above the optimum temperature since then the rates of side reactions are increased.

An increase in pressure produces an increase in the rate of hydrogenation. The pressure selected for conducting a hydrogenation depends largely on the particular compound in question. For example, with phenol and benzene an increase of pressure from 30 to 300 atm. increases the rate of hydrogenation only by about 50% in the presence of nickel, whereas the rate of hydrogenation of aniline increases three- to fourfold.

Agitation.—In order to effect a hydrogenation smoothly, it is necessary to bring the acceptor, catalyst and hydrogen in intimate contact. This is usually accomplished by shaking the reaction mixture, thus keeping the catalyst well dispersed and affording continuous supply of reactants to the surface. The rate of reaction increases steadily with agitation up to a certain point.

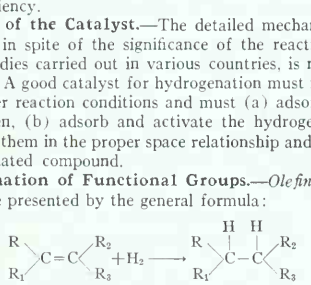
Solvent.—In many cases, it is desirable to conduct a hydrogenation in the presence of a suitable solvent, especially in the case of high-melting solids and compounds that react very vigorously with hydrogen. Solvents also often facilitate the suspension of the catalyst in the reaction mixture and prevent the separation of an immiscible liquid. The solvents that have been found most useful are ethyl alcohol, low-boiling alkanes, ether, dioxane and acetic acid; the latter can be used only with platinum and palladium-type catalysts.

Catalyst Poisoning.—This can be either deliberate or unintentional. In certain types of selective hydrogenation, the catalyst is deliberately poisoned in order to deactivate it to the desired level. The partial poisoning of the nickel catalyst with sulfur makes it an efficient catalyst for the hydrogenation of butadiene to butene without causing the latter to be hydrogenated. The poisoning of palladium with sulfur permits the selective hydrogenation of an acyl chloride to an aldehyde.

Catalyst poisoning is usually unintentional. Deterioration of the catalysts on use can be attributed generally to the presence of sulfur in the reactants, to clogging of the catalyst pores with carbonaceous material and to a host of other causes. In general, Group Vb of the periodic table (phosphorous, arsenic, antimony, bismuth) and Group VIb (sulfur, selenium, tellurium) are poisons for the hydrogenating catalysts such as nickel, platinum and palladium. A poisoned catalyst can often be reactivated by oxidation with certain peracids in the presence of hydrogen peroxide. Oxidation converts the poison into a compound that does not retard catalyst efficiency.

Function of the Catalyst.—The detailed mechanism of hydrogenation, in spite of the significance of the reaction and the extensive studies carried out in various countries, is not too well understood. A good catalyst for hydrogenation must maintain its activity under reaction conditions and must (a) adsorb and activate hydrogen, (b) adsorb and activate the hydrogen acceptor, (c) maintain them in the proper space relationship and (d) desorb the hydrogenated compound.

Hydrogenation of Functional Groups.—*Olefins.*—The reaction can be presented by the general formula:



The saturation of olefinic double bonds occurs readily in the presence of any of the typical hydrogenation catalysts listed above. Platinum and palladium are active at low pressures and temperatures, nickel is active at higher pressures and at temperatures of 40°–60° C., while copper chromite is active at 100° C. and 200 atm. pressure. The ease of hydrogenation depends on the number and nature of attached groups; an increase in substitution is accompanied by decreasing ease of hydrogenation.

The purpose of hydrogenation of vegetable or animal oils is to obtain a hard fat of greater viscosity than the original liquid oil and to remove certain undesirable impurities, thus rendering the oil edible and useful for industrial consumption. The process consists essentially in hydrogenation of the glycerides of unsaturated acids into glycerides of saturated or partially saturated acids. The reaction is carried out at 100°–200° C. and at pressures less than 15 atm. Nickel is the most commonly used catalyst. The quantity of nickel used is less than 1%. In the United States many tons of glycerides, mainly cottonseed and soybean oil, are hydrogenated to make shortening.

The hydrogenation of diisobutylene to isooctane is of special industrial interest because of the high antiknock performance of the isooctane (2,2,4-trimethylpentane) in internal combustion engines.

Aromatics.—Aromatic rings are more difficult to hydrogenate than isolated olefinic double bonds. Nickle-type catalysts are perhaps the most satisfactory catalysts; temperatures ranging from 125° to 175° C. and pressures of about 100 atm. are satisfactory. Platinum oxide is an effective catalyst for the hydrogenation only in the presence of acids, such as acetic acid. The hydrogenation of mononuclear aromatic hydrocarbons proceeds to completion to form cyclohexanes. The hydrogenation of benzene to cyclohexane and of phenol to cyclohexanol are of commercial importance, since these two compounds on oxidation form adipic acid which is the main intermediate in the production of nylon (synthetic fibre).

Naphthalene can be hydrogenated to tetrahydronaphthalene (tetraline) and decahydronaphthalene (decaline) depending on the experimental conditions. Both compounds are important industrial solvents.

Hydrogenolysis of Functional Groups.—*Nitro Compounds.*—The nitro group undergoes catalytic reduction with great ease and any of the common hydrogenation catalysts is effective:

$$RNO_2+3H_2 \longrightarrow RNH_2+2H_2O$$

Reduction of the nitro group is highly exothermic and certain precautions must be taken to prevent dangerously high reaction temperatures. The hydrogenation of these compounds can be controlled by use of a low ratio of catalyst to acceptor and low temperatures. In order that the water produced during the hydrogenolysis does not destroy the homogeneity of the reaction medium it is advisable to use an alcohol as a solvent.

Esters.—Copper chromite is the catalyst most widely used for the reduction of esters to primary alcohols:

$$RC(=O)OCH_2R_1+2H_2 \longrightarrow RCH_2OH+R_1CH_2OH$$

The reaction is generally conducted at 250° C. and 175 atm. pressure. Substituents containing a functional group have no marked effect on the yield of primary alcohol, provided they are located at sufficiently great distance from the ester function. When the ester is directly bound to an aromatic ring reaction (A) takes place, if the aromatic ring is separated from the ester by one or more carbon atoms reaction (B) occurs:

$$\text{(A)}\quad C_6H_5C(=O)OC_2H_5+3H_2 \longrightarrow C_6H_5CH_3+C_2H_5OH+H_2O$$

$$\text{(B)}\quad C_6H_5CH_2C(=O)OC_2H_5+2H_2 \longrightarrow C_6H_5CH_2CH_2OH+C_2H_5OH$$

Hydrogenolysis of esters is used extensively commercially for making higher molecular weight alcohols from the esters of fatty acids and from waxes. The alcohols thus produced are esterified with sulfuric acid and converted to synthetic detergents.

Acid Chlorides.—Often it is necessary to convert an acid to the corresponding aldehyde. The most convenient method of accomplishing this involves the conversion of the acid to the acid chloride and hydrogenation of this derivative in the presence of a supported palladium catalyst, generally palladium on barium sul-

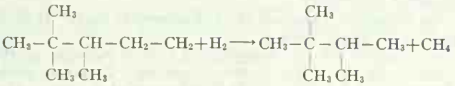
fate. This selective hydrogenation, known as the Rosenmund reduction, is applicable for the preparation of aliphatic, aromatic and heterocyclic aldehydes.

$$RC\begin{matrix}O\\Cl\end{matrix} + H_2 \longrightarrow RCHO + HCl$$

Experimental conditions must be chosen so that the aldehyde is not further reduced to the alcohol or hydrocarbon. This is often accomplished by the addition of a regulator, which is simply a selective poison that deactivates the catalyst with respect to reduction of aldehydes but not with respect to acid chlorides. A compound containing sulfur is usually used for this purpose; quinoline treated with sulfur is most commonly used. The reduction is accomplished by bubbling hydrogen through a solution of the acid chloride in which the catalyst and the regulator are suspended.

The Rosenmund reduction is used extensively in the synthesis of fine chemicals and pharmaceuticals.

Hydrogenolysis of Carbon-Carbon Bonds.—*Paraffins.*—Under conditions that are sufficiently drastic paraffinic hydrocarbons undergo extensive hydrogenolysis to yield principally methane. In the presence of nickel at 400° C., hexane, for example, reacts with hydrogen to yield methane. By employing conditions that are less drastic it is possible to effect a more selective reaction by removing certain specific methyl groups (as methane) from branched-chain hydrocarbons to form hydrocarbons having one less carbon atom. In this reaction, referred to as selective demethylation, methyl groups attached to secondary carbon atoms are removed more readily than those attached to tertiary carbon atoms. Methyl groups attached to quaternary carbon atoms are the most difficult of all to remove.



The reaction is conducted at 200°–320° C. and 1–20 atm. pressure in a flow system with nickel or cobalt as catalyst. Careful control of reaction conditions is necessary.

This reaction is of practical importance in that it can be used for the synthesis of branched-chain hydrocarbons that are difficult to obtain by conventional means.

Alkylaromatics.—The large demand for simple, relatively low molecular weight, aromatic hydrocarbons, such as benzene, toluene and naphthalene, directed attention toward the utilization of kerosene extracts containing high concentrations of alkyl-substituted benzenes and naphthalenes. The hydrogenolysis of the alkylaromatics is usually carried out at high temperatures, 525°–625° C., 25–70 atm. pressures, a hydrogen to hydrocarbon ratio of 3:1 and an hourly liquid space velocity (volume of liquid charged per volume of catalyst per hour) of 1.0. The catalysts preferred are molybdena, chromia or vanadia deposited on alumina.

Primary Alcohols.—The hydrogenolysis of primary alcohols in the presence of catalysts, such as nickel, platinum or palladium, furnishes excellent yields of hydrocarbons having one less carbon atom than the original alcohol:

$$RCH_2OH + 2H_2 \longrightarrow RH + CH_4 + H_2O$$

In the presence of a nickel catalyst the reaction is conducted at 250° C. and 50–100 atm. pressure. The reaction has been applied to a variety of alcohols.

Hydrogenolysis of Coal.—Coal is a mixture of very high molecular weight compounds, containing sulfur, oxygen and nitrogen, in addition to carbon and hydrogen. Coal in a powdered form is first mixed with a small amount of catalyst and with a high-boiling recycle oil containing aromatics, hydroaromatics and phenols. This paste and about 2,000 cu.m. of hydrogen per ton of coal oil is pumped at 500 atm. through a preheater in which the mixture is heated to about 430° C. From the preheater the reactants pass through three pressure vessels in series, where the exothermic heat of reaction results in a temperature increase to 470° C. The contact time is of the order of two hours.

The products are: (1) heavy oil which is recycled to make coal oil paste; (2) middle oil, boiling in the range of 200°–310° C., which is submitted to vapour phase hydrogenolysis to form motor fuel; (3) a relatively small fraction of gasoline; (4) gaseous hydrocarbons; and (5) residue of unreacted coal ash, which is used for fuel.

Most heavy metals and their oxides and sulfides are active as catalysts in primary liquefaction of coal. Tin added as massive metal or as any reactive compound is the most active catalyst known for converting bituminous coal to a heavy oil by hydrogenolysis.

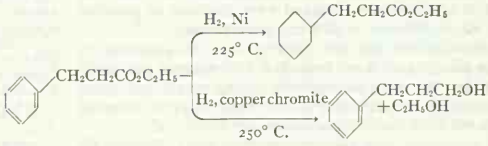
The coal hydrogenation method was used in Germany before and during World War II.

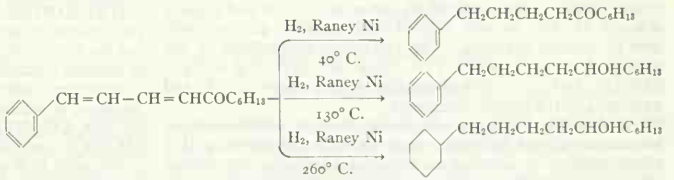
Selective Hydrogenation.—This is a valuable tool used by chemists for reducing one functional group in the presence of another functional group, which is also able to undergo hydrogenation.

This type of hydrogenation is made possible by the existence of a variety of catalysts, wide choice of temperature and pressure conditions, a choice of solvents and a reasonable knowledge of the relative reactivity toward hydrogenation of the various functional groups.

The choice of catalysts can be of great importance. Copper chromite, for example, is more active for the reduction of the carbon-oxygen bond than for that of the benzenoid ring. Nickel is more active toward a benzenoid ring than toward an ester group.

Some of the examples listed below show the effect of catalysts and the effect of temperatures upon the selective hydrogenation of certain compounds:





Hydrogenation of Carbon Monoxide.—A diversity of chemical reactions has involved the catalytic hydrogenation of carbon monoxide. Many of these reactions are of industrial importance.

Methane.—A complete hydrogenation to methane occurs when carbon monoxide and hydrogen are brought into contact in the presence of a nickel catalyst at a temperature above 250° C. This reaction is of industrial importance in the conversion of the carbon monoxide of manufactured gas to methane to increase the heating value and to provide a less toxic fuel gas.

Methanol.—In 1923 the means for making methanol, the main product of the hydrogenation of carbon monoxide, was found. This was brought about through the use of certain mixed catalysts containing zinc oxide and chromium oxide and a reaction apparatus that did not contain iron or iron alloys.

The prevailing commercial catalysts are composed of the above two oxides, to which copper or copper oxide may or may not be added. The copper is a good conductor of heat, with the result

that its addition promotes the distribution of the heat of reaction throughout the catalyst bed; furthermore, it can enhance the activity of the zinc–chromium catalyst. The ratios of the various constituents vary.

The lowest temperature at which the reaction has been found to proceed at an appreciable rate in the presence of a catalyst is 225° C. Most commercial syntheses operate between 300° and 375° C., and between 275 and 350 atm. The usual conversion of carbon monoxide to methanol is 12% to 15%. The ratios of hydrogen to carbon monoxide used vary from 2:1 to 6:1, and the gaseous space velocities (volume of gas per volume of catalyst per hour) from 20,000 to 50,000.

Fischer–Tropsch Synthesis.—Catalysts such as nickel and cobalt, which normally yield chiefly methane from a mixture of hydrogen and carbon monoxide at atmospheric pressure and 250°–400° C., may be modified by the addition of oxides of thorium, magnesium or aluminum and by special preparation procedures so as to produce mainly liquid hydrocarbons. If modified iron is used as a catalyst, alcohols and liquid hydrocarbons are produced. This discovery, made in 1925 by Franz Fischer and Hans Tropsch, led to the rapid industrial development of synthetic gasoline in Germany during 1931–38.

Nickel catalysts were soon found to be less useful than cobalt or iron. Cobalt catalysts were used exclusively in all German plants during 1932–46, although later research on iron catalysts showed that with proper preparations and suitable experimental conditions they would equal the performance of the cobalt catalyst.

The standard catalyst in the commercial synthesis of gasoline in Germany during World War II was composed of:

$$Co:ThO_2:MgO:kieselguhr = 100:5:8:200$$

The best results were obtained when pressures of from 5 to 15 atm. and temperatures of about 250° C. were used and the ratio of $H_2:CO = 2:1$. The product of this synthesis contained about 14% methane, 1% ethane, 25% C_3 and C_4 hydrocarbons, 30% gasoline, 14% diesel oil, 14% paraffin wax and 1% to 2% aliphatic alcohols. The hydrocarbons obtained were mixtures of paraffins and olefins; no naphthenes or diolefins were formed.

Active iron catalysts for the synthesis can be prepared by impregnating precipitated ferric hydroxide with aqueous potassium carbonate so that the dried mixture will contain 0.25% potassium oxide. The activity and durability of the iron catalyst is enhanced by pretreatment with pure carbon monoxide at 325° C.

Synthesis conditions with the iron catalysts are 225°–235° C., 20 atm. press., using 1 vol. of H_2 per 1 vol. of CO and a space velocity of 100 to 200 vol. of the reactant gas per volume of catalyst per hour. The percentage composition of the product is 15% (C_1+C_2), 15% (C_3+Cu), 24% (C_5 to C_{10}), 12% (C_{11} to C_{18}), 22% hydrocarbons boiling above 320° C. and 12% oxygenated organic compounds.

Oxo Reaction.—The oxo reaction involves the addition of carbon monoxide and hydrogen to an olefin in the presence of a cobalt catalyst to produce an aldehyde containing one carbon atom more than the starting compound. The reaction can be presented by the following general equation:

$$RCH=CH_2 + CO + H_2 \rightarrow RCH_2CH_2CHO \text{ and } RCH(CHO)CH_3$$

The reaction may be regarded as the addition of a hydrogen atom and a formyl group across the double bond. The reaction was first carried out (Roelen, 1938) with ethylene and the products of the reaction were diethyl ketone and propionaldehyde. Because both products contained a carbonyl or oxo group, the reaction was called the oxo reaction. Later it was found that the ketone formation was relatively unimportant, aldehydes being the principal products.

The effective catalyst in the oxo synthesis is cobalt hydrocarbonyl, which probably results from the intermediate formation of dicobalt octacarbonyl:

$$2Co + 8CO \rightarrow [(CoCO)_4]_2 \qquad \triangle H = -55 \text{ kg. cal./mole}$$
$$H_2 + [(CoCO)_4]_2 \rightarrow 2HCo(CO)_4$$

For a maximum yield of aldehydes the reaction should be operated at as low a temperature as possible, compatible with a reasonable rate. The temperature is usually 110°–140° C., and under these conditions the cobalt should be introduced as dicobalt octacarbonyl. As the temperature is raised, there is a tendency for the aldehydes to be reduced to the alcohols. The usual operating pressure of the oxo synthesis is 200 to 300 atm. of synthesis gas ($H_2:CO = 1:1$). It is possible to adjust conditions so that the aldehydes are produced even at 185° C.; this can be done by using sufficient gas to enable the oxo synthesis to proceed, but insufficient to permit the subsequent hydrogenation.

Most oxo reactions are performed with cobalt concentration of about 0.5 to 5 mole per cent.

Straight-chain terminal olefins yield a mixture of aldehydes consisting of about 40%–60% straight-chain and 60%–40% branched-chain aldehydes. Nonterminal straight-chain olefins yield a mixture of aldehydes practically identical with that given by the isomeric terminal olefins.

The olefin mixture of the greatest commercial interest as a substrate for the oxo reaction is the mixture of heptylenes obtained by the copolymerization of C_3 and C_4 olefins and composed chiefly of 2,2-, 2,3- and 2,4-dimethylpentanes. The mixed C_8 alcohols eventually obtained by the oxo process are useful in the manufacture of plasticizers.

Hydrogenation of Elemental Substances.—Hydrogen combines with many elements in the presence of finely divided metals such as platinum or palladium. The elements of fluorine, chlorine, bromine and iodine form the corresponding hydrogen halides. Hydrogen combines also with sulfur, selenium and tellurium. The reaction of nitrogen with hydrogen to form ammonia is of great industrial importance.

See NITROGEN, FIXATION OF; and references under "Hydrogenation" in the Index volume.

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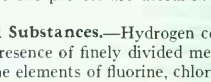
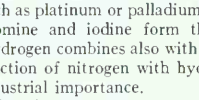
HYDROGEN BOMB: *see* ATOMIC ENERGY: *The Hydrogen Bomb*.

HYDROGEN CYANIDE: *see* HYDROCYANIC ACID.

HYDROGEN IONS. A hydrogen ion may be an electrically charged molecule (or atom) of hydrogen in the gaseous state, but the term is applied more often, as it is in this article, to ions in solution arising from acids, acid salts, etc.

According to the theory of Svante Arrhenius, hydrogen ions are produced in solution by the dissociation of acids. For example, the acid $CH_3.COOH$ was supposed to dissociate to the anion CH_3COO^- and the hydrogen ion H^+.

The view here adopted is that the proton, the nucleus of the hydrogen atom having unit positive charge and represented by H^+, may transfer from any one of a large number of proton donors to one or another proton acceptor. Examples of proton donors and the corresponding (or conjugate) proton acceptors are:

Donor and acceptor	*Donor and acceptor*
$CH_3.COOH$ and $CH_3.COO^-$	
NH_4^+ and NH_3	
H_3PO_4 and $H_2PO_4^-$	
$H_2PO_4^-$ and HPO_4^{2-}	
	$H^+.H_2O$ and H_2O
	H_2O and OH^-

In aqueous solution transfer of a proton from a proton donor to water gives the hydrogen ion, $H^+.H_2O$, of an aqueous solution. Likewise, in an ammonia solution the transfer of a proton

from a proton donor to a molecule of the solvent, NH_3, gives the hydrogen ion, NH_4^+, of an ammonia solution. (The terms donor and acceptor are discussed in detail in ACIDS AND BASES.)

This article is restricted to aqueous solutions and to an elementary treatment, but the elementary principles presented are widely applicable if due consideration is given to the distinctions between different solvents.

A general, reversible process of proton exchange may be represented by: proton donor A + proton acceptor B $\rightleftharpoons$ proton acceptor A + proton donor B. Confining attention to water solutions, in which H_2O is a proton acceptor and the hydrated proton, $H^+.H_2O$, is a proton donor, we may formulate in the classical way the equilibrium equation (1).

$$\frac{[\text{Proton acceptor}][H^+.H_2O]}{[\text{Proton donor}][H_2O]} = k \tag{1}$$

Here brackets signify the molar concentration (in the algebraic sense) of a substance the symbol of which is enclosed, and k is a constant.

Strictly, equation (1) is valid only at infinite dilution. Also at infinite dilution $[H_2O]$ is a constant. Then equation (1) may be written as (2), which expresses a limiting relation.

$$\frac{[\text{Proton acceptor}]}{[\text{Proton donor}]} = \frac{K}{[H^+.H_2O]} \tag{2}$$

It is advantageous to preserve this limiting relation and to use its form as in the following development.

Inasmuch as equilibriums of this sort, when observed under ordinary circumstances, are not strictly determined by the concentrations of the participating substances, but rather by their chemical potentials (*see* THERMODYNAMICS), it has been found convenient to replace the concentration of each substance by its activity. The activity of a substance A may be defined by relation (3)

$$(A) = [A]f_A \tag{3}$$

where () is used here to represent activity, brackets are used as before to signify molar concentration and f_A is the activity coefficient. If concentration is expressed as molal instead of molar concentration, a different symbol should be used for the activity coefficient. This device is virtually to make equations such as equation (4) exact by definition. Accordingly equation (2) should be written as equation (4)

$$\frac{(\text{Proton acceptor})}{(\text{Proton donor})} = \frac{K}{(H^+.H_2O)} \tag{4}$$

Introducing relations of type (3) we have:

$$\frac{[\text{Proton acceptor}]}{[\text{Proton donor}]} = \frac{K}{(H^+.H_2O)} \times \frac{f_{\text{donor}}}{f_{\text{acceptor}}} \tag{5}$$

For a narrow range of conditions the ratio $f_{\text{donor}} / f_{\text{acceptor}}$ may not vary to an extent that will affect seriously the simpler formulation of a set of relations, and then this ratio may be combined with the true ionization constant K to give the "apparent ionization constant" K′ of equation (6)

$$\frac{[\text{Proton acceptor}]}{[\text{Proton donor}]} \cong \frac{K'}{(H^+.H_2O)} \tag{6}$$

It was virtually with this approximate relation, applied to each of a large number of systems, that the subject was first outlined. We shall use it for the same purpose, but it should be noted that the following comments involve approximations and that more elaborate treatments must be sought in texts.

Equation (6) suggests the fundamental reason for the widespread interest in determining the activities of hydrogen ions in aqueous solutions.

A particular proton donor will have properties that differ from those of its corresponding acceptor. Manifestation of the one or the other set of properties will depend, of course, on the amount of the respective substance, or, per unit volume, on the molar concentration, but the relative degree of manifestation will depend on ratios such as those defined by statements (7) and (8).

$$\frac{[\text{Proton acceptor}]}{[\text{Proton acceptor}] + [\text{Proton donor}]} = \alpha \tag{7}$$

$$\frac{[\text{Proton donor}]}{[\text{Proton acceptor}] + [\text{Proton donor}]} = 1-\alpha \tag{8}$$

By (6), (7) and (8) one obtains (9)

$$\frac{\alpha}{1-\alpha} = \frac{K'}{(H^+.H_2O)} \tag{9}$$

Thus, the degree to which the proton acceptor predominates, as expressed by α, is determined by the value of K′, which is characteristic of each system in given circumstances, and by the hydrogen ion activity of the solution. When, for example, K′ = $(H^+.H_2O)$, $\alpha = 0.5$, or, in other terms, half of the proton donor has been transformed to the corresponding acceptor. Even in solutions so complicated that it is impracticable to determine every set of proton donor and acceptor, control of the hydrogen ion activity will establish certain ratios for all pairs of these substances. This may be favourable or detrimental to complicated processes, such as the growth or metabolism of bacteria or of any of the innumerable organisms in sea water that are directly exposed to this environment. Control of $(H^+.H_2O)$ is indispensable when a particular proton donor, or its corresponding acceptor, is to be brought into prominence for any one of innumerable purposes.

Although in alkaline solutions the transfer of protons to water molecules is so little that the concentration of hydrogen ions might be regarded as of doubtful physical significance and the response of devices such as the hydrogen electrode might be regarded as due to direct transfer of protons to the electrode from proton donors, it is customary to postulate a hydrogen ion activity for all cases. Indeed, from a purely thermodynamic point of view, the postulation of the hydrogen ion as the intermediate is quite legitimate. This leads to the consideration of hydrogen ion activities ranging in values from, say, 10 to 1×10^{-14}. It is inconvenient to plot relations with this large range of values. In 1909 S. P. L. Sørensen used the function $-\log [H^+]$ and designated it by the symbol pH. Later he and others recognized that $-\log [H^+]$ should be replaced by $-\log (H^+.H_2O)$ and accordingly the modern interpretation of pH is often stated to be the "negative logarithm of hydrogen ion activity." There remains a small uncertainty in estimating a hydrogen ion activity so that pH numbers as ordinarily used are somewhat arbitrary.

If this be understood, we may proceed with the conveniences provided by the following definitions.

$$\text{pH} = -\log (H^+.H_2O) \tag{10}$$

$$\text{pK}' = -\log K' \tag{11}$$

By (9), (10) and (11) we reach equation (12)

$$\text{pH} = \text{pK}' + \log \frac{\alpha}{1-\alpha} \tag{12}$$

If α be plotted as abscissa and pH as ordinate, one obtains the family of symmetrical curves shown in fig. 1, the position of each curve being determined by the value of pK′ which is characteristic of each system under the conditions where pK′ applies. The mid-point of each curve ($\alpha = 0.5$) falls where pH = pK′. If the value of pK′ is known and pH is measured, one can estimate the degree to which a particular proton donor has been transformed to the conjugate acceptor. The estimate may be made by calculation or by reading values on a carefully drawn curve such as one of those in fig. 1.

Water itself forms both hydrogen ions and hydroxyl ions, $O\bar{H}$, by the process $2H_2O \rightleftharpoons H^+.H_2O + O\bar{H}$. The equilibrium expressed in classical terms is:

$$\frac{[H^+.H_2O][O\bar{H}]}{[H_2O]^2} = k_w$$

At the limiting condition where water is the only constituent, $[H_2O]$ is a constant so that we then have the so-called ionic product of water expressed by (13).

$$[H^+.H_2O][O\bar{H}] = K_w \tag{13}$$

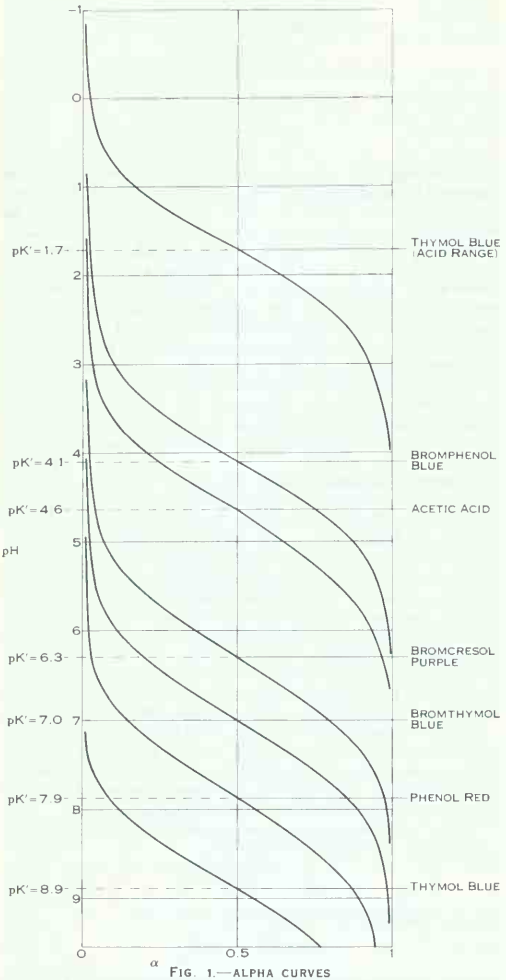


FIG. 1.—ALPHA CURVES

Relation of pH to the degree of transformation of proton donor to conjugate proton acceptor in systems of specified values of pK'

For present purposes one may neglect the activity coefficients that would have to be applied to make a similar equation valid for ordinary conditions and one may use the approximate value 1×10^{-14} for the value of the "apparent" constant K'_w. Then the hydrogen ion concentration would appear to be equal to the hydroxyl ion concentration pH = 7.0. This is a convenient "equator" with which to demark "acid" solutions from "alkaline" solutions. If it be desired to calculate the activity of hydroxyl ions from measured values of pH, an equation similar to equation (13), but properly modified to include the values of activity coefficients for the conditions used, provides the means of calculation.

If attention be confined to simple cases, such as mixtures of an acid and its sodium salt, one can state in simple form some principles that are widely applicable. For this purpose let typography be simplified by using H^+ as the symbol of $H^+.H_2O$. Let HA represent a neutral proton donor, such as acetic acid, and A^- the conjugate acceptor, the anion of a simple acid. Assume a sodium salt, such as sodium acetate, to be completely ionized in aqueous solution. For a mixture of the acid and its sodium salt define:

$$S=[HA]+[A^-] \tag{14}$$

$[A^-]$ being the concentration of anions arising from ionizations of both acid and salt, and [HA] being the concentration of the acid that remains unionized. The solution must be electrically neutral. Hence:

$$[Na^+]+[H^+]=[A^-]+[\overline{OH}] \tag{15}$$

Equations (14), (15) and (6) may be combined to give equation (16).

$$\frac{(H^+)([Na^+]+[H^+]-[\overline{OH}])}{S-([Na^+]+[H^+]-[\overline{OH}])}=K' \tag{16}$$

For many purposes it is unnecessary to do more with this equation than make certain approximations. Suppose, for example, in making the solution such an amount of acid and its sodium salt were used that S = 0.1 and $[Na^+]=0.5$ "molar." Suppose also that a crude estimate places the value of $[H^+]$ between 1×10^{-3} and 1×10^{-4} "molar." By use of the value $K'_w \cong 1 \times 10^{-14}$ a crude estimate of the value of $[\overline{OH}]$ would be that it is between 1×10^{-11} and 1×10^{-10} "molar." Then equation (16) reduces to:

$$\frac{(H^+)[Na^+]}{S-[Na^+]}\cong K' \tag{17}$$

But $[Na^+]$ is equivalent to the stoichiometrical concentration of salt and $S-[Na^+]$ is equivalent to the stoichiometrical concentration of acid used in making up the solution. Hence

$$pH\cong pK'+\log\frac{[Salt]}{[Acid]} \tag{18}$$

If in equation (16) $[Na^+]=0$, that is if the acid alone is present, $[\overline{OH}]$ usually will be negligible in the sum $[H^+]-[\overline{OH}]$ so that equation (16) reduces to:

$$\frac{(H^+)[H^+]}{S-[H^+]}\cong K' \text{ or practically to } \frac{(H^+)^2}{S-(H^+)}\cong K' \tag{19}$$

For a weak acid the value of $S-(H^+)$ is little different from the value of S so that:

$$pH \text{ approximates } 0.5\ pK'-0.5 \log S \tag{20}$$

With the approximations of equations (18) and (20) one can calculate roughly the course taken by pH during the titration of a weak acid by a standard solution of an alkali. More reliable, however, are so-called titration curves obtained by plotting values of pH measured at successive intervals during stepwise addition of alkali, pH being plotted against equivalents of added alkali. Such curves are illustrated in fig. 2 and 3.

Buffer Action.—It will be noted in fig. 1 that the curves do not have as great a slope near the mid-points (where $\alpha = 0.5$) as they do near the asymptotes. The flatter sections of these alpha curves correspond roughly to the flatter sections of the respective titration curves of the weaker acids (*see* fig. 2). In other words a variable degree of stabilization of pH is associated with a mixture of a proton donor and its conjugate acceptor, the stabilization being the more pronounced the greater their concentrations and usually the nearer the ratio of concentrations approaches unity. Stabilization also occurs at each end of the pH scale where, at the one extreme, hydrogen ions as well as the conjugate proton acceptors, water molecules, are abundant, and at the other extreme where hydroxyl ions as proton acceptors as well as the conjugate donors, water molecules, become abundant. This partial stabilization of pH is called buffer action. Systems providing buffer action are called buffers. Some are used as standards of pH for the determination of pH by the indicator method (see *Indicators of* pH, below) or as solutions with which to standardize the glass electrode (see *Glass Electrode*, below). Buffers serve to condition the environments of living cells and to control innumerable chemical reactions. In the titration of an acid with a standard solution of an alkali, such as NaOH, it is necessary to know that pH at which there have been added the number of

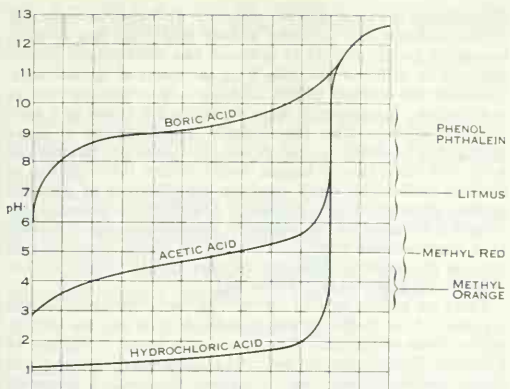


FIG. 2.—TITRATION CURVES OF THREE ACIDS SHOWING BUFFER EFFECTS. THE LIMITED RANGES OF SUCH EFFECTS AND THE DIFFERENT pH-VALUES ATTAINED AT THE EQUIVALENCE POINT

equivalents of alkali equal to the number of equivalents of acid in the original solution. This pH is called the equivalence point or end point.

The calculation is simple in those cases in which both acid and alkali are completely ionized as in the case of HCl and NaOH in water. For example, when HCl is titrated by NaOH the law of electroneutrality requires:

$$[H^+]+[Na^+]=[Cl^-]+[O\bar{H}] \qquad (21)$$

$[Cl^-]$ is equivalent to the number of moles of HCl originally used, per litre of the solution as the solution exists at the end of the titration. $[Na^+]$ is equivalent to the number of moles of NaOH used, per litre of solution as the solution exists at the end of the titration. At the equivalence point $[Cl^-]=[Na^+]$. Hence $[H^+]=[O\bar{H}]$. Therefore, if activity coefficients be neglected, the equivalence point in this particular case is approximately at pH = 7.0 (*see* equation [13]).

In the titration of a "weak" acid, one that is only partially ionized, the equivalence point may be calculated with approximations adequate for ordinary purposes as follows. In equation (16) introduce the condition for the equivalence point that $[Na^+]=S$ (*see* equation [14]). The numerator of equation (16) then becomes $(H^+)(S+[H^+]-[O\bar{H}])$ and the denominator becomes

$$-[H^+]+[O\bar{H}] \text{ or } -[H^+]+\frac{K'_w}{[H^+]} \qquad (22)$$

Usually S is so much larger than $[H^+]-[O\bar{H}]$ that the numerator closely approximates (H^+) S. If we now assume (H^+) to approximate $[H^+]$, a little algebraic manipulation will lead to equation (23):

$$pH=0.5\ pK'+0.5\ pK'_w+0.5 \log (S+K') \qquad (23)$$

or, when S is much greater than K',

$$pH=0.5\ pK'+0.5\ pK'_w+0.5 \log S \qquad (24)$$

Examples:

S molar	pK'	pH of eq. point	S molar	pK'	pH of eq. point
0.1	3.0	8.0	0.1	5	9.0
0.01		7.5	0.01		8.5

The greater the value of pK' the greater will be the pH of the equivalence point and the nearer an overlap of the titration curve with the curve obtained on addition of NaOH to water. Therefore, in titrating small quantities of a weak acid the volume is kept as small as possible and a microburette is used to deliver alkali of relatively high titre.

Much the same sort of calculation may be used in making a rough estimate of the equivalence point in the titration of ammonia, for example, by a standard solution of HCl. In such cases the equivalence points for various conditions will be at pH values less than 7.0.

The pH of the equivalence point is indicated by the colour of a suitable indicator. In this use of an indicator consideration is given to the fact that in most of the ordinary titrations a large change of pH occurs near the equivalence point. Thus, in the titration of HCl with NaOH, as one equivalent of NaOH per equivalent of HCl is approached the addition of a very small fraction of one equivalent of NaOH causes a large change of pH. At pH values in the region near 6, phenol red will remain yellow. From that point an extremely small fraction of one equivalent of alkali is needed to reach pH 7.0 and within the interval phenol red will exhibit a readily detected, partial colour change. Likewise, if pH 8.5 is to be the equivalence point in the titration of a weak acid, phenolphthalein will remain colourless until this equivalence point is approached and will exhibit a partial transformation to the red form at pH 8.5.

Advanced treatises should be consulted for more elaborate treatments including those dealing with various sources of error.

Indicators of pH.—An indicator of pH is a substance capable of existing in solution as a proton donor and conjugate proton acceptor, at least one of which forms absorbs visible radiant energy so that it may be distinguished by the eye. Usually an indicator is employed at a concentration so low as not to affect seriously the pH of buffered solutions.

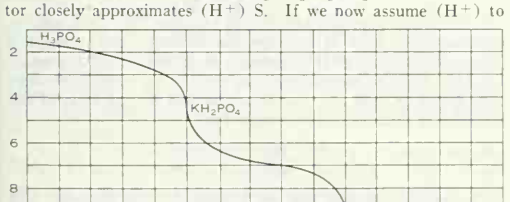
The degree of transformation, α, of an indicator from a particular form as proton donor to the conjugate acceptor is related to the pH value of a solution by an "alpha curve" such as those shown in fig. 1.

Some indicators can form two sets of conjugate proton acceptor and donor. Such is the case in each of the sulfonphthaleins. At low pH (near pH 0) each exhibits a colour change distinct from that observed in passing through a region of higher pH.

Inasmuch as a particular indicator will exhibit change of form over a limited range, or over limited ranges, of pH, as defined by its alpha curve, or curves, it is necessary to have a series of indicators for each of the various purposes.

There are two principal uses of indicators of pH. One is to determine the pH of a solution whatever it may be; the other to detect that particular pH called the equivalence point for the titration of a particular acid with a standard solution of an alkali or the equivalence point in the titration of a proton acceptor (such as NH_3) with a standard solution of an acid.

The simplest of several methods for the determination of pH with indicators is the following. It is necessary to select that indicator which shows a definite and appreciable degree of transformation when added to the solution under test. A suitable indicator having been selected by preliminary trials, one prepares



FROM "THE DETERMINATION OF HYDROGEN IONS" BY W. MANSFIELD CLARK (WILLIAMS AND WILKINS COMPANY)

FIG. 3.—TITRATION CURVE OF PHOSPHORIC ACID

Abscissa: equivalents of alkali per mole H_3PO_4

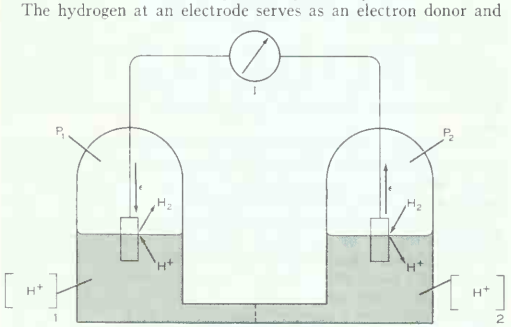
a few buffer solutions having pH values within the expected range, the pH values differing by 0.2 pH unit or 0.1 pH unit. Tables giving the composition and pH values of standard buffer solutions are given in various treatises. Apportion equal volumes of these buffers in test tubes of the same internal diameter. To each of these buffer solutions and to the same volume of the tested solution in a tube of the selected, uniform bore, add precisely the same volume of the same stock solution of indicator. Illuminate compared tubes equally. When a tested solution and a standard solution have the same appearance (the same colour to a normal eye) the degree of transformation, α, of the indicator will be the same in both solutions provided no change of indicator takes place other than change between proton donor and proton acceptor forms. If the colour of the tested solution is intermediate between the colours of two standards, a judgment can be made of the standard that should match. It usually is presumed that the pH values of tested solution and standard are the same when a colour match is found. However, such a presumption would be based on equation (9) and, as noted in developing this equation, the apparent constant, pK′, includes a ratio of activity coefficients. These coefficients will vary with the salt content of the solution. Hence pK′ may not be the same in standard and tested solutions if the compositions differ considerably. The difference of pH associated with the same value of α is often called the "salt error." Among other sources of error are the combination of an indicator with proteins, precipitation by various agents and the superposition of the natural colour of the tested solution. Compensation for the latter can sometimes be made satisfactorily by devices described in texts.

Use of indicators to determine equivalence points in titrations has been noted briefly above, in the section *Buffer Action*.

Hydrogen Electrode (Hydrogen Cell).—A hydrogen cell is an electric cell which is conveniently regarded as made up of two half cells (*see* fig. 4). Each half cell contains an electrode of a noble metal, such as platinum, coated with platinum black or palladium black as catalyst. Each electrode dips into a buffer solution which maintains a constant activity of the hydrogen ions and the solution is brought into equilibrium with some definite partial pressure, P, of hydrogen. The process occurring at the interface between electrode and solution is one of oxidation-reduction, specifically that represented by $2H^+ + 2\epsilon \rightleftharpoons H_2$ where ϵ represents an electron. This reversible process is catalyzed by the platinum, or palladium black. Postulation of the intermediate $H^+.H_2O$ will not affect the final result, if attention is confined to water solutions.

If the two solutions are joined directly there may be a large liquid junction potential. When a solution saturated with respect to KCl is interposed, the liquid junction potential is reduced to an uncertain value which is small and is frequently neglected. We shall, for the moment, neglect this junction potential.

The hydrogen at an electrode serves as an electron donor and the hydrogen ion as an electron acceptor. If the partial pressures of the hydrogen are the same in both half cells, that solution having the greater activity of hydrogen ions will have the greater tendency to withdraw electrons from the metal of the electrode. Therefore the terminal of this electrode will be positive relative to the other. Consequently if the electrodes are joined by a wire, electrons will flow from the electrode in the solution of lesser hydrogen ion activity to that in the other solution, through the wire. To allow this to happen would violate the condition of maximal work under which condition the difference of potential between electrodes will be maximal. Therefore this potential difference is balanced by the oppositely oriented potential difference of a potentiometer both for the purpose stated above and to measure the potential difference between the electrodes (*see* INSTRUMENTS, ELECTRICAL MEASURING).



FROM "THE DETERMINATION OF HYDROGEN IONS" BY W. MANSFIELD CLARK (WILLIAMS AND WILKINS COMPANY)

FIG. 4.—A HYDROGEN CELL. SCHEMATIC

L. Liquid junction (*see* text)
I. Current indicating instrument when cell is allowed to operate. Should be replaced by potentiometer when measurements are made

There are several ways of formulating the relation between the activities of the hydrogen ions in the half cells and the electromotive force of the cell. The following is based on the use of J. Willard Gibbs's chemical potential as extended to electrons and on the thermodynamic relation between the chemical potential, μ_A, of any substance A and the activity (A) of that substance; *i.e.*,

$$\mu_A = RT\ln(A) + \mu_{0A} \tag{25}$$

where μ_{0A} is a constant, dependent only on temperature and pressure, and is the value of μ_A when (A) = 1.

For the oxidation-reduction process

$$2H^+ + 2\epsilon \rightleftarrows H_2$$

there will subsist a comparable relation between chemical potentials. Distinguish by primes and double primes the cases for half cells 1 and 2, respectively

$$2\mu'_{H+} + 2\mu'_\epsilon = \mu'_{H_2} \tag{26}$$

$$2\mu''_{H+} + 2\mu''_\epsilon = \mu''_{H_2} \tag{27}$$

By (26) and (27):

$$\mu'_\epsilon - \mu''_\epsilon = 1/2(\mu'_{H_2} - \mu''_{H_2}) - (\mu'^{+}_{H} - \mu''_{H^+}) \tag{28}$$

The difference of electron chemical potentials must be distinguished sharply from electrostatic difference of potential or electromotive force, emf.

If chemical potentials are defined in terms of free energy per equivalent, $\mu'_\epsilon - \mu''_\epsilon$ has the dimensions of energy per equivalent and can be expressed in volt-faradays **EF**. Now when the emf of the cell is balanced by that of the potentiometer there is equality of the chemical potentials of the electrons in adjacent phases between which there is no passive resistance to electron transfer. Therefore the potential difference, **E**, measured at the potentiometer is given by $\frac{\mu'_\epsilon - \mu''_\epsilon}{\mathbf{F}}$. On the right of (28) substitute (25) in appropriate form for each item. Thus is obtained (29).

$$\mathbf{FE} = RT\ln\frac{\sqrt{(H_2)'}.(H^+)''}{\sqrt{(H_2)''}.(H^+)'} \tag{29}$$

For the ratio of proton activities in equation (29) there may be substituted the ratio of hydrogen ion activities, but to simplify typography we may let H^+ represent the hydrogen ion of a water solution. With no serious error, the ratio of the partial pressures of hydrogen, P' and P'', may be substituted for the ratio of the activities of hydrogen and we have (30).

$$\mathbf{E} = \frac{RT}{\mathbf{F}}\ln\frac{(H^+)''}{\sqrt{P''}} - \frac{RT}{\mathbf{F}}\ln\frac{(H^+)'}{\sqrt{P'}} \tag{30}$$

The normal hydrogen half cell is defined as the hydrogen half cell where the partial pressure of hydrogen is one normal atmosphere and the hydrogen ion activity is 1. This is the half cell to which all other half cells are referred in systematic accounts. Therefore it is convenient and agreed that the single potential difference between electrode and solution of the normal hydrogen half cell shall be called arbitrarily zero at all temperatures.

Accordingly we shall regard the half cell identified in (30) by single primes as the normal hydrogen half cell and we shall con-

sider **E** of (30) as if it were the potential of the other hydrogen half cell. To designate this system of comparison $\mathbf{E}_h$ will be used in place of **E**. Then:

$$\mathbf{E}_h = \frac{RT}{\mathbf{F}} ln \frac{(H^+)}{\sqrt{P}} \qquad (31)$$

The following values of R and **F** were selected by J. W. M. DuMond and E. R. Cohen (*Rev. Mod. Phys.*, 25:691 [1953]):

R (gas constant) = 8.31439 absolute volt-coulombs/degree gram equivalent.

F (faraday) = 96,494 abs. coul./deg. g. equiv.

And according to a report of the National Research Council Committee on Physical Constants (issued July 1, 1949):

T (degrees Kelvin) = t (° C.) + 273.16.

The modulus for converting a logarithm with base e to the corresponding logarithm with base 10 is 2.302585. Hence

$$\mathbf{E}_h = 0.00019840T \log_{10} \frac{(H^+)}{\sqrt{P}} \qquad (32)$$

According to the derivation of the coefficient in this equation $\mathbf{E}_h$ should be expressed in absolute volts and not in international volts, as was the custom prior to Jan. 1, 1948 (*see* Circular of the National Bureau of Standards, C459 [1947]); 1 absolute volt = 0.99967 international volt.

If $P = 1$ atmosphere and $t = 25°$ C.,

$$\mathbf{E}_h = -0.059156 \text{ pH}$$

A difficult problem is that of establishing either the conditions under which the activity of the hydrogen ions is unity as demanded in the use of the primary, standard, hydrogen half cell or a definite hydrogen ion activity in any other half cell used as a secondary standard. The difficulties are fundamentally two aspects of the same problem, that in the use of any process in which two kinds of ions are concerned it is impossible to determine experimentally the individual activity coefficients. Thus, if two hydrogen half cells are joined in liquid junction, with or without the intervening saturated solution of KCl customarily used to reduce the potential difference at the liquid junctions, the calculation of a junction potential with the highest precision requires knowledge of the individual activity coefficients of all diffusing ions. Invaluable data can be obtained regarding solutions of HCl, for example, by the use of a cell without liquid junction, one electrode responding to the activity of the hydrogen ions and the other (such as the silver-silver chloride electrode) responding to the activity of the chloride ions. But then it is necessary to use the mean activity coefficient for these two sorts of ions. In practice it is convenient to use a "saturated calomel half cell" in place of one of the hydrogen half cells, the potential of this half cell having been determined by using a solution of known pH in the hydrogen half cell. The saturated calomel half cell is one in which the solution is saturated with KCl and Hg_2Cl_2 (calomel) and the electrode is mercury.

For precise measurements with a hydrogen cell many items of technique must be given attention.

Glass Electrode (Cell with Glass Membrane).—This is an amazingly successful device for the measurement of pH. It has been developed so largely by empiricism that its theoretical treatment will be left to advanced treatises. The description that follows outlines a method used in practically all laboratories concerned with aqueous solutions and in plants concerned with control of many industrial processes.

The cell with glass membrane may be used with solutions that cannot be studied with the hydrogen electrode. These include solutions containing substances that poison the catalyst of a hydrogen electrode or substances easily reduced. While special provisions must be made in measuring with the hydrogen electrode solutions containing CO_2, no special provisions are necessary with the glass electrode other than prevention of loss of CO_2. Coloured solutions, the pH of which cannot be measured well by the indicator method, present no special difficulty.

On the other hand, it must be appreciated that the method is essentially one of comparison between solution tested and a series of solutions standardized by hydrogen electrode measurements. Therefore, the precision depends primarily upon reproduction of the standards. There are also factors other than a difference of hydrogen ion activities that affect the glass membrane; in particular other cations have an effect that is prominent in alkaline solutions. Furthermore, the very high electric resistance of a cell with glass membrane makes necessary both a special null-point instrument in the potentiometry of such a cell and special precautions to be taken by the user of the instrument.

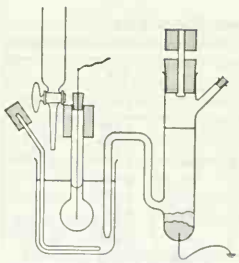


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FIG. 5.—A CELL WITH GLASS MEMBRANE IN BULB FORM

In fig. 5 a special cell containing a glass membrane is represented diagrammatically. The corresponding conventional statement of constitution is:

$$\underset{a}{Ag} \mid AgCl(s), HCl\ (0.1\ M) \mid \underset{b}{\text{Glass membrane}} \mid \underset{c}{\text{Solution x}} \mid \underset{d}{KCl\ (sat.)} \mid \underset{e}{Hg_2Cl_2 \mid Hg}$$

Up to b there is a silver electrode, coated with silver chloride, immersed in a 0.1 molar solution of hydrochloric acid.

On the right is a mercury electrode overlaid by solid calomel and a solution saturated with potassium chloride. The latter is in contact with solution x. A thin glass membrane separates solution x from the 0.1 M HCl solution. In fig. 5 this membrane is the thin wall of a bulb blown with a special glass.

Although the only difference of potential made aware of by experiment is that between the silver and mercury electrodes which is to be measured by a potentiometer, it is reasonable and convenient to assume potential jumps at a, b, c, d and e. With well-prepared electrodes, a given glass membrane and constant temperature, the potential jumps at a, b and e are constant. We may assume also that the liquid junction potential at d is practically a constant. At least it will be usually the same as that involved in the measurement of the pH of a standard by the hydrogen electrode method when such a standard is placed in the position of solution x. But if solution x be very different in nature from the standards, a new error may be introduced.

With the above assumptions, the variable potential jump at c is found to be a function of the pH of solution x. Indeed, the remarkable fact is that with special glasses and in the pH range of about 1 to 9 the potential difference across the glass membrane varies as

$$\frac{RT}{\mathbf{F}} ln \frac{(H^+)_1}{(H^+)_2}$$

where $(H^+)_1$ is the activity of the hydrogen ions on one side of the membrane and $(H^+)_2$ is the activity of the hydrogen ions on the other side of the membrane.

Accordingly, for the cell illustrated, there is usually a linear relation between the emf of the cell and the pH of solution x and the slope of the line relating emf to pH is

$$\frac{\triangle \text{ emf}}{\triangle \text{pH}} = 0.05916 \text{ at } 25° \text{ C.}$$

or other appropriate values at other temperatures. Individual glass membranes may not give such a relation exactly and may change in behaviour from time to time.

For this reason, and because the method is essentially comparative and secondary, it is wiser to rely upon standardization with standard buffer solutions than to depend upon the above "ideal" relation. To this end, each of a series of standard buffer solutions is placed in turn at the position of solution x, the emf of the cell is measured and the values of emf are plotted against the corresponding values of pH supplied in the specifications of the standard buffers. (*See* table.) Then, on testing an unknown, the observed emf of the cell will give on the line

Standard Buffer Solutions. Values of pH

(M = molar. *See* original references for values at other temperatures)

Solution	pH		
	10° C.	25° C.	38° C.
0.05M K tetroxalate	1.67*	1.68*	1.70*
KH tartrate, satd. at 25° C.	—	3.56*	3.54*
0.05M KH phthalate	4.00*	4.01*	4.03*
	—	4.010†	4.025†
	—	4.000‡	4.015‡
0.025M KH_2PO_4, 0.025M Na_2HPO_4	6.92*	6.86*	6.84*
	—	6.855†	6.835†
0.01M $Na_2B_4O_7$	9.33*	9.18*	9.08*
$Ca(OH)_2$, satd. at 25° C.	13.00§	12.45§	12.05§

*Standard values recommended by the National Bureau of Standards. For original references *see* R. G. Bates, *Electrometric pH Determinations* (1954).
†Hitchcock and Taylor, *J. Am. Chem. Soc.*, 60:2710 (1938).
‡MacInnes, Belcher and Shedlovsky, *J. Am. Chem. Soc.*, 60:1094 (1938).
§Bates, Bower and Smith, *J. Res. Natl. Bur. Standards*, 56:305 (1956).

chart the value of pH. If the standard values of pH lie on a straight line, interpolation by calculation may be made. Under these conditions, the pH is given by the operational definition

$$pH_x = pH_s + \frac{E_x - E_s}{0.059156} \text{ at } 25° \text{ C.} \qquad (33)$$

where x and s refer to solution x and the standard buffer solution, respectively. The national bureau of standards in Washington, D.C., supplies certified materials for the preparation of the standard buffer solutions.

Particularly in alkaline solutions the potential becomes a function not only of pH but also of the concentration of other cations such as Na^+.

There have been several systematic studies of the relation of the compositions of glasses to the behaviour of glass electrodes. Several satisfactory glasses are available commercially. The bulb form illustrated in fig. 5 is the most frequently used but with certain modifications to lower electrical leakage around the thin glass membrane. The bulb form is especially convenient because the silver-silver chloride electrode and hydrochloric acid solution (or other electrode-solution pair) may be placed on the inside and the standard or test solution on the outside.

By reason of the high electric resistance of the glass membrane, a galvanometer usually cannot be used directly as null-point instrument in the potentiometry of these cells.

Accordingly, in commercial instruments for the potentiometry of cells with glass membrane the electron valve is nearly always used to amplify the extremely small currents which flow at imbalance.

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(W. M. CK., R. G. B.)

HYDROGEN PEROXIDE is a compound composed of hydrogen and oxygen, the formula for the molecule being H_2O_2. It was discovered in 1818, and in dilute solutions has been a familiar product since the turn of the 20th century, but high concentrations were considered too unstable to be practicable until World War II, when new techniques of storage and handling were developed. Hydrogen peroxide was used as a propellant for the launching of Germany's V-1 missile; it has been a factor in postwar rocket experiments; and it has been used as the oxidant in a propellant mixture for submarines. Important industrial applications have also been found.

Hydrogen peroxide is of special interest in a comparison of its properties with those of water, because of its chemical relation to oxygen and water, because of the diverse reactions it undergoes and because of the numerous catalytic phenomena encountered in a study of these reactions. It is seldom prepared in the pure state, for in this condition mechanical shock or contact with many kinds of matter can result in violent explosion by decomposition. It is ordinarily handled as a solution in water, for in this state its sensitivity is much reduced.

The pure substance is a colourless liquid of melting point −0.9° C., and of density 1.442 g. per cubic centimetre at 25° C. It is considerably less volatile than water, its vapour pressure at 25° C. being 2.0 mm. as compared with 23.7 mm. for water. Hydrogen peroxide decomposes before the normal boiling point is reached, but by an extrapolation using measurements of its vapour pressure at lower temperatures, the normal boiling point has been estimated to be 151.4° C. The latent heats of vaporization and of fusion are 326 calories per gram and 79 calories per gram, respectively. The dielectric constant of hydrogen peroxide is 73.6 at 20° C. which is almost as high as that of water. As might be expected from the high value of the dielectric constant hydrogen peroxide is also a strongly dissociating solvent. Many simple salts are dissolved by the liquid and are highly dissociated in the resulting solution. Water and hydrogen peroxide are miscible in all proportions. A solid of composition $H_2O_2.H_2O$ and melting point −51° C. can be separated from the solution on lowering the temperature.

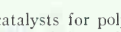
Speculation about the structure of hydrogen peroxide has been abundant, but reasoning based on purely chemical data has not led to a unique assignment of structure. However, by a combination of physical methods it has been shown that in the hydrogen peroxide molecule the oxygen atoms are directly bonded to each other, with one hydrogen atom on each oxygen atom. The molecule is not linear, but the line from a hydrogen atom to an oxygen atom makes an angle of about 100° with the line joining the two oxygen atoms. Furthermore, the hydrogen atoms do not lie in a single plane with the two oxygen atoms, but the plane defined by one hydrogen atom and the oxygen atoms makes an angle of about 100° with the plane defined by the other hydrogen atom and the oxygen atoms.

Uses of Hydrogen Peroxide and Its Derivatives.—Most applications of hydrogen peroxide exploit the properties it possesses as an oxidizing agent. It is a powerful oxidizing agent but is sufficiently slow so that the rate of its oxidizing action can conveniently be controlled by adjusting the conditions. Furthermore, water, the product resulting from its reduction, is not a harmful ingredient in most processes.

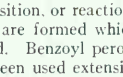
Hydrogen peroxide has been used in the bleaching of wool, silk, linen, furs, hair and hair products and fats. The bleaching action on animal fibres is particularly important, since such fibres sustain less damage from the action of hydrogen peroxide than from other moderately priced oxidizing bleaches. The substance has also been applied as a preservative and as a disinfectant, since it possesses strong bactericidal properties. Many of the derivatives of hydrogen peroxide also are used as bleaches.

Peroxyhydrates of sodium carbonate, sodium borate and sodium phosphate are used in pharmaceutical, cosmetic and laundry preparations.

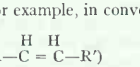
The use of peroxides as catalysts for polymerization reactions has become of great importance. Their catalytic property depends on the fact that on decomposition, or reaction with some reducing agents, unstable substances are formed which readily attack the molecules to be polymerized. Benzoyl peroxide, acetyl peroxide and peroxydisulfates have been used extensively for this type of reaction. Hydrogen peroxide and its derivatives find use in synthetic organic chemistry, for example, in converting a double bond grouping



to an epoxy grouping



or in hydroxylating it to form



Such reactions are of importance in the chemistry of fats, waxes, terpenes and steroids.

Important developments in the use of hydrogen peroxide as a propellant appeared during World War II. The reaction $2H_2O_2 \rightarrow 2H_2O + O_2$ is exothermic, the decomposition to water vapour and oxygen of 1 g. of liquid hydrogen peroxide yielding about 380 cal. of heat. This reaction, catalyzed by manganese salts, was used by the Germans during World War II as a source of energy for the launching of the V-1 missiles.

The heat of reaction of hydrogen peroxide with combustible materials is greater than that of the corresponding reactions of oxygen. With methyl alcohol, for example, the heat of the reaction $CH_3OH + 3H_2O_2 \rightarrow CO_2 + 5H_2O$ is greater than that of the reaction $CH_3OH + 3/2O_2 \rightarrow CO_2 + 2H_2O$ by a factor of 1.25. This suggests the use of hydrogen peroxide as the oxidizing component of combustible mixtures, particularly where conservation of space is important. Such applications also began to be developed during World War II.

Chemical Properties.—Hydrogen peroxide possesses weakly acid character, and a metal peroxide such as barium peroxide, BaO_2, may be regarded as the salt of the acid H_2O_2 and the base $Ba(OH)_2$. In a 1% solution in water, only about 0.0003% of the hydrogen peroxide is dissociated to hydroperoxide ion, HO_2^-, and hydrogen ion. The tendency of H_2O_2 to dissociate does, however, exceed that of water. Besides the metal peroxides mentioned above, many other derivatives of hydrogen peroxide, in which the oxygen to oxygen link is maintained, are known. Some of these derivatives will be discussed below.

Hydrogen peroxide represents an intermediate stage for the transformation of oxygen to water, and for the reverse transformation. This observation is fundamental to an understanding of a large class of the reactions of the substance. The scheme below indicates the relationship of hydrogen peroxide to oxygen and to water.

$$2H_2O \underset{\text{reduction}}{\overset{\text{oxidation}}{\rightleftharpoons}} H_2O_2 \rightleftharpoons O_2$$

The scheme also serves to illustrate the application in this system of the general terms oxidation and reduction (*q.v.*). For example, the transformations of water to hydrogen peroxide or to oxygen by the action of suitable reagents are described as oxidations of water. Agents which bring about the oxidation or the reduction of another substance are called oxidizing or reducing agents, respectively. On mutual interaction, the oxidizing agent is reduced and the reducing agent is oxidized. From its relation to water and to oxygen, it may be seen that hydrogen peroxide can function as an oxidizing agent (that is, on interaction with a reducing agent it is transformed to water) and that it can also function as a reducing agent, for on interaction with an oxidizing agent it is transformed to oxygen. This dual role, which is readily displayed by the substance, makes its chemistry of unusual interest.

Hydrogen peroxide is a fairly powerful reducing agent and is much more powerful than water in this respect. The oxidizing agents chlorine, ceric salts and potassium permanganate (the last named being used in acid solution) readily oxidize hydrogen peroxide to oxygen, but the oxidation of water by these substances is slow. The reaction with potassium permanganate in acid solution may be used as a basis for the quantitative determination of hydrogen peroxide,

$$5H_2O_2 + 2MnO_4^- + 6H^+ \rightarrow 2Mn^{2+} + 5O_2 + 8H_2O.$$

As an oxidizing agent, hydrogen peroxide is very powerful, more powerful in fact than are oxygen and chlorine. The oxidations by hydrogen peroxide of metal iodides to iodine, of sulfites to sulfates and of ferrous salts to ferric salts proceed readily even in dilute solution. The reaction in acid solution with potassium iodide is the basis of another method for the quantitative determination of hydrogen peroxide, $H_2O_2 + 2I^- + 2H^+ \rightarrow 2H_2O + I_2$. When the hydrogen peroxide is concentrated, the oxidation of organic or other reducing substances can proceed as a combustion process and indeed with explosive violence.

Many of the reactions of hydrogen peroxide with even powerful oxidizing or reducing agents are slow, and interesting and diverse cases of catalysis are observable in these systems. For example, the rate of reduction of hydrogen peroxide by iodides is markedly accelerated by strong acids, by iron and copper salts, by soluble molybdates as well as by many other substances. The few substances named represent what are probably three essentially different modes of action for catalysts in this system. Catalysts for the reaction of hydrogen peroxide with certain reducing agents occur also in plant extracts and in blood, and are called peroxidases.

Hydrogen peroxide is unstable with respect to decomposition into water and oxygen: $2H_2O_2 \rightarrow 2H_2O + O_2$. This reaction may be regarded as a self-oxidation-reduction of hydrogen peroxide. So great is the tendency for the decomposition that in order to reverse it at room temperature a pressure of oxygen above a 1% solution of hydrogen peroxide in water in excess of 10^{20} atm. would have to be applied. Hydrogen peroxide exists only because the speed of decomposition under suitably chosen conditions is small. Most important of these conditions is the absence from the sample of catalytic impurities.

The catalysts which enhance the speed of decomposition of hydrogen peroxide are numerous and diverse in nature. Most surfaces increase the rate of decomposition noticeably. Among the more effective ones are the following: some metal surfaces, of silver, gold or platinum, for example, particularly if freshly deposited in a finely divided condition; some solid metal oxides, lead dioxide and manganese dioxide being examples. Accidental impurities such as dust are also catalytically active. Among soluble catalysts for the decomposition are iron and copper salts, particularly a mixture of the two, bromides and iodides under special conditions and alkaline substances. Catalase, an enzyme which occurs in plant and animal tissue, is also a catalyst for the decomposition. It has been suggested that an important function of catalase in living tissue is to bring about the destruction of the hydrogen peroxide which forms when oxygen is reduced by some substances during the metabolic processes. The effervescence observed when a solution of hydrogen peroxide is applied to a wound is a result of the liberation of oxygen on catalytic decomposition of the solution.

An increase in temperature or absorption of light by the substance also increases the rate of decomposition of hydrogen peroxide.

In many cases the mode of action of the catalysts which function in solution seems to involve both oxidized and reduced forms of the added substance. A schematic representation of the steps involved is given below. X and R stand, respectively, for the oxidized and reduced forms of the catalyst.

$$X + H_2O_2 \rightarrow R + O_2$$
$$R + H_2O_2 \rightarrow X + 2H_2O$$

The net result of the two steps is catalytic decomposition of the hydrogen peroxide, and it is evident, since there is no net consumption of the added substance, that a small amount can bring about the decomposition of large amounts.

Preservation and Handling.—Hydrogen peroxide has commonly been sold dissolved in water at strengths of about 3% to 30%. Large quantities of a more concentrated product, about 90% or so in hydrogen peroxide, began to be produced at the time of World War II. The handling and storage of the unstable substance utilizes the fact that at room temperature or lower the decomposition of even the concentrated solution proceeds slowly in the absence of catalytic impurities and of light. Solutions of the lower strength are often stabilized by the addition of inhibitors; that is, catalysts which decrease the rate of reaction. A wide variety of substances function as inhibitors for the decomposition. One class including many mineral acids functions by keeping the solutions acid. Sodium silicate belongs to a class which functions also in basic solution. Acetanilide is a commonly employed representative of a large class of organic compounds which probably function by destroying catalysts for the decom-

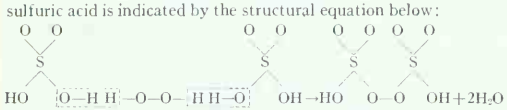
position which are produced by the decomposition itself.

The choice of container material is important for the handling and storage of all strengths, and particularly of the concentrated solutions. Containers of specially treated aluminum, block tin or Pyrex glass have been used for the 90% solution, and these containers as well as those of ordinary glass or ceramic materials for handling solutions of lower strength.

Preparation and Manufacture.—From the relation of hydrogen peroxide to water its preparation by direct oxidation of water might be expected. No appreciable concentrations of hydrogen peroxide, however, have been built up by reactions of this type. This observation can be correlated with the fact that hydrogen peroxide is both a more rapid and more powerful reducing agent than is water, so that an oxidizing agent which oxidizes water will oxidize hydrogen peroxide even more rapidly, and thus prevent its accumulation in the system.

Production by the Electrolytic Method.—The direct oxidation of water to hydrogen peroxide at an anode during electrolysis is vitiated by the process mentioned above, as well as by catalytic decomposition of the substance at the electrode surface. Some derivatives of hydrogen peroxide, from which it can be prepared readily, are not so sensitive to these influences. Such derivatives do appear at high concentration when an appropriate solution is subjected to anodic oxidation, and they are thus used as intermediates in the electrolytic method for manufacture of hydrogen peroxide.

Peroxydisulfates have most commonly been employed as such intermediates. The relation of hydrogen peroxide to peroxydisulfuric acid is indicated by the structural equation below:



Peroxydisulfuric acid

The oxidation of sulfuric acid to peroxydisulfuric acid at the anode has been investigated in some detail, and the following conditions are found favourable for efficient oxidation: shiny platinum as anode material, relatively high current density at the anode, cooling below room temperature and a moderate rather than high or low concentration of sulfuric acid. The presence in the electrolyte of certain substances, among which are hydrogen fluoride and potassium ferricyanide, is found to be beneficial. These substances exert an influence even at low concentration, and probably function by changing the catalytic effect of the electrode surface, so that oxidation to peroxydisulfate rather than to oxygen occurs in the solution. Acidified solutions of ammonium sulfate and of potassium sulfate are also oxidized to peroxydisulfate with high current efficiency.

Other operational features which lead to successful commercial practice are as follows: All materials must be of high purity to minimize decomposition of hydrogen peroxide during the concentration process. Ammonium bisulfate, potassium bisulfate and sulfuric acid are most often used as electrolytes. To prevent mixing of the anode and cathode solutions, the electrolytic cell is divided into anode and cathode compartments by the use of an unglazed porcelain diaphragm. A battery of electrolytic cells can be arranged to allow continued circulation of anode and cathode solution. This prevents local heating in the cells and leads to a cyclic rather than batch operation of the process.

Hydrogen peroxide is obtained from peroxydisulfates by the reaction with water: $H_2S_2O_8 + 2H_2O \rightarrow 2H_2SO_4 + H_2O_2$. This reaction proceeds with reasonable speed at temperatures of 60° C. or higher, if the solution is fairly acid. Hydrogen peroxide vapour mixed with water vapour is obtained from the heated anode liquor by evaporating the solution, these substances being much more volatile than other components of the solution. To minimize decomposition of hydrogen peroxide at the moderately high temperature of the evaporation step it must be carried out rapidly. One way of effecting this is to allow the anode liquor to flow in a thin film down a heated surface, thus exposing a large area of surface for unit volume of liquid.

Concentrated solutions of hydrogen peroxide can be prepared by introducing the mixed vapours of water and hydrogen peroxide into a fractionating column. Hydrogen peroxide, being less volatile than water, accumulates in the lower part of the column.

To manufacture concentrated solutions of hydrogen peroxide it is necessary to reduce the concentration of catalysts for the decomposition. This can be done by repeating the evaporation step before the final fractionation of the solution is undertaken.

Production by Methods Involving Reduction of Oxygen.—When barium oxide is heated at 500° or 600° C., it absorbs oxygen to form barium peroxide. On treatment with a suitable acid, hydrogen peroxide is obtained from this solid: $BaO_2 + H_2SO_4 \rightarrow BaSO_4 + H_2O_2$. This was the principal commercial process before the electrolytic method was developed. Several modifications have been attempted, differing from each other chiefly in the choice of acid, which in turn influences the method used for regeneration of barium oxide from the spent solid. Sulfuric acid has most often been employed, and in this case it is found desirable to convert the barium peroxide to its hydrate, $BaO_2.H_2O$, preliminary to the acid treatment. Unless this is done, a coating of barium sulfate over the solid prevents complete reaction of the barium peroxide. L. J. Thénard, who in 1818 first proved the existence of hydrogen peroxide, made use of the barium peroxide method in his preparation of the substance.

Sodium forms sodium peroxide directly on burning in excess air. Potassium, rubidium and cesium under the same conditions yield compounds containing oxygen in an oxidation state between that of peroxide and of elementary oxygen. The formulas for these compounds are KO_2, RbO_2 and CsO_2.

The interaction of some reducing agents with oxygen produces hydrogen peroxide directly. This is the case with many organic compounds. For example, the reduction of oxygen by hydrazobenzene to form hydrogen peroxide proceeds almost quantitatively. Hydrogen itself can be used as the reducing agent. Some hydrogen peroxide is formed when a mixture of hydrogen and oxygen, the former at a low partial pressure, is subjected to a silent electrical discharge, or when a mixture of the gases containing also mercury vapour absorbs ultraviolet light. The combination to hydrogen peroxide proceeds also in water containing finely divided platinum or palladium as catalysts. In slightly acid solution at a mercury cathode, substantial reduction of oxygen to hydrogen peroxide can be achieved if the partial pressure of the gas is fairly high. Efforts have been made to exploit all of these types of reaction for the commercial production of hydrogen peroxide.

Peroxy Compounds.—The unit of structure containing two oxygen atoms bound together, each of these in turn being bound to other atoms, is present in all true peroxy compounds. Almost all true peroxy compounds yield hydrogen peroxide when treated by a strong acid such as sulfuric acid, and this fact can be used to distinguish substances containing the peroxide linkage from others of similar formula, which do not. Thus, barium peroxide, BaO_2, but not lead dioxide, PbO_2, forms hydrogen peroxide on being subjected to the test. The study of the structure of the solids using X-ray methods substantiates the conclusion that only the former is a true peroxide.

Peroxy compounds may be considered derivatives of hydrogen peroxide, and they can be classified conveniently by developing the analogy between peroxy compounds and similar simple oxy compounds. The analogous structural units in the two systems are indicated below:

Peroxy compounds	*Oxy compounds*
H—O—O—H	H—O—H
R—O—O—H	R—O—H
R′—O—O—R	R′—O—R

It is seen that the group –O–O– is formally equivalent to –O– and –O–O–H to –O–H.

In the classification below, the common peroxides are considered in their relation to simple oxy compounds.

Peroxy Analogues of Metal Oxides and Hydroxides.—Some well-defined metal peroxides are: Na_2O_2, MgO_2, CaO_2, BaO_2,

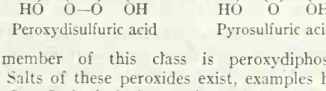
ZnO_2. There is evidence also for the existence of peroxides of copper, mercury and other metals. These substances are solids at room temperature, the solid being composed of the positively charged metal ions and the negatively charged peroxide ion, O_2^{2-}.

Among the metal hydroperoxides NaOOH is the proxy analogue of NaOH. The distinction between this class and the members of the class of the peroxy analogues of the oxyacids is not always sharp, just as a definite classification of a substance as being an acidic or basic hydroxide cannot always be made. Metal peroxides and hydroperoxides are strong oxidizing agents. Some of them, Na_2O_2 for example, react rapidly with water to yield hydrogen peroxide (which decomposes rapidly since the solution becomes basic); others require a strong acid to bring about the reaction.

Peroxy Analogues of Oxyacids or Their Salts.—The peroxides in this class are related to the oxyacids by replacing an –O–H group of the oxyacid by the group –O–O–H. Well-defined examples of such peroxy compounds are peroxymonosulfuric acid, H_2SO_5, peroxymonophosphoric acid, H_3PO_5, and peroxyacetic acid, $CH_3CO.OOH$. Other members are derived from chromic, molybdic, tungstic, vanadic, columbic, tantalic, carbonic and germanic acids, from the hydroxides of tin, titanium, zirconium, thorium, cerium, uranium and from many organic acids. The peroxide derivative of titanium hydroxide has a deep yellow colour and is the basis of a qualitative test for the presence of hydrogen peroxide in water solution.

Some of the foregoing examples are known only as the peroxy derivatives of the salts corresponding to the acids. It is of interest to note that the –O–O–H group in the peroxy compounds is in general not so acidic as the –O–H group in the related oxy compound. All the members of this class are powerful oxidizing agents, and most of them oxidize iodides to iodine more rapidly than does hydrogen peroxide. The catalysis of the reaction between hydrogen peroxide and iodides by soluble molybdates probably results from the rapid formation of a peroxymolybdic acid, which in turn rapidly oxidizes iodides.

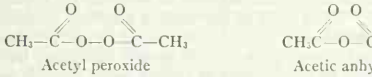
Peroxy Analogues of Pyroacids or of Pyrosalts.—A single example is cited to establish the analogy:



Peroxydisulfuric acid Pyrosulfuric acid

Another member of this class is peroxydiphosphoric acid, $H_4P_2O_8$. Salts of these peroxides exist, examples being $K_2S_2O_8$ and $Na_2C_2O_6$. On hydrolysis, members of this class yield the corresponding peroxymonoacid in the first step. All are powerful oxidizing agents, but are not readily oxidizable.

Peroxy Analogues of Acid Anhydrides.—The chemical properties are similar to those of the preceding group, except that the compounds do not possess acid properties.



Acetyl peroxide Acetic anhydride

Benzoyl peroxide is a second common example of this class.

Peroxy Analogues of Alcohols, Ethers and Other Oxy Organic Compounds.—Some examples, with oxy analogues, are:

CH_3OOH	CH_3OH
Methyl hydroperoxide	Methyl alcohol
$CH_3–O–O–CH_3$	$CH_3–O–CH_3$
Dimethyl peroxide	Dimethyl ether

The analogy extends to many other compounds but is not complete in every case, since in a few instances the oxy analogue of a known peroxide is not known. Most members of this group are strong oxidizing agents, and in common with other organic peroxides many are dangerous to handle in the pure state, because of the possibility of explosive decomposition initiated by shock.

Peroxy Analogues of Hydrates.—In these compounds, hydrogen peroxide is incorporated into crystals of various substances in the same way that water is incorporated into hydrates. The substances in this class when dissolved in water yield a solution of hydrogen peroxide and the carrier substance, and they thus provide a convenient means of handling hydrogen peroxide. Examples are: $Na_2SO_4.9H_2O.H_2O_2$ and $Na_3PO_4.2H_2O_2$.

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HYDROGRAPHY, the science dealing with all the waters of the earth's surface, including the description of their physical features and conditions; the preparation of charts showing the position of lakes, rivers, seas, the contour of the sea bottom, the position of shallows, deeps, reefs and the direction and volume of currents; a scientific description of the position, volume, configuration, motion and condition of all the waters of the earth. *See* OCEAN AND OCEANOGRAPHY.

HYDROLOGY is the science which treats of the occurrence, quality and effects of water on the land areas of the earth. It deals with snow and ice on the land, liquid water in streams and lakes and water occurring in the interstices of soil and rock. Meteorology (*q.v.*) and oceanography (*see* OCEAN AND OCEANOGRAPHY) are related sciences. Various aspects of hydrology are discussed in the separate articles: DROUGHT; FLOOD; GLACIER; RAINFALL; SNOW, etc. In addition to the references to related material given in the several sections of this article, *see* also GEOCHEMISTRY: *Geochemistry of the Hydrosphere;* GEOLOGY; GROUND WATER; SOIL.

Hydrologic Cycle.—The central concept in hydrology is the hydrologic cycle. Water evaporated from the oceans is carried over the continents by moving air masses and precipitated as rain or snow. About one-third of this water returns to the oceans as surface streamflow or subterranean percolation. The remaining two-thirds is returned to the atmosphere by evaporation or by transpiration of plants. The energy of the sun thus serves to distill sea water and distribute the resultant fresh water over the land to supply the needs of plants, animals and man.

This fresh water is not, however, delivered continuously to all parts of the world at a rate commensurate with local needs. Desert areas receive little or no water, while some other regions receive far too much. Even in areas where the normal precipitation is adequate, there may be prolonged periods of drought or periods when excessive precipitation causes floods. The hydrologist seeks to predict the probable magnitude of droughts and floods and the amount of water available for use in a specific area. He may also make short-term forecasts of floods and water supply for the operation of reservoirs and for emergency flood protection. The science of hydrology is, therefore, basic to planning of projects for reducing flood damage, developing water power, controlling erosion and providing adequate water for domestic, agricultural and industrial use.

Origin of Hydrologic Concept.—The source of the waters of springs and streams constituted a puzzling problem that early aroused much discussion and controversy. Before the 17th century it was generally assumed that the spring water could not be derived from rain because the rainfall was believed inadequate in quantity and the earth too impervious to permit penetration of the rain water far below the surface. Some ancient philosophers assumed that the water was derived from huge, inexhaustible, subterranean reservoirs, but others recognized that there must be replenishment of the reservoirs which supply the springs. Thus arose the concept of a hydrologic cycle in which the sea water was supposed to be conducted through subterranean channels below the mountains and then, somehow, purified and raised to the springs. In the middle ages this hypothesis was based on passages in the Bible such as Eccles. i. 7, and for centuries it was heresy to doubt it.

It is now known that the ground water, which supplies the springs, wells and fair-weather flow of the streams, is derived from rain and snow by infiltration from the surface, except a minor part which is juvenile water derived from the hot magma within the earth. Among early champions of the infiltration theory were the Roman architect Marcus Vitruvius, who lived about the time of

Christ, the Italian artist and sage Leonardo da Vinci (1452–1519) and the French potter and pioneer paleontologist Bernard Palissy (1510–89).

The founders of the science of hydrology may be considered to be the French physicists Pierre Perrault (1608–80) and Edmé Mariotte (*c.* 1620–84) and the English astronomer Edmund Halley (1656–1742). First Perrault and then Mariotte made crude measurements of the precipitation in the basin of the Seine river and of the discharge of the river, and thus demonstrated that water which falls as rain and snow is ample to supply the flow of the river. Mariotte also made observations which showed that rain water penetrates the earth. Halley made careful tests of the rate of evaporation and crude estimates of runoff, from which he concluded that the evaporation from the Mediterranean sea is ample to supply the inflow from streams.

Precipitation.—Water is always present in the atmosphere as an invisible gas (water vapour). Under favourable conditions this vapour condenses into droplets of water or ice crystals, forming clouds and ultimately rain or snow. If all the moisture in the atmosphere were precipitated it would cover the earth to an average depth of only about one inch. However, a continued inflow of moisture-laden air into a storm area may result in precipitation of more than 40 in. in 24 hours. The intensity of precipitation, the annual amount and the seasonal distribution vary greatly from place to place and from time to time in a given place. The causes of these variations are the subject matter of meteorology, but their effects on the regimen of surface and underground water create the basic problems of hydrology.

Amounts of precipitation are expressed in terms of the depth in inches or millimetres which would accumulate on a flat surface if none of the water were allowed to run off. The simplest rain gauge consists of a cylindrical vessel surmounted by a funnel of larger diameter so that the depth in the cylinder is multiplied for more accurate measurement. A variety of patterns are used with the funnels ranging from 3 to 8 in. in diameter.

Snow constitutes only a minor portion of the precipitation on the world as a whole, but in frigid zones and at high altitudes snow may be the most common form of precipitation. The snow pack accumulated in mountains adjacent to arid or semiarid regions may constitute a natural reservoir far larger than any built by man. The melting of this mountain snow during spring and early summer is often an important source of irrigation water. In many such regions snow surveys are conducted to determine the water content of the snow pack as a basis for forecasts of water yield to the adjacent valleys. The water content is determined by extracting a core of snow with a special sampling tube and weighing the tube and the snow core.

Glaciers.—Where snowfall is too heavy and the climate too cold for all of the snow to melt in summer, there is a progressive accumulation until glaciers are formed which creep down the valleys and move into warmer zones, where their fronts are melted off or are pushed into the sea, forming icebergs. Records have been kept of the annual advance or retreat of the ice fronts of many glaciers, especially in the Swiss Alps beginning in 1874. Photogrammetric maps are made of certain glaciers in the Alps, and these show the volumetric changes from year to year.

Various sources of information show that within historic times there were important cycles of advance and retreat, indicating cycles of climatic fluctuation. There was general advance from about 1600 to about 1850, and general retreat after that time. In the Pleistocene epoch (*q.v.*), covering approximately 1,000,000 years, there were four great glacial stages, when the northern parts of Europe, Asia and North America were covered with ice which at some places was thousands of feet thick. In those cold stages so much water was locked up in ice that sea level all over the earth went down a few hundred feet below the modern level. However, there is still so much ice in the polar and mountain regions that if it should all melt, the sea level would rise about 200 ft.

Runoff.—As rain falls to the earth a portion is intercepted by the leaves and stems of vegetation and eventually returned to the atmosphere by evaporation. Still another portion is retained in puddles on the ground surface. Part of this water may infiltrate into the soil but the greater portion is usually evaporated. Much of the remaining water which reaches the ground infiltrates into the soil under the action of gravity and capillarity. The infiltration capacity of soils varies greatly. Water will infiltrate more rapidly into dry soil than into moist soil. Sandy soils are more pervious than clay soils, while broken lava and cavernous limestone terranes are highly permeable. Forests and grasslands usually have a higher infiltration capacity than cultivated soils because cultivation destroys the channels created by decayed roots and by worms, and because the vegetal cover protects the soil from compaction by raindrops. The infiltration capacity of rock outcrops, paved surfaces, buildings, etc., is practically zero. Some of the infiltrated water is absorbed by the soil as soil moisture. When the soil moisture is replenished, water moves laterally through the soil toward the streams and downward toward the ground water. Only when rainfall intensity exceeds infiltration capacity does surface runoff or overland flow occur.

The quantities of water which are distributed to interception, puddles, soil moisture, lateral flow, surface runoff and ground water vary greatly from storm to storm depending on many factors. A key problem in hydrology is to determine the relations governing this distribution, so that it is possible to predict the quantity of inflow to the streams from a given storm for the determination of designs for reservoir spillways, culverts and storm drains and for flood forecasting.

Ground Water.—The term ground water is applied to water found in zones of saturation in the ground where all interstices between soil or rock grains are filled with water. Soil or rock strata which are sufficiently permeable to yield useful quantities of water to wells are called aquifers. The upper surface of the zone of saturation is called the water table. Artesian aquifers are covered by a stratum of impermeable material and the confined water is under pressure so that it will rise in a well to a level above the top of the aquifer and may even discharge at the ground surface without pumping. Where the water table intersects streams, lakes or swamps, ground water is discharged and becomes surface water. A spring occurs when the water table intersects the ground surface. Movement of ground water is extremely slow and years or even centuries may elapse between the time a particle of water is added to the ground water and the time it is discharged from the ground water.

Under natural conditions a ground-water basin will remain in approximate equilibrium with the water table rising slightly during wet periods and falling during droughts. When man withdraws ground water through wells this equilibrium is disturbed. A major problem in hydrology is to determine the amount of water which may be withdrawn annually from a ground-water basin without depleting the supply to such an extent that use of the water becomes uneconomical. Where large ground-water reserves exist it may be permissible to mine them in the same sense that other minerals are mined, but this must be recognized in estimating the safe yield. Water level in key wells is observed periodically or recorded continuously by automatic gauges to provide data on changes in ground-water storage. The ground water may be artificially recharged by introduction of surface water through percolation areas or recharge wells. In many areas ground-water basins are operated as reservoirs (*q.v.*) in the same manner as (and sometimes in conjunction with) surface reservoirs. *See* also SPRINGS; WELL.

Evapotranspiration.—Water in lakes and streams, soil moisture and snow on the ground is subject to evaporation. Soil moisture is also subject to transpiration, the process by which plants take up moisture through their roots and discharge it to the atmosphere through their leaves. The total of these water losses from an area is called evapotranspiration. Estimates of probable evapotranspiration from cropland serve as a basis for determining the need for irrigation water. Evaporation loss from lakes and reservoirs in arid regions may amount to as much as ten feet of depth per year. This loss can be an important factor in determining the amount of water which the reservoir can supply for beneficial use. Hydrology is concerned with land management for maximum water

yield and therefore is interested in minimizing nonbeneficial evapotranspiration. Evapotranspiration by forests and grassland is a beneficial use of water insofar as the vegetation produces timber or livestock feed and protects the soil from erosion. Brush and stream bank or swamp vegetation may utilize large amounts of water without benefit to man.

There is no method for direct measurement of evaporation from lakes or evapotranspiration from land areas. The evaporation from small tanks of water can be measured, but these measurements must be adjusted to provide estimates of loss from natural water bodies. Potential evapotranspiration can be measured by determining the water loss from tanks filled with soil, planted with vegetation typical of the area and supplied with sufficient water to satisfy the needs of the plants. Actual evapotranspiration from the adjacent area will be less than the measured loss from the tank to the extent that the natural water supply for plant growth is deficient during some parts of the year.

Streamflow.—The water in surface channels is known as streamflow and for the most part is ultimately discharged into the ocean. Some streams flow in closed basins from which there is no outlet, and their flow is ultimately evaporated or percolated to the ground water. Streams flowing entirely above the water table may lose much or all of their flow to the ground water if the stream bed is sufficiently permeable. Data for annual maximum water level on the Nile river at Cairo, Egy., are reasonably complete from A.D. 622 except for the 16th and 17th centuries. However, the earliest systematic measurements of daily discharge of a stream were those on the Rhine river at Basel, Switz., from 1809 to 1821.

Records of streamflow are usually obtained by periodic measurements of the velocity of flow with a current meter. The cross-sectional area of the stream multiplied by the measured velocity yields the flow rate. The discharge at each such measurement is correlated with the stage (water level) at the time of measurement to obtain a stage–discharge relationship. Continuous records of stage are then obtained by automatic, float-operated recorders, or frequent readings of water level are obtained from a scale set in the stream. The rate of flow at any time or the volume of streamflow for any period can be calculated from this stage record by use of the known relation between stage and flow.

In arid regions streams commonly go dry during rainless periods, while in humid regions dry-weather flows are usually small and derived largely from ground water. In response to rainfall or snowmelt the flow rate increases to a maximum and then decreases when the rain or melting ends. The response of small basins or basins with steep topography is usually very rapid, the peak relatively high and the duration of the response relatively short. Large basins or basins with flat terrane, many lakes or highly permeable soils will show slow increases, relatively low peaks and a slow decline following the peak. Many such increases of streamflow occur each year in most streams but only occasionally does the peak flow exceed the capacity of the stream channel causing a flood.

Much study has been given to the many factors which determine the magnitude and expectancy of floods and droughts. The flood history of streams that have been gauged over a long period of years may be analyzed by statistical methods to determine expectancy. Because of the difficulty of defining a drought precisely, statistical analysis of drought is less successful. Extremes of flow on ungauged streams must be estimated from physical analysis and comparison with similar streams. Despite the geologic evidence of long-term climatic changes, indications are that within the time periods of interest in most engineering designs, extremes of flow may be considered as random processes governed by chance and not subject to cyclic variation.

Water Quality.—Much of the energy of falling raindrops and flowing water is expended in erosion of soil and rock. The impact of raindrops has been shown to be important in initiating soil erosion. Vegetal cover shelters the soil from this impact and thus reduces erosion. Water in streams erodes the bed and banks, carving canyons and forming flood plains. Erosion is a natural process which has created arable valleys and fertile deltas which are important agricultural areas. However, cultivation and other activities of man may accelerate erosion of valuable topsoil, which may ultimately fill useful storage space in downstream reservoirs or clog stream channels. Hydrology is concerned with finding means of minimizing erosion on the land and with estimating the quantity of sediment carried by streams. This requires study of the mechanics of erosion of land surfaces, the influence of various protective measures on the erosion rate and the mechanics of sediment transport in flowing water. The quantity of suspended sediment in a stream is measured by lowering a sampler into the stream to extract a sample of sediment-laden water. The sample is filtered to remove the sediment, which is dried and weighed to determine the concentration of sediment in the sample. The total volume of streamflow multiplied by the concentration ratio yields the total sediment transport.

Sediment is not the only material transported by water. Most natural waters contain dissolved minerals of various kinds derived from the mineral constituents of the rocks and soil of the drainage basin. Some minerals are undesirable in water which is used for irrigation, domestic or industrial purposes. Hence, chemical analysis of natural waters is part of the task of hydrology. These analyses are used to predict the limitations on use of the water and the steps necessary to make its use possible. Chemical analysis of ground water may help in establishing its source.

See also references under "Hydrology" in the Index volume.

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(R. K. L.)

HYDROLYSIS: *see* SOLUTIONS.

HYDROMECHANICS, the branch of applied physics that deals with the equilibrium and motion of liquids, most commonly water, and with the behaviour of bodies floating or immersed in liquids. Hydromechanics finds application in widely diverse problems ranging from the design of submarines and ocean liners to the study of motion of naval torpedoes. Hydromechanics includes hydrostatics, which is the study of liquids at rest; hydraulics, which is concerned with the properties, behaviour and effects of liquids at rest or (usually) in motion (*see* HYDRAULICS, APPLIED); and hydrodynamics, which is concerned with the motion of liquids and the interaction of liquids with boundary surfaces.

Liquids (*e.g.*, water) and gases (*e.g.*, air) are known collectively as fluids. The properties and actions of fluids are determined essentially by the behaviour of the molecules of which they are composed, the major difference between liquids and gases being that in the former the molecules are spaced more closely together (*see* LIQUID STATE). Because of this similarity of molecular structure, many of the laws governing the mechanics of liquids are identical to those governing the mechanics of gases, and the growing field of study known as fluid mechanics includes both theoretical analyses and experimental results that are applicable to fluids in general (*see* MECHANICS, FLUID).

HYDROMEDUSA, a name (pl. hydromedusae) generally applied to jellyfish (medusae) of certain hydrozoans. The term Hydromedusae formerly was used to indicate a group of Coelenterata, almost coextensive with the present class Hydrozoa. *See* HYDROZOA.

HYDROMETALLURGY is the science and technology of extracting and recovering metals chemically from ores by the use of aqueous solutions, as distinct from pyrometallurgy which comprises smelting and other similar high-temperature operations. (For discussion of various methods of extracting metals *see* METALLURGY.) The principles involved in hydrometallurgy are those of physical chemistry, inorganic chemistry, electrochemistry and analytical chemistry; indeed, the production of metals by hydrometallurgy can be broadly described as extensions of these principles on a commercial and economic scale. The procedures commonly employed in hydrometallurgical operations represent combinations of the techniques used in mineral dressing, chemical engineering and electrochemical technology.

The operations usually involved are: the dissolution of a metal or metal compound by a suitable lixiviant (water alone or with

added reagents) usually termed leaching; the separation of waste and purification of the leach solution; and the precipitation of metal from the leach solution by chemical or electrolytic means.

Developed initially at the turn of the 20th century for recovering gold from low-grade ores, the technology of hydrometallurgy has advanced to the point where not only have the earlier techniques been improved but such procedures as ion exchange, solvent extraction, distillation and high-pressure, high-temperature leaching and precipitation have been proved to the extent that they are recognized as conventional operations.

In addition to the cross references to related articles given under the various headings of this article, *see* also ELECTROCHEMISTRY; ELECTROMETALLURGY; ION EXCHANGE.

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I. HISTORICAL BACKGROUND

Hydrometallurgical processes are used commercially because they are convenient to operate, the recovery of metals is high and operating costs usually are low, and especially because of the variety of quantitative chemical separations that can be made in aqueous solutions much more readily than is possible with the melts used in pyrometallurgical processes. The importance of these considerations is attested by the fact that hydrometallurgical techniques are used wholly or in part to produce, in commercial form, all but 6 or 7 of the 82 known metallic elements.

Of the metals produced by the use of aqueous solutions, few are converted from ore to pure metal using only hydrometallurgy: usually the "wet" methods are used in combination with other procedures. Aluminum, for example, is produced by dissolving the ore (bauxite) in caustic soda solution, precipitating aluminum hydroxide from the solution and calcining the hydroxide to produce aluminum oxide which is treated in an electrolytic cell containing fused salts to produce pure aluminum metal. Some zinc sulfide ores are first oxidized at a high temperature to produce zinc oxide which is then dissolved in weak sulfuric acid and the acid solution electrolyzed to produce pure zinc. Simple tin ores are smelted directly, but complex ores are first treated with acid solutions to remove impurities and the remaining insoluble tin mineral is smelted to produce pure metal. Some copper ores are smelted to produce impure copper metal which is then refined by electrolysis in copper sulfate solutions; others are dissolved directly with acid solutions and the copper metal precipitated from the solutions by various means. Nickel and cobalt are produced either by purely hydrometallurgical processes or by combined pyrometallurgical and hydrometallurgical techniques. Much of the world's gold is recovered from ores by dissolution with cyanide solutions from which the gold is subsequently precipitated as metal. The list could be extended to include uranium, vanadium, chromium, rare earths, alkali metals, platinum metals, gallium, indium, germanium, tantalum, the radioactive metals and many others for which chemical techniques employing aqueous solutions are used, either alone or in combination with pyrometallurgy, to produce metals on a commercial scale.

Because the successful operation of hydrometallurgical processes depends so greatly on a knowledge of metal chemistry and of chemical engineering, it is not surprising that wide commercial application is a comparatively recent development. As early as the 16th century ferrous sulfate was produced by slowly oxidizing pyrite (FeS_2) in the open air to form $FeSO_4$, extracting the soluble sulfate with water and evaporating to crystallize hydrated ferrous sulfate (green vitriol). During the next three centuries copper sulfate (blue vitriol) was produced in a similar manner at Ríotinto in Spain, where chalcopyrite ($CuFeS_2$) had been mined since early in the Christian era. Some copper metal may have been produced at Ríotinto and other copper mines from the copper sulfate solutions by precipitation with iron but the amount was negligible, as iron, which was sacrificed to precipitate the copper, was itself difficult to make and hence scarce.

With the increasing knowledge of chemistry and the advancement of chemical technology in the mid-19th century the first important commercial applications of hydrometallurgy were established. A particularly important factor was the development of commercial direct current generators in the 1860s and 1870s which provided for the first time an efficient low-cost technique for precipitating metals by electrolysis from aqueous solutions. The improvements in mechanical equipment such as extraction vessels, liquid-solid separation units and precipitation techniques devised for the treatment of gold ores following the discovery of the cyanide process (*q.v.*) in 1890 provided the full complement of tools required for broad extension of hydrometallurgical methods.

After the beginning of the 20th century methods were improved and were augmented by the addition of still other techniques such as ion exchange, solvent extraction and superatmospheric pressure extraction and metal precipitation. There evolved the great copper-leaching plants in South America, the United States and Africa; vast aluminum extraction plants throughout the world; the electrolytic zinc industry; the plants producing nickel and cobalt from sulfide ores and from the lateritic deposits in Cuba and other tropical areas; the gold-producing plants of South Africa, Canada, Australia and the United States; and, by no means last, the gigantic plants in many parts of the world that employ hydrometallurgical techniques to extract uranium from ores that contain as little as $\frac{1}{2}$ lb. of uranium in 2,000 lb. of ore.

The exceptional advances that have been scored by hydrometallurgy in the past century can be attributed almost entirely to one factor—the better understanding of the scientific and technologic principles upon which these processes are based. It is not out of the way, therefore, at this point to review briefly the principles and procedures upon which the industry depends.

II. PRINCIPLES AND METHODS

In treating ores, minerals, scrap metals and similar material by hydrometallurgical methods, one inescapable fact that must be constantly borne in mind is that, because of the endless variety of sources, no two are absolutely identical. Thus every hydrometallurgical process presents a unique problem, which must be solved on the basis of the chemical, physical and economic factors peculiar to the starting material involved.

A second consideration is that, as all hydrometallurgical operations are carried out using water as a solvent, the reactions that can be used are limited by the physical and chemical properties of water. The freezing point of salt solutions represents a minimum temperature boundary; the boiling point is another boundary which, of course, can be extended if reaction vessels are enclosed and operated under superatmospheric pressure. The specific gravity and viscosity of aqueous solutions have an important bearing on the ease of separation of solids from liquids by settling,

filtration, centrifuging and other physical means. Of the utmost importance are the solubilities of gases and metal salts in water or other aqueous solutions containing acids, ammonia, caustic soda, bicarbonates and cyanide at different temperatures and in the presence of various solutes.

Chemically, water can combine with certain metal salts to produce hydrated compounds. Also, it can enter into hydrolysis reactions in which it acts as a source of hydrogen ions (H^+) or hydroxyl ions (OH^-) and into oxidation-reduction reactions. In an electrolytic cell water decomposes to form H_2 at a lower voltage than do the dissolved salts of many of the metals, thus restricting the number of metals that can be electrolytically precipitated from an aqueous solution.

A third factor that influences most hydrometallurgical operations is that, as a rule, one of the reactants is a solid metal or compound which is either dissolved by the solutions during leaching or is precipitated from the leach solution by chemical or electrolytic means. Thus some limitations are imposed by the physical character of the solids present—their crystal form, porosity, particle size, surface area, solubility in the aqueous solutions used and, perhaps most important, the character and state of the solid-liquid interface layer, where the actual reaction of dissolution or precipitation takes place.

The feasibility and successful conduct of a hydrometallurgical operation depend on a variety of factors any or all of which may be critical depending on individual circumstances. The very nature of these processes postulates the need for an adequate supply of water and, because metals are present as ions in aqueous solutions, requires that a source of energy be available to convert the ions to metallic form. Beyond these essential features the practical, physical and chemical factors that must be considered are:

1. The metals or minerals that are to be dissolved must be soluble in the leaching solution used and must be accessible to the solution—*i.e.*, not occluded by insoluble constituents.
2. The solvent used must usually be such that it will dissolve selectively the desired metals or minerals leaving the other minerals or metals as an insoluble solid residue.
3. The solution, when it contains valuable metals, should be such that the metals present can be readily separated from one another.
4. The solution must also be such that the desired metals can be precipitated from it by one means or another producing either pure metal, a mixture of metals or a metal salt.
5. For economic reasons, it is usually necessary that the leach solution be capable of being regenerated and used again, or that it be treated to recover by-products: not infrequently by-product recovery from end solutions is an important source of revenue.

The various aspects of hydrometallurgical processes can be illustrated and explained by discussing in some detail the principle involved in each phase of the operation and outlining the procedures commonly used to carry them out in practice.

A. Preparation

The ores, concentrates, synthetic sulfides, alloys and other materials that are to be leached in aqueous solutions must be prepared physically and chemically to provide for accessibility of the lixiviant and for dissolution of the desired constituents. The extent of physical preparation required depends almost entirely upon the size of the grains of the mineral present in the ore. In general, it may be said that from the point of view of increasing rate of dissolution, it is desirable to grind the ore particles as fine as possible and thus present the greatest surface area to the lixiviant. The advantages to be gained by grinding are limited, however, by the excessive cost of grinding particles to less than about 40 microns in diameter and by the difficulties involved in separating very fine particles from the aqueous solution when leaching is completed. If the ore is porous the surface area is usually large and less grinding is required.

Chemical pretreatment, which is quite another matter, is carried out with the object of decomposing the constituents of the ore, concentrate or other materials to render them soluble or insoluble or to increase their porosity and thus permit access of solvent to fine particles that were originally occluded by a dense constituent. A variety of chemical pretreatments in common use are discussed below.

1. Oxidizing Roast.—Sulfide ores of zinc, copper, cobalt and some other metals are oxidized in air at temperatures above 500° C. to produce the metal sulfates or oxides which, unlike the sulfides, are readily soluble in weak sulfuric acid. Ores containing gold in the presence of sulfides such as pyrite (FeS_2) or arsenopyrite (FeAsS) are roasted in air to convert the dense sulfide minerals to porous oxides, thus permitting access of cyanide leaching solution to gold particles which were originally occluded by the sulfides.

By proper control of temperature and gas concentration cobalt and iron sulfide ore, for example, can be roasted to convert the cobalt sulfide to cobalt sulfate and the iron sulfide to iron oxide, thus giving a product from which the cobalt sulfate can be extracted with weak sulfuric acid leaving an insoluble iron oxide residue.

2. Oxidizing Roast With Added Reagents.—The object of this procedure is to convert some of the metal compounds in an ore to soluble form, leaving others as insoluble compounds. Thus residues from pyrite burning which contain small amounts of copper, cobalt, nickel, zinc, gold, silver and other valuable metals are mixed with salt (NaCl) and roasted to convert the valuable metals to soluble chlorides, leaving the iron as an insoluble oxide. Similarly, nickel oxide containing 0.1% sulfur is mixed with a small amount of soda ash (Na_2CO_3) and roasted at 1,200° C.: the soda ash reacts with the sulfur to form sodium sulfate (Na_2SO_4) which can be dissolved with water, leaving sulfur-free nickel oxide.

Also, with ores containing both uranium and vanadium, the vanadium, normally insoluble after roasting, can be rendered soluble by roasting with the admixture of calcium sulfate or salt which converts the vanadium to a soluble vanadate. In the sulfuric acid "bake" (commonly used in preparing ores, flue dusts and similar materials containing copper, cobalt, germanium and other metals for subsequent leaching) the ore is mixed with concentrated H_2SO_4 and baked at relatively low temperatures to produce soluble sulfates of the metals.

3. Nonoxidizing Roast.—Minerals such as pyrite and arsenopyrite when heated to a suitable temperature without access of air are decomposed, the "free" atoms of sulfur and arsenic being volatilized, leaving a residue which resembles pyrrhotite ($Fe_{1-n}S$). In this form they react with solutions of ferric chloride, chlorine, oxygen or other strong oxidizing agents to produce elemental sulfur.

4. Reducing Roast.—The purpose of the reducing roast is to reduce selectively metal oxides to metallic form. Nickel silicate ores, for example, containing magnesia, silica and iron oxide, as well as nickel and cobalt in oxidized form are heated in the presence of reducing gases (H_2 and CO) under such conditions that only nickel and cobalt are reduced to metallic form, the iron, silica and magnesia remaining as oxides. The metallic nickel and cobalt can then be selectively dissolved in oxidizing solutions containing ammonia and ammonium salts.

5. Fusion in Molten Salts.—Refractory minerals of tantalum and columbium are usually insoluble even in the strongest acid or alkaline solutions. It is common practice to fuse these minerals in molten caustic (NaOH) or sodium bisulfate ($NaHSO_4$), thus converting the metals to the corresponding sodium salts (sodium tantalate, columbate, etc.) which can then be dissolved in aqueous solutions, separated and recovered.

6. Technology of Preparatory Methods.—As the principal object of preparatory operations is to provide a product that is chemically and physically adapted to subsequent leaching procedures it follows that the equipment used for this purpose must be such that it can operate effectively and efficiently to give a product with controlled chemical composition, preferably in the form of finely divided, porous particles. In roasting, the temperature and chemical composition of the atmosphere surrounding the particles must be closely controlled.

The units which have been found most efficient and which are commonly used for roasting include the multiple hearth roaster, flat hearth roaster, suspension (flash) roaster and fluid bed roaster.

In the multiple hearth roaster the fine ore or concentrate is charged to the top hearth of a series of six to sixteen superimposed circular hearths each equipped with a raking mechanism. Suitable

provision is made for controlled access of air and flow of gases as well as for addition of heat or reducing gases when required. The fine ore follows a zigzag path through the roaster, dropping from hearth to hearth, and is discharged from the bottom hearth.

The flat hearth roaster comprises a single circular or rectangular hearth equipped with raking mechanisms, access doors for air or reducing gases and suitable heating arrangements. In the rectangular furnaces fine ore enters at one end and is raked to the opposite end of the furnace where it is discharged.

In the suspension roaster, dry, finely pulverized sulfide ore is mixed with air in a burner and is blown into a large combustion chamber where the sulfides ignite and burn in much the same way as pulverized coal burns in a steam boiler plant. The oxidized particles drop to the bottom of the combustion chamber while the gases are discharged at the top.

In the fluid bed roaster (fig. 1), which is usually circular, a mixture of sulfides and water is injected into a moving fluid bed of gases and oxidized particles kept in motion by a current of air supplied through orifices in the flat bottom of the roasting chamber. The sulfide particles are almost instantaneously oxidized by the gases, the water being evaporated equally rapidly. The heat of combustion of the sulfides maintains the necessary temperature in the roasting chamber. The oxidized particles in the moving bed may be discharged through a pipe placed halfway up the roasting chamber or with the hot gases which leave at the top of the roaster.

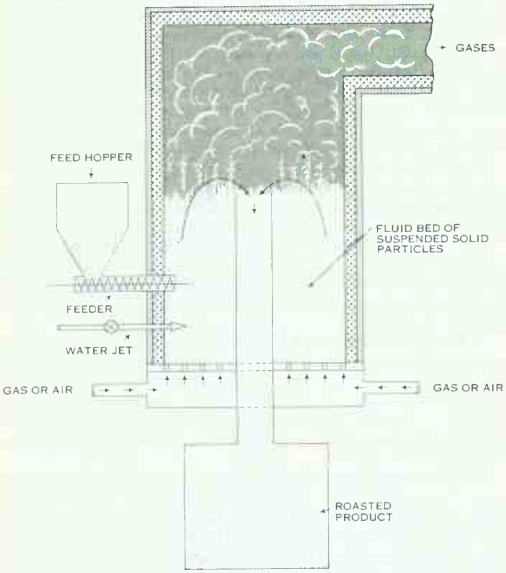

FIG. 1.—FLUID BED ROASTER

Each type of roaster has characteristics that determine its usefulness in hydrometallurgical operations. The multiple hearth unit is usually used where close temperature and gas composition control are not essential; the flat hearth unit is much the same but permits better control of roasting atmosphere. The suspension roaster has the advantage of high capacity, prevention of contact between roasting particles and close control of temperature, but requires the inclusion of extensive dust-handling equipment to recover the dust leaving with the gases at the top of the roaster. Also the mineral fed to the burner must be perfectly dry. The fluid bed roaster accepts very wet feed and gives excellent control of temperature and atmosphere; the output is governed by the volume of air required to maintain proper fluid characteristics in the moving bed; dust handling is also an important aspect.

All four types are widely used and have been found efficient in the preparation of fine porous materials chemically suited for hydrometallurgical processes.

See also FURNACE, METALLURGICAL.

B. Leaching

The term leaching, which is generally applied to the selective dissolution of metal compounds and minerals from ore mixtures, originated in the soap industry where, in early times, it was common practice to recover caustic potash from wood ashes by mixing the ashes with water and separating the soluble potash from the insoluble ash residue. Such a process, the dissolution of a desired metal compound with water alone, represents the simplest form of leaching. It is apparent, however, that the usefulness of this technique can be greatly extended if reagents such as acids, alkalis and salts are used in combination with the water to form a leaching solution which will convert metals and metal compounds normally insoluble in water to a water-soluble form. This, indeed, forms the basis for the whole hydrometallurgical industry.

Whatever leaching solution is used there are certain factors that affect the rate and efficiency of a leaching process. In the first place, the process involves a reaction between a solid and a liquid which can proceed only by diffusion in the very thin layer of liquid at the point of contact between the liquid and the solid. If, as sometimes occurs, it is also necessary to have present at the solid-liquid interface a dissolved gas, such as oxygen, the solubility of the gas in the leaching solution has an important effect on the rate of reaction. Thermodynamic and kinetic considerations imply that, in the majority of cases, higher temperatures provide increased reaction rates.

1. Reaction Types.—The character of a leaching operation is determined not only by the factors mentioned and the general properties of the leach solution but by the specific type of reaction involved. These types may be classified as follows:

Dissolution With All Products Soluble.—The metal compound is completely dissolved by the leach solution and all products of reaction are soluble. A typical example is the dissolution of zinc oxide in sulfuric acid as represented by the equation:

$$ZnO + H_2SO_4 \rightarrow ZnSO_4 + H_2O$$

Simultaneous Oxidation and Dissolution.—The solid metal or mineral must be oxidized and, upon oxidation, is then soluble in the leach solution, all products of reaction being soluble. Examples are the dissolution of gold in cyanide solution or of uranium in a sodium carbonate solution in the presence of oxidizing agents as follows:

$$2Au + \tfrac{1}{2}O_2 + 4NaCN + H_2O \rightarrow 2Na[Au(CN)_2] + 2NaOH$$

$$U_3O_8 + \tfrac{1}{2}O_2 + 3Na_2CO_3 + 6NaHCO_3 \rightarrow 3Na_4[UO_2(CO_3)_3] + 3H_2O$$

Simultaneous Oxidation and Dissolution, One Product Being Insoluble.—An example of this type is the leaching of pentlandite (NiS.FeS) in an oxidative ammonia leach according to the reaction:

$$NiS.FeS + 3FeS + 7O_2 + 8NH_3 + xH_2O \rightarrow [Ni(NH_3)_4]SO_4 + 2Fe_2O_3.xH_2O + 2(NH_4)_2S_2O_3$$

Here the $Fe_2O_3.xH_2O$ is insoluble and forms a porous layer on the surface of the leaching particle.

Chemical Reaction With Production of a Soluble and a Gaseous Product.—An example is the treatment of iron sulfide with sulfuric acid: $FeS + H_2SO_4 \rightarrow FeSO_4 + H_2S$.

2. Leach Solutions.—The solutions commonly employed are chosen with a view to providing the most efficient and least costly operation. In general they should have the following characteristics:

a. The solution should be selective to the extent that it dissolves the desired metals and does not react with valueless minerals.

b. When added reagents are used in aqueous solution they should be such that their solubility in the solution is high enough to insure adequate reaction rates.

c. The leach solution should not be reactive to the extent that corrosion of leaching vessels becomes excessive. Hydrochloric acid solution, for example, although it is a good selective solvent that can be prepared in concentrated form, is greatly restricted in use by the fact that

it very readily attacks all common base metals and can thus be used only in vessels constructed of glass, stoneware, plastics or hard rubber—all costly and weak materials.

d. Reagents should be readily available at low cost or be such that they can be easily regenerated or converted to useful by-products.

Of the acidic reagents, sulfuric acid is usually lowest in cost and most readily available, largely because it can be produced as a by-product in roasting sulfide minerals or by burning elemental sulfur in air. Also dilute sulfuric acid has the advantage that it can be easily regenerated by electrolysis or by other means; it is nonvolatile at ordinary temperatures in aqueous solutions; it is reasonably selective; it can be contained in metal or wooden vessels; and it can be prepared in any desired concentration. If sulfides are present in an ore that is to be leached, sulfuric acid can be generated by oxidation of the sulfides *in situ* if the leaching is carried out at a high enough temperature in the presence of oxygen.

Providing the mineral compound reacts with sulfuric acid to produce a soluble sulfate the many properties named make sulfuric acid a desirable leaching reagent. Not unexpectedly, sulfuric acid solution is used as a solvent for most of the copper, cobalt, zinc, cadmium, vanadium and uranium ores that are treated by hydrometallurgical processes.

Nitric acid finds little use as a leaching medium for ores, largely because of its volatility and its tendency to decompose to nitrous oxides, etc., necessitating reoxidation if the acid is to be regenerated for subsequent use. The cost is much higher than that of sulfuric acid and regeneration is essential if it is to be used for treating low-grade ores. Its use is restricted to treating alloys or oxidized ores as it is decomposed with the production of elemental sulfur and sulfates when in contact with metal sulfides. It is used for "parting" gold-silver alloys, *i.e.*, converting the silver to soluble silver nitrate and leaving the gold unattacked in the metallic form.

Hydrochloric acid is, like nitric acid, restricted in use by its tendency to volatilize. It dissolves many oxides readily and reacts vigorously with sulfides to produce H_2S and metal chlorides, but is difficult and costly to regenerate from the chlorides. The corrosive effect of chloride ions in solution, as mentioned above, limits the commercial usefulness of hydrochloric acid in leaching operations. It is used, however, successfully in two important operations: (1) in combination with NaCl in a brine solution, to leach copper, zinc, cobalt, nickel, lead and other metals from pyrite residue which has been given a chloridizing roast; (2) in treating impure tin ores containing sulfides as well as cassiterite (tin oxide) to dissolve the sulfides, leaving a residue of pure tin oxide for subsequent smelting—a "reverse" type of leaching in which the desired metal is undissolved. Hydrochloric acid and chlorides are used in other hydrometallurgical procedures in the production of magnesium, for removal of impurities from tungsten ores and, in an unusual fashion, in the production of germanium and gallium by treating the concentrates with hydrochloric acid to produce chloride solutions. These solutions are then extracted and fractionally distilled to separate pure chlorides from which the pure metals can be prepared by electrolysis or other means.

There are several less important acidic reagents that have found restricted use, among them ferric sulfate, ferric chloride, sulfur dioxide (sulfurous acid) and hydrofluoric acid. The principal use of ferric sulfate is in leaching copper ores containing both copper oxide and copper sulfide minerals. Here a leach solution containing both sulfuric acid and ferric sulfate is employed: the sulfuric acid to dissolve the copper oxides and ferric sulfate to dissolve the sulfides. Ferric chloride has been used to dissolve copper-iron sulfide minerals, producing copper sulfate, ferrous sulfate and elemental sulfur. Sulfurous acid is used to leach manganese dioxide (MnO_2) from certain ores by forming soluble manganous sulfate, together with thionates and other soluble compounds. Hydrofluoric acid is used to dissolve silica from pulverized magnetite ores where the latter are to be used for iron powder manufacture and must be substantially free of silica. These and other acid solvents are restricted in use by cost, volatility, chemical instability or other characteristics; they are used only in specific operations where the required result can not be obtained by using a cheaper, more convenient reagent.

A group with entirely different properties comprises the basic reagents—caustic soda, sodium carbonate and bicarbonate, sodium cyanide and ammonium salts in the presence of free ammonia. The general characteristic of leach solutions containing these reagents is that, differing from acid solutions, they tend to form soluble metal compounds containing oxy-anions such as CrO_4^{2-}, anionic complexes such as $[UO_2(CO_3)_3]^{4-}$ or cationic complexes of the form $[Ni(NH_3)_x]^{2+}$. Basic leach solutions do not generally react with basic constituents, such as carbonates, in an ore. Thus, if an ore contains a high percentage of carbonates, the useless consumption of acid solely to decompose (*e.g.*, calcium carbonate) could easily reach such proportions as to make acid leaching economically impossible. In such cases basic leaching is the first and often the only choice.

Of the basic reagents, caustic soda (NaOH) is the most widely used. It is relatively inexpensive, nonvolatile, chemically stable, selective, not too difficult to regenerate and it can be prepared at any desired concentration. Thus, where it is chemically suited, it is the preferred basic leaching reagent. Its use is limited, however, to the extraction of metals such as zinc, aluminum, silica, gallium, antimony, chromium, tungsten and other similar metals. The hydroxides of these metals are soluble in an excess of caustic soda to form the corresponding zincates, aluminates, gallates, tungstates, etc., which have various solubilities in aqueous solutions depending on the NaOH content of the solutions. Caustic soda has the added advantage that it is stable at temperatures up to 1,000° C. and can thus be used to fuse refractory minerals, such as those of tungsten, vanadium, chromium and others, forming the corresponding sodium salts (tungstate, vanadate, chromate, etc.) which, on cooling, can be leached with water or weak caustic solution.

Another useful and practical basic reagent is sodium carbonate, which has the same desirable properties as caustic soda. However, because it is not so strongly basic, it forms basic salts less readily and is for that reason much more selective than caustic soda. A more unusual, much more selective and yet better-known basic leaching agent is sodium cyanide which, in an oxidizing solution, dissolves gold, silver, copper and a few other metals.

Another important basic solvent is ammonia, which in the presence of anions such as sulfate, carbonate, nitrate or chloride forms, with certain metals, cationic ammine complexes. Because the number of metals that will form ammine complexes is small—copper, cobalt, nickel, zinc, cadmium, magnesium, ferrous iron, mercury, palladium, silver, etc.—ammonia is a selective reagent. It is more costly, more volatile and less stable than caustic soda or sodium carbonate, but can be very easily regenerated and has the advantage that, for example, the ammonium sulfate formed in oxidative leaching of sulfides with ammonia is itself a valuable by-product.

3. Technology.—The procedures and equipment used in commercial operations are designed primarily to provide the most efficient operation at the lowest cost. All the factors relating to reaction rate, choice of leach solution and character of the reaction are taken into consideration but the selection of equipment is also influenced by climate, labour costs, size of operation, location, grade and character of ore to be treated and other similar factors. Depending on the importance of one or more of these factors the units and techniques commonly employed are as follows:

Percolation.—When the ore is such that the desired mineral particles are exposed by relatively coarse crushing—from a coarse sand to 1 in. maximum size—it can be leached by percolation. Tanks, usually rectangular, are constructed of mastic-lined, reinforced concrete with a filter bottom several inches thick consisting of silica or other inert material with jute sacking laid on the upper surface. (*See* fig. 2.) The crushed ore is placed in the tank to a depth of from 2 to 15 ft. and the leach solution pumped in at the top. As the solution percolates through the bed the mineral is dissolved and clear solution is withdrawn from below the porous filter bottom. This is continued in several cycles, including washing, until the ore is completely leached and washed, when the last of the wash water is drained off and the tank ex-

cavated mechanically in preparation for a new charge. In some large copper-leaching operations each tank may hold as much as 12,000 tons of ore, requiring a week or more to leach, wash, excavate and refill.

Fine Particle Leaching.—In keeping with the principle that the maximum surface area, and hence highest leaching rate, is provided by agitating a mixture of finely ground solids and leach solution, the majority of leaching operations involve the treatment of a "slime." One of the simplest devices used for this purpose is the pachuca tank, first developed in a gold ore treatment plant in Pachuca, Mex. (*See* CYANIDE PROCESS.) It comprises a tall circular tank, with a conical bottom, in which the leaching pulp is both aerated and vigorously agitated by a jet of compressed air entering at the bottom of the cone. In some models agitation is assisted by installing a vertical tube in the centre of the tank to give an air-lift effect. The pulp to be leached is fed and discharged continuously.

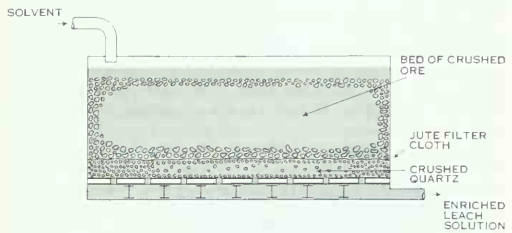

FIG. 2.—PERCOLATION LEACHING TANK

Another type of slime leaching unit consists of a large tank (up to 20 ft. in diameter) with a short central draft tube, the top being at the level of the pulp in the tank. A motor-driven impeller within the tube forces the pulp and entrained air downward through the tube thus both aerating and agitating the pulp.

When leaching is to be carried out under pressures above atmospheric pressure an autoclave of some type is required. This may take the form of a horizontal cylinder with internal impellers suspended on shafts protruding through the upper surface of the cylinder or having a slow-moving paddle type agitator. (*See* fig. 3.) The pulp fed to the first compartment by a pump is agitated vigorously by a mechanical agitator in the presence of compressed air. Overflowing the baffle walls into the second and third compartments it is finally discharged through an automatic valve actuated by a level controller. The gases (mostly nitrogen) leave through an automatic pressure release valve. Simple cylindrical vertical towers agitated by steam or air are also used.

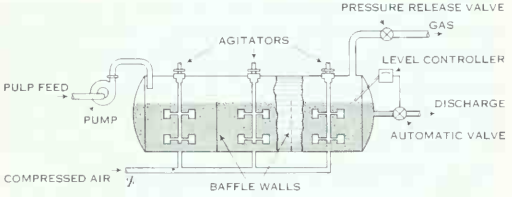

FIG. 3.—CONTINUOUS AUTOCLAVE FOR LEACHING WITH AIR OXIDATION

For certain difficult leaching operations where one of the products of reaction is a solid, such as copper sulfide in the leaching of iron-copper-cobalt-sulfide with sulfuric acid, it is customary to conduct the leach in a ball mill or other grinding unit. This removes the solid layer as it is formed and continually provides a fresh surface for reaction with the leaching solution.

Countercurrent Leaching.—If an ore, whether coarse or fine, is mixed with fresh solution, the concentration of reactants (ore and leach solution) will be high initially. As the reaction proceeds the concentration of soluble material in the ore and that of the reagent in the leach solution both decrease, thus reducing the reaction rate and rendering the operation less efficient. Theoretically the best plan would be to treat partly leached ore with strong solution and fresh unleached ore with a weaker solution. This is carried out in practice by using countercurrent leaching techniques.

In such an operation fresh ore in a first stage is leached with partially depleted solution from a second stage—this partially leaches the ore. The pulp is then filtered, the strong (pregnant) solution proceeding to metal recovery and the partially leached solids being mixed with strong leaching solution and placed in a second-stage unit. When leaching in the second stage is complete the liquids and solids are again separated by filtration, the liquid returned to mix with fresh ore in a succeeding cycle and the solids sent to waste or to such subsequent treatment as may be required. A countercurrent operation may involve as many as five individual stages.

Liquid-Solids Separation.—When leaching is complete the liquids and solids must be separated; also the solids that are to be discarded must be washed to prevent loss of entrained leach liquors. This can be accomplished in a variety of ways by combining settling units with filters and centrifuges.

An efficient settling unit is a thickener, a circular tank up to 200 ft. diameter with a central feed for the pulp and an overflow trough or launder at the periphery. As the solids settle to the flat inverted conical bottom they are moved to a central discharge orifice at the bottom of the cone and removed by pumping. The overflow is substantially clear while the thickened pulp may contain 50% to 60% solids by weight even though the pulp entering at the top may have been only 1% to 2% solids by weight. By arranging several thickeners in series and by advancing thickened pulp in one direction and overflows in the opposite direction the washing process known as countercurrent-decantation is efficiently performed.

Where solids are semicolloidal or so fine that they will not settle readily, flocculating agents such as "Separan," "Aerofloc," certain natural gums, causticized starch, carboxyl methyl cellulose and other similar materials added in very small amounts to the pulp cause the fine solid particles to adhere to one another forming flocs which settle readily.

Filters may be of several types—either batch or continuous, vacuum or pressure—but large-scale operation is carried out most efficiently and at least cost by using continuous vacuum filters (fig. 4) in which the pulp is pulled onto the surface of a rotating drum or leaf covered with a woven cloth which is immersed in the pulp. At a point in the rotation of the drum where the liquid has been drained from the solids by the vacuum and the solids washed, if necessary, by a spray wash, air pressure is substituted for the vacuum and the moist cake of solids discharged from the drum. As the drum re-enters the pulp, vacuum is substituted for compressed air and the cycle repeated.

In pressure filters which are used for pulps containing a relatively small percentage of solids, or for solids that are difficult to filter, the pulp is charged to a pressure vessel containing cloth filter diaphragms, the vessel closed and the pressure applied. When the cake has built to a suitable thickness on the diaphragms the pressure is removed, the filter opened, the cake removed mechanically or by hand and the cycle repeated.

The centrifuge, which is usually used for separating crystals and coarse oxide from liquids is a rapidly spinning circular basket with perforated sides. The pulp is fed to the centre and liquid is forced by centrifugal force through the perforations, the solids being retained. When a sufficient amount of solids has accumulated on the perforated sides the feed is discontinued and the solids removed, usually by a mechanical scraper and the cycle is repeated; continuous units are also used.

Another device that provides a somewhat less efficient but nevertheless useful liquid-solid separation is the hydroclone or hydrocyclone (*see* ORE DRESSING) in which the rapid circular motion of the pulp in a cylindrical vessel effects partial separation of solids and liquids by centrifugal force.

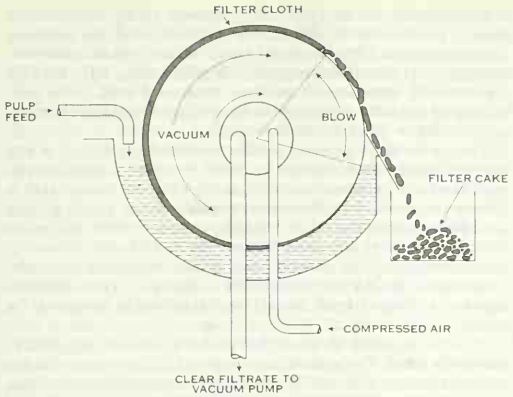

FIG. 4.—CONTINUOUS ROTARY VACUUM FILTER

Other Techniques.—In some specialized operations, such as those which require the addition or removal of heat, provision must be made for preheating the pulps or for cooling the leaching vessels. Also, with volatile solvents, condensers or other recovery units are required; if hydrogen or hydrogen sulfide is generated the gas must be effectively removed from the leaching vessel. Consideration must always be given to materials of construction; they must be inert with respect to the leach solution, to prevent corrosion, and sufficiently hard or resilient to prevent erosion by sharp solid particles. Mild steel, wood, stainless steel, rubber coatings, mastic, lead, glass, stoneware, brick and combinations of two or more of these materials are used depending on the temperature, abrasive quality of the solids and the solvent used.

C. Solution Purification

With the exception of the very few leaching operations in which the leaching solution is used to remove soluble impurities from a valuable solid, the filtered liquid resulting from the leaching step is further treated to separate and recover the metal values contained in it. The extent of treatment required depends not only upon the amount and variety of metals dissolved during leaching, but much on the chemistry of the cations and anions present in the solution. Because no two ores are similar in composition every leach solution is unique and thus requires the application of a procedure specifically suited for it. This may vary from a simple precipitation of a metal salt by pH (acidity-alkalinity) change, by hydrolysis or by addition of other metals, to separations effected by organic reagents, fractional crystallization or adsorption. The key to success in this field may be said to be a thoroughly sound knowledge of the principles of inorganic and physical chemistry and of chemical engineering.

1. The pH Change.—The solubilities of metal salts and their tendency to hydrolyze are affected in different ways by variations in pH. In commercial hydrometallurgical operations the number of reagents that can be economically used to change pH is usually restricted by cost as well as by the physical character of the precipitates produced and the possible contamination of solution or precipitate with undesirable impurities.

Acid solutions are adjusted by the addition of caustic soda, calcium carbonate, sodium carbonate, lime, magnesia or ammonia, depending on the metals present and the result desired. In solutions containing ferrous sulfate and cobaltous sulfate, for example, the ferrous sulfate can first be oxidized to ferric sulfate, the pH raised by addition of ammonia or calcium carbonate to about 4.2, and the iron precipitated as hydrated ferric oxide which can be separated from the cobaltous sulfate by filtration. If the solution contained copper it would be necessary to raise the pH to about 5.0 to precipitate the copper as hydroxide but at this pH cobalt hydroxide would also begin to precipitate and thus destroy the effectiveness of the separation.

In solutions containing ferric iron, aluminum, magnesium and uranium in the form of sulfates, it is possible by adding ammonia to bring the pH up to about 4.0, to precipitate ferric hydroxide, aluminum hydroxide and uranium hydroxide and thus separate the uranium from the solution leaving magnesium sulfate in soluble form. Addition of ammonia to raise the pH to 5.0 instead of 4.0 would precipitate the hydroxide of magnesium along with the iron and uranium and thus not only add to the cost (for additional ammonia) but give a much more impure precipitate.

Basic solutions can be adjusted by acid additions or, in some cases, by dilution or boiling. For example, an ammoniacal solution containing nickel ammine and cobaltic ammine can be treated with sulfuric acid to reduce the pH from 8.0 to 6.5 forming nickel ammonium sulfate which is relatively insoluble in the presence of ammonium sulfate at pH 6.5 and leaving the cobaltic ammine in soluble form. The nickel ammonium sulfate can then be easily separated from cobaltic ammine solution by filtration or centrifuging, thus effecting a substantially quantitative separation.

In the saturated sodium aluminate solution produced by leaching bauxite in strong caustic soda, cooling to lower temperatures causes the aluminate to hydrolyze and precipitate aluminum hydroxide which can then be separated and recovered, the caustic solution being regenerated.

The pH of basic solutions containing free ammonia and copper ammines can be lowered by boiling off the ammonia to the point where the ammines hydrolyze and copper hydroxide is precipitated. A similar reaction forms the basis of the ammonia-ammonium carbonate process used in Cuba to treat oxidized nickel ores, the product of boiling being basic nickel carbonate, in this case the desired end product.

In the hydrometallurgy of zinc small amounts of arsenic, antimony, ferric iron, silica and alumina are removed from solutions by oxidation and hydrolysis at controlled pH.

2. Reduction.—In the electromotive series, if a metal high in the series is placed in contact with an aqueous solution of a metal lower in the series the general tendency is for the lower metal to be reduced and the higher metal to be oxidized and dissolved. Metals below cadmium, when reduced, will precipitate in metallic form. Thus it is possible, for example, to precipitate copper metal from copper solution by adding iron metal to the solution, the iron being oxidized to ferrous iron, which is soluble.

Advantage is taken of this property of metals to remove impurities from leaching solutions in the hydrometallurgy of zinc where small amounts of copper and cadmium present in the zinc sulfate solution are precipitated by the addition of zinc powder. Similarly, in weakly acid nickel sulfate or chloride electrolytes and other similar solutions containing copper ions, the copper can be precipitated by the addition of nickel powder, leaving a pure nickel solution.

In another comparable situation chlorine is removed from a solution in which it is present as cupric chloride by agitating the solution with metallic copper, reducing the cupric to cuprous chloride which is insoluble and can thus be separated.

The order of some more common metals in the electromotive series is: potassium, sodium, magnesium, aluminum, zinc, iron, tin, lead, hydrogen, copper, mercury, silver, platinum and gold.

3. Reagent Additions.—An endless variety of separations can be effected by reagent additions but the commercial application is restricted by cost, physical properties of precipitates and avoidance of unwanted impurities. Hydrogen sulfide and similar sulfur-bearing reagents such as thiosulfate, thionates, SO_2 and sulfur, alkali sulfides and metal sulfides can all be used in the appropriate alkaline or acid environment to effect separations that depend on the relative solubilities of the metal sulfides.

Carbon dioxide, sulfur dioxide and chlorine can also be used where selective solubility of the products can be obtained. Carbon dioxide, for example, added to ammoniacal solutions of calcium sulfate will quantitatively precipitate the calcium as calcium carbonate.

In special circumstances salts or organic compounds can be used to effect separations. Gold, for example, can be separated from a chloride solution containing gold and platinum metal chlorides

by adding to the solution ferrous sulfate which reduces and precipitates gold metal but not the platinum group metals. Thorium can be separated from small amounts of other rare earths by precipitating it as the oxalate. In the hydrometallurgy of zinc, traces of cobalt can be removed from the neutral leach solutions by the addition of α-nitroso-β-naphthol.

4. Ion Exchange.—Certain resins consist of porous rigid frameworks having replaceable hydrogen atoms or hydroxyl groups exposed: those with hydrogen ions are known as cationic exchangers and those with hydroxyl groups as anionic exchangers. When a solution containing cations is brought into contact with a cationic resin the cations replace hydrogen in the resin and hydrogen ions enter the solution. The reaction may be represented as follows:

$$\text{Hydrogen-resin} + Cu^{2+} \rightarrow \text{Cu-resin} + 2H^{+}$$

The reaction is reversible and Cu-ion and hydrogen-resin can be regenerated by adding strong acid to the Cu resin. Also, the tendency of different species of cations to replace hydrogen varies. Thus, if a dilute solution containing a mixture of cations is brought into contact with a hydrogen resin, it is possible for one species of cation to react selectively and be adsorbed by the resin leaving other cations in solution. The resin can then be removed from the solution and treated with strong acid (*e.g.*, HNO_3) forming a concentrated metal nitrate and regenerating the hydrogen resin for subsequent use in another cycle.

This type of separation has proved exceptionally useful in separating rare earths, in separating hafnium from zirconium and in recovering uranium from acid solutions containing only a few milligrams per litre of uranium in the presence of salts of iron, silicon, aluminum, magnesium and other metals, all of which are largely unaffected by the resin.

Ion exchange techniques offer the prospect of obtaining separations that can not be effected by any other means. For that reason the development of new types of resins, both anionic and cationic, is a continuing objective of research in the hydrometallurgical industry.

5. Solvent Extraction.—Another method of separating metals from aqueous solutions depends on the ability of certain organic liquids to dissolve, selectively, specific metal salts by the formation of complexes which are more soluble in organic solvents than in aqueous solutions. A typical example, long recognized by analytical chemists, is the procedure in which a mixture of the chlorides of ferric iron, cobalt, copper, nickel, vanadium and chromium in a strongly acid aqueous solution is vigorously shaken with ether and allowed to settle, forming two separate layers. The upper layer of ether selectively dissolves ferric chloride leaving the chlorides of the other metals named in the aqueous layer which can be removed by decantation and an efficient separation thus effected.

This principle has been extended and applied in the separation of uranium from acid solutions in which it is present in amounts of 1 to 5 g. per litre together with salts of iron, aluminum, vanadium, magnesium, etc. In one application, the leach solution is first treated with H_2S or aluminum metal to reduce Fe^{3+} to Fe^{2+} and is then agitated with a kerosene solution of an alkyl phosphoric acid which selectively reacts with uranyl ions leaving Fe^{2+} and other ions in the aqueous phase. An extractant commonly used is dodecyl phosphoric acid (DDPA). The uranium can be removed from the extractant by treatment with strong hydrochloric acid and the extractant regenerated for use in a subsequent cycle. The uranyl chloride solution is distilled, the HCl distillate recycled to a subsequent cycle and the concentrated uranium residue further treated to produce uranium metal.

As a solvent extraction process is fully cyclic and can be operated continuously, and as extractants can be developed comparatively easily, it is not unexpected that this type of separation continues to find new applications in hydrometallurgy.

6. Technology.—The equipment used for separation processes is relatively simple and is usually selected on the basis that it will provide the specific conditions required for the desired separation.

Mechanically stirred open tanks, pachuca tanks, steam-heated boilers, packed towers and similar units are used for reactions that take place at atmospheric pressure. Where high temperatures, high pressures or volatile reagents such as SO_2, CO_2, NH_3 and H_2S are involved, autoclaves or enclosed towers are used. The solid and liquid products are separated by settling, screening, filtration, centrifuging or other mechanical means.

The ion exchange process operates intermittently in such a way that the solution to be treated is passed through columns of resin until the resin becomes saturated, at which point the solution is diverted to a second similar series of resin towers. In the process used for removing the metal from the saturated resin (known as eluting), acid, etc., is passed through the first (loaded) tower to remove metal ions in an acid solution and regenerate the resin. The column then is ready for reuse in a subsequent cycle while the metal is recovered from the acid solution which is termed the eluate.

A useful variation of this technique is the resin-in-pulp (RIP) process in which the leached pulp, from which the coarser barren solids have been removed but which still contains barren slimes, is brought into contact with resin which extracts the desired metal ions from the aqueous portion of the pulp, the solids being unaffected. When the resin is saturated it is removed, eluted and regenerated; the pulp, consisting of barren leached solids and depleted solution, is discarded. This procedure, which avoids the need of filtering the solids before separating and recovering the valuable metal ions from the leach solution, offers a distinct advantage in certain operations where the solids are so finely divided or colloidal in nature that settling or filtration would be difficult if not impossible.

Solvent extraction is carried out in a continuously operating mixer-settler in which the pregnant leach solution and organic solvent are fed through a tube into a reaction area at the centre of a vertical vessel, suitable agitation being provided at the point of entry. The organic extractant overflows the top of the vessel while the depleted aqueous solution is removed at the bottom.

D. Precipitation

The principal objective of many hydrometallurgical procedures is to produce the extracted metals in metallic form. As the metals are present in solutions as cations carrying a positive charge the essential mechanism of precipitation is reduction, which means the addition of electrons. This can be accomplished in several ways: by electrolysis with direct current; by using a metal higher in the electromotive series; or by treating the solution with a reducing gas such as hydrogen.

The processes in which the product is a metal hydroxide, sulfide or other insoluble metal salt have been considered in the preceding section on separations and need not be further described.

1. Electrolytic Precipitation.—The electrolytic cell used for precipitating metals from solutions comprises essentially a container for the solution (electrolyte) in which is placed (a) a cathode upon which the metal is to be plated, and (b) an anode made of some conducting material—metal or carbon—which is not soluble in the electrolyte used. The reaction can be simply represented by the following equation:

$$\text{Metal ion} + H_2O + \text{electrons} \rightarrow \text{Metal} + \tfrac{1}{2}O_2 + 2H^{+}$$

The net result of electrolysis is that metal is deposited on the cathode, oxygen is evolved at the anode and an equivalent amount of acid (hydrogen-ion) is generated. The amount or weight of metal plated, and of water decomposed to O_2 and hydrogen ions, is determined by Faraday's law which states that a current flow of 96,540 coulombs (ampere-seconds) will deposit an amount of metal equal to its atomic weight divided by its valence. The voltage required is at least the "decomposition voltage" of the metal salt in the electrolyte, to which must be added the voltage necessary to overcome ohmic resistance of the electrolyte and electrical contacts and the overvoltages that may be developed at either anode or cathode.

The conduct of an electrolytic operation is profoundly affected by the cations present in the electrolyte. The salts of metals below

hydrogen in the electromotive series have a lower decomposition voltage than that of water and can be electrolytically decomposed and the metal readily deposited from an acid or basic solution. For the metals that lie above hydrogen the difficulty is encountered that water, which is always present, has a lower decomposition voltage than the metal salts, thus creating a tendency to produce hydrogen at the cathode instead of the desired metal, although under certain conditions the deposition of hydrogen may be suppressed. Any hydrogen produced reduces, by an exactly equivalent amount, the metal that should be precipitated according to Faraday's law and in this way reduces the current efficiency of the cell. To electrolyze these metals with high efficiency requires the provision of special conditions such as careful control of pH in the electrolyte, or the use of electrolytes in which the decomposition voltage of the metal salt is, in effect, below that of hydrogen.

It may be inferred from the above that electrolytic precipitation is selective: the metal salt having the lowest decomposition voltage of any salt present will be electrolyzed and the metal plated out in preference to all metals above it in the electromotive series. Where more than one metal salt is present the metal salt having the next highest decomposition voltage will react and deposit the second metal after the lower metal has been removed from solution. If the decomposition voltages of two metals are close, there will be some overlapping in their deposition.

Certain impurities (other cations) present in an electrolyte tend to catalyze the decomposition of water and hence to reduce the efficiency of electrolytic precipitation of metals above hydrogen in the electromotive series. For this reason and also to prevent contamination by other metals which would plate out preferentially, leach solutions must be carefully purified before being electrolyzed. The higher the metal is in the electromotive series, the more important and at the same time the more difficult, is the purification.

Notwithstanding these difficulties, leaching and purification followed by electrolysis with insoluble anodes is widely used commercially in the production of manganese, zinc, cadmium, cobalt and copper and a number of other metals.

2. Cementation.—The precipitation of metal from a solution by the addition of a more reactive metal, with dissolution of the latter, is termed cementation. A typical reaction is:

$$\underset{\text{metal}}{Fe^{\circ}} + \underset{\text{ion}}{Cu^{2+}} \rightarrow \underset{\text{metal}}{Cu^{\circ}} + \underset{\text{ion}}{Fe^{2+}}$$

The reactivity of a metal in this context is related to its position in the electromotive series—the higher the metal is in the series the more reactive it is. Metals higher than cadmium in the series can not be precipitated in metallic form from aqueous solution by cementation with a more reactive metal as the equilibrium between H_2O and the ions of metals above cadmium is such that the oxidation of the metal, and hence its retention as an ion, is favoured.

If a cementation reaction is to proceed to completion it is essential that the precipitated metal should not form a continuous nonporous layer on the surface of the reactive metal. Otherwise the precipitated metal would soon reach equilibrium with the surrounding metal salt solution and prevent contact between the reactive metal and the metal ions in solution and thus stop the reaction.

Reaction rates in this system are improved by increased surface area of reactive metal, by increased temperature, by increased agitation and by concentration of the ions of the less reactive metal in the solution. Thus it is advantageous to carry out cementation with finely divided reactive metal at the highest convenient temperature in an agitated mixture. Concentration of the less reactive metal in solution must decrease as the metal is precipitated and total reaction time is restricted largely by the extent to which it is desired to reduce the metal content of the solution. It is possible to precipitate metals quantitatively from solution by cementation. (The term cementation is also used to designate an outmoded process of making steel by heating iron in contact with carbon.)

3. Reducing Gases.—Under certain conditions hydrogen serves as a source of electrons to precipitate metals from aqueous solution, its behaviour in this respect resembling in some measure that of a reducing metal. It appears that metals which lie below or just above hydrogen in the electromotive series and which are either homogeneous or heterogeneous hydrogenation catalysts can be precipitated readily by molecular hydrogen. The list of these metals includes nickel, cobalt, copper, mercury, silver, gold and the platinum metals.

The precipitation by hydrogen of metals lower in the series (silver, gold, palladium, platinum etc.) can be effected at room temperature and atmospheric pressure, although the rate of precipitation is higher with increased hydrogen pressure. Copper, nickel and cobalt, however, can be rapidly precipitated with hydrogen only at temperatures above 100°–125° C. and under a pressure of at least 5 atm. of hydrogen. The rate of precipitation of nickel and cobalt is directly proportional to the surface area of the nickel or cobalt metal present to catalyze the dissociation of hydrogen. The reduction of copper salts occurs homogeneously in solution.

Hydrogen can also be used in the presence of nickel catalyst to reduce uranium from the hexavalent to the tetravalent form in carbonate solutions and to produce uranium dioxide which is insoluble in these solutions. In this way uranium and, by a similar procedure vanadium, can be quantitatively separated from carbonate solutions.

In all hydrogen reduction reactions the hydrogen is converted to hydrogen ion, thus tending to increase the acidity of the solution as the reaction proceeds.

4. Technology of Precipitation.—The generators, cells and other equipment used in metal precipitation are similar to those employed in electrolytic refining. The unique characteristic of metal precipitation by electrolysis, termed "electro-winning," is the use of insoluble anodes with accompanying evolution of oxygen at the anode.

The considerable amount of gas (*e.g.*, 180 l. per kilogram of zinc) emanating from the solution carries with it a small amount of acid vapour which causes a loss of acid that tends to corrode metal parts in the cell room. Another factor that occasionally assumes serious proportions is that in an electrolyte containing chlorides, chlorine is generated at the anode, which makes it necessary to use for the anode an alloy that is not attacked by the chlorine.

In the electrolytic precipitation of cobalt from sulfate solutions it is necessary to maintain the pH of the electrolytic cell at about 4.5. Acid generated by electrolysis, which would tend to lower the pH of the electrolyte, is effectively neutralized by the addition to the electrolytic cell of pure cobalt hydroxide, a unique but effective procedure in electrolysis.

Electrolytic precipitation finds its principal use in the hydrometallurgical production of zinc, copper, manganese, cadmium and cobalt.

Cementation.—Precipitation by cementation, which is usually more efficient in acid solutions (below about pH4), can be effected by displacement by electropositive metal powders or metal scrap. Precipitation by cementation is used chiefly in recovering copper from acid sulfate or chloride solutions by the addition of scrap iron. Powder cementation is used to precipitate silver and gold from cyanide solutions, copper from solutions containing zinc, cobalt or nickel, cadmium from zinc sulfate solutions and silver from nitrate solutions.

Metal powder cementation is carried out by adding a slight excess of the reactive metal powder to the solution, which is agitated in an open tank. The precipitated metal and any undissolved powder are filtered off and recovered. Batch operation is preferred, the treatment being continued until precipitation is complete. If a two-stage countercurrent precipitation is used, it is possible to produce a high-grade metal precipitate with a very small excess of the reactive metal powder. The reactive metal will reduce oxidized salts such as ferric sulfate in the leach solution to their lowest valence. It is therefore advantageous to keep oxidation at the lowest possible level and to remove dissolved oxygen from the solution before cementation. Gold cyanide solutions are deaerated by a vacuum technique before adding powdered zinc or

aluminum to precipitate the gold.

When scrap metals are used for cementation the technique employed is adapted to suit the character of the scrap used. Normally the solution is poured over coarse scrap contained in launders or perforated baskets. In some important installations batches of solution are treated with bulky, irregular-shaped scrap, such as old oil drums or structural steel scrap, in large inclined rotating acid-proof vessels.

Hydrogen Precipitation.—The principal use of hydrogen precipitation is in the recovery of nickel, cobalt and copper from ammoniacal leach solutions. For example, a suitably purified nickel solution is introduced into a horizontal cylindrical autoclave fitted with mechanically operated stirring mechanisms. A minute amount of ferrous sulfate catalyst is added (to initiate the reaction), the solution heated to 150°–200° C. and hydrogen is introduced at about 400 lb. per square inch pressure. The nickel ammine sulfate present reacts rapidly with the hydrogen to produce metallic nickel powder and ammonium sulfate, the nickel content of the solution being reduced from 50 g. per litre to 0.1 g. per litre in 10 to 15 min. The agitators are stopped, the powder settled and the barren solution discharged. A second charge of nickel-rich solution is added, the agitators started and the cycle repeated. At intervals the autoclave is discharged with the agitators operating, thus removing the nickel powder with the barren solution. The powder is allowed to settle out of the barren solution and is filtered, washed, dried and packed in drums. A high-purity nickel metal is produced by this procedure. Copper and cobalt metals can be similarly precipitated: uranium and vanadium can be precipitated from carbonate solutions as UO_2 and V_2O_3 in a similar manner in the presence of a nickel catalyst.

E. Regeneration

Unless the solvent used is cheap or can be converted into a useful by-product it is desirable to regenerate it for reuse in a succeeding cycle of the leaching process. An important advantage of electrolytic precipitation of metals from acid solutions is that acid is regenerated equivalent to the metal precipitated. Thus the reagent consumption is only that necessary to make up for mechanical losses—there is theoretically no chemical consumption of reagent. The hydrometallurgical processes for producing copper and zinc depend for their economic success upon this feature.

In cyaniding gold ores the amount of sodium cyanide (NaCN) consumed is very small, theoretically only that necessary to react with the gold and silver dissolved. However, if excessive amounts of copper, cobalt, nickel or other metal salts that react with the cyanide are present, the cyanide can be regenerated by treating the solution after gold precipitation with acid to produce hydrocyanic acid (HCN) which is absorbed in caustic soda to regenerate NaCN.

Carbonate solutions of uranium are treated with caustic soda to precipitate the uranium as an insoluble uranium salt leaving a small excess of caustic in the barren sodium carbonate solution. The necessary amount of sodium bicarbonate required for leaching a succeeding lot of uranium ore is regenerated by treating the barren solution with carbon dioxide.

When cementation is used to precipitate metals the barren solutions contain the corresponding salt of the reactive metal. If the purpose of cementation is simply to remove small amounts of an undesired metal for purposes of purification, such as precipitation of copper and cadmium from zinc leach solutions or copper from cobalt solutions, the resulting solution is treated for recovery of the remaining metal. When, however, the objective is to strip the major metal constituent from the solution, as in precipitating copper from leach solutions with scrap iron, the resulting solution is usually valueless, containing (in the case mentioned) only ferrous sulfate and it is therefore discarded.

Ammonia leaching of copper-nickel-cobalt sulfides under pressure in the presence of oxygen (compressed air) with final precipitation of nickel powder by hydrogen under pressure results, as noted above, in the formation of ammonium sulfate. After removal of the nickel the barren solution can be evaporated to produce pure ammonium sulfate which can be marketed as fertilizer. If desired the ammonium sulfate solution could be reacted with lime (CaO) to precipitate calcium sulfate and regenerate ammonia for reuse in a succeeding cycle.

Leaches conducted with ammonium carbonate (*e.g.*, to dissolve copper, nickel or uranium) result in the production of an ammine solution of these metals. Upon boiling, the oxides, hydroxides or basic salts of the metals are precipitated and the volatilized NH_3 and CO_2 recombined to regenerate fresh ammonium carbonate solution.

In the treatment of many valuable metals to form concentrated leach solutions, as in the production of chromium salts, lithium compounds, thorium, zirconium, etc., the leach solution is usually destroyed by added chemicals and regeneration is not attempted.

III. EXAMPLES OF COMMERCIAL PROCESSES

The principles and methods of hydrometallurgical processes can best be illustrated by reference to important commercial applications. The processes described below have been selected to represent specific applications of different techniques and are intended to give one hydrometallurgical method of producing the metal concerned but not necessarily the only one.

A. Copper

In some of the great copper mines of the world which are located in semiarid areas in South America, Africa and the southwestern United States, the ores consist largely of oxidized copper minerals such as cuprite (oxide), brochantite (sulfate), atacamite (chloride), etc., which, unlike copper sulfide minerals, are not readily amenable to concentration by froth flotation. These minerals are however all soluble in dilute sulfuric acid, which provides a basis for recovering the copper economically by leaching processes.

The largest mine of this type was at Chuquicamata, Chile, where, until a sulfide smelting plant was added in the 1950s, more than 200,000 tons of copper was produced annually from an ore containing 2% copper of which about 90% was present as oxidized copper minerals. Such an operation provides an outstanding example of countercurrent percolation leaching and electrolytic precipitation with regeneration of sulfuric acid solvent.

In an operation of this kind the ore is crushed to about 1 cm. maximum diameter and is charged into tanks with filter bottoms, each tank holding as much as 11,000 tons of ore per charge. Several tanks are operated in series, the fresh sulfuric acid leach solution from the electrolytic cells being fed to a tank containing nearly spent ore, percolating through the interstices in the charge and passing through the filter bottom. The filtrate goes forward to the next tank, etc., until in the final tank the copper-bearing leach solution is brought into contact with fresh ore. The leaching cycle requires about four days, after which the liquor is drained from the spent ore which is then washed with dilute water solutions, again by percolation. The washed spent ore is excavated and discarded. By changing the flow of leach liquors each tank is in turn filled, leached, washed and excavated.

The pregnant leach solution contains some cupric chloride resulting from the dissolution of small amounts of copper chloride in the ore. To reduce the chlorine content the solution is passed through towers containing metallic copper which reduces the cupric chloride to insoluble cuprous chloride which is removed by settling and filtration.

The purified solution is electrolyzed in mastic-lined, reinforced concrete cells with 60–70 lead-antimony anodes in each cell. The solution entering the cells contains about 3% H_2SO_4 which is increased to 6% by electrolysis and then returned to the percolation leaching plant to treat a succeeding batch of ore.

B. Zinc

Up to 1916 substantially all the world's zinc was produced by distillation of zinc vapour at high temperatures from a mixture of zinc oxide and carbon. Hydrometallurgical processes (first introduced in the U.S. at Anaconda, Mont., and in Canada at Trail, B.C.) resulted in the production of high-purity electrolytic zinc which found special application in brass manufacture and die-

casting. Within a few years die-casting alone required more than 200,000 tons of high-purity zinc per year. Electrolytic zinc is profitably produced in many countries—Canada, the United States, Australia, Poland and others—where abundant low-cost electrical energy is available.

One process comprises roasting a high-grade (50%–60%) zinc sulfide concentrate, preferably with a low iron content, in such a way that the sulfide is converted to fine porous particles of zinc oxide. The roasted oxide usually contains small amounts of the oxides of lead, copper, cadmium, arsenic and antimony as well as silica and precious metals.

The oxide is leached with sulfuric acid in a two-stage countercurrent system to produce a neutral zinc sulfate solution containing sulfates of cadmium, copper, manganese and cobalt. Iron, arsenic, antimony, lead, silica and precious metals are separated in an insoluble residue and further treated by smelting methods to recover the valuable metals present.

The neutral zinc sulfate solution is treated with zinc powder to precipitate copper and cadmium and with α-nitroso-β-naphthol to remove cobalt, leaving a pure neutral solution containing zinc and manganous sulfates. The purified solution is electrolyzed, using insoluble lead anodes, to produce pure zinc on the cathodes and manganese dioxide at the anodes and to regenerate sulfuric acid at about 10% strength, which is returned to the leaching plant to treat a succeeding lot of zinc oxide.

In this process, because of the position of zinc in the electromotive series relative to hydrogen, great care must be taken to remove impurities from the neutral zinc sulfate solution fed to the electrolytic cells. Germanium, cobalt, nickel and antimony must be maintained at very low levels as they tend to catalyze hydrogen deposition at the cathode and thus impair current efficiency.

C. Aluminum

The principal useful ore of aluminum is bauxite—a mixture of aluminum hydrates of the form $Al_2O_3.xH_2O$ in which the average ratio of H_2O to Al_2O_3 is about 2 to 1. The ores also contain, in varying amounts, iron oxides, silica, lime and magnesia as well as small but measureable amounts of vanadium and gallium.

The ore after grinding to a fine powder is treated in continuous autoclaves with strong caustic soda solution at 160° C. which rapidly dissolves the aluminum hydrates to form a hot, concentrated solution of sodium aluminate. On cooling and "seeding" with particles of aluminum hydrate the sodium aluminate decomposes to form aluminum hydrate and sodium hydroxide. The aluminum hydrate is separated by thickening and filtration and is washed and heated to remove the H_2O. The resulting pure Al_2O_3 is charged to cells containing a molten sodium aluminum fluoride electrolyte for electrolytic production of aluminum metal.

In the dissolution of aluminum ores with caustic soda some of the silica, vanadium and gallium present also dissolve. One of the most important aspects of this process is the control of temperature, concentration and seeding techniques in the various stages to hold to the lowest practical level the silica content of the precipitated aluminum hydrate. At regular intervals the caustic leach solution must be specially treated to remove vanadium, gallium and other impurities to prevent their reaching a level where they would precipitate with, and contaminate, the aluminum hydrate.

D. Nickel

There are two important types of nickel ore: (1) nickel-iron sulfides mixed with copper and cobalt sulfides and frequently platinum metals, that occur in temperate areas such as the Canadian Pre-Cambrian shield; and (2) iron-nickel-magnesium silicates found in such great abundance in tropical areas in Cuba, New Caledonia, Brazil, the East Indies and elsewhere. The sulfide ores are easily treated by pyrometallurgical methods to produce nickel; the silicate ores less easily so. Both types can be treated by hydrometallurgical processes designed to suit the requirements of each.

In the process developed at the U.S. government-owned Nicaro mine in Cuba before its abandonment in 1960, the silicate ores were first treated with reducing gases (H_2 and CO) at red heat to reduce selectively the nickel oxide present to nickel metal particles, without fusion. The reduced material was leached in closed vessels with aerated ammonia-ammonium carbonate solution to oxidize and dissolve the nickel as nickel ammine carbonate. The iron, magnesia and other impurities were separated, washed and discarded.

The nickel ammine solution was boiled to drive off ammonia and carbon dioxide and to precipitate a mixture of nickel hydroxide and nickel carbonate which was dried and ignited at a red heat to remove H_2O and CO_2 and produce nickel oxide which was briquetted and sold in this form. The ammonia and carbon dioxide driven off during the boiling operation were reabsorbed in water to regenerate ammonium carbonate for a succeeding leach.

The Cuban ores contain no copper and, as relatively little cobalt was dissolved under the conditions used, the nickel oxide produced was pure enough to meet market requirements without the necessity of introducing extensive solution purification steps.

A nickel-iron-copper-cobalt sulfide concentrate from the Sherritt Gordon mine in Manitoba, Can., which contains no platinum metals, is treated by another type of ammonia process. The procedure comprises leaching the mixed sulfides in continuous autoclaves with ammonia solution and compressed air. The minerals dissolve to produce nickel, copper and cobalt ammines and ammonium sulfate. Upon boiling to remove part of the ammonia, copper is quantitatively precipitated as sulfide. The copper-free solution is treated in autoclaves at 200° C. and 500 lb. per square inch pressure with hydrogen to selectively precipitate nickel in the form of high purity powder which is sold either in this form or as small briquets.

The cobalt remaining after nickel precipitation is removed by H_2S addition and recovered separately in metallic form while the solution (now free of metals) is evaporated to produce fertilizer grade ammonium sulfate.

E. Gold

The first hydrometallurgical process to be used widely on a commercial scale was the recovery of gold by extraction with aerated sodium cyanide solutions, developed in 1889 and 1890. The apparatus devised for this process and still in use in modern hydrometallurgical plants, such as pachuca tanks, thickeners, countercurrent washing systems and vacuum filters, provided the stimulus for the development of a variety of other leaching processes. The procedures used have been changed but little in modern practice. For details *see* Cyanide Process.

F. Uranium

One of the great triumphs in modern technology was the development of hydrometallurgical processes for extracting uranium from low-grade ores that took place during the years immediately following World War II. Because of its chemical behaviour uranium can not be separated from silica and other minerals by pyrometallurgical methods. Up to the end of World War II the production of uranium depended upon concentration of low-grade ores by physical methods (as tabling, jigging, etc.) to produce a concentrate containing 10% or more uranium, together with silica, sulfides and other gangue minerals. The concentrate was then treated by hydrometallurgical processes involving the use of sulfuric acid with sodium nitrate and other costly reagents to dissolve the uranium which was then recovered from the solutions by chemical separations.

However, ores containing pitchblende or other uranium mineral in such form that it can be efficiently concentrated by physical processes, occur only in limited quantities. The major source of uranium in the world is the disseminated ores containing from 0.01% to as much as 0.5% uranium, which are not amenable either to physical concentration or pyrometallurgical treatment.

As a result of intensive research a variety of new and useful processes were developed in a surprisingly short time. By 1954 large plants in Africa, Canada and the United States were recovering uranium successfully from phosphate liquors, gold mill tailings, low-grade ores and similar materials containing (in the case of gold mill tailings) as little as 0.01% uranium. An important

outgrowth of this activity was the development and introduction on a commercial scale in metallurgical operations of the ion exchange and solvent extraction techniques.

The processes for leaching uranium ores are varied but the majority conform to the following general pattern:

The finely ground ore is leached in agitators or pachuca tanks with a dilute sulfuric acid solution to which is added an oxidizing agent, such as sodium chlorate or manganese dioxide, to convert the lower-valence uranium minerals present to the higher-valent soluble form. The insoluble portions of the ore are separated by countercurrent decantation or filtration from the uranium sulfate solution which contains small amounts of iron, copper, aluminum and other sulfates.

The sulfate solution is passed through ion-exchange resin columns where the uranium ions become attached to the resin preferentially to the other ions present. The barren solution is discarded.

The loaded resin is eluted with nitric acid or sodium chloride solutions to produce a concentrated solution of uranium (the resin being simultaneously regenerated for reuse) which is neutralized with caustic soda or ammonia to precipitate an insoluble uranate. This high-grade precipitate is then further treated by solvent extraction and other methods to produce high-purity uranium metal.

Other methods involving the use of alkaline sodium carbonate solutions at atmospheric or elevated pressures are also employed, and there is a wide diversity in detail of both acid and alkaline procedures depending on the character of the uranium mineral in the ore and the impurities and gangue minerals associated with it.

See also COPPER; ZINC; ALUMINUM; NICKEL; GOLD; URANIUM; etc.

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(F. A. FO.)

HYDROMETEOR, an aggregation of particles of water or ice in the atmosphere. This includes all precipitation but excludes cloud forms (*see* CLOUD), nonaqueous meters such as lithometeors (smoke, dust, sand), photometeors (halos, coronas, rainbows) and electrometeors (northern lights, lightning and thunder).

Types.—The World Meteorological organization's *International Cloud Atlas* (1956) lists the following hydrometeors and their definitions (abridged):

Rain.—Precipitation of liquid water particles, usually in the form of drops of more than 0.5 mm. (0.02 in.).

Drizzle.—Fairly uniform precipitation composed exclusively of fine drops of water—diameter less than 0.5 mm. (0.02 in.).

Freezing Rain or Drizzle.—Rain or drizzle, the drops of which freeze on impact.

Snow.—Precipitation of ice crystals, most of which are branched.

Snow Pellets.—Precipitation of white and opaque spherical grains of ice, with diameters of about 2–5 mm. (0.1–0.2 in.).

Snow Grains.—Precipitation of very small, fairly flat, white and opaque grains of ice; their diameter is generally less than 1 mm. (0.04 in.).

Ice Pellets.—Precipitation of transparent or translucent spherical pellets of ice which have a diameter of 5 mm. (0.2 in.) or less.

Hail.—Precipitation of small balls or pieces of ice with a diameter ranging from 5 to 50 mm. (0.2 to 2.0 in.).

Ice Prisms.—A fall of unbranched ice crystals, in the form of needles, columns or plates, often so tiny that they seem to be suspended in the air.

Fog.—A suspension of very small water droplets in the air, generally reducing the horizontal visibility at the earth's surface to less than 1 km. (⅝ mi.).

Ice Fog.—A suspension of numerous minute ice crystals in the air, reducing the visibility at the earth's surface.

Mist.—A suspension in the air of microscopic water droplets, reducing the visibility at the earth's surface.

Drifting Snow and Blowing Snow.—An ensemble of snow particles raised by the wind.

Spray.—An ensemble of water droplets torn by the wind from the surface of an extensive body of water.

Dew.—This is a deposit of water drops on objects at the ground.

White Dew.—A deposit of white frozen dew drops.

Hoarfrost.—A deposit of ice having a crystalline appearance, which generally assumes the form of scales, needles, feathers or fans.

Rime.—A deposit of ice, composed of grains more or less separated by trapped air.

Glaze (Clear Ice).—A generally homogeneous and transparent deposit of ice formed by the freezing of supercooled drizzle droplets or raindrops on objects, the surface temperature of which is below or slightly above 0° C. (32° F.).

Spout.—A phenomenon consisting of an often violent whirlwind, revealed by the presence of a cloud column or inverted cloud cone (funnel cloud), protruding from the base of a cumulonimbus.

(E. M. BS.)

HYDROMETER, an instrument for measuring the density of liquids. Recognition that such an instrument provides a ready means of determining liquid density dates from early times, and there is evidence that Archimedes (*c.* 287–212 B.C.) was familiar with it. The hydrometer remained of little importance until it began to be used in the 18th century for determining the strength of alcoholic beverages. By the 20th century hydrometers had widespread industrial applications.

A hydrometer described by Robert Boyle (1675) was made of glass and differs in no essential feature from modern glass hydrometers (*see* fig. 1). The hydrometer will tend to sink until it displaces its own weight in a liquid. In keeping with Archimedes' principle, hydrometers tend to sink more deeply as liquid density decreases (*see* DENSITY; SPECIFIC GRAVITY; MECHANICS, FLUID: *Basic Relations*).

A Logical System of Hydrometry.—Neglecting the comparatively small effects of surface tension, the plane of intersection of a liquid surface with the stem of a freely floating hydrometer is a function of the density of the liquid. Graduated marks in or on a hydrometer stem are used to indicate density. These densities are conveniently expressed in terms of grams per millilitre, a common basis for the density scale of hydrometers.

Density (often expressed as the equivalent specific gravity) is used as a criterion of quality of petroleum products. Since these liquids have comparatively high coefficients of expansion, it is necessary to measure the density at some specified temperature. The temperature generally adopted is 60° F., and a hydrometer calibrated at this temperature directly will indicate density in a sample at 60° F. It is often more economical to take the hydrometer reading at the prevailing temperature of the sample and to use empirically derived tables to correct the hydrometer reading to 60° F. (15.6° C.).

In using a hydrometer for estimating the concentration of sugar solutions the hydrometer is read in a solution of known temperature, and then by means of similar empirical tables the percentage of sugar is obtained.

Summarizing the scheme, the hydrometer is used to determine density, and tables are used to convert the observations to a standard basis; *e.g.*, to percentage composition. In such a system the hydrometer scale is clearly defined and not dependent on the properties of a particular liquid; the conversion of density to percentage composition, etc., is left to the users, who should be

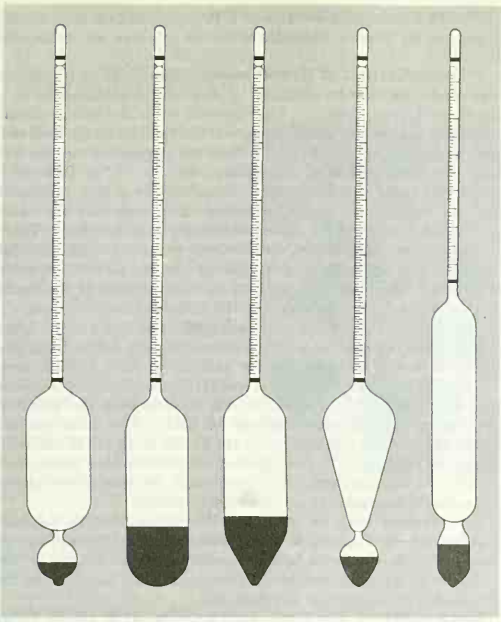

FIG. 1.—MODERN GLASS HYDROMETERS

in the best position to employ the most reliable data relating to the liquids in which they are interested; also, tables can be revised without making hydrometers obsolete.

The wide use of arbitrary-scale hydrometers, in preference to instruments graduated in terms of density or specific gravity, results from the recognized advantage of using simple whole numbers instead of long, not so easily remembered decimals. For example, "190 proof" ethyl alcohol is a more convenient designation than "ethyl alcohol having a specific gravity of 0.81603 at 60°/60° F." or "95% ethyl alcohol by volume at 60° F." The syringe used to determine the freezing points of antifreeze solutions in automobile cooling systems is a familiar arbitrary-scale instrument. The hydrometer float is enclosed in a glass tube into which the solution is drawn by the syringe bulb. The hydrometer often is calibrated to show directly the freezing point of the solution. In most such instruments a temperature correction is disregarded, the results being sufficiently accurate for practical purposes.

Principles of Hydrometer Design.—The range of densities within which a given hydrometer operates is a function of the mass of the hydrometer M (in grams), the volume of the bulb V (in millilitres) below the lowest graduation mark, and the volume of the stem v (in millilitres) between the highest and lowest marks. The relationship may be expressed as $M = \delta_0(V + v) = \delta_N V$, where δ_0 is the density (in grams per millilitre) at the highest mark and δ_N the density corresponding to the lowest mark. Thus, given a range of densities, the designer specifies the relation of bulb volume to stem volume as

$$V = v \times \frac{\delta_0}{\delta_N - \delta_0}$$

Spacing of Graduation Marks.—Let δ be the density corresponding to any graduation mark between those indicating the limiting densities δ_0 and δ_N and let v' be the volume of the stem between the marks for δ_0 and δ. Then $M = \delta_0(V + v) = \delta(V + v - v') = \delta_N V$, and eliminating M and V gives

$$v' = v \times \frac{\delta - \delta_0}{\delta_N - \delta_0} \times \frac{\delta_N}{\delta}$$

If the stem diameter is uniform, and L is the distance between the δ_0 and δ_N marks, and l is the distance from the highest graduation mark to the δ mark, then

$$l = L \times \frac{\delta - \delta_0}{\delta_N - \delta_0} \times \frac{\delta_N}{\delta}$$

For a hydrometer of range 1.000 (δ_0) to 1.050 (δ_N) g. per millilitre, having $L = 150$ mm., the above relation gives the following values:

Distance from	1.000	mark to	1.010	mark	= 31.2	mm.
"	1.010	"	1.020	"	= 30.6	"
"	1.020	"	1.030	"	= 30.0	"
"	1.030	"	1.040	"	= 29.4	"
"	1.040	"	1.050	"	= 28.8	"

The length corresponding to a change in density of 0.010 g. per millilitre therefore decreases toward the lower end of the scale; *i.e.*, the graduation marks on a density hydrometer become more closely spaced as density increases.

Temperature Corrections for Density Hydrometers.—Suppose a hydrometer is correctly adjusted to read δ g. per millilitre in a liquid at $t°$ C. and also to read δ when placed in a second liquid at $t'°$ C.

The density of the first liquid at $t°$ is $\delta = M/V$, M being the mass of the hydrometer and V the volume of the portion of the hydrometer below the mark δ.

When the hydrometer is reading δ in the second liquid at $t'°$, the volume of the submerged portion of the hydrometer is $V\{1 + \alpha(t' - t)\}$ ml. where α is the coefficient of cubical expansion of the hydrometer. The corrected density δ' at $t'°$ of the second liquid is therefore given by the equation

$$\delta' = \frac{M}{V\{1 + \alpha(t' - t)\}}$$

or to a close approximation $\delta' = \delta\{1 - \alpha(t' - t)\}$.

Let c be a correction to be applied to the reading δ in the second liquid in order to give the density δ' of that liquid at $t'°$. Then $\delta' = \delta + c$, whence $c = \delta\alpha \cdot (t - t')$. An average value for α is 0.000026 in glass hydrometers, so that if $(t - t')$ is 10° C. the following values of c result for various values of δ:

δ	0.6	1.0	1.5	2.0
c	0.0002	0.0003	0.0004	0.0005

An error of 0.0005 g. per millilitre is negligible for most purposes for which hydrometers are used and so the above values of c are commonly negligible. Hence a hydrometer that indicates densities correctly at its standard temperature $t°$ C. may be used at any temperature within the range $(t \pm 10)°$ C. and will still indicate densities at the temperature of observation with sufficient accuracy for ordinary purposes.

It is possible to prepare tables to correct to standard temperature for individual liquids, and corrections for change in volume of hydrometer as well as for density change of liquid can be included.

Effects of Surface Tension on Hydrometer Readings.—When a hydrometer is floating the liquid piles up against the stem. There is a downward pull on the stem of the hydrometer equal to $T \times \pi \times d/10$ dynes for a stem of circular cross section where T is the surface tension in dynes per centimetre and d mm. is the diameter of the stem. The virtual effect of this is to increase the mass of the hydrometer by an amount equal to $\frac{\pi dT}{10g}$ where g is the acceleration caused by gravity in centimetres per second per second (*see* fig. 2).

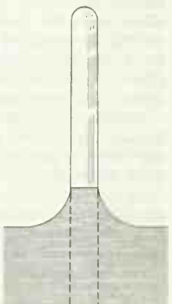

FIG. 2.—SURFACE TENSION ON A HYDROMETER

Suppose that a hydrometer reads δ in a liquid having a surface tension T_1 and that this reading correctly represents the density. Now suppose the hydrometer to be placed in a second liquid having the same

density but a greater surface tension T_2. The virtual increase in mass due to surface tension in the second liquid will exceed that in the first liquid by

$$\frac{\pi d}{10g} \cdot \left\{T_2 - T_1\right\}$$

Hence the hydrometer will sink deeper in the second liquid. If l mm. is the additional length of stem submerged in the second liquid, the increase in the mass of liquid displaced by the hydrometer is

$$\frac{\pi}{4} \cdot \frac{d^2}{100} \cdot \frac{l}{10} \cdot \delta$$

Hence

$$\frac{\pi d}{10g}\left\{T_2 - T_1\right\} = \frac{\pi}{4} \cdot \frac{d^2}{100} \cdot \frac{l}{10} \cdot \delta$$

from which

$$l = \frac{400}{d\delta g}\left\{T_2 - T_1\right\}$$

Let λ be the length of a subdivision on the hydrometer scale near the point corresponding to the density δ and let $\phi = l/\lambda$. From the above equations

$$\phi = \frac{400}{\lambda d\delta g}\left\{T_2 - T_1\right\}$$

where ϕ represents the error in terms of subdivisions corresponding to a change in the surface tension amounting to $\{T_2 - T_1\}$. It is obviously desirable that ϕ should be as small as possible; *i.e.*, that λd should be as large as possible. For a hydrometer having $\lambda = 1.5$ mm. equivalent to 0.001 g. per millilitre, if $\delta = 1.030$ g. per millilitre and $d = 5$ mm. then $\phi = 0.053\ \{T_2 - T_1\}$. If such a hydrometer is adjusted to read correctly at 1.030 in dilute sulfuric acid having a surface tension of 70 dynes per centimetre and is used in milk of the same density but having a surface tension of 50 dynes per centimetre, then ϕ is 1.03, so that the hydrometer is in error when used in milk by slightly more than one whole subdivision; *i.e.*, slightly more than 0.001 g. per millilitre.

Some liquids, notably dilute aqueous solutions, have high surface tensions when the liquid surface is perfectly clean, but even very slight contamination may lower the surface tension by as much as 20 dynes per centimetre. The errors consequent upon such variations in surface tension are the most serious of the limitations to the accuracy attainable with hydrometers.

Hydrometer Scales in Common Use.—Specific gravity, written $S_{t_1°/t_2°}$, is the ratio of the density of the liquid at a temperature of $t_1°$ to the density of water at $t_2°$, and is in most common use.

Sikes's hydrometer is of metal and can be made heavier by the addition of weights. The hydrometer reading, referred to special tables, gives the percentage of "proof spirit" (in Great Britain, 49.28% by weight of pure alcohol). Per cent of proof spirit at 60° F. is a scale widely used in the U.S. where proof spirit contains 50% by volume of pure alcohol. Other hydrometers for alcohol have scales indicating percentages by weight or by volume.

Bates's saccharometer is a metal hydrometer used in Great Britain, with a form of specific gravity scale. The Brix hydrometer indicates percentage of sugar by weight at specified temperatures, the most common in the U.S. being 20° C. (68° F.).

Baumé hydrometers provide an evenly spaced scale graduated according to many different formulas in various countries. The U.S. national bureau of standards gives the relation between specific gravity and the Baumé scale as follows:

For liquids heavier than water,

$$S_{60°/60°\text{F.}} = \frac{145}{145 - \text{degrees Baumé}}$$

For liquids lighter than water,

$$S_{60°/60°\text{F.}} = \frac{140}{130 + \text{degrees Baumé}}$$

The Twaddell hydrometer, used with liquids heavier than water, gives specific gravity estimates when its readings are multiplied by .005.

Standardization of Hydrometers.—The errors of a hydrometer obviously may be obtained by reading the hydrometer in a liquid of known density. One method is to determine simultaneously the density of the liquid and the reading of the hydrometer in the liquid. This can be done by employing the electromagnetic float method of determining density. (*See* DENSITY.) The hydrometer and float can be placed side by side in the liquid and the hydrometer reading observed under precisely the same conditions as those under which the density is determined. Thorough stirring just before observations are made and efficient temperature control are essential to secure uniform density throughout the liquid and to bring the temperature of the liquid to that at which the corrections to the hydrometer are required.

The direct standardization of hydrometers by this method takes considerable time and generally is employed only for hydrometers intended for use as standards for calibrating other hydrometers. Given a hydrometer with known scale errors, a similar hydrometer may be calibrated by floating it side by side with the standard and taking simultaneous readings on both. The difference between the readings combined with the known error of the standard gives the correction to the scale of the hydrometer under test. If the two hydrometers differ appreciably in dimensions, allowance should be made for surface tension effects.

Hydrometers may be submitted for verification to national institutions—in England to the National Physical laboratory; in the U.S. to the national bureau of standards; in France to the Laboratoire d'Essais; and in the German Federal Republic to the Physikalische Technische Reichsanstalt.

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(E. L. PR.; V. ST.; J. C. HS.; X.)

HYDROPATHY, the treatment of disease by water, commonly called the "water cure," is a system that professes to cure all disease by water. The use of water medicinally both by application and by drinking was recognized by the ancient Greeks and Romans and older civilizations. Hydropathy as a formal system, however, came into vogue about 1829 under the leadership of Vincent Priessnitz (1801–1851), a Silesian farmer who believed in and widely publicized the medicinal values of the water upon his paternal homestead. It became a popular and accepted form of medical treatment during the 19th century both in Europe and in America.

The term hydropathy is not widely used in modern times; the formal system of hydropathy is divided into two categories: spa therapy and hydrotherapy. Spa therapy, much more accepted medically in Europe than it is in the United States, is based on both drinking and bathing in certain waters containing agents believed to be of medicinal value. Many United States authorities believe that most of the medicinal effects of spa therapy are indirect, resulting from the relaxation of the patient as the result of the environmental factors of the spa.

There is much more widespread medical acceptance of the scientific value of hydrotherapy, the external application of water for specific therapeutic purposes. Its primary values are found through its versatility as a medium for the external application of heat, which brings about an increase in the temperature of the tissues, vasodilation and an increase in circulation. Sedation and relief of pain and muscular tension are the best-accepted effects of heat therapy. The hydrotherapeutic means of applying heat most usually used are whirlpool baths, the Hubbard tank (underwater mechanical massage), hot packs, contrast baths and paraffin. Because the effects of superficial heating are practically the same regardless of the source and type selected, its application is based on availability of source, extent of area to be treated, depth of effective penetration, time necessary to produce desired effects, ease of application, margin of safety and individual preference. Hydrotherapy is a therapeutic modality usually employed

by specialists in physical medicine and rehabilitation and by physical therapists.

See also PHYSICAL THERAPY. (H. A. RK.)

HYDROPHOBIA: *see* RABIES.

HYDROPHYLLACEAE, the waterleaf family of dicotyledonous flowering plants belonging to the order Polemoniales, containing annual or perennial herbs and shrubs (*Eriodictyon, Wigandia*) with regular five-merous sympetalous flowers, the ovary usually unilocular with parietal placentae, and a several- to many-seeded capsule. The flowers, often showy and mostly insect pollinated, are chiefly blue, purple or white in one-sided (helicoid) cymes.

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PHACELIA, LARGEST GENUS IN THE FAMILY HYDROPHYLLACEAE

Similarities and affinities are perhaps greatest to Boraginaceae, from which they differ principally in the capsular fruit, an unlobed ovary and bifurcated terminal styles. They comprise a small family of about 18 genera and 250 to 300 species, found chiefly in western United States, the best-known genera being *Nemophila* (baby-blue eyes), *Phacelia* (the largest genus), *Eriodictyon* (yerba santa), *Hydrophyllum, Wigandia, Nama* and *Hydrolea* (pantropical). (LN. C.)

HYDROPHYLLUM, commonly called waterleaf, a small genus of mostly perennial North American herbs of the Hydrophyllaceae family. They have large, attractive, palm-shaped leaves, about a foot across, and clusters (one-sided cymes) of small, bell-shaped, greenish white, blue or purple flowers. *H. canadense* and *H. virginianum* are often planted in partial shade in the wild garden.

HYDROPLANE: *see* BOATING.

HYDROPONICS, from the Greek *hydro,* "water," and *ponos,* "labour," refers to the growing of plants without soil and is sometimes called soil-less culture.

For many years in the study of their nutrition, plants were grown with their roots immersed in solutions, but the commercial adoption of this method of culture was not entirely successful because of difficulties in plant support and solution aeration. Gravel culture therefore largely supplanted solution or water culture as a means of growing plants without soil. An inert medium such as gravel of various kinds, fused shale and clay, granite chips or other such materials with a particle size of one-fourth inch to three-eighths inch in diameter serves as a support for the plants. This medium is placed in a watertight bed or bench and a fertilizer solution is periodically pumped each day into the bench or bed, the frequency depending upon the prevailing light intensity and temperature, and other weather factors, the size of plants or concentration of the fertilizer solution, stronger solutions being pumped more frequently. The solution drains back into a tank and the frequency of pumping usually is controlled automatically.

The solution is composed of different fertilizer-grade chemical compounds containing varying amounts of nitrogen, phosphorus and potassium, the major elements necessary for plant growth. These fertilizers also contain compounds of various trace or minor elements, such as sulfur, magnesium, calcium, etc. There are many satisfactory formulas for fertilizer solutions; one proved successful with florist crops is:

Chemical	Per 1,000 gal. of water
Potassium nitrate	5 lb. 13 oz.
Ammonium sulfate	1 lb.
Magnesium sulfate (Epsom salts)	4 lb. 8 oz.
Monocalcium phosphate	2 lb. 8 oz.
Calcium sulfate	5 lb.
Total	18 lb. 13 oz.

The chemicals can be mixed in dry form and stored if desired. The concentration of the solution is increased as the plants grow larger by using 1½ or 2 times the amount of chemicals per 1,000 gal. of water. To the above solution is added each week four ounces of iron (ferrous) sulfate and one ounce of manganous sulfate dissolved in a gallon of water acidified with several drops of sulfuric acid. Other trace elements are added if necessary. Tests of the solution are made every two or three weeks for pH (acidity) and the major elements and additions of the necessary chemicals are made as needed. The solution can be used indefinitely with the necessary additions of water and chemicals.

The main advantage of gravel culture is in the labour saved by automatic watering and fertilizing, though installation costs are higher than costs for plants grown in soil. No greater yields may be expected than from similar plants in soil in the same environment. A wide variety of vegetables and florist crops can be grown satisfactorily in gravel culture. Commercial acceptance of hydroponics is impeded by high installation costs, the necessity for frequent testing of the solutions and the greater familiarity of plant cultivators with soil. For further discussion of the elements necessary for plant growth *see* FERTILIZERS AND MANURES. *See* also PLANTS AND PLANT SCIENCE: *Metabolism.*

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HYDROSPHERE, the whole mass of oceanic waters filling the major depressions in the earth's crust, and covering about 72% of its surface. The name is used in distinction from the atmosphere (*q.v.*), the lithosphere and the centrosphere or mass within the crust.

HYDROSTATICS, the branch of hydromechanics which deals with the equilibrium of fluids (*see* MECHANICS, FLUID).

HYDROXIDE, a term used in its most general sense to designate any chemical compound containing oxygen and hydrogen bonded together in the OH group. One or more of the OH groups are in turn linked to another element or radical. Employed in this broad sense the name is indicative of the composition but not necessarily the nature of the compound. In practice it is therefore preferable to restrict the term to those compounds containing the hydroxide ion, OH^-, and the positively charged ion of a metal or a radical, *e.g.*, sodium hydroxide; it is also preferable to characterize the presence of the hydroxyl radical, OH, by hydroxy, as in the organic compound hydroxyacetic acid, $CH_2OHCOOH$, and in co-ordination compounds by hydroxo, as in potassium tetrahydroxoaurate, $KAu(OH)_4$.

The hydroxides include the familiar bases of the laboratory and industrial processes. Those of the alkali metals, lithium, sodium, potassium, rubidium and cesium, are the strongest bases, the most stable and the most soluble of the hydroxides. Lithium hydroxide is somewhat unlike those of the other metals of this group, being less soluble and less stable; it decomposes at red heat, losing water to form the oxide Li_2O, whereas the others may be volatilized without loss of water. Sodium hydroxide (*see* ALKALI), NaOH, also known as caustic soda or lye, is of great industrial importance. Calcium, barium and strontium, alkaline earth metals, form soluble hydroxides which are strong bases but less stable than the alkali hydroxides. Of these calcium hydroxide or slaked lime is the most common. With the exception of thallium hydroxide, TlOH, the hydroxides of other metals such as magnesium, iron, bismuth, nickel, cobalt and copper are only sparingly soluble in water but react with acids. The hydroxides of beryllium, lead, zinc, aluminum, chromium (trivalent), tin (divalent), gold (trivalent) and certain other metals show both acidic and basic properties; that is, they dissolve in water solutions of either bases or acids. Hydroxides and other substances, *e.g.*, oxides and sulfides, with these dual properties are called amphoteric.

Oxygen acids, although structurally represented to show the presence of hydroxyl radicals, *e.g.*, boric acid, $B(OH)_3$, and hypochlorous acid, $Cl(OH)$, are not called hydroxides. (J. B. Ps.)

HYDROXYLAMINE, represented by the formula NH_2OH, was first prepared in 1865 by W. C. Lossen as the chloride by the reduction of ethyl nitrate with tin and hydrochloric acid. Hydroxylamine reacts with aldehydes and with ketones to form the important class of organic compounds known as oximes (*q.v.*). Oximes can be reduced easily to amines; they find use in the manufacture of dyes, plastics, synthetic fibres and medicinals.

The synthesis of hydroxylamine may be effected by the following general procedures: (1) chemical or electrochemical reduction of nitric acid, nitrous acid, nitrates and nitrites, and of oxides of nitrogen; (2) interaction of nitrites with acid sulfites in 1:2 molar proportions to yield the hydroxylamine disulfonates which are easily hydrolyzed to form hydroxylammonium sulfate ($NO_2^- + 2HSO_3^- + H^+ \rightarrow HON(SO_3)_2^{2-} + H_2O$; $HON(SO_3)_2^{2-} + 2H_2O \rightarrow NH_2OH.H^+ + 2SO_4^{2-}$); (3) oxidation of ammonia; and (4) hydrolysis of nitroparaffins ($RCH_2NO_2 + H^+ + H_2O \rightarrow RCOOH + NH_2OH.H^+$). Although electrolytic reduction of nitric acid in presence of sulfuric acid at low temperatures using amalgamated lead cathodes once furnished most of the hydroxylamine, methods (2) and especially (4) have gradually assumed greater technical importance. These technical processes may, however, be supplanted by a procedure which entails the catalytic hydrogenation of nitric oxide in the presence of acid ($NO + 3[H] + H^+ \rightarrow NH_2OH.H^+$) to yield hydroxylamine salts.

Pure anhydrous hydroxylamine was first obtained by C. A. Lobry de Bruyn from the chloride by treating an absolute methyl alcoholic solution with sodium methylate ($NH_2OH.HCl + NaOCH_3 \rightarrow NaCl + NH_2OH + CH_3OH$). The precipitated sodium chloride is filtered and hydroxylamine recovered after removal of alcohol by distillation under reduced pressure. Butyl alcohol and sodium butylate are preferred since addition of ether to the solution of hydroxylamine and cooling yields the free base as a solid product. The pure compound is a colourless, odourless crystalline solid, melting at 33° C., boiling at 58° C. (at 22 mm.) and decomposing readily at higher temperatures, sometimes with explosive violence. It is very soluble in water to give solutions which are moderately stable and less basic than aqueous solutions of either ammonia or hydrazine, both of which it resembles chemically. The dissociation constant for hydroxylamine as a base (*e.g.*, $NH_2OH.H_2O \rightleftarrows NH_2OH.H^+ + OH^-$) is $K = 6.6 \times 10^{-9}$. Hydroxylamine inflames in dry chlorine and is reduced to ammonia by zinc dust. It combines with sulfur dioxide to give sulfamic acid ($NH_2OH + SO_2 \rightarrow NH_2SO_3H$). It is a strong reducing agent, giving a precipitate of cuprous oxide from alkaline copper solutions and depositing metallic silver from solutions of silver salts. Under certain conditions it may act as an oxidizing agent, as in the conversion of ferrous hydroxide to ferric hydroxide. It is highly probable that two structures may be assigned to hydroxylamine, viz., H_2NOH in acid solution and H_3NO, the amine oxide formulation, in alkaline solution (F. Haber). Although many methods have been suggested for the estimation of hydroxylamine, most of them depend on careful adjustment of the acidity of the solution. That of F. Raschig, however, is less sensitive to conditions and is the most trustworthy; the hydroxylamine solution is boiled with a considerable excess of ferric sulfate in sulfuric acid, and the ferrous salt thus formed by reduction [$2Fe_2(SO_4)_3 + 2NH_2OH \rightarrow 4FeSO_4 + 2H_2SO_4 + N_2O + H_2O$] is titrated with potassium permanganate.

Hydroxylammonium salts form readily, the sulfate and the chloride being best known. Like ammonia, hydroxylamine forms co-ordination compounds such as $ZnCl_2.2NH_2OH$ and $[Co(NH_2OH)_6]Cl_3$ (*See* Co-ordination Compounds). The hydroxylamine derivatives of sulfuric acid include salts of the hydroxylamine mono-, di-, tri-, isodi- and isomono- sulfonic acids with the respective formulas: $HONH(SO_3H)$, $HON(SO_3H)_2$, $(HSO_3)NO(SO_3H)_2$, $(HSO_3)ONH(SO_3H)$ and $H_2NO(SO_3H)$. The hydroxylamine isomonosulfonic acid, more properly designated as O-hydroxylamine sulfonic acid, is a powerful oxidizing and aminating agent, prepared by reaction of hydroxylamine sulfate with oleum (*see* G. T. Moeller [ed.], *Inorganic Syntheses*, vol. v [1958]).

Hyponitrous acid, $HON=NOH$, may be regarded as one of the hydroxylamine derivatives of nitrous acid, and its salts are readily prepared from hydroxylamine and an alkyl nitrite in alcoholic solution in the presence of a base. The related nitrosohydroxylamine, $HN(NO)OH$, is known only in the form of organic derivatives such as "cupferron," a widely used analytical reagent, which is the ammonium salt of N-phenylnitrosohydroxylamine, $C_6H_5N(NO)ONH_4$.

The organic hydroxylamines are compounds in which one, two or all three hydrogen atoms are replaced by organic radicals. Their structure may be indicated using the older convention by specifying substitution either in the α or β positions:

$$\overset{\beta}{H_2N} - \overset{\alpha}{OH}$$

but preferably by prefixing N or O to designate the point of attachment. Thus, NH_2OCH_3 is O-methylhydroxylamine, whereas C_6H_5NHOH is N-phenylhydroxylamine. Trisubstituted hydroxylamines are generally considered to be amine oxides, R_3NO (*see* above), and are obtainable by the action of hydrogen peroxide on tertiary amines (*see* Amines). Other well-known organic derivatives include the hydroxamic acids,

$$RC(=O)-NHOH$$

and the amidoximes, $RC(NH_2)NOH$, both derivable from, and related generically to, the carboxylic acids.

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HYDROZOA, a class of animals, the vast majority of which are marine, belonging to the phylum Coelenterata (*q.v.*). The Hydrozoa include not only the cylindrical polyp (*q.v.*) forms, such as the solitary fresh-water hydra (*q.v.*), but also medusae (sometimes called hydromedusae) or jellyfish (*q.v.*). They are, in fact, that group of Coelenterata in which neither the one nor the other of these two forms of body predominates, and in this respect they contrast strongly with the other main classes (Scyphozoa and Anthozoa). Moreover, both polyp and medusa have a simpler plan of structure than in the other classes.

The polyp itself is frequently (though not always) small. Its mouth leads directly into the internal cavity of its body (coelenteron), without the intermediary of a definite throat or gullet of any kind, and the epidermis and gastrodermis meet at the lips. The coelenteron is a simple cavity lined by gastrodermis; it is not subdivided by partitions into lesser cavities, nor does it contain definite organs of any kind. With these limitations the actual form of the polyp varies very greatly. The medusa presents infinite variety of form, but it too lacks a throat, and although its coelenteron sends out radiating canals that run from the central cavity through the solid tissues of the bell, it is otherwise simple in that it contains no definite organs. The medusae of Hydrozoa are, generally speaking, smaller and more slightly built creatures than the medusae belonging to the related class Scyphozoa, although in certain cases they attain a larger size than the average, which is a matter of millimetres.

The Hydrozoa are also characterized by the fact that the sex cells, when they ripen in the clusters known as gonads, typically lie in or under the epidermis, although the site of their original formation may be in either epidermis or gastrodermis. It is among the Hydrozoa above all other Coelenterata that the phenomenon known as polymorphism (variation in body form) attains its height. The details of this condition are described in parts of the present article and a summary of the question is given after the section *Siphonophora*, below.

The infrequency of brackish or fresh-water forms among the Coelenterata makes their occurrence of interest. The ordinary marine Hydrozoa are either pelagic (swimming or floating organisms) or sedentary, according to their nature, and many of either kind exist. The brackish and fresh-water forms exhibit the same diversity, though few in number. One of the most interesting is a

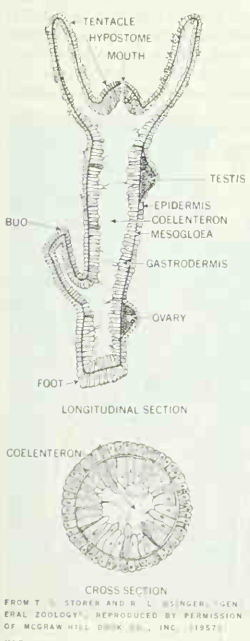
minute creature, *Protohydra*, the length of which is about 3 mm. This organism inhabits the surface layer of mud, rich in diatoms, which is to be found in the bottom of pools in certain tidal marshes; it also occurs in oyster beds and similar places. It is carnivorous, and reproduces freely by transverse fission. It possesses no tentacles, and is as simple in structure as any known coelenterate.

The best known of the nonmarine Hydrozoa, however, are the genera *Craspedacusta, Limnocnida, Cordylophora* and the hydras. Of the hydras more details are given below, and the chief interest of *Cordylophora* lies in the fact that it may flourish in water of different degrees of salinity as well as in fresh water; it is otherwise ordinary. *Craspedacusta sowerbyi* possesses a feebly developed polyp generation (up to about 2 mm. long) that produces small colonies containing about two to seven individual polyps without tentacles. These colonies can produce buds of two kinds; some become separated from the parent, form polyps and produce new colonies; others develop into medusae, and these are liberated and swim away. The species of *Craspedacusta* (with which is now included *Microhydra*, the former name for the polypoid stage) are not very clearly recognized; but representatives of the genus occur in lakes, millstreams and similar places in North America, Europe and Asia, and have appeared in water lily tanks at various botanic gardens, and in other tanks and aquaria.

The Hydrozoa may be divided into three orders: Hydroida, including the majority of hydrozoans; Trachylina, chiefly medusoid forms; and Siphonophora, with highly polymorphic swimming or floating colonies. Some authorities add two more orders: Milleporina and Stylasterina, both of which are characterized by their members having massive calcareous exoskeletons; they are often grouped together as the Hydrocorallina, but are here considered as belonging to the order Hydroida.

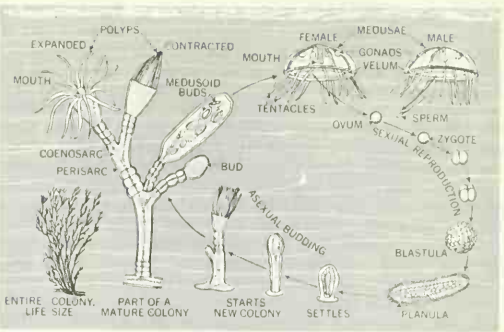
HYDROIDA

The Hydroida are, roughly, those hydrozoans that possess a definite alternation of the polypoid and medusoid generations in their life history: the polyp is sedentary and usually constructs a fixed colony, whereas the medusa is free-swimming when fully developed. There are exceptions to this general statement, but they are not characteristic of the group as a whole. The variety of form and life history exhibited, however, is great. The common and well-known fresh-water hydras (*Hydra, Chlorohydra, Pelmatohydra*), along with *Craspedacusta*, are the only thoroughly successful fresh-water coelenterates. Both forms, however, are atypical hydroids: the hydras have no medusoid stage and *Craspedacusta* species have a much reduced hydroid stage. Hydras, of one species or another, occur in ponds and ditches and similar situations in many parts of the world. They are small isolated polyps, each with a pillarlike body and a limited number of tentacles. The length of the body is a matter of millimetres, and the tentacles in some species may be longer when stretched out than the body, although both they and the body can contract into rounded knobs. The hydra attaches itself to stems and waterweeds, or floats beneath the surface film. It catches prey, often



FROM T. S. STORER AND R. L. USINGER, "GENERAL ZOOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1957)

FIG. 1.—STRUCTURE OF HYDRA: (TOP) LONGITUDINAL SECTION; (BOTTOM) CROSS SECTION



MODIFIED FROM R. WOLCOTT, "ANIMAL BIOLOGY"; REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1946)

FIG. 2.—STRUCTURE AND LIFE CYCLE OF OBELIA, A COLONIAL MARINE HYDROID

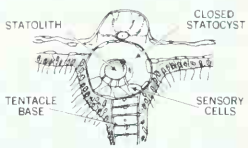
of a large size compared with its own bulk, in the manner characteristic of the Coelenterata by stinging and then swallowing it (*see* COELENTERATA). From the body of the hydra there grow out buds, each of which acquires tentacles of its own and ultimately becomes separated from the parent; but no medusae whatever are produced, this being quite exceptional among the Hydroida. Most hydras are dioecious, *i.e.*, either male or female, but some species are hermaphroditic, bearing ovaries and testes on different parts of the body (fig. 1).

The few other simple genera which are known, such as *Protohydra*, may be related to *Hydra* or may be primitive or degenerate forms of separate origin. With the above preliminary, the characteristics of the group as a whole, without reference to these special forms, may be considered.

Structure.—The following is a description of the structure of a typical hydroid, provided by the genus *Obelia* (fig. 2). *Obelia* begins its life as a single polyp, possessing a number of simple tentacles in a circlet around the base of its conical proboscis, or manubrium. The polyp sends out rootlike structures (hydrorhizae) that attach it to the surface of a stone, the frond of a seaweed or other suitable support, and grows a stalk that raises it somewhat in the water. From this stem a bud arises from which, although it is at first a mere knob, a new polyp is gradually developed. This process of growth proceeds in a definite and regular manner, until a small treelike colony, from less than an inch to several inches in height, is formed; the branches are definitely arranged, and all bear polyps. If one of the colonies is examined in detail, it will be found that each of the polyps possesses, outside its body, a little transparent cup of relatively stiff, chitinous material, into which it can withdraw when alarmed; and that not only are the polyps connected with each other by a stem composed of soft tissues, but the cups also are connected by a chitinous layer, outside the soft stem, that stiffens and supports the latter. The cups are known as hydrothecae, the soft stem as coenosarc and the chitinous layer (including stem and cups) as the perisarc. The new polyps develop only from the tips of a branch of coenosarc, and not from one another; and in a well-developed colony it will be seen that some additional branches have grown out, most in the lower part of the colony, each of them similar in structure to a developing polyp, and usually regarded as representing one. These branches, known as blastostyles, do not develop a mouth and tentacles; instead each produces a number of buds that gradually develop into small medusae and that are known as medusoid buds. The blastostyle, like an ordinary polyp or hydranth, has a covering of perisarc known as a gonotheca, but this is at first imperforate. In due course it becomes open at the end, and the medusae separate from the blastostyle and swim away into the sea, where, after a period of free life, they produce eggs and sperms, which, after fertilization, develop into new polyps.

The fully developed medusa has the form of an umbrella, or bell, with a manubrium similar to that of a polyp hanging down inside

it and bearing the mouth at its end (fig. 2). The manubrium is lined by gastrodermis, and contains a cavity, the main part of the coelenteron. The substance of the umbrella consists of jellylike mesogloea with epidermis on both external surfaces. In the *Obelia* medusa the layer of mesogloea is penetrated by four narrow tubes or canals, lined by gastrodermis, which run out from the base of the manubrium like the four arms of a cross. Connecting these radial canals with each other is a flat sheet of gastrodermis (endoderm lamella or mesolamella) and also a circular canal that runs round the edge of the umbrella close to the bases of the tentacles. The tentacles are solid in *Obelia,* both in the medusa and polyp. At the edge of the bell, on the inner side of the ring of tentacles, is a little circular shelf (the velum) that projects inward and slightly narrows the opening of the bell. Around the margin of the bell, at the bases of certain of the tentacles, lie the sense organs, minute sacs, formed by the epidermis, and each containing a calcareous particle (the statolith). They are known as statocysts (fig. 3) and in *Obelia* are eight in number, two being definitely placed in each of the quadrants between the radial canals; they probably initiate and control the swimming contractions of the bell. The sex cells of the medusa ripen in the epidermis of each of the four gonads (one to a radial canal), which, when ripe, shed their products into the sea. The fertilized eggs develop into new polyps, which initiate fresh colonies.



FROM L. H. HYMAN, "THE INVERTEBRATES: PROTOZOA THROUGH CTENOPHORA". REPRODUCED BY PERMISSION OF MCGRAW HILL BOOK CO., INC. (1940)

FIG. 3.—CLOSED STATOCYST OF OBELIA

Other Hydroida depart from *Obelia* in modifications of one kind or another. In some cases the polyp generation, which usually forms a colony, includes a single nutritive individual only. The individual polyps and medusae, as well as the colony, undergo great modification however.

The polyps sometimes possess cups of perisarc as does *Obelia,* but often they are without these. Their tentacles are simple, or knobbed at the tip, or branched; arranged in one circlet or in two (one round the lip, one at the base of a conical manubrium), or irregularly over part or most of the surface of the polyp.

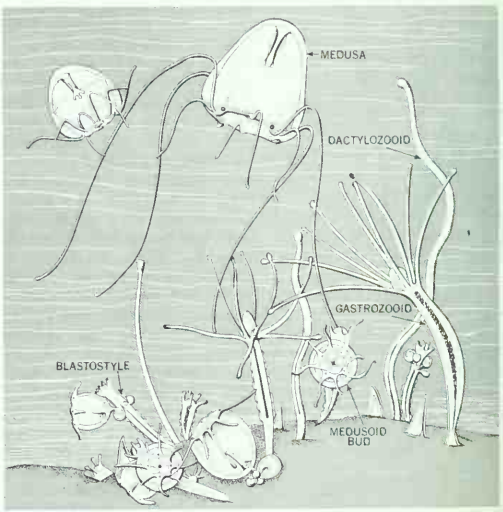
The medusae vary even more than the polyps, both in shape and structure. The shape of the bell may be shallow, almost flat, or high domed, and varies with the movements of the animal. The number, arrangement and structure of the tentacles varies considerably from species to species.

The living medusae are some of the most beautiful of marine creatures. Their transparency, which is often touched with definite colour in given parts, and the regularity of their structure are responsible for this, and in some cases their movements also are extremely graceful. The sense organs vary from one kind of medusa to another. Statocysts are present in a number of cases, and these exhibit varying degrees of complexity of structure, with this in common to all of them—that the epithelium of the statolithic sac or pit (the simplest of statocysts consist of an open pit) is derived from the epidermis, and no gastrodermis takes part in its formation. Many medusae possess sense organs of another nature, known as ocelli, and these are sensitive to light. In their simplest condition they consist of a clump of sensory cells mingled with pigment cells; the more complicated ones possess a definite lens. These ocelli may be situated close to statocysts. Many medusae possess ocelli only, and others statocysts only. Another important variation in structure is that in some medusae, as in *Obelia,* the gonads are situated on the radial canals, but in many others the sex cells ripen instead on the manubrium.

Colonies.—These are frequently small and relatively soft, the chitinous perisarc giving a considerable amount of support, but not constituting a really rigid skeleton. Many such colonies are an inch or less in height, although colonies several inches long are common. Only rarely does the colony become actually large, but in a few cases it achieves a size and solidity that give it rank with the reef-forming corals; in these cases the skeleton is massive and calcareous, and is in fact coral.

Hydroid colonies are, roughly speaking, of two kinds—matlike and treelike structures. The matlike forms consist of a network of hydrorhizae attached to a stone, seaweed or other support, from the upper surface of which arise the polyps. The network is sometimes straggling, sometimes compact, and may form a continuous sheet. The treelike forms are mostly delicate feathery structures, resembling rather the fronds of a finely divided seaweed than any animal. The size of the whole colony, the exact way in which it branches and the way in which one polyp after another is added upon a branch affect the general appearance of the ultimate result. Sometimes the branches themselves are thick and are composed of a dense network of branching hydrorhizae, the polyps projecting at the surface. This condition, which is achieved in a manner different from that of the average treelike colony, is found in the massive, limy colonies.

These massive forms deserve special mention. They have been considered in time past as a separate group of Hydrozoa, the Hydrocorallina, but it has become evident that they may be simply hydroids with a more than usually solid skeleton, and that some of them are probably related to one series of hydroid ancestors and others to a different series. A good example of these creatures is found in *Millepora.* This animal constructs a colony containing innumerable minute individual polyps, which are connected with each other by a continuous surface sheet of epidermis and by a network of ramifying tubular hydrorhizae. The colony secretes a massive, limy skeleton that may become a foot or more in height, and that, though varying in form in different species, is often branched somewhat like the antlers of a stag, but in more compact fashion. The polyps inhabit little pits in the surface of the skeleton, and can retire into these completely when alarmed. The network of hydrorhizae is lodged in a network of canals in the surface layers of the skeleton, the deeper parts consisting of coral only and containing no soft parts; this internal portion was secreted by the soft parts originally, but as growth proceeded and further skeleton was formed, these retired to the surface layers. One can imagine that a similar state of affairs would be produced if a colony such as that of *Clathrozoon* were to secrete limy material into the meshes between its network of hydrorhizae. *Millepora* is extraordinarily interesting in one respect: when the time comes for sexual medusae to be produced by the colony, these are not formed from buds as in *Obelia* and other hydroids; instead the sex cells, which are migratory, move from the hydrorhizae



FROM KUKENTHAL, "HANDBUCH DER ZOOLOGIE"

FIG. 4.—PART OF A COLONY OF PODOCORYNE (ENLARGED), SHOWING GASTROZOOIDS, DACTYLOZOOIDS, BLASTOSTYLES AND MEDUSOID BUDS, AS WELL AS FREE MEDUSAE

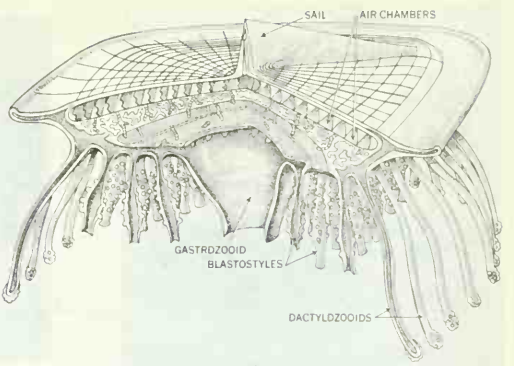
into one or another of the polyps. Each polyp so affected loses under their influence its characteristic structure, and becomes transformed by degrees into a medusa. The pit surrounding it enlarges and becomes closed in, so that it forms a cavity cut off from the outer world, and until the medusa is ready to escape it remains so; finally the cavity opens again and the medusa comes out. It is a weak swimmer and cannot feed; it swims a very short distance before shedding its ripe eggs or spermatozoa, the union of which gives rise to polyps that begin the life cycle anew.

Diversities Exhibited by the Polyps and Medusae.—In certain colonies, such as those of *Millepora* and *Podocoryne* (fig. 4), the polyps are not all alike. Some of them, called gastrozooids, possess mouths as well as tentacles, and inside these polyps digestion of food takes place. Other polyps, on the contrary, possess no mouths but may have tentacles and are well provided with stinging capsules (nematocysts). These polyps themselves cannot feed, but they play a defensive part in the colony and assist the others in the capture and paralyzing of food; they are known as dactylozooids. This is a simple example of the phenomenon of polymorphism, which has been previously mentioned and which will be further discussed below. It is carried to greater lengths in *Podocoryne* than in *Millepora*, since in the former case the colony produces also blastostyles similar in principle to those of *Obelia*. These may be regarded as modified polyps, with a body but without mouth or tentacles, which produce sexual buds. Therefore a *Podocoryne* colony possesses four kinds of individuals—gastrozooids, dactylozooids, blastostyles and sexual buds.

Medusae may arise from blastostyles or from ordinary polyps; the blastostyles may arise from the hydrorhizae of a colony or from a polyp itself. Moreover, a medusa may itself bud off others from its manubrium, or from its tentacle bases or other parts. The most remarkable fact connected with the medusae, however, is that despite the fact that a medusa is obviously an advantageous development for spreading sex cells, there is yet a strong tendency among the Hydroida toward a condition in which the medusa not only remains permanently attached to the colony from which it sprang but also becomes much reduced and simplified in structure. A series of medusae can be traced in which at one end there is found the fully formed free-swimming jellyfish, at the other end a degenerate saclike structure, devoid of any medusalike features and resembling the gonad of an active medusa, such as that of *Obelia*. This degenerate formation, which remains attached to the colony, is known as a sporosac and consists of a layer of epidermis containing or covering the sex cells and surrounding a gastrodermal core. Between these two extremes all intermediate stages may be found.

It has been considered by some authors that the sporosacs represent not a reduced but a primitive condition and that the other stages are to be regarded as developments leading up to the fully formed medusa. This would seem reasonable from the point of view that the roving medusa is an obvious gain to a fixed colony, but the facts of the case do not seem to support it. From the structure and mode of occurrence of the various grades of medusae, and from the fact that in the development of certain of the reduced forms medusoid features appear for a time and are subsequently lost, it is judged that they are not primitive but degenerate. The precocious development of the sex cells may be the factor that leads to the reduction of the medusae, the gain being increased fertility.

Of the few parasitic coelenterates known, one, a hydroid, is particularly interesting: this is *Hydrichthys boycei*. The colony is one of the matlike kind, and the mat, instead of being affixed to a stone or weed, is attached to the fins or body of a fish. The underside of it sends hydrorhizae into the integuments of the fish, and under its growing edge are cells that are able to destroy the surface of the fish's skin and expose the vascular layer beneath. The polyps, which have no tentacles, bend down over the edge of the mat, apply their mouths to the wound made by the latter, and obtain blood from the vessels of the fish. Another parasite, better known than *Hydrichthys*, is *Polypodium*, a trachyline; this is parasitic at one stage of its life in the eggs of a sturgeon, which it destroys.



FROM DELAGE AND HEROUARD, "ZOOLOGIE CONCRÈTE"

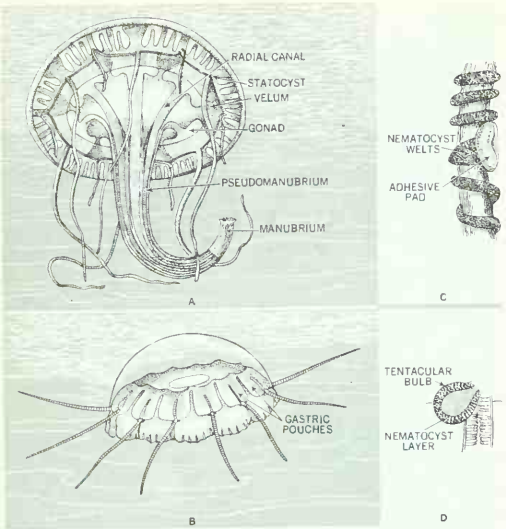
FIG. 5.—CUTAWAY VIEW SHOWING INTERNAL STRUCTURE OF BY-THE-WIND SAILOR (VELELLA)

Disputed Forms.—A colony quite unlike any so far described is formed by *Velella*, which, although it has for many years been considered a siphonophore, is now often classified with the Hydroida. Here the whole organism has the aspect at first sight of a single flat medusa bearing a sail on its upper side and tentacles around its margin (fig. 5). On closer examination it is found, however, that the apparent tentacles are really a circle of long dactylozooids, and that the underside of the disclike colony is covered by a number of curious blastostyles, which, unlike average blastostyles, possess mouths. In the centre of these is a single large gastrozooid, the only one that the colony possesses. The disclike portion of the animal to which all these polyps are attached is complex in structure. It is thick and contains below the skin layers of its upper side an internal chitinous float, below which is a mass of soft tissue, a concentrated coenosarc. The float is itself flattened in shape, is subdivided into air chambers, bears a vertical extension in the centre stiffening the "sail" and is prolonged into the soft tissues as fine air tubes. The coenosarc contains a ramifying system of gastrodermal tubules, in communication with the cavities of the various polyps, which is probably both absorptive and excretory in function. The coenosarc also contains a massive concentration of nematocysts, doubtless a depot from where they migrate, when sufficiently developed, into the parts where they can function. Very similar to *Velella* but without a sail is *Porpita*. In these creatures the colony has become so compact and the parts so markedly subordinated to the whole that their interrelation resembles rather that of organs than that of independent beings; but free medusae are liberated by the colony.

TRACHYLINA

The Trachylina are an assemblage of Hydrozoa that differ sufficiently from any of the Hydroida or Siphonophora to warrant their inclusion in a separate group (fig. 6).

Among the Trachylina the medusa is the dominant form, and some reach a diameter of four inches. The Trachylina are mostly oceanic forms, pelagic throughout life. The cleavage of the fertilized egg of most trachylines (*Aglaura*, *Liriope*, *Geryonia*, etc.) typically produces a planula larva that develops into a more or less polypoid larva; the latter is transformed directly into a medusa. In *Gonionemus* and *Craspedacusta* the planula develops into a minute polyp that reproduces asexually, giving rise to other polyps, and then budding off medusae. In certain forms (Cuninidae) the polypoid larva is parasitic within medusae of its own or other kinds. In such cases it reproduces by budding, and both the parent and daughter polyps become transformed into medusae; or, the larva may form a stolon from which medusae are budded. Among the aberrant forms assigned to the Trachylina is *Polypodium*, found in inland Russian waters; this is a small solitary polyp that walks on its twelve tentacles. It is budded off a stolon parasitic in the eggs of sturgeon.



(A, C, D) FROM L. H. HYMAN, "THE INVERTEBRATES" (VOL. 1), REPRODUCED BY PERMISSION OF McGRAW-HILL BOOK CO., INC. (1940). (B) FROM H. BIGELOW IN MEMOIRS, MUSEUM OF COMPARATIVE ZOOLOGY, 37 (1909)

FIG. 6.—STRUCTURE OF TRACHYLINA JELLYFISH: (A) UNDERSIDE OF TRACHYMEDUSA (GERYONIA); (B) SIDE VIEW OF NARCOMEDUSA (CUNINA); (C) TENTACLE OF GONIONEMUS, SHOWING ADHESIVE PAD; (D) TENTACLE BASE OF GONIONEMUS, SHOWING TENTACULAR BULB

Beyond the facts thus outlined the Trachylina contribute little of general interest to the study of the Coelenterata, although their structure and life histories are in themselves extremely interesting. For this reason they are dealt with very briefly here, and the only part of their structure calling for further mention is that of the sense organs. Ocelli are rare among them, but all possess organs containing statoliths. These are of a different grade from those of the Hydroida in that they exhibit the structure not of epidermal pits or sacs containing statoliths but of small tentacles containing a gastrodermal core in which lie one or more statoliths, and are covered by epidermis. These modified tentacles are known as tentaculocysts, and they may, like tentacles, project freely at the surface or become embedded in a pit or sac formed by the surrounding tissues.

SIPHONOPHORA

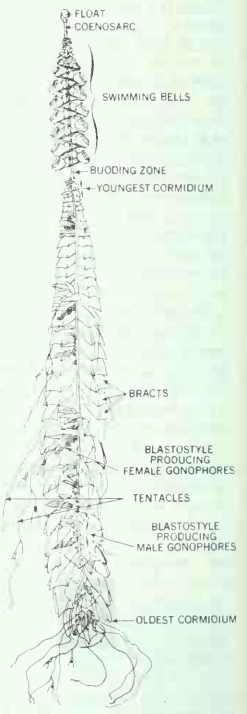
The Siphonophora constitute one of the most interesting groups of the animal kingdom, since they illustrate the lengths to which an organism may go in the direction of stringing together a number of different kinds of individuals in a single chain (fig. 7). They exhibit the phenomenon of polymorphism in the extreme.

The Siphonophora, unlike the Hydroida, are essentially pelagic animals: they are exclusively marine, and most characteristic of warm seas. They all form colonies, but the colony is unattached and either floats or swims. It produces sexual medusae comparable to those of a hydroid, and these may or may not be set free from the colony; consequently there may be an alternation of generations, both pelagic, or the medusa generation may never gain independent existence. There is, however, this difference from the state of affairs among the Hydroida—a medusa that is set free as such is an exception, and it has never the full structure of a hydroid medusa, possessing no mouth or sense organs. Most siphonophore medusae remain attached to the colony or to a segment of it, and many of them exhibit grades of reduction in structure. These are known as gonophores, but they are never as degenerate as a hydroid sporosac. From the eggs produced by the medusae or gonophores a planula larva of a curious type develops, and this by budding produces a colony. The siphonophore contrasts with a trachyline in that it is here the colony, and not the sexual medusa, that is the dominant form. In addition to this, a new factor is introduced that is not found either in the Trachylina or in the Hydroida. This is the production by the colony not only of more than one kind of polyp (as in *Hydractinia*) but also of more than one kind of medusa. Besides the sexual medusae, corresponding to the sole medusa form in the other groups, there are found here medusae of modified structure that neither feed nor produce gonads but that act as swimming bells for the whole colony; and other structures that are also probably modified medusae. Of these latter one is a gas-containing float.

Structure of Colonies.—It will be impossible to understand the siphonophore organization without first considering the structure of several typical colonies; these are so diverse in constitution that a general statement at the present stage would be unprofitable.

Halistemma consists of a small float and, depending from it, a long thin string that is tubular and contractile. The latter, the stem or coenosarc, corresponds to the stalk of an *Obelia*. Arranged on the string just below the float are a number of swimming bells; each of these is a medusa attached to the coenosarc by a short stem arising from the outer side of its bell, and possessing radial canals and a velum but no manubrium or mouth. At intervals along the coenosarc are found little knots or clusters of individuals. These are not all alike, larger and smaller ones alternating regularly. Each cluster (cormidium) contains a certain number of individuals but not the same selection in each case. The types of individuals comprised in the whole series are leaflike protective structures, the bracts, together with digestive polyps (gastrozooids) each with a mouth and with a single tentacle which is attached to it at the base; other polyps (dactylozooids) with no mouths, each with a single tentacle at its base, which act as feelers and stingers; and lastly blastostyles upon which male and female gonophores are produced. The tentacles of the gastrozooids, which act as fishing lines, are branched, and bear terminal stinging batteries; those of the dactylozooids are unbranched.

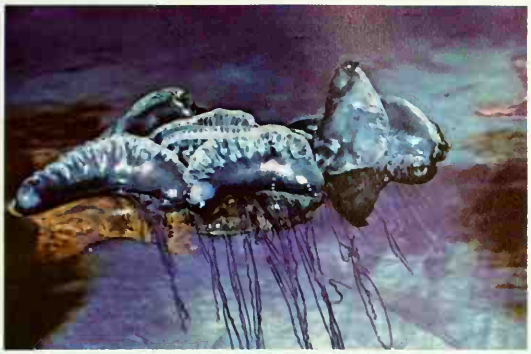
A type of colony similar in principle to that of *Halistemma* is formed by *Physophora*. A small float bears a tubular string of coenosarc with swimming bells. But below these bells the rest of the coenosarc, instead of forming a long string, is short and compact, with the result that all the other individuals of the colony (which include dactylozooids, gastrozooids and blasto-



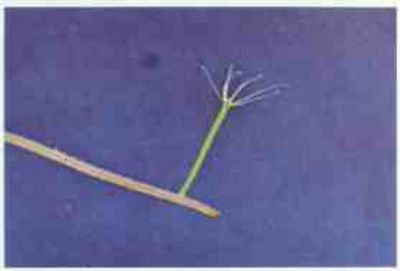
FROM A. K. TOTTON, "SIPHONOPHORA OF THE INDIAN OCEAN," "DISCOVERY" REPORTS" (VOL. XXVII)

FIG. 7.—STRUCTURE OF STRINGLIKE SIPHONOPHORE COLONY: (A) STEM WITH CORMIDIA; (B) SINGLE CORMIDIUM ENLARGED

MARINE AND FRESH-WATER HYDROZOANS



Portuguese men-of-war (*Physalia*), large siphonophores of warm oceans. Dangling from the gas-filled float, which may be up to 12 in. long, are contractile, stinging tentacles



Hydra viridis, a green fresh-water polyp less than ¼ in. long

Polyorchis, a medusa, about one inch across, common on the American Pacific coast. At the base of the bell are red sense organs; the feeding tube, with the mouth at its tip, is surrounded by stringlike sex organs

Oaten-pipes hydroid (*Tubularia larynx*), a single hydranth (enlarged) from a colony. The yellowish tubes encase the stems that hold aloft the flowerlike but carnivorous polyp "head"

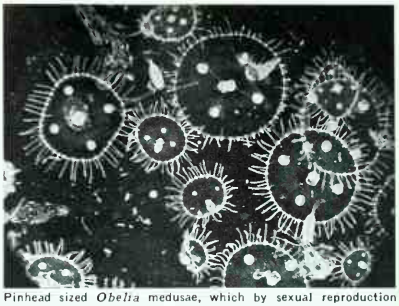
Two hydranths (enlarged) from a sessile colony of *Obelia*

Colonies of club-headed hydroid (*Clava squamata*) on seaweed. The inch-long polyps stretch their tentacles to ensnare small prey

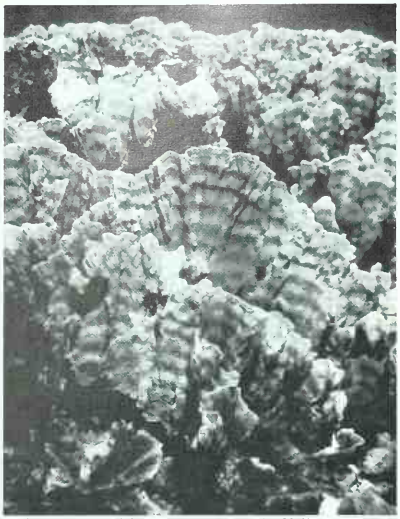
BY COURTESY OF (TOP LEFT) NATIONAL GEOGRAPHIC SOCIETY, © NATIONAL GEOGRAPHIC SOCIETY PHOTOGRAPH (CENTRE) HERMANN EISENBEISS (TOP RIGHT) M. WOODBRIDGE WILLIAMS (BOTTOM LEFT, BOTTOM CENTRE) DR. ROMAN VISHNIAC FROM PUBLIX (BOTTOM RIGHT) DOUGLAS P. WILSON, F.R.P.S.

HYDROZOA

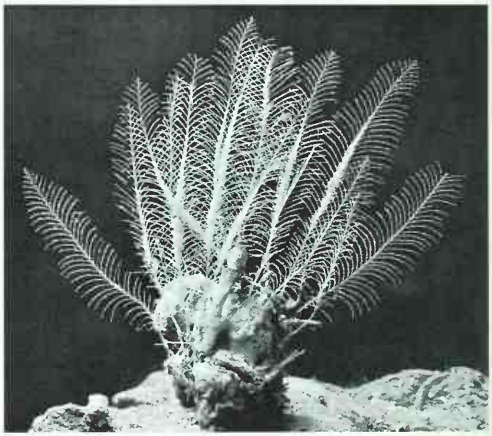
COLONIAL HYDROIDS AND MEDUSAE



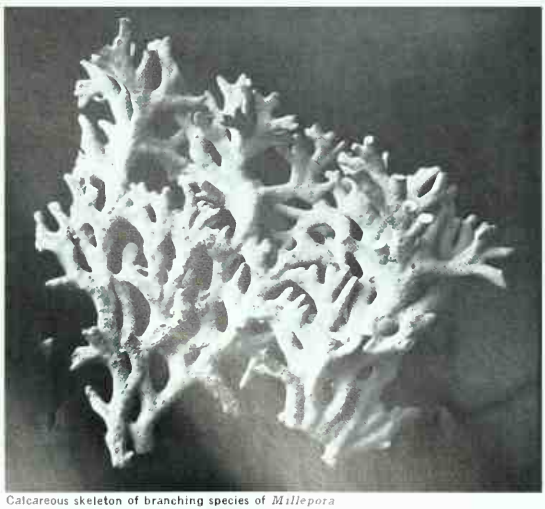
Pinhead sized *Obelia* medusae, which by sexual reproduction give rise to polypoid colonies



Leaflike colonies of false or stinging coral (*Millepora*), up to two feet high



Colonies of a featherlike hydroid (*Kirchenpaueria pinnata*). Five to six inches high

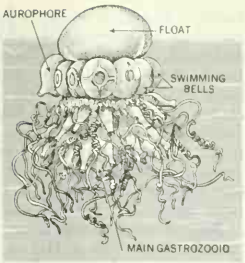


Calcareous skeleton of branching species of *Millepora*

Ostrich-plume hydroid (*Aglaophenia*). The golden-brown fronds, about three inches high, are found in cool tide pools

PHOTOGRAPHS, (TOP LEFT) PAUL DROZ, (TOP RIGHT, CENTRE RIGHT) DOUGLAS P. WILSON, F.R.P.S., (BOTTOM RIGHT) M. WOODBRIDGE WILLIAMS

styles) are concentrated into a group with the dactylozooids forming a protective circlet around the outside. The same principle is further exemplified in a still more modified degree by *Stephalia* (fig. 8), in which the same essentials are present but the proportions and shapes of all the parts have changed. In this case the float is large and prominent and it opens to the exterior through a special spoutlike structure (aurophore) at one side. The swimming bells are restricted to a single circle below the float, instead of being strung out as in *Halistemma* and *Physophora*, and the coenosarc bearing the cormidia is neither the long string of the former nor the insignificant vesicle of the latter, but is a bulky mass bearing in the middle of its lower surface a large terminal gastrozooid and supporting the cormidia on its sides. This mass is penetrated by a number of tubes lined by gastrodermis that run into each other and communicate with the digestive cavities of the gastrozooids.



FROM L. H. HYMAN, "THE INVERTEBRATES" (VOL. 1); REPRODUCED BY PERMISSION OF MCGRAW-HILL BOOK CO., INC. (1940)

FIG. 8.—STRUCTURE OF STEPHALIA

From *Stephalia* to *Physalia* (Portuguese man-of-war; *q.v.*) (fig. 9) is a natural transition. Here there are no longer any swimming bells, but there is a large crested float opening to the outside by a pore, and bearing a gastrozooid at one end. In a young Portuguese man-of-war the underside of the float bears directly a half-dozen cormidia, each containing a gastrozooid without a tentacle, a dactylozooid with a long unbranched fishing line, with powerful stinging capsules, and a branching blastostyle bearing small dactylozooids upon it, and also male and female gonophores. As the colony increases in size new individuals are added somewhat irregularly upon the stalks of the old, and the simple early arrangement is lost. The colours of *Physalia* (blue, orange, etc.) are of great brilliance, and it is a well-known denizen of the Atlantic, Pacific and Indian oceans, often occurring in fleets. The colony is not bound to float at the surface; it can deflate the float and sink, reforming the gas within it and so rising once more within a quarter of an hour.

There are a number of siphonophore colonies that differ from any so far mentioned in that they possess swimming bells but no float; examples are found in the suborder Calycophora.

POLYMORPHISM AND ALTERNATION OF GENERATIONS

The phenomena known as polymorphism and alternation of generations (metagenesis) are aspects of one and the same thing, a biological division of labour, in which different functions are performed by (1) different forms in a life cycle or (2) different members of a colony.

Polyp *v.* Medusa.—Alternation of generations as found in *Obelia* is an example of the first type of polymorphism, which may be defined as the ability of a single species of animal to exist under more than one form—in this instance as polyp and medusa. In a clear-cut case of alternation of generations one of these forms is sexual and succeeds the alternative nonsexual form, the two coexisting on a single colony only for the period during which the medusae are developing from buds. It may be noted that some writers no longer regard the polyp and medusa as alternate "generations," but the polyp as a persistent larva and the medusa as the adult. This view has its difficulties, however, and for purposes of the present argument the older terminology is retained. In any case the polyp phase is very persistent.

Variety of Colonial Members.—The other type of polymorphism is that exhibited by such colonies as *Podocoryne* and in far higher degree by the Siphonophora. There is not only the distinction of individuals into sexual and nonsexual forms but the nonsexual polyps are themselves divided into kinds (gastrozooids, dactylozooids, etc.). This is exemplified even in *Obelia* by the distinction of the polyps into hydranths and blastostyles. In the Siphonophora there is an additional development in that there exist nonsexual as well as sexual medusae, and probably more than one kind of these (swimming bells, bracts and float).

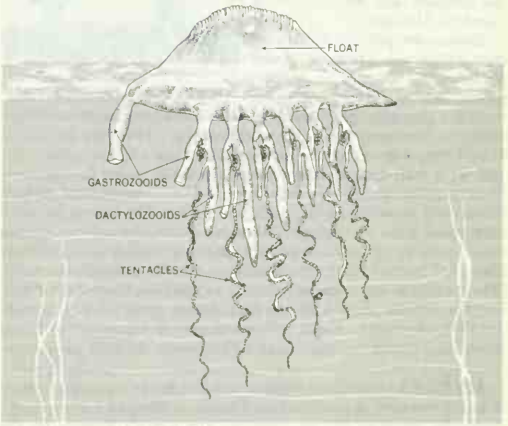
In other words there exist: (1) a differentiation into sexual and nonsexual forms and (2) a division of labour between the nonsexual forms by virtue of which they become, for practical purposes, reduced to the condition of organs.

It must be noted, however, that the sexual forms tend to lose their independence; and the separate free-swimming generation so obvious in *Obelia* and similar forms becomes at the other end of the series a degenerate sporosac attached to the colony as permanently as any nonsexual individual. In fact it has become a sex organ or gonad, and "alternation of generations" has been transformed into "division of labour."

Interesting divergences from the ordinary kinds of polymorphism typical of the Hydroida and Siphonophora are found among the Trachylina, Scyphozoa and in forms such as *Millepora*. In *Millepora* a polyp, be it a gastrozooid or a dactylozooid, becomes directly transformed under the influence of the immigrating sex cells into a medusa, instead of the medusa being formed from an independent bud. The polyp is a changeling. In the Trachylina the same process takes place, but in this case it is a pelagic or parasitic larval polyp that turns into a jellyfish, not an adult member of a colony.

Polymorphism is chiefly interesting as an example of the extraordinary ability of animals to produce an almost infinite number of variations upon a given theme. It has also been much employed as a subject for argument, however. The argument frequently adopted has been that a siphonophore or a compound hydroid is a colony and that its parts represent, morphologically speaking, individuals connected by a common intermediate tissue, the coenosarc. This view may appear to be farfetched when one contemplates a sporosac, which is in effect a gonad, since it involves the claim that this structure represents not an organ but an animal. It is also true that in some cases, such as those of meandrine corals, it is difficult to decide whether a polyp with a dozen mouths represents one polyp or twelve.

Viewing the coelenterate series as a unity the interpretation of the systems encountered as colonies of individuals appears to be the soundest working hypothesis. The alternative view, that everything that results from the development of a single egg is an individual animal, however much it may subdivide asexually, and that gastrozooids, bracts and the rest are nothing more than the organs of this animal, seems relatively satisfactory when applied to such a form as the adult *Velella*. But when one applies it to a free-swimming medusa it becomes reduced to an absurdity—is a jellyfish, an organism provided with mouth and stomach, canals, velum, tentacles and sense organs, simply a moving organ and not



FROM DELAGE AND HEROUARD, "ZOOLOGIE CONCRETE"

FIG. 9.—COLONY OF YOUNG PORTUGUESE MAN-OF-WAR (PHYSALIA)

an animal at all? Further, one may meet on many shores hosts of sea anemones, none of which have developed from eggs; each is an independent organism, not part of a colony, and each has been produced asexually by fission. Are these anemones then "organs"? To reduce the term "organ" to such a level is to remove its actual meaning. It is interesting to note that F. Moser combines the two theories by regarding the Coelenterata other than Siphonophora as colonies of individuals, but the Siphonophora themselves as relatively primitive organisms, individuals comprising organs and the forerunners of true colonies.

In this connection it should, however, be noted that in the above paragraphs the term "individual" has been used in a purely morphological sense—*i.e.*, the individuals of a siphonophore represent morphological individuals that have suffered a loss of independence similar to that of the component cells of any multicellular animal, which latter may be regarded as having been derived originally from a colony of individual single-celled animals. In a physiological sense, on the other hand, the siphonophore colony is a unity and may be regarded as an individual system. The status of such a system in relation to the wide general question of individuality is discussed in INDIVIDUALITY, BIOLOGICAL.

See ANTHOZOA; SCYPHOZOA; *see* also references under "Hydrozoa" in the Index.

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(T. A. S.; C. HA.)

HYENA (HYAENA), the name applied to the Hyaenidae, the smallest family of carnivores, which contains only three living species in two genera that are confined to the old world. Hyenas superficially resemble dogs but are more closely allied to the civets (family Viverridae), from which they are believed to have branched off in the Miocene. Hyenas are distinguished by four toes on each foot, the comparative length of the forelegs, the nonretractile claws and the enormous strength of the jaws and teeth, enabling them to crush large bones.

B. GRZIMEK

STRIPED HYENA (HYAENA STRIATA)

The striped hyena (*Hyaena striata*) is found in southwestern Asia, and northern and eastern Africa; the brown hyena (*H. brunnea*) occurs in southern Africa; the spotted hyena (*Crocuta crocuta*) ranges throughout much of southern and eastern Africa north to Ethiopia.

Hyenas are principally scavengers and in many regions depend largely on the remains of carcasses left by lions. Although they are generally quite cowardly, they will attack helpless animals and may become quite daring when hungry. There are records of their biting sleeping human beings. The striped hyena is about the size of a wolf but possesses proportionately larger forequarters. It is grayish-brown with indistinct, darker, longitudinal stripes. There is a mane along the neck and back. The brown hyena is larger and lacks the stripes. Both are essentially solitary species but a number of individuals may gather around a carcass where they will quarrel and utter demoniac sounds, generally at night. The spotted hyena is somewhat more robust than the striped hyena, lacks a definite mane and has dark brown spots on a yellowish-brown background. Fossil remains of both living genera of hyena have been found in Pliocene and Pleistocene deposits in Europe.

(R. T. O.)

HYÈRES (sometimes HYÈRES-LES-PALMIERS), a resort town of Var *département* in southeastern France, is situated 5 km. (3 mi.) from the coast at the west end of the French Riviera on the southern slope of a hill, sheltered from the mistral wind, 18 km. (11 mi.) E. of Toulon by road. Pop. (1962) 18,301. There are narrow steep streets in the old feudal town. Important streets and buildings include the Porte de la Rade, Rue Massillon with houses of the 16th and 17th centuries, Rue des Porches, St. Blaise tower built by Templar friars in the 12th century, St. Paul's church and square, Prince's Gate, and the Romanesque and pre-Gothic church of St. Louis built in the 12th century by Franciscan friars. Close to the old town are the modern quarters with broad avenues bounded by palm trees, the town hall, the museum with paintings and collections (in the Park hotel) and the Ricquier public garden planted with exotic trees and bushes.

Buses connect Hyères to the railway at Toulon. There are boat services to the Îles d' Hyères which include Porquerolles, Port-Cros and Île du Levant. There is no important industry, but the region is intensively cultivated with market gardens which supply Paris and London with flowers and early vegetables.

Hyères belonged successively to the Greeks of Marseilles, the Romans, the lords of Fos and Marseilles and the counts of Provence, and was given to the king of France in 1481. It was the residence of many kings, including Louis IX (St. Louis), Francis I, Charles IX, Henry IV and Louis XIV. Jean Baptiste Massillon, the 18th-century preacher, was born at Hyères in 1663.

(A. C. J. L.)

HYGIEIA, in Greek religion, the goddess of health. The oldest traces of her cult are at Titane in the territory of Sicyon west of Corinth, where she was worshiped together with Asclepius (*q.v.*). She is there completely assimilated to him and not an independent personality. Her cult was introduced to the city of Epidaurus in the Peloponnese, Asclepius' own most famous centre, at a late date; and when she appears with him at Athens in 420 B.C. it is as a new invention, an offshoot of the already existing worship of Athena Hygieia, rather than as Asclepius' companion from Epidaurus or as a Peloponnesian importation. At first no special relationship existed between her and Asclepius, but gradually she came to be regarded as his daughter, the place of his wife being already secured by Epione. Certain later literature, however, makes her the wife of Asclepius. The cult of Hygieia then spread concurrently with his, and was introduced at Rome from Epidaurus in 293 B.C., when she was gradually identified with Salus (*q.v.*). While in classical time Asclepius and Hygieia are simply the god and goddess of health, in the declining years of paganism they are protecting divinities. Hygieia's animal is a serpent, sometimes shown drinking from a saucer held in her hand.

HYGIENE, the science of preserving health. The subject embraces all agencies affecting the physical and mental well-being of man. It involves, in its personal aspect, consideration of food, water and other beverages; clothing; work, exercise and sleep; personal cleanliness; special habits, such as the use of tobacco, narcotics, etc.; and mental health. In its public aspect it deals with climate; soil; character, materials and arrangement of dwellings; heating and ventilation; removal of waste matters; medical knowledge on incidence and prevention of disease; and disposal of the dead. These topics are treated in such articles as BACTERIOLOGY; DIET AND DIETETICS; FOOD PRESERVATION; HEALTH EDUCATION; HEATING AND VENTILATION; HOUSING; INDUSTRIAL MEDICINE; MATERNAL AND CHILD HEALTH; NUTRITION; PSYCHIATRY; SEWAGE DISPOSAL; WATER SUPPLY AND PURIFICATION. *See* PREVENTIVE MEDICINE; PUBLIC HEALTH; SAFETY.

HYGINUS, SAINT (d. *c.* 140), pope from *c.* 136 to *c.* 140, is said to have been a Greek by birth. It was during his pontificate that the gnostic heresies began to appear in Rome. His feast day is Jan. 11.

HYGINUS, GAIUS JULIUS (fl. *c.* 25 B.C.), Latin author and scholar who, according to Suetonius (*De Grammaticis*, 20), was appointed by Augustus superintendent of the Palatine library. He went to Rome from Spain or Alexandria as a slave or perhaps a prisoner of war and was freed by Augustus.

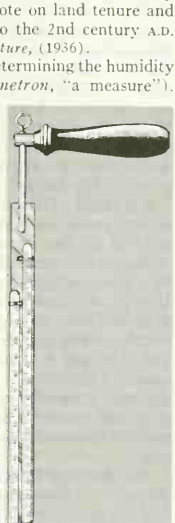
He was a pupil of the learned Cornelius Alexander Polyhistor and a friend of Ovid. Of his numerous works, including topographical and biographical treatises, commentaries on Helvius Cinna and the poems of Virgil, and disquisitions on agriculture and beekeeping, nothing has survived.

Two works incorrectly attributed to Hyginus, however, are extant: (1) *Fabulae* or *Genealogiae*, edited by H. J. Rose, with commentary (1934), about 300 mythological legends and celestial genealogies, valuable for the use made by the author of the works of Greek tragedians since lost; (2) *De Astronomia*, usually called *Poetica Astronomica*, edited by B. Bunte (1875), an elementary treatise on astronomy and the myths connected with the stars, derived chiefly from Eratosthenes (*q.v.*). Although the *Fabulae* are in an abridged form with later accretions, there is some evidence that both works are by the same hand, but the style and the elementary mistakes (especially in the rendering of the Greek originals) are held to prove that they cannot have been the work of so distinguished a scholar as Hyginus; nor can they have been by another Hyginus of Trajan's time, who wrote on land tenure and kindred subjects. Both probably belong to the 2nd century A.D.

See H. J. Rose, *A Handbook of Latin Literature*, (1936).

HYGROMETER, an instrument for determining the humidity of the atmosphere (Gr. *hygros*, "wet"; *metron*, "a measure"). These instruments can be classed according to the method employed for detecting moisture, namely: (1) evaporation, the most common instrument, called a psychrometer, consisting of two thermometers mounted together, one of which has a wet cloth sleeve over its bulb. The less humid the air, the greater the evaporation from the wet bulb and the greater the difference in reading between it and the standard (dry-bulb) thermometer; (2) dew point apparatus, making use of cooling devices to cause the water vapour to condense from the air and measuring the temperature at which the condensation occurs; (3) hair or strips of goldbeater's skin (ox gut), making use of the principle that these organic substances will increase in length as the relative humidity is increased; (4) chemical absorption, making use of chemical drying agents which extract the moisture from the air, and the increased weight of the dryer noted; (5) electrical, making use of the principle that changes in the electrical resistance of a chemically treated coil of wire can be related to changes of relative humidity. *See* Humidity, Atmospheric.

(B. G. H.)



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PSYCHROMETER, A HYGROMETER THAT USES THE EVAPORATION METHOD TO DETERMINE HUMIDITY

HYKSOS (Shepherd Kings), the name given by Manetho, as quoted by Josephus (*Contra Apionem*, i, 14), to invaders from the east who, in the time of "King Tutimaios," marched against Egypt, took possession of it without striking a blow, razed temples and cities and murdered and enslaved the population; their king, Salitis, ruled from Memphis and levied tribute from all Egypt. Josephus identifies them with the Israelites.

In Manetho's list of dynasties, the 15th is described as "six foreign kings from Phoenicia" and the 16th and some of the 17th are also called "shepherd kings." The king lists of the New Empire omit the Hyksos, but a fragment of the Turin canon of kings ascribes 108 years to "six foreign chieftains." Archaeological evidence of their existence, though scanty, is not entirely lacking. The name Hyksos is probably a version of the Egyptian term "ruler of a foreign country" (*heqa-khase*), usually applied to Bedouin sheikhs from Asia; this is the word used in the Turin papyrus. Josephus erroneously applied it to a whole nation, whereas it must have designated the foreign dynasts. A number of scarabs and other objects of the Second Intermediate period bear non-Egyptian, largely Semitic names, written in hieroglyphs and prefaced by *heqa-khase*, while objects and graffiti preserve similar names with the normal Egyptian royal titulary.

The names of the rulers of the 15th dynasty, sometimes called the Great Hyksos, are given by Manetho as Salitis, Beon, Apachnan, Apophis, Iannas and Assis (or Kertos). The first is perhaps King Shelek of the Berlin table of Memphite priests; Apophis is the name of at least two known kings; Iannas may be the Khian whose name is found sporadically over a wide area; and Kertos might be Khamoudi, the sole surviving name in the Turin fragment. The distribution of objects bearing the names of these rulers indicates that they may have controlled all Egypt, Nubia and south Palestine.

Later Hyksos sheikhs or kings whose names appear on scarabs, and the whole 16th dynasty of Manetho, were perhaps vassals of the Great Hyksos or successors who ruled reduced territories after princes of Thebes had established control over the south of Egypt. They probably included a group of eight kings who in the Turin canon appear to follow the six "Hyksos."

To what extent the Manethonian tradition of godlessness and oppression can be accepted is doubtful. An inscription of Queen Hatshepsut refers to a time of disaster when Asians were ruling in Egypt "without Re," but the meaning of this is uncertain since several Hyksos kings had names compounded with the name of this god. Their chief deity was Set, worshiped at Avaris, their stronghold in the eastern delta, as Setekh the Asian storm-god.

The period of Hyksos rule must have lasted from *c.* 1720 B.C. to *c.* 1567 B.C. The circumstances of their expulsion from Egypt are known in part. The rulers of Thebes who formed the 17th dynasty at first shared Egypt with the Asians, and a later story tells how King Seqenenre II was provoked into opening war on King Apophis. Another Apophis was the adversary of Kamose who carried the war of liberation into the delta, besieged the enemy in Avaris and foiled Apophis' attempt to call a king of Nubia to his aid. Kamose's successor King Ahmose (*q.v.*; Amasis) I completed the reconquest, expelling the Hyksos from the delta and finally from Sharuhen (perhaps Tall al Far'a) in southern Palestine. The Hyksos thereafter disappear from history. *See* also Egypt: *History*.

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(M. S. Dr.)

HYLAS, in Greek legend, son of Theiodamas, king of the Dryopians in Thessaly; favourite of Heracles and his companion on the Argonautic expedition. Having gone ashore at Kios in Mysia to fetch water, he was carried off by the nymphs of the spring in which he dipped his pitcher. Heracles sought him in vain; and ever afterward, in memory of Heracles' threat to ravage the land if Hylas were not found, the inhabitants of Kios each year on a stated day roamed the mountains, shouting aloud for Hylas. Although the legend is first told in Alexandrian times, the Mysian rite which it professes to explain may well be very old. The best source of the story is Theocritus' 13th idyll.

HYLOMORPHISM (Hylemorphism), the central doctrine of Aristotle's philosophy of nature, according to which every natural body consists of two intrinsic principles, the one potential, namely primary matter (Gr. *hyle*), the other actual, namely the substantial form (Gr. *morphe*; *see* Form; Substance). Before Aristotle, the Ionian philosophers had been concerned to discover the basic constituents of bodies, but Aristotle observed that it was necessary to distinguish two types of principles (*Physics*, i, 4–9; *Metaphysics*, vii, 3 and 7–8). On the one hand, he held, one must look for the primordial elements, that is, for bodies which are not derived from others and of which all other bodies are composed; and he found his solution to this question in the doctrine of the four elements, earth, water, air and fire, which he took from Empedocles. On the other hand, one must look also for the intrinsic conditions whereby a body, whether elementary or compound, is or comes to be what we understand it; and to answer this question he proposed his hylomorphic doctrine. The primordial elements correspond in a sense to the elements of modern physics insofar as the single elements have, or can have, independent existence or activity of their own and can therefore be known directly by way of experiment. Matter and form, however, are not bodies or physical entities that could exist or act in-

dependently: they exist and act only within the compound and by the compound. Thus they can be known only indirectly, by intellectual analysis, as the metaphysical principles of bodies.

Aristotle based his argument for the hylomorphic composition of bodies chiefly on the analysis of "becoming" or substantial change. If a being changes into another being, something permanent must exist which is common to the two terms of the change; otherwise there would be no transformation, but merely a succession, by the annihilation of the first term and the creation of the second. This permanent and common something cannot itself be a being in an absolute sense, because a being already is and does not become and because a being "in act" cannot be an intrinsic part of a being possessing a unity of its own; it must therefore be a being "in potency," a potential principle, passive and indeterminate. At the same time, in the two terms of the change, there must also be an actual, active, determining principle. The potential principle is matter, the actual principle form.

The hylomorphic doctrine was received and variously interpreted by the Greek and Arab commentators of Aristotle and by the scholastic philosophers. Thomas Aquinas gave the best account in his commentaries on Aristotle's *Physics* and *Metaphysics* and in his *De ente et essentia*. In fact, many medieval authors, such as Avicebron and Bonaventura, extended hylomorphism to all beings in creation, not only bodies but also angels and separate intellects. Opposed to hylomorphism are atomism, mechanism and dynamism, which all deny the intrinsic composition of metaphysical principles in bodies and recognize only physical principles (indivisible, unchangeable corpuscles according to atomism; matter as pure mathematical extension according to mechanism; and forces and energies according to dynamism). These theories agree also in denying any intrinsic change in the ultimate realities of which the physical world is composed; and further in reducing the phenomenon of becoming to a simple local movement or to purely accidental changes of a single selfsame reality.

Physics as a science in the modern sense need not approach the metaphysical question of the composition or intrinsic simplicity of bodies as such, but has generally been influenced by the philosophical systems underlying scientific research. Even so, after having been dominated for 300 years by mechanism, atomism and dynamism, physics in the 20th century returned to a more naturalistic conception allowing the intrinsic transmutability of the physical elements, protons, neutrons, electrons, mesons, etc., the transformation of mass into energy and vice versa, the nonconservation of elementary particles and many other phenomena studied in quantum mechanics. It thus poses again the problem which Aristotle's hylomorphism was designed to solve. Nevertheless, since for Aristotle matter and form were metaphysical principles, they must not be equated with any physical concept or entity.

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(F. SE.)

HYLOZOISM, in philosophy, a term applied to any system which explains all life, whether physical or mental, as ultimately derived from matter (Gr. *hyle*, "matter"; *zoe*, "life"). Such a view of existence has been common throughout the history of thought and especially among physical scientists. Thus the early Greek thinkers of the so-called Ionian school of philosophy sought for the beginning of all things in various material substances, water, air, fire, which were regarded as being in some sense alive and taking some active part in the development of being. This primitive hylozoism reappeared in modified forms in medieval and Renaissance thought. For later developments *see* MATERIALISM.

HYMANS, PAUL (1865–1941), Belgian statesman and diplomat who figured prominently in the European settlement after World War I, was born at Ixelles, Brussels, on March 23, 1865. He became a barrister in 1885, and from 1898 to 1914 was professor of comparative parliamentary history at Brussels university. From 1900 he was deputy for Brussels and soon became the Liberal leader. After a mission to Pres. Woodrow Wilson in Aug. 1914 he was plenipotentiary in London, 1915–17, when he became head of the ministry of economic affairs. In 1918–20 and in 1924–25 he was minister for foreign affairs. In Nov. 1918 he attended the Inter-Allied council at Versailles; he also represented Belgium at the peace conference in 1919 and on its behalf signed the peace treaty. In the same capacity he attended the conferences at San Remo, Boulogne, Brussels and Spa. He played a leading part in the settlement of the Ruhr question, the Dawes plan, the Security pact and the economic union of Luxembourg with Belgium.

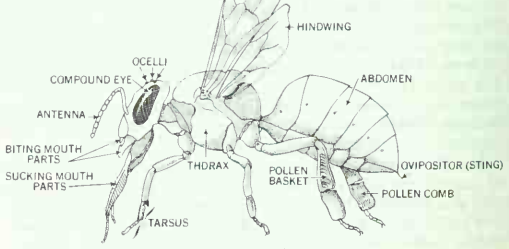
In Jan. 1920 Hymans was appointed Belgian representative on the League of Nations and in the same year was made president of the first assembly at Geneva. He was again minister for foreign affairs, 1927–34 and 1934–35, and member of the council of ministers, 1935–36. A member of the Académie Royale de Belgique, Hymans continued *L'histoire parlementaire de la Belgique* (1875 *et seq.*) and wrote *Frère-Orban* (1905 *et seq.*), *Portraits, essais et discours* (1914), *Pages libérales* (1936) and *Fragments d'histoire* (1940). He died in Nice, France, on March 8, 1941.

HYMEN (HYMENAEUS), originally the refrain of the Greek marriage song. The term gradually came to be thought of as the name of an ideal person, whose adventures had given rise to the custom of this song. He was generally held to be a son of Apollo by a Muse, perhaps Calliope; and, often, to have a brother called Ialemus and another associate, Linus, on occasion likewise regarded as his brother. He might instead, however, be the son of Dionysus and Aphrodite and as such was a god of fruitfulness. In Attic legend he was a beautiful youth who, being in love with a girl, disguised himself as a woman and followed her in a procession to Eleusis. When the band were carried off by pirates he rescued them and as a reward obtained the girl in marriage. His happy married life caused him ever afterward to be invoked in marriage songs.

HYMENOPTERA, one of the largest orders of insects, containing more than 110,000 described species, some of them specialized for highly organized social life. Among the better-known members are the bees, wasps, ants and sawflies, but included also are numerous less familiar groups such as the gall wasps, chalcid flies, ichneumon flies and others. As a whole the order is decidedly beneficial, for the bees are the most important insect pollinators of plants and the wasps, chalcid flies, ichneumon flies and associated forms, either as predators or as parasites, are major agents in the natural or biological control of many destructive insects.

CHARACTERISTICS

General Features.—The Hymenoptera are chiefly small- to moderate-sized insects, but occasional forms are large, measuring as much as two inches in length; others are so minute as to be



FROM H. WEBER, "GRUNDRISS DER INSEKTENKUNDE"

FIG. 1.—THE HONEYBEE, A REPRESENTATIVE HYMENOPTERAN OF THE SUBORDER APOCRITA

barely visible to the naked eye. The winged members have four membranous wings with the venation more or less reduced or, in extreme cases, absent. The hind wings are noticeably smaller than the forewings and are interlocked with them by tiny hooklets on the anterior margin. In certain groups of solitary wasps, particularly the velvet ants (Mutillidae) and certain tiphiid wasps (Tiphiidae), the females are wingless, and in the ants the workers are without wings. Winglessness also occurs in scattered genera of ichneumon flies and chalcid flies, usually only in the females but sometimes in both sexes, and rarely (*i.e.*, in the chalcid fly genus *Melittobia*) only in the males. The mouth parts of Hymenoptera are fitted for biting or for biting and sucking. The compound eyes are usually large, and there are usually three ocelli, or simple eyes, arranged in a triangle on the top of the head. The antennae vary greatly; rarely they may be no longer than the head is wide and have eight or fewer segments, but usually they are moderately long, sometimes even longer than the body and composed of many segments. Often the basal antennal segment, or scape, is greatly elongated; sometimes the apical segments are more or less enlarged to form a club; and, rarely, certain segments of the flagellum are conspicuously branched. The tarsi are nearly always five-segmented. The abdomen of the female has an ovipositor at its tip. In the sawflies it is modified into a sawlike tool used for making slits in the leaves or stems of plants in which the eggs are deposited, but in all other Hymenoptera it is developed for piercing or stinging.

Nesting Habits and Reproduction.—Although the majority of hymenopterans are solitary, some species have acquired the habit of living in well-ordered colonies as is the case with all ants and certain bees and wasps; this behaviour, its evolution and adaptive significance, is discussed in the article SOCIAL INSECTS.

In addition to the ordinary sexual method of reproduction, parthenogenesis, or reproduction without fertilization, occurs widely throughout the Hymenoptera. The best-known instance is in the honeybee in which unfertilized eggs produce males (drones). In some sawflies unmated females likewise produce only male offspring, but in others, as in the cosmopolitan pear sawfly (*Caliroa cerasi*) there is permanent parthenogenesis, the progeny of unfertilized females being always females. In the Parasitica, where all species can reproduce without fertilization, the offspring of unmated females are generally males, but throughout the group there are occasional species in which the progeny of unfertilized females are regularly females and males occur very rarely or not at all.

Polyembryony, the production of more than one individual from a single egg, is another phenomenon that occurs in certain of the parasitic Hymenoptera. Twinning, or the development of two embryos from a single egg, is usual in *Platygaster hiemalis*, a widespread proctotrupoid wasp parasite of the hessian fly. In *Platygaster vernalis*, also a parasite of the hessian fly, 8 to 10 individuals develop from one egg; and in certain species of *Macrocentrus*, a genus of ichneumon flies, one egg eventually gives rise to 10 to 20 individuals. The extreme in polyembryonic development is attained by certain chalcid flies of the genus *Copidosoma*, where more than 2,000 individuals may develop from a single egg deposited in the body of a caterpillar.

CLASSIFICATION

There are differences of opinion among entomologists on the arrangement and constitution of groups in the order Hymenoptera. The following is a working classification in general use.

Suborder Symphyta (Chalastogastra)

Superfamily Megalodontoidea, primitive sawflies
" Tenthredinoidea, sawflies
" Siricoidea, horntails and wood wasps
" Cephoidea, stem sawflies

Suborder Apocrita (Clistogastra, Petiolata)

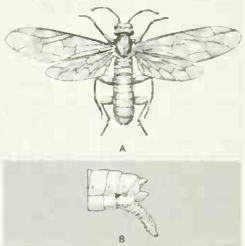
Division Parasitica

Superfamily Ichneumonoidea, ichneumon flies and others
" Chalcidoidea, chalcid flies
" Cynipoidea, gall wasps and others
" Proctotrupoidea, proctotrupoid wasps

Division Aculeata

Superfamily Chrysidoidea, cuckoo wasps and others
" Bethyloidea, bethyloid wasps
" Scolioidea, scolioid wasps
" Formicoidea, ants
" Vespoidea, vespoid wasps
" Sphecoidea, sphecoid wasps
" Apoidea, bees

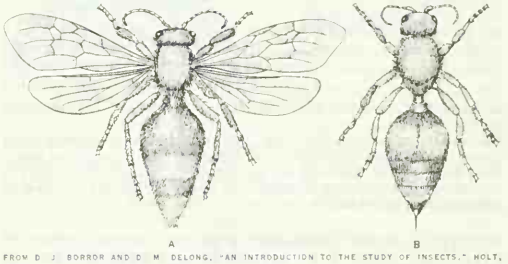
Symphyta.—This group, which includes the sawflies, horntails and wood wasps, is characterized by having the abdomen broadly joined to the thorax, with no constriction at its base; the larvae are usually caterpillarlike and provided with a variable number of legs. Except for the family Orussidae, members of which are parasites of wood-boring beetle larvae, all the Symphyta are plant feeders, some being serious pests of trees and shrubs. (*See* SAWFLY.)



(A) FROM D. J. BORROR AND D. M. DELONG, "AN INTRODUCTION TO THE STUDY OF INSECTS," HOLT, RINEHART AND WINSTON, INC.; (B) FROM H. WEBER, "GRUNDRISS DER INSEKTENKUNDE"

FIG. 2.—THE ELM SAWFLY (CIMBEX AMERICANA), SUPERFAMILY TENTHREDINOIDEA: (A) MALE; (B) CLOSE-UP OF TIP OF ABDOMEN OF FEMALE SHOWING SAWLIKE OVIPOSITOR

Apocrita.—This group contains all the other Hymenoptera, more than nine-tenths of the known species of the order. They are principally distinguished from the Symphyta by having the abdomen more or less constricted at the base and the larvae being legless and maggotlike in general appearance. The Apocrita are divided into two major groups: the Parasitica, which include the gall wasps, chalcid flies, ichneumon flies and their relatives; and the Aculeata, or stinging forms (for a more detailed treatment of which, *see* WASP; BEE; ANT). Only the more common Parasitica are dealt with here.



FROM D. J. BORROR AND D. M. DELONG, "AN INTRODUCTION TO THE STUDY OF INSECTS," HOLT, RINEHART AND WINSTON, INC.

FIG. 3.—VELVET ANT, A MUTILLID WASP (DASYMUTILLA OCCIDENTALIS): (A) MALE; (B) WINGLESS FEMALE

Gall Wasps.—The gall wasps compose the superfamily Cynipoidea. Most of them are gall makers; they are especially numerous on the various species of oak, each form developing its own characteristic gall, usually on a leaf or twig (*see* GALL, PLANT). Also contained in the Cynipoidea, however, are various forms that do not cause the formation of galls but are parasitic. The largest of these are the Ibalidae, most of which exceed half an inch in length and have the abdomen strongly compressed from side to side; these are parasitic on wood-boring larvae of certain Symphyta of the family Siricidae. Most of the parasitic Cynipoidea, however, are very small and develop as parasites in the pupae of certain flies, in the cocoons of lacewings, and in aphids where they are hyperparasitic, actually parasitizing other Hymenoptera that are primary aphid parasites.

FROM J. C. PORTER IN "IOWA STATE JOURNAL OF SCIENCE"

FIG. 4.—CUCKOO BEE (MELICTA CALIFORNICA MIRANDA): AN INQUILINE OF ANOTHER BEE, ANTHOPHORA OCCIDENTALIS

Chalcid Flies.—The chalcid flies, forming the superfamily Chalcidoidea, are mostly very small, the majority being less than $\frac{1}{8}$ in. long; the wings are almost veinless and the antennae are short, usually with 10 to 13 segments, sometimes less. A few are plant pests; these belong principally to the families Eurytomidae and Torymidae. They include the joint-worms of the genus *Harmolita*, which often cause severe injury to growing grain and other grasses, and the clover seed chalcid, which develops in and destroys the seeds of clover and other legumes. Species of the Agaontidae live in the flowers and fruits of figs; one species, *Blastophaga psenes*, which pollinates the Smyrna fig with pollen from the wild fig, is essential for the production of fruit of the Smyrna fig. The great majority of the Chalcidoidea, however, are parasitic on other insects, and many are important in the control of insect pests. Some are strictly egg parasites; others are parasites of aphids or scale insects, or of the larvae or pupae of flies, beetles, sawflies or moths. Certain species have been transported long distances in attempts to introduce and establish them in countries where their natural hosts have become destructive. Some of the parasitic forms, however, are not beneficial but are hyperparasites, developing as parasites of various hymenopterous and dipterous primary parasites, but even some of these, like the widespread *Dibrachys cavus*, which has been recorded from more than one hundred host species, are sometimes primary.

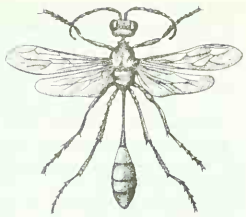


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FIG. 5.—THREAD-WAISTED WASP (SPHECINAE) (AMMOPHILA NIGRICANS)

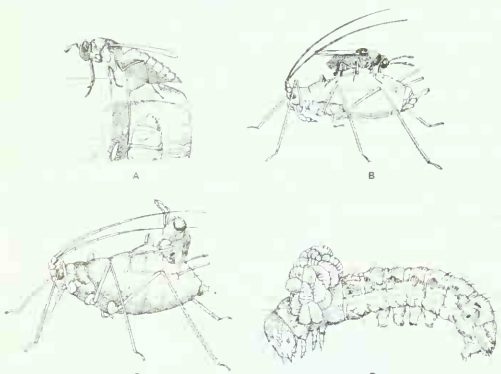

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FIG. 6.—PARASITIC CHALCID FLIES: (A) HABROCYTUS OVIPOSITING ON A LARVA; (B) ZARHOPALUS INQUISITOR FEEDING AT AN OVIPOSITION PUNCTURE MADE IN THE ABDOMEN OF AN APHID; (C) ADULT OF APHELINUS JUCUNDUS EMERGING FROM AN APHID; (D) COLONY OF EUPLECTRUS LARVAE FEEDING ON A CATERPILLAR

BY COURTESY OF U.S. DEPARTMENT OF AGRICULTURE

FIG. 7.—ICHNEUMON FLY WITH PROJECTING OVIPOSITOR

Proctotrupoid Wasps.—Wasps of the superfamily Proctotrupoidea are not closely related to the Chalcidoidea, but many of them resemble the latter superficially and are often mistaken for them. They differ essentially in having the pronotum (shield over the first segment behind the head) extending back to the tegulae (processes at the base of the forewings) and in having the ovipositor issuing from the extreme tip of the abdomen. All are parasitic. Members of the family Scelionidae parasitize the eggs of grasshoppers, crickets, flies, stink bugs, moths and other insects as well as those of spiders. The Platygasteridae, Diapriidae and Ceraphronidae mostly parasitize the larvae or pupae of flies. The family Evaniidae, known as ensign flies, develop in the egg cases of roaches. They are characterized by having the petiolate abdomen attached high on the thorax, far above the bases of the hind legs. Their presence is a good indication of the occurrence of roaches. The Pelecinidae, the largest of the Proctotrupoidea (the females may measure more than two inches in length) parasitize beetle grubs in the soil.

Ichneumon Flies.—The Ichneumonoidea, the largest superfamily of the Parasitica in number of known species, is treated in the article ICHNEUMON FLY.

See also ENTOMOLOGY; INSECT; BEEKEEPING.

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HYMETTUS (modern Gr. IMITTOS), a mountain in Attica, bounding the Athenian plain on the southeast (highest point 1,026 m. [3,366 ft.]), has always been famous for its honey, a fame which it shared in classical times with Hybla (*q.v.*) in Sicily. Near the summit is a small sanctuary of Zeus Hymettius. The spring mentioned by Ovid (*Ars Amatoria*, iii, 687–688) is probably near the monastery of Kaisariani on the western slope and is identified with that known in ancient times as Kyllou Pera, whose waters were taken as a cure by childless women. The marble of Hymettus, which often has a bluish tinge, was used for building in ancient Athens, and even for sculpture, although the white marble of Mt. Pentelicus (modern Pentelikon or Pendeli) was preferred for both purposes. (J. Bo.)

HYMN, in modern usage, a song for congregational use in Christian worship, normally metrical and strophic in form. The word is derived from the Greek *hymnos*, which signified a song composed in honour of gods, heroes or famous men. All civilizations have examples of songs (associated in some with dances) composed for religious or panegyric purposes. The word "hymn" can still be used in this sense, but usually its use presupposes a Christian association.

In Christian use the act, though not the name, has Hebrew origins, which are to be found chiefly in the Old Testament Psalms. While in the worship of the synagogue there was nothing corresponding to modern congregational singing (it will be seen below that congregational singing was, in any case, a modern development), the exalted public style of many of the Psalms suggested at once to primitive Christians a style in which new songs of praise to Christ might be composed. Where St. Paul exhorts Christians to edify one another with "psalms and hymns and spiritual songs" (Eph. v, 19; Col. iii, 16) it is at least possible that he had in mind not only the Psalms but new hymns, especially when the prophetic and even ecstatic content of the word "spiritual" in the Old and New Testaments is remembered. And where the same apostle says, of early Christian worship (I Cor. xiv, 26, Authorized Version); "Every one of you hath a psalm" as part of a reference to the worshipers' each brjnging a personal religious experience with him even as each brought his share of the love feast, he could have been envisaging new compositions. Some believe, furthermore, that certain passages in the Epistles are quotations from Christian hymns; among these are Eph. v, 14; Phil. ii, 5–11; I Tim. iii, 16; I Tim. vi, 15 ff.; II Tim. ii, 11 ff.; Rev. iv, 11 and v, 12.

But this is no more than tolerably probable conjecture. Hardly more can be said of the evidence in the 96th letter of Pliny the Younger, governor of Bithynia, to the emperor Trajan (*c.* A.D. 115), where he happens to mention that the Christians are accustomed *carmen dicere . . . secum in vicem*. Some have thought,

because of its association with a mention of praise to Christ "as a god" (*quasi deo*), that this refers to hymn singing; but it could equally mean no more than the antiphonal recitation of a liturgy.

The earliest Christian hymn the text of which has survived in full is the *Phos hilaron* ("O gladsome light," *English Hymnal* [2nd ed.; 1933], 269; *The Hymnal (1940)* [Protestant Episcopal; 1943], 176), a hymn used at a lamplighting ceremony, which dates from *c.* A.D. 200 or earlier. But it was the post-Constantinian church which began the systematic development of hymnody. (For Greek hymnody *see* BYZANTINE MUSIC; GREEK LITERATURE: *Byzantine*; KANON; KONTAKION.)

Latin Hymnody.—In the west, the earliest hymn writer was probably Hilary of Poitiers who, *c.* 360, composed a book of lyrics to one of which St. Jerome makes specific reference. Not much later, Ambrose, bishop of Milan, as St. Augustine records (*Confessions*, ix, 7), instituted the singing of "hymns and psalms after the manner of the Eastern churches, to keep the people from being altogether worn out with anxiety and want of sleep." This "anxiety" was connected with the Arian controversy (*see* ARIANISM), during one of whose turbulent periods the congregation at Milan, says St. Augustine, "stayed day and night in the church, ready to die with their bishop."

St. Ambrose has been credited with a number of hymns, but only three can be certainly ascribed to him (being so attributed by St. Augustine himself): *Deus creator omnium, Aeterne rerum conditor* and *Iam surgit hora tertia*. The idea of hymn singing seems from the foregoing quotation to have been taken over from the Eastern churches; the form of these hymns (iambic octosyllables in four-line stanzas—in English usage known as Long Metre) was influenced by Christian Latin poetry of the period; their content—ascetic, trinitarian and associated with the night-time—is explained partly by the immediate circumstances and partly because almost certainly the hymns were written as a Christian answer to Arian compositions which their enemies were singing.

In imitation of Ambrose's technique, but associated with more peaceful occasions, a considerable corpus of Latin hymnody grew up. Much of it was inspired by the liturgical reforms of Pope Gregory I (d. 604; *see* LITURGY). The hymns in this group (to be dated roughly 500–1000) are either in Long Metre or Sapphic Metre (11, 11, 11, 5). But certain Christian Latin poets, such as Prudentius and Venantius Fortunatus (*qq.v.*), experimented with other lyric metres, especially the six-line trochaic verse, 87, 87, 87.

Medieval Hymns.—The next important development in hymnody was the invention of the Sequence. Notker Balbulus (d. 912), a monk of St. Gall, composed a prose which was designed to fill up the pause between the "Alleluia" and the Gospel at the Eucharist, making use of the extended musical phrase which it had become customary to sing to the "Alleluia's" final syllable. This composition is preserved in translation as "The strain upraise" (*E.H.* 494). Inspired by this example, later authors wrote sequences (as they came to be called) for the Christian seasons, of which the best known are *Salus aeterna* ("Saviour eternal," *E.H.* 10), *Laetabundus* ("Come rejoicing," *E.H.* 22), and *Victimae Paschali* ("Christians, to the Paschal Victim," *E.H.* 130; *H.* 97), all written before 1100. A natural development was the writing of sequences in metre, and this led to the composition of some of the most exquisite of all Christian lyrics, notably *Veni sancte Spiritus* ("Come, thou holy Paraclete," *E.H.* 155; *H.* 109), probably by Stephen Langton (d. 1228) and *Dies Irae* (*q.v.*), by Thomas of Celano (d. *c.* 1260) ("Day of wrath and doom impending," *E.H.* 155, 351; *H.* 109, 468).

St. Thomas Aquinas composed a few hymns especially for the office of Corpus Christi, of which the best known are *Pange lingua gloriosi corporis mysterium* (*E.H.* 326; *H.* 199), in imitation of Fortunatus' *Pange lingua gloriosi lauream certaminis* ("Sing my tongue, the glorious battle," *E.H.* 95–96; *H.* 66), and *Verbum supernum prodiens* ("The Word of God, proceeding forth," *E.H.* 330; *H.* 209), imitating an Ambrosian hymn beginning with the same words (*E.H.* 2; *H.* 8).

Medieval devotional Latin hymnody has produced, through translation, a number of well-known English hymns. *Dulcis Jesu memoria*, an anonymous poem probably by a Cistercian monk, *c.* 1200, has given us "Jesu, the very thought of thee" (*E.H.* 419; *H.* 462, *cf.* 486); and the monumental poem *Hora novissima* by Bernard of Cluny, in 2,966 lines of invariable dactylic hexameter, has given us, among other selections, "Jerusalem the golden" (*E.H.* 412, *cf.* 371, 392, 495; *H.* 597, *cf.* 595–596, 598). The solemn and epigrammatic *Veni creator Spiritus* (uncertainly ascribed to Rabanus Maurus; d. 856) is an early example of extraliturgical Latin hymnody.

Somewhere between the liturgical and the devotional groups come *Gloria, laus et honor* by Theodulf of Orléans (750–821), a carollike hymn in elegiacs, translated by J. M. Neale as "All Glory, Laud and Honour" (*E.H.* 622; *H.* 62); and Peter Abelard's *O quanta qualia* ("O what their joy and their glory must be," *E.H.* 465; *H.* 589), written for use at the abbey of which Héloïse was prioress.

Mention of the *Te Deum* (*q.v.*), the most universally used of all Latin hymns, has been left to the end of this section, because although it is beyond doubt a hymn, in both provenance and form it is mysterious. The story that it was antiphonally improvised by St. Ambrose and St. Augustine at Augustine's baptism is without doubt legend. It has been plausibly ascribed to Niceta, bishop of Remesiana (d. *c.* 414). But it reads like a mosaic of traditional credal utterances, and its curious form—part devoted to the First Person, an equal part to the Second Person and a half-clause to the Third Person of the Trinity, with an antiphonal litany appended—suggests a historic origin (in its present form) some time between the beginning of the Arian controversy (318) and the beginning (*c.* 350) of that phase of it which concerned the Person of the Holy Spirit.

The music with which these various forms of hymnody were associated is discussed in the article PLAINSONG.

The German Reformation.—With such exceptions as have been noted, medieval hymnody was not congregational. The notion that congregational singing was to be associated with the central acts of worship was established only with the Reformation. Up to then popular praise took the form of carols rather than hymns (*see* CAROL).

Martin Luther's conception of hymnody was considerably influenced by the form of contemporary popular and secular song, not only in that he adapted many popular tunes as chorale tunes but also in that the pattern followed by many of his hymns, and those of his contemporaries and successors, recalled the pattern on which secular lyrics were written. It may be noted how, in the chorale "Ein feste Burg" ("A safe stronghold," *E.H.* 362; "A mighty fortress is our God," *H.* 551), an initial phrase, repeated, is followed by development material and a final short phrase recapitulating the first. This pattern was often found in the music of late medieval court musicians.

German hymnody has had a continuous history from the publication of the *Encheiridion* (1524), edited by Luther and J. Walther, but its classical period runs from 1524 to the death (1676) of Paul Gerhardt (*q.v.*). The chief authors (who were sometimes composers as well), apart from Luther himself, are Michael Weisse (d. 1534) of the Bohemian Brethren, J. Jonas (1493–1555), P. Eber (1511–69) and P. Nicolai (1556–1608) in the 16th century; and, in the 17th, N. Decius (d. 1629), M. A. von Löwenstern (1594–1648), M. Rinkart (1586–1649; author of the original of "Now thank we all our God") and Gerhardt himself.

The three last mentioned are authors characteristic of the period of the Thirty Years' War, which produced much noble hymnody. Gerhardt was the greatest, in both output and quality, of them all. His best-known hymn is "Befiehl du deine Wege" (translated by John Wesley as "Commit thou all thy griefs," *H.* 446). Gerhardt's period of activity corresponded with that of J. Crüger (*see* also CHORALE), and together they brought German hymnody to the highest pitch reached since its inception—a height to which it has not risen again.

Later German Hymnody.—Pietism brought a new lyrical and subjective note into German hymnody. The hymns of J. Scheffler (*q.v.*; Angelus Silesius) and the tunes of G. Joseph (fl. 1657) are good early examples. J. G. Ebeling (1637–76) and C. Peter (1626–69) wrote music of a high standard, and some strong hymns

came from J. Neander (1651–81), notably the hymn translated as "Praise to the Lord, the Almighty" (*E.H.* 536), and C. Knorr von Rosenroth (1636–89).

After the turn of the 18th century the best work in German hymnody was in the devotional, rather than the congregational, context. G. Tersteegen (1697–1769) and N. von Zinzendorf (1700–61) from the Moravian Church and, among Lutherans, N. Heermann (1707–91) and C. F. Gellert (*q.v.*) wrote good hymns which have become familiar to English-speaking congregations, especially Gellert's "Jesus lebt," translated as "Jesus lives! Thy terrors now, Can no longer, death, appal us" (*E.H.* 134). The Enlightenment brought much doctrinal skepticism but also some fresh hymn writing in the work of M. Claudius (*q.v.*) and K. J. P. Spitta. In music, a devotional style which was perhaps first seen in the psalm tunes of H. Schütz was developed among pietist composers, and the finest examples of this are to be found in the works of J. A. Freylinghausen and J. S. Bach (*q.v.*). This proved a style which it was dangerous to imitate, and a tendency to vulgarity and sentimentality during the 18th century was resisted only by such conservative editors as J. B. König (1691–1758), C. Dretzel (1698–1731) and J. Schicht (1753–1823).

In the 19th century the writing of new hymns came almost to a halt, and in music more work was done by editors than by composers. What was new in the 19th century has hardly survived in German, let alone in English, use. A brief revival of hymnody was seen in the German Confessional Church of 1933–45; but it is safe to judge that the best work in both words and music, with the exception of Bach, was done before 1700. The great output and high quality of hymnody up to then discouraged the later writing of hymns in Germany and set a higher standard than later authors and composers found themselves able to reach.

Genevan Psalmody.—It was during his brief ministry in Strasbourg (1538–41) that John Calvin caused his first metrical and musical psalter to be collected. This was a small volume, published in 1539, containing 19 psalms and 2 other pieces; the music, austerely set for unison singing, was edited by M. Greiter. On removing to Geneva (1541) Calvin engaged the services of Louis Bourgeois (d. *c.* 1561) as musical editor, and in successive editions between 1542 and 1551 Bourgeois composed or adapted settings for 83 of the 150 psalms, the words of which were partly based on the psalms of Clément Marot and partly written by other poets. Unison singing without accompaniment remained the Genevan rule, but Bourgeois published an edition in five-part harmony at Lyons in 1549. After the resignation of Bourgeois the work was completed by several successors, the most eminent of whom was C. Goudimel (d. 1572). The final psalter, with 150 psalms, 125 tunes and 110 different metres, was published in 1562.

Meanwhile certain English and Scottish exiles who had taken refuge at Geneva during the reign of Queen Mary (1553–58), impressed by the Genevan style, sought to adapt Genevan tunes or compose new tunes in the same style for English metrical psalms (*see* METRICAL PSALMS). Thus were published the two "Anglo-Genevan psalters" in 1556 and 1558, which brought the Genevan tunes (often severely modified to suit English ballad metre) to England and Scotland.

English Psalmody.—The English psalters proved a dynamic source of new music, and during the period 1558–1677 many editions of the English psalter were published, of which musically the most significant were those of Thomas Este (1592) and Thomas Ravenscroft (1621) and (in Scotland) those of Andro Hart (1615) and Edward Miller (1635). It soon became clear that the complexity of most of the Genevan tunes (which were written for French metres) exacted too much of British congregations, and so the custom of singing each Psalm to its "proper" tune was soon dropped, and in most places a few tunes were used for the whole psalter. The English psalter used only a few metres, and it was easy for a group of "common tunes" to gain favour at the expense of the Genevan tunes. Moreover, although the English adaptation of Genevan tunes normally formed itself in four 14-syllable lines, the "common tune" was content with two such lines, and thus "Common Metre" (8, 6, 8, 6), still the archetypal "English" metre for hymns, came into currency. The use of common tunes also made it necessary to identify hymn tunes not by the number of their Psalm (as "Old 100th" or "Old 124th"—settings of the 100th and 124th Psalms) but by names. This practice was first systematically used by Ravenscroft.

Alongside the official psalter, many private versions were published. A few of these are of special musical importance, such as that of Matthew Parker, for which Thomas Tallis (1505–85) composed eight tunes (*e.g.*, *E.H.* 92; *H.* 424); and that of William Sandys (1637) for which several tunes were composed by Henry Lawes (1596–1662) (*e.g.*, *E.H.* 234). Hymns as such were not yet composed (apart from metrical versions of the commandments, the Gospel Canticles and the Lord's Prayer, which were authorized with the psalter), but George Wither (1588–1667) composed two books of lyrics and hymns, *Hymns and Songs of the Church* (1623) and *The Hallelujah* (1641), the first of which involved him in legal proceedings. It was distinguished by its accompanying tunes, which were the work of Orlando Gibbons (1583–1625).

Many poems written during this period have come to be sung as hymns, notably those of George Herbert (*e.g.*, "Teach me, my God and King" and "King of Glory, King of Peace," first discovered and used as hymns, though severely edited, by John Wesley) and Henry Vaughan; but none of these was used as a congregational hymn in its author's lifetime. It was not until late in the 17th century that hymns began to be freely written. The first were probably a small collection of communion hymns by the Baptist Benjamin Keach, published in 1673.

The New English Hymnody.—It was Isaac Watts (*q.v.*) who in 1707 began the fashion of modern hymnody by publishing the first edition of his *Hymns and Spiritual Songs*. Altogether, in four books (1705–19), Watts published about 750 hymns and Psalm versions although he was capable of startling bathos, as in the lines

> Now Satan comes with dreadful roar,
> And threatens to destroy,
> He worries whom he can't devour
> With a malicious joy, . . .

he established himself as the "father of English hymnody" by the sublimity of his best work, examples of which are "When I survey the wondrous cross" (*E.H.* 107; *H.* 337) and "There is a land of pure delight" (*E.H.* 498; *H.* 586). His celebrated hymn "Our God, our help in ages past" is from *The Psalms of David Imitated in the Language of the New Testament* (1719), being part of his version of Ps. xc; and "Jesus shall reign" (*E.H.* 420; *H.* 542) is part of the version of Ps. lxxii from the same book. Watts' great contribution to English hymnody was his capacity for expressing wonder, praise and adoration at all the aspects of Christian experience—God's goodness in creation, redemption and continuing grace. Perhaps his most characteristic lines are "Where reason fails with all her powers, There faith prevails, and love adores," which end the hymn "We give immortal praise."

Watts was an Independent (or Congregationalist), and he was followed, in the same communion, by Philip Doddridge (1702–51), a lesser but still important author, most famous for the original of "O God of Bethel" (*E.H.* 447; *H.* 497). The evangelical revival under John and Charles Wesley (*qq.v.*) finally established hymnody in the English scene. Charles Wesley's 9,000 lyrics use many experimental metres, and John Wesley's translations fertilized the field by introducing many of the finest German hymns to Englishmen. The great strength of the hymnody of the Wesleys is in their insistence on Christian doctrine and their dependence on the Bible. Thus Charles Wesley's famous Christmas hymn "Hark the Herald Angels Sing" (*E.H.* 24; *H.* 27) contains the whole doctrine of the incarnation:

> Veiled in flesh the Godhead see,
> Hail the incarnate Deity!
> Pleased as man with man to dwell
> Jesus, our Immanuel. . . .
> Born to raise the sons of earth,
> Born to give them second birth. . . .

and his "Love divine, all loves excelling" (*E.H.* 437; *H.* 479), often sung at weddings, is a perfect expression of man's share in God's redeeming and unbounded love.

This sudden expansion of hymnody brought with it new musical styles. The Wesleys imported many German tunes, and their later editions contain much music in a post-Handelian style; later editions of Watts produced music in a post-Purcellian style, such as had, under Jeremiah Clarke (1659–1707) and William Croft (1678–1727) distinguished the early music editions of the "New Version" (1696) of the metrical psalter.

The development of hymnody throughout the 18th century was, thus, a phenomenon of the dissenting and evangelical churches in England. Scotland stood aloof, remaining loyal to the psalter of 1650. The only Scottish concession was in the *Paraphrases* (1745, 1781); among these were versions of a number of New Testament passages which were largely drawn from the work of Watts and Doddridge. Few important Scottish tunes appeared in the 18th century, but "Aberdeen" (or "St. Paul"; *E.H.* 561) was first published in 1749, and the warmer idiom of Methodism is seen at its best in Charles Hutcheson's "Stracathro" (*E.H.* 445; *H.* 325), a tune published in 1832 the singular beauty of which has captivated succeeding generations.

Anglican Hymnody.—The Church of England (of which, of course, the Wesleys regarded themselves as nondissenting priests to the end of their lives) regarded hymnody as technically illegal, for the rubrics did not provide for the introduction of hymns into the services appointed in the Book of Common Prayer. In 1820 a controversy at Sheffield, where the vicar of St. Paul's church had been using hymns, and had published a hymnbook for use in his church, led to a re-examination of the church's law and, in consequence of this test case, hymnody was declared legitimate. One of the central figures in this controversy was James Montgomery (*q.v.*), a layman of Scottish descent, who ranks as the greatest nonclerical hymnwriter before Robert Bridges. Among his famous hymns are "Hail to the Lord's Anointed" (*E.H.* 45; *H.* 545), "Songs of praise the angels sang" (*E.H.* 481) and "For ever with the Lord" (*E.H.* 391). His only 18th-century competitor for that title is William Cowper (1731–1800), who with John Newton (1725–1807) wrote the *Olney Hymns* (1779). This was a parish hymnbook typical of those produced by Anglican evangelicals, but especially famous as being the source of many well-known hymns, such as "God moves in a mysterious way" (Cowper; *E.H.* 394; *H.* 310) and "How sweet the name of Jesus sounds" (Newton; *E.H.* 405; *H.* 455).

The legalization of hymnody in the Church of England came very close to the beginning (1833) of the Oxford Movement (*q.v.*). Between the two dates, however, stand two important collections: *Hymns, Adapted to the Weekly Church Service of the Year,* edited by Bishop Reginald Heber (*q.v.*) and published the year after his death (1827), and *The Christian Year* (1827) by John Keble. Heber's book can be called the first hymnary of the Church of England. Most of it was of his own composition, and it is the source of "Holy, Holy, Holy" (*E.H.* 162; *H.* 1), among many other well-known hymns. It also printed for the first time one of the greatest of 19th-century hymns, Dean Milman's "Ride on, ride on in majesty" (*E.H.* 620; *H.* 64). Keble's book was not a hymnbook but a book of poems, many of which have been made into hymns, such as "New every morning" (*E.H.* 260; *H.* 155).

The Oxford Movement introduced a new interest in hymns in relation to the liturgy; a host of hymn writers who wrote hymns suitable for use with the Book of Common Prayer; many hymns written for the seasons and holy days of the church; and research into and revival of medieval hymns which in translation would make good hymns for general congregational use or would be suitable as liturgical hymns for part of the offices. The most eminent hymn writers of the Oxford Movement were Bishops Christopher Wordsworth (*q.v.*), author of "Gracious Spirit, Holy Ghost" (*E.H.* 396), and W. W. How (1823–97), who wrote "For all the Saints" (*E.H.* 641), J. Ellerton (1826–93), H. F. Lyte (1793–1847), and Mrs. C. F. Alexander (1818–95). Of translators the most prolific was J. M. Neale; others were B. Webb, E. Chandler and E. Caswall. J. H. Newman's "Praise to the Holiest" (*E.H.* 471; *H.* 344) was not written as a hymn, but after its first appearance (1868) in the hymnbook became one of the most famous of the Oxford Movement's hymns.

Hymns Ancient and Modern.—The publication in 1861 of *Hymns Ancient and Modern* marked the beginning of the modern era of hymnody. It was distinguished by its austerity of style, its close conformity to the Prayer Book and its setting of each of its 273 hymns to its own "proper" tune. It was not the first hymnary to exemplify any of these practices; several editors during the preceding decade had made gestures against the exuberance of evangelical hymnody, and had sought, by setting hymn and tune together, to bring into order the confusion that was consequent on the use of separate hymn- and tune-books. But *Hymns Ancient and Modern* so combined authority and practicality that it became, and has remained, the most widely used hymnary in English. It was revised in 1875, 1904 and 1950, and supplements were added to the 1861 edition in 1868, and to that of 1875 in 1889 and 1916. Its first presiding musician was W. H. Monk (1823–89), the musical editor of the first edition, and among the composers whom it brought to prominence were J. B. Dykes and J. Stainer in its earlier editions, and in the later revisions B. Luard Selby (1853–1919) and S. H. Nicholson (1875–1947).

Meanwhile, certain authors and composers had sought to enlarge the hymn singers' vocabulary by exploring afresh the uses of other countries. Since 1558, English hymnody had been strangely insular, but at about that time, with the widening of musical culture, many German chorales were introduced to English use, and with them many translations of German hymns. *Hymns Ancient and Modern* had introduced many German tunes, although often in an anglicized form. Catherine Winkworth (1827–78), on the other hand, was the leader of a school of translators who sought to translate German hymns in their original metres; and "Now thank we all our God" (*E.H.* 533; *H.* 276) is the most famous of the many translations she made. Others who did likewise were Frances E. Cox (1812–97) and Jane L. Borthwick (1813–97).

New Standards.—It was Robert Bridges, however, who, in his *Yattendon Hymnal,* compiled for the parish church of Yattendon, Berkshire (1899), showed to what literary heights the translator and hymnographer might aspire. His hymnal contained some of his own hymns, translations from German and Latin—including Gerhardt's "Nun ruhen alle Wälder" as "The duteous day now closeth" (*E.H.* 278) and Charles Coffin's "Happy are they, they that love God" (*E.H.* 398)—and Genevan tunes. In the 19th century the great demand for new hymns, and easier music publishing, had sadly inflated the currency with hymns of little value, either in words or music. Bridges was a truculent and outspoken enemy of this tendency, and the minor cultural revolution he began was communicated to the Church of England through the work of Percy Dearmer (1867–1936) and Ralph Vaughan Williams (1872–1958), in their joint editorship of the *English Hymnal* (1906). Where *Hymns Ancient and Modern* had resisted the overdemonstrative tendencies of evangelical hymnody, the *English Hymnal* in its turn resisted the use of an overyielding musical idiom which, modestly handled, as at first, could be attractive, but, extravagantly indulged in, had become pernicious.

The dissenting denominations during the second half of the 19th century contributed little to the repertory of hymns and hardly ever rose to distinction. In a sense, their capital had already been accumulated. In the shaping of their hymnbooks they gradually assimilated many of the characteristics of *Hymns Ancient and Modern,* while in the practice of congregational hymn singing they gave a lead which the Anglicans found less and less easy to ignore. The most conspicuous additions, apart from the work of new Anglican authors, came from the United States and were mainly introduced in the first place by the Free churches, but were given currency among Anglicans by the *English Hymnal.* U.S. culture in the 19th century developed a humane style which, if it sometimes went with an uncertainty of dogma, excelled in literary distinction anything written at the same time in England. S. Johnson's "City of God" (*E.H.* 375; *H.* 386) and W. H. Chadwick's "Eternal ruler of the ceaseless round" (*E.H.* 384) are among the best examples of 19th century American hymnody; among the most popular were "It came upon the midnight clear" (*E.H.* 26; *H.* 19) by the Unitarian E. H. Sears and "O little town of Bethlehem" (*E.H.* 15; *H.* 21) by Bishop Phillips Brooks. Only G. K. Chesterton in "O

God of earth and altar" (*E.H.* 562; *H.* 521) and H. Scott Holland in "Judge eternal, throned in splendour" (*E.H.* 423; *H.* 518), both hymns calling for national righteousness and social justice, clearly improved on the best that the United States could offer.

The advance in musical and literary taste to which the *English Hymnal* committed English congregations was taken to succeeding stages by *Songs of Praise* (1926, 1931) and *The BBC Hymn Book* (1951). The former was greatly influenced by the work of the composer Martin Shaw (1875–1958) and his interest in hymns suitable for use in schools and in the revival of folk music. Nonconformist hymnaries have been much influenced by Anglican taste and Anglican theology.

Scotland.—In Scotland, hymnody was added to psalmody only in the mid-19th century; hence the Scottish contribution has been slight, and Scottish congregations continue to rely on English words and music for their hymns. Scotland's most eminent hymnographer is Horatius Bonar (1808–89), best known for devotional hymns such as "I heard the voice of Jesus say" (*E.H.* 574). Translations of Celtic lyrics by Scottish authors have enriched the repertory.

Wales.—Welsh hymnody is of interest outside Wales chiefly for its music. The impact of the evangelical revival on Wales released a stream of strangely haunting tunes which have become famous throughout the English-speaking world. The great classic period of the writing of Welsh hymn tunes was from about 1780 to the death of Ieuan Gwyllt (1822–77), its greatest composer. The music of this period is strongly key-centred, often written in a strict melodic form, and carries evocative but essentially simple harmonies. Very few Welsh hymns exist in English translation, but some by W. Williams of Pantycelyn (1717–91), author of "Guide me, O thou great Jehovah" (*E.H.* 397), and Howell Elvet Lewis (1860–1953) are in common use.

Gospel Hymns.—A special contribution from the United States has been the "gospel hymn," especially associated with the names of the evangelist Dwight L. Moody (*q.v.*) and the composer Ira D. Sankey. In the hands of Sankey, the gospel hymn was a simple, repetitive hymn of evangelical emphasis set to a naïve carollike tune (the best example is "There were ninety-and-nine in the wilderness," *E.H.* 584). The form became fatally easy to imitate and debase; it can be seen at its best and worst in *Sacred Songs and Solos* (n.d.). Its use in England can be dated from 1872, the year of Sankey and Moody's first English evangelical crusade.

European Developments.—Continental Protestant hymnody has for 300 years been intimately influenced by the Lutheran tradition, whether or not its singers are Lutherans. Regional influences are blended with the Lutheran ethos especially in Scandinavia, where in Swedish and Norwegian books, and to some extent too in those of the Baltic states, a new romantic tradition has been developed. Italian Protestantism (chiefly represented by the Waldensian Church) cultivates a sturdy congregational hymnody, but much of its music is influenced by local folksong and operatic styles. In the Netherlands an urge toward a modern style in the music of hymnody has been given by A. C. Schuurman (b. 1904).

The Mission Field.—Protestant missionaries have introduced western hymnody to the churches of the mission field, and the fruit of their work can be seen in such books as the *Chinese Hymns of Universal Praise* (Shanghai, 1948). But although the western churches were bound to teach their music and their hymns to the younger churches in the mission field, use of indigenous lyrics has never been neglected, and is encouraged particularly where these churches are becoming independent. The best compendious source for a study of this hymnody is the international hymnbook, *Cantate Domino* (1951).

Roman Catholic Hymnody.—Hymns are not used at the celebration of the Mass in the Catholic Church; but at benediction and on other occasions their use is increasing among Roman Catholics. Strictly, the ancient Catholic congregational heritage is the carol rather than the hymn. In England the establishment of the Roman Catholic hierarchy in 1850 was accompanied by a considerable demand for hymns, which was satisfied by such writers as F. W. Faber (1814–63), author of "My God, how wonderful thou art" (*E.H.* 441), and hymn tunes of a lyrical kind were freely composed or adapted. Modern Catholic use is prescribed by the revised *Westminster Hymnal* (1940) and owes a good deal of its vitality to the work of R. R. Terry (1865–1938). In Roman Catholic churches, only hymns by Catholic authors are permitted to be sung, although Protestant music is used, and, occasionally, non-Catholic translations of Catholic originals. A standard for the translation of Catholic hymns has been set by the work of Ronald Knox (*q.v.*).

On the continent, Catholic hymnody underwent a revival during the liturgical movements which followed the Counter-Reformation. The Latin hymns of Charles Coffin (1676–1749) and many of his anonymous contemporaries have provided sources for several English hymns. The diocesan prayer books of the period 1675–1800 have provided some admirable tunes, based usually on plainsong but reduced to metrical rhythm for greater ease of congregational singing and known as French church melodies (*e.g.*, *E.H.* 181, 435; *H.* 344, 228). The Mechlin *Graduale* of 1848 provided some plainsong tunes in a debased but popular form, a few of which are well known, such as the *Veni Creator* tune at *E.H.* 154, ii. But the researches at Solesmes later in the century caused a revival of authentic plainsong which tended to set aside these popular approximations in favour of original versions. In England the plainsong revival was most notably communicated to singers by J. H. Arnold (1887–1956). Another Catholic source of hymn music was the embassies of Catholic countries in London during the 18th century, particularly those of Portugal and Spain. At the Portuguese embassy the work of S. Webbe (1740–1816) gave currency to several fine tunes, and it was there that the hymn "Adeste Fideles" was probably first sung in England. This was later translated as "O come, all ye faithful"; but its original manuscript is in the hand of a music copyist named J. F. Wade (1711–86) to whom the music is credibly attributed, and to whom also is due the best text of the Latin.

See also CHURCH MUSIC; and references under "Hymn" in the Index.

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(E. R. Ro.)

HYNDMAN, HENRY MAYERS (1842–1921), British politician, was the leading exponent of class-war Marxist socialism. He was born in London on March 7, 1842, the son of a wealthy barrister. He was educated at Trinity college, Cambridge, and traveled extensively. He was deeply influenced by the Paris Commune of 1871 and in 1881 joined with several extreme Radicals in forming the London Democratic federation, which advocated views that were practically socialist. For its first conference (June 1881) he wrote *England for All*, the first socialist book published in England since the collapse of Owenism. In this he expounded the views of Karl Marx, which he now finally adopted. But as he omitted to make what Marx felt was the necessary acknowledgment of his indebtedness, Marx was offended; Friedrich Engels, who disliked Hyndman, deliberately widened the breach. The chief, and indeed only exponent of Marxism in the country where Marx lived, was thus not on speaking terms with his leader.

This, however, did not stop the spread of Marxist socialism. The Democratic federation in 1884 became the Social Democratic federation (S.D.F.) and many of the prominent socialists of the new generation, although not James Keir Hardie or Ramsay MacDonald, were molded by Hyndman. William Morris, John Burns, Tom Mann, H. H. Champion and George Lansbury were among his colleagues and pupils. But it was significant of Hyndman's failings that only one of these men succeeded in working with him for any length of time. Hyndman remained always an aristocrat among the socialists. He was proud and dominant in his manners, intellectually intolerant and resentful of criticism or disagreement. Even when distributing leaflets announcing meetings he always wore a top hat and frock coat and he frequently, in Trafalgar square or elsewhere, taunted his ragged audiences with being such fools as to provide the money on which such as he could dress so well. But the qualities of his defects were also present—his indomitable energy which enabled him to create a socialist movement, his self sacrifice and patience, and his uprightness and hatred of compromise and of loose thinking. In the late 1880s the socialist and unemployed movement suddenly grew to an enormous size; the riots in Trafalgar square were succeeded by the famous dock strike (1889); and for a short while public opinion, hostile or friendly, magnified the importance of the S.D.F. and its leader, whom it credited with the control and inspiration of these occurrences.

With the return of better trade in the 1890s the explosive period of Hyndman's career ended, though he incurred a great deal of hostility by his denunciation of the South African War. He was severely critical of the policy of both the Independent Labour party and the Labour party and till 1914 was the acknowledged chief of a small, but hard working and influential party of doctrinaire revolutionaries. But as early as 1905 he had begun to attack "the German menace," and when World War I broke out he took a strongly pro-French and patriotic line. For the first time he was unable to carry his party with him: in 1915 the British Socialist party (as it had become) ousted him and his sympathizers from control. They formed a small group known as the National Socialist party. Hyndman expounded his new views in *The Evolution of Revolution* (1920); other publications included *Record of an Adventurous Life* (1911) and *Further Reminiscences* (1912). He died in London on Nov. 22, 1921.

See Mrs. R. T. Hyndman, *The Last Years of H. M. Hyndman* (1924); F. J. Gould, *Hyndman, Prophet of Socialism* (1930).

(R. J.)

HYŌGO, a *ken* (prefecture) of Japan in the western part of the Kinki district, western Honshū, since ancient times an important point of communication between the Ōsaka-Kyōto area and the Asian continent as well as western Japan. Area 3,216 sq.mi. Pop. (1960) 3,906,487. Manufacturing industries include the processing of foodstuffs, textiles and lumber, and are followed in importance by agriculture, forestry and mining. The Tokaido and the Sanyo trunk railways meet at Kōbe, capital of the prefecture, and the Sun'in line, another trunk line, traverses the northern part. Kōbe port leads the country in foreign trade. Cotton textiles and mining products are among the chief exports and raw cotton and rubber among the chief imports.

There are a number of cities, including Kōbe, Nishinomiya and Amagasaki (*qq.v.*), along the Ōsaka bay, which form part of the Hanshin (Ōsaka-Kōbe) industrial zone. (R. B. H.)

HYOSCINE: *see* SCOPOLAMINE.

HYOSCYAMINE, the chief alkaloid occurring in the leaves and tops of henbane, deadly nightshade (belladonna) and Jimson weed. It is a powerful poison and the major natural source of atropine, its racemic form (*see* STEREOCHEMISTRY). Hyoscyamine occurs in the plant sources almost entirely as the levorotatory form, *l*-hyoscyamine, which is converted to atropine, containing both levorotatory (*l*) and dextrorotatory (*d*) molecules, during the process of extraction or by the action of dilute alkali. The *d*-isomer does not exist free in nature. In its action on nerve endings *l*-hyoscyamine is about twice as potent as atropine, the *d*-isomer being almost inactive; the two isomers, however, exert almost equal effects on the brain and spinal cord. Thus *l*-hyoscyamine is almost entirely responsible for the peripheral actions of atropine, but the two isomers contribute equally to the action on the central nervous system. The difference in potency between *d*- and *l*-hyoscyamine is attributed to differences in their rates of chemical breakdown in the body as well as to differences in their ability to reach the sites in the body where they exert their effects.

See also ALKALOIDS; ATROPINE; HENBANE. (V. E.)

HYPAETHRUS, an architectural term used by Vitruvius for an opening in the roof to admit light. Alternative forms are hypaethros and hypaethrum. Many students of Greek temples, especially James Fergusson and T. J. Hittorff, basing their conclusions upon the Vitruvian reference to such a hypaethrus in the temple of Zeus Olympius at Athens, and upon coping tiles found in the temple at Aegina, have concluded that all Greek temples had some such method of admitting light. Moreover, late Greek tombs at Cyrene and Alexandria show raised copings in the centre

of the roof as if for such an opening. And according to Strabo (*c.* 50 B.C.), the temple of Apollo Didymaeus at Miletus (second half of 4th century B.C.) had its entire vast cella open to the sky and planted with groves of laurel. Pausanias, however, states that this temple was never completed; if this is so a roof may have been planned originally.

Modern consensus is counter to the idea that the hypaethrus was a common feature. No arrangements for drainage have been found in connection with Greek temples, and the very reference of Vitruvius on which the speculations of Fergusson, Hittorff and others are based seems to point to the arrangement as exceptional enough to warrant mention, and used only in the largest buildings. Thus the ordinary temple would be lighted only by the enormous doorway; certainly light thus obtained would furnish a more beautiful and impressive illumination than any direct glare from above.

(T. F. H.)

HYPATIA (d. A.D. 415), who was a typical representative of Alexandrian Neoplatonism (*q.v.*), was the daughter of Theon of Alexandria, a writer on mathematics from whom she seems to have derived an interest in the subject. She is said to have occupied the chair of Platonic philosophy at Alexandria and to have lectured on Plato, Aristotle and other philosophers. Her most notable pupil was Synesius of Cyrene, who became bishop of Ptolemaïs *c.* 411 and whose affectionate and admiring letters to her are the main source of information about her personality. This close friendship between the pagan Neoplatonist teacher and the Christian Neoplatonist pupil illustrates one aspect of the complex relationship between Christians and pagans at Alexandria under the Christian Roman empire, the close and fruitful contact, so important for later developments, of Christianity with pagan philosophy. Hypatia's cruel murder in 415, by a Christian mob in the course of a characteristic Alexandrian riot, shows another. The notice of Hypatia in Suidas gives the titles of several of her works, all now lost. They are mathematical and astronomical commentaries; the existence of any strictly philosophical works is not known. Available information about her suggests that her philosophy was the embodiment of Alexandrian Neoplatonism, which was more scholarly and more scientific in its interests, less given to metaphysical elaboration and less intransigently pagan than the Athenian school, whose greatest philosopher was Proclus.

See F. Ueberweg, ed. by K. Praechter, *Die Philosophie des Altertums* (1926); also K. Praechter, "Hypatia," in Pauly-Wissowa, *Real Encyclopädie der classichen Altertumswissenschaft*, vol. ix (1914). Charles Kingsley's historical romance *Hypatia* (1853) is to be recommended rather as an illustration of the mentality of the author and his period than as a source of reliable information about Hypatia and 5th-century Alexandria.

(A. H. Ag.)

HYPERBOLA. This geometric, two-branched curve is a conic section (*q.v.*) obtained by the intersection of any circular cone with a plane cutting both nappes of the surface (fig. 1). It may be defined as the locus of a point whose distances from two fixed points F and F', the foci, have a constant difference. This difference is equal to segment $2a$ (fig. 2), which is the transverse axis cutting the hyperbola.

Let O be the midpoint of the focal segment FF'. The points A, A' defined by the relation:

$$OA = OA' = a$$

lie on the curve, for

$$AF' - AF = AF' - A'F' = AA' = 2a$$

and similarly for A'. The points A, A', called the vertices of the curve, lie inside the focal segment $FF' = 2c$; for, if M is any point of the curve, we have in the triangle MFF'

$$2c = FF' > (MF - MF') = 2a$$

Let L be any point on the line FF', outside the segment FF'. The two circles (F, LA), (F', LA') centred at F, F' and having for radii LA, LA', respectively, intersect in two points P, P' belonging to the curve, since

$$PF' - PF = P'F' - P'F = LA' - LA = AA' = 2a$$

The points of intersection Q, Q' of the circles (F, LA'), (F', LA) are another pair of points of the curve. From this construction by points the following properties of the hyperbola are derived: The two infinite branches have no point in common. The line FF' (fig. 2) lies on an axis of symmetry, the transverse (real) axis. The point O is a centre of symmetry and the perpendicular to FF' at O is another axis of symmetry, the conjugate axis, which does not cut the curve, since the difference of the distances of any of its points from the foci is equal to zero. More generally, if a point S lies inside either of the two branches of the hyperbola, then $SF - SF' > 2a$; if S lies between the two branches, then $SF - SF' < 2a$.

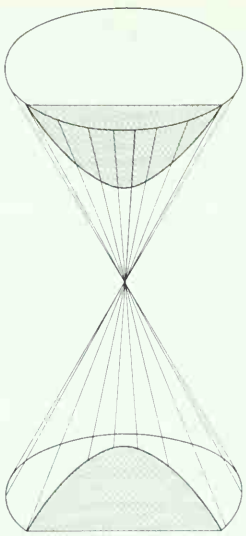


FIG. 1.—THE HYPERBOLA AS A CONIC SECTION

If the two axes of symmetry of the hyperbola are taken as co-ordinate axes, the co-ordinates of the foci F' and F are, respectively, $(-c, 0)$ and $(c, 0)$. If $M\ (x, y)$ is a point on the curve, the definition of the curve given above may be translated into the equation:

$$\sqrt{(x-c)^2 + y^2} - \sqrt{(x+c)^2 + y^2} = 2a$$

which, after simplification, becomes the standard equation of the hyperbola:

$$x^2/a^2 - y^2/b^2 = 1 \qquad (1)$$

where $b^2 = c^2 - a^2$; and, by analogy with the case of the ellipse (*q.v.*), $2b$ is taken as the length of the conjugate axis of the hyperbola.

Two tangents may be drawn from the centre O to the curve. The chord of contact of these two tangents is the line at infinity; in other words, the points of contact of these tangents recede indefinitely, and the tangents are thus the asymptotes of the curve. The equations of the asymptotes are

$$ay + bx = 0 \qquad (2)$$
$$ay - bx = 0$$

The equation

$$y^2/b^2 - x^2/a^2 = 1$$

represents the conjugate hyperbola of the one considered, and vice versa. Conjugate hyperbolas are so related that the transverse axis of one is the conjugate axis of the other, and they have common asymptotes.

The tangent to the hyperbola at a point M is the bisector of the external angle formed by the focal radii MF, MF' of the point of contact M. The chord through a focus and perpendicular to the transverse axis is called the *latus rectum*.

The locus of the symmetric of a focus F of the hyperbola with respect to the tangents of the curve is the circle $(F', 2a)$, centred at the other focus F' and having for radius the length $2a$ of the transverse axis. The asymptotes of the hyperbola are the perpendiculars dropped from the centre O upon the tangents drawn from the focus F to the circle $(F', 2a)$, or vice versa, from F' to the circle $(F, 2a)$.

The locus of points from which pairs of mutually perpendicular tangents may be drawn to the hyperbola is a circle whose centre coincides with the centre of the hyperbola and the square of whose radius is equal to $a^2 - b^2$.

In equation (1) above, if $b = a$ then that equation becomes

$$x^2 - y^2 = a^2$$

and the hyperbola is said to be equilateral, with major and minor

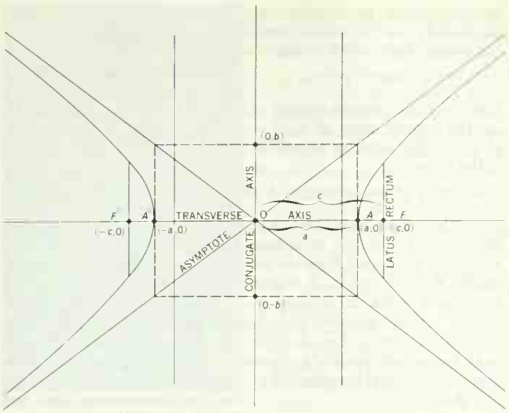


FIG. 2.—GRAPH OF THE HYPERBOLA

axes equal. The equations (2) above become $y - x = 0$, $y + x = 0$, showing that the asymptotes of an equilateral hyperbola are perpendicular to each other. If those asymptotes are taken for co-ordinate axes, the equation of the curve takes on the form $xy = k$, k being a constant. Since this equation shows that x and y are inversely proportional, the equilateral hyperbola may be said to be the graph of two inversely proportional variable quantities. *See* also CONIC SECTION; ANALYTIC GEOMETRY; ELLIPSE; PARABOLA; PROJECTIVE GEOMETRY. (N. A. CT.)

HYPERBOLE (Gr. *hyper,* "over", and *ballein,* "to throw"; hence, "in excess"), a figure of speech exaggerating the qualities or importance of a thing or person, used in satire and serious eulogy. Shakespeare's Cleopatra, lamenting Anthony's death, declares, "His legs bestrid the ocean . . ." *See* FIGURES OF SPEECH: *Figures of Degree of Emphasis.* (G. W. A.)

HYPERBOLIC FUNCTIONS, six functions related to the equilateral hyperbola in a manner analogous to the relation of the trigonometric functions to the circle, as explained later in this article. Two are usually defined by means of the exponential function e^x as follows:

$$\sinh x = \frac{e^x - e^{-x}}{2}$$

$$\cosh x = \frac{e^x + e^{-x}}{2}$$

The number e is the base of natural logarithms (2.71828 . . .). The remaining four functions are defined in terms of $\sinh x$ (read "hyperbolic sine of x") and $\cosh x$ so that relations analogous to those for the trigonometric functions are obtained. The definitions are

$$\tanh x = \frac{\sinh x}{\cosh x} = \frac{e^x - e^{-x}}{e^x + e^{-x}}$$

$$\operatorname{ctnh} x = \frac{1}{\tanh x} = \frac{e^x + e^{-x}}{e^x - e^{-x}} \qquad (x \neq 0)$$

$$\operatorname{sech} x = \frac{1}{\cosh x} = \frac{2}{e^x + e^{-x}}$$

$$\operatorname{csch} x = \frac{1}{\sinh x} = \frac{2}{e^x - e^{-x}} \qquad (x \neq 0)$$

The fact that $\operatorname{ctnh} x$ and $\operatorname{csch} x$ are undefined for $x = 0$ is indicated to the right of their definitions.

Of the six functions, two, $\cosh x$ and $\operatorname{sech} x$, are even and the other four are odd. These properties of the functions are expressed by the equations

$$\sinh(-x) = -\sinh x$$

$$\cosh(-x) = \cosh x$$

$$\tanh(-x) = -\tanh x$$

and the three that are obtained from these when the reciprocals of the members are taken. Four of the functions have simple values when the argument is zero:

$$\sinh 0 = \tanh 0 = 0, \cosh 0 = \operatorname{sech} 0 = 1$$

In addition to these relations there are three fundamental identities involving the squares of the functions viz.

$$\cosh^2 x - \sinh^2 x = 1$$

$$1 - \tanh^2 x = \operatorname{sech}^2 x$$

$$\operatorname{ctnh}^2 x - 1 = \operatorname{csch}^2 x$$

and three important addition formulas

$$\sinh(x \pm y) = \sinh x \cosh y \pm \cosh x \sinh y$$

$$\cosh(x \pm y) = \cosh x \cosh y \pm \sinh x \sinh y$$

$$\tanh(x \pm y) = \frac{\tanh x \pm \tanh y}{1 \pm \tanh x \tanh y}$$

From these basic identities many others are readily derivable. They all bear the same striking resemblance to trigonometric identities. This is a consequence of the fact that all identities in the trigonometric and hyperbolic functions are valid when the variables are complex and in the domain of complex numbers the functions are related as follows:

$$\sin ix = i \sinh x$$

$$\cos ix = \cosh x$$

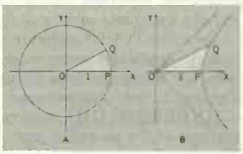
$$\tan ix = i \tanh x$$

$$\operatorname{ctn} ix = -i \operatorname{ctnh} x$$

$$\sec ix = \operatorname{sech} x$$

$$\operatorname{csc} ix = -i \operatorname{csch} x$$

If in any trigonometric identity the variables x, y, . . . are replaced by ix, iy, . . . , respectively, and substitutions are then made from these equations between the two sets of functions, the trigonometric identity is transformed into an identity for hyperbolic functions. In like manner a hyperbolic identity is transformed into an identity for trigonometric functions by the six relations that are obtained from the above six when sin and sinh, cos and cosh, etc., are interchanged. Corresponding formulas may have different signs in some of the terms because of the occurrence of i^2 which is -1.



(A) PARAMETRIC EQUATIONS OF THE CIRCLE: AND (B) THE EQUILATERAL HYPERBOLA. (*See* TEXT)

Trigonometric and hyperbolic functions of complex numbers may be evaluated by means of the addition formulas and the relations between the hyperbolic and trigonometric functions. For example,

$$\sin(a+bi) = \sin a \cosh b + i \cos a \sinh b$$

$$\cos(a+bi) = \cos a \cosh b - i \sin a \sinh b$$

$$\sinh(a+bi) = \sinh a \cos b + i \cosh a \sin b$$

$$\cosh(a+bi) = \cosh a \cos b + i \sinh a \sin b$$

The quantities in the right members are obtainable from tables for the trigonometric functions and from similar tables for the hyperbolic functions. Another interesting consequence of the relation between the two sets of functions is that, although the hyperbolic functions have no real period, they are nevertheless periodic with an imaginary period πi for $\tanh x$ and $\operatorname{ctnh} x$, and $2\pi i$ for the other four functions.

The inverse hyperbolic sine of x is written $\sinh^{-1} x$. It is defined in the usual manner as the function for which $\sinh(\sinh^{-1} x) = x$ is an identity in x. In the domain of reals, the inverse exists as a continuous, real, single-valued function for all real values of its argument. There are two continuous, real, single-valued functions for which $\cosh(\cosh^{-1} x) = x$ is an identity in x. One is positive-valued and the other negative. It is customary to denote the positive-valued inverse function by $\cosh^{-1} x$, which is defined for all real values of x greater than or equal to 1. The other inverse function is then $-\cosh^{-1} x$.

Likewise sech x has two inverses that are continuous, real and single-valued; the positive one is denoted by $\operatorname{sech}^{-1} x$ and the negative one by $-\operatorname{sech}^{-1} x$. Both are defined on the interval $0 < x < 1$. Each of the remaining three functions has one continuous, real, single-valued inverse defined on the real domain that is indicated at the right in the equations below. These equations relate the inverse hyperbolic functions to the logarithmic function.

$$\sinh^{-1} x = \ln (x + \sqrt{x^2 + 1})$$

$$\cosh^{-1} x = \ln (x + \sqrt{x^2 - 1}) \quad (x \geq 1)$$

$$-\cosh^{-1} x = \ln (x - \sqrt{x^2 - 1}) \quad (x \geq 1)$$

$$\tanh^{-1} x = \tfrac{1}{2} \ln \frac{1 + x}{1 - x} \quad (|x| < 1)$$

$$\operatorname{ctnh}^{-1} x = \tfrac{1}{2} \ln \frac{x + 1}{x - 1} \quad (|x| > 1)$$

$$\operatorname{sech}^{-1} x = \ln \frac{1 + \sqrt{1 - x^2}}{x} \quad (0 < x \leq 1)$$

$$-\operatorname{sech}^{-1} x = \ln \frac{1 - \sqrt{1 - x^2}}{x} \quad (0 < x \leq 1)$$

$$\operatorname{csch}^{-1} x = \ln \frac{1 + \sqrt{1 + x^2}}{x} \quad (x > 0)$$

$$\operatorname{csch}^{-1} x = \ln \frac{1 - \sqrt{1 + x^2}}{x} \quad (x < 0)$$

For complex values of x the inverse hyperbolic functions have infinitely many complex values.

Parametric equations for the circle $x^2 + y^2 = a^2$ are $x = a \cos u$, $y = a \sin u$. Likewise, parametric equations for the equilateral hyperbola $x^2 - y^2 = a^2$ are $x = a \cosh u$, $y = a \sinh u$. When $a = 1$ the variable u has, for the circle, three possible geometric interpretations. The usual one is the angle POQ in figure (A).

It may also be taken as the length of the arc PQ and as twice the area of the sector POQP in the same figure. The latter is the trigonometric analogue of the geometric interpretation of u in the parametric equations for an equilateral hyperbola $x^2 - y^2 = 1$. For the hyperbola, u in $x = \cosh u$, $y = \sinh u$ is twice the area of the sector POQP (*see* figure [B]). The formulas for the derivatives, integrals and power series expansions of the hyperbolic functions are obtainable from standard mathematical tables. *See* also TRIGONOMETRY: *Trigonometric Functions.* (R. W. BD.)

HYPERBOLOID, in geometry, either of two open centric surfaces of the second degree (conicoids, quadrics). The general equation of such centrics takes the form

$$Ax^2 + By^2 + Cz^2 = 1$$

where A, B, C may have four orders of signs: $+\ +\ +$ (ellipsoid) and $-\ -\ -$ (a *nowhere* ellipsoid, with no real points); the other two, $+\ +\ -$ and $+\ -\ -$, yield hyperboloids of one sheet or two sheets. The central rectangular equations may be written

$$x^2/a^2 + y^2/b^2 - z^2/c^2 = 1$$

and

$$x^2/a^2 - y^2/b^2 - z^2/c^2 = 1$$

Planes parallel to XY cut the hyperboloid in similar ellipses, $x^2/a^2 + y^2/b^2 = z^2/c^2 + 1$, and the hyperboloid of two sheets in similar hyperbolas

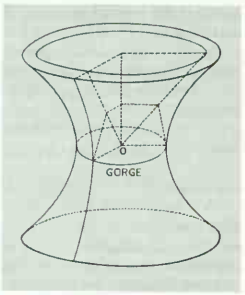


FIG. 1.—HYPERBOLOID OF ONE SHEET

$$x^2/a^2 - y^2/b^2 = z^2/c^2 + 1$$

likewise for sections parallel to the other co-ordinate planes. It is simplest to consider the limiting cases, when $a = b = c$. Then the hyperboloid

$$x^2 + y^2 - z^2 = a^2$$

is plainly the "revolute" of the rectangular hyperbola $x^2 - z^2 = a^2$ rotated round the Z-axis, each point (x, z) tracing a circle $x^2 + y^2 = a^2 + z^2$. For $z = 0$, $x^2 + y^2 = a^2$ becomes the minimal circle. The general surface (fig. 1) is found, as in the ellipsoid (*q.v.*), by compression (or expansion) of all y's and z's in the ratios b/a and c/a respectively, which yields

$$x^2/a^2 + y^2/b^2 - z^2/c^2 = 1$$

The "revolute" has as tangent at ∞ the central cone $x^2 + y^2 - z^2 = 0$, which remains tangential in the form

$$x^2/a^2 + y^2/b^2 - z^2/c^2 = 0$$

after the affine transformation. Rotating the same hyperbola $x^2 - z^2 = a^2$ around X yields the conoid $x^2 - y^2 - z^2 = a^2$, whose asymptotic cone is $x^2 - y^2 - z^2 = 0$. On compression (or expansion) parallel to Y or Z in the ratio b/a, c/a respectively, there results the general hyperboloid of two sheets

$$x^2/a^2 - y^2/b^2 - z^2/c^2 = 1$$

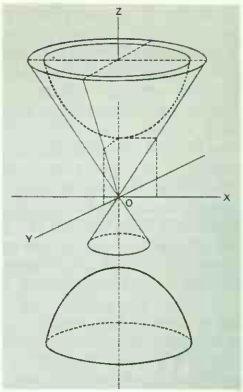


FIG. 2.—HYPERBOLOID OF TWO SHEETS (*See* TEXT)

with its asymptotic cone $x^2/a^2 - y^2/b^2 - z^2/c^2 = 0$ (fig. 2).

Surfaces of the second degree are all ruled; *i.e.*, traceable by a right line moving in a definite way. For, combining the two equations of a line and the one of such a surface, we may eliminate two co-ordinates and obtain a resultant equation in one co-ordinate, and this equation, which is of the second degree, vanishes identically when its three coefficients reduce each to 0; and since the equations of the line have four parameters, this reduction is possible in an infinite number of ways; hence, there is an infinite number of lines lying on a conicoid, like line elements forming a cone. In the ellipsoid and the hyperboloid of two sheets these lines are imaginary, but in the hyperboloid of one sheet they are real, forming two systems, each line of each system meeting all lines of the other system but none of its own (fig. 3). *See* MATHEMATICAL MODELS.

FIG. 3.—LINES GENERATING A HYPERBOLOID

HYPERBOREANS, a mythical people intimately connected with the worship of Apollo at Delphi and of Artemis at Delos. They were so called under the influence of a derivation from Boreas, the north wind; and their home was placed, particularly in Delphic legend, in a paradisal region, beyond the north wind, whither Apollo himself retired for the three months of winter. They lived for 1,000 years; if any desired to shorten this period, he decked himself with garlands and threw himself from a rock into the sea. Their names do not occur in Homer, but Herodotus states that they were mentioned in Hesiod and in one of the Theban epics. According to Herodotus, two Hyperborean maidens, Opis and Arge, accompanied Apollo and Artemis to the island of Delos, where the maidens died and were buried. Later, the Hyperboreans sent two more maidens, Hyperoche and Laodice, with offerings to the goddess of childbirth, Eileithyia, at that shrine; for the journey they were placed under the escort of five men, whom the people of Delos named Perpherees. But, their offerings delivered, the maidens died at Delos; so on future occasions the Hyperboreans wrapped their offerings in wheat straw and requested their neighbours to hand them on, from nation to nation, until they finally reached Delos. There may well have been an Apollo-worshiping people living in the north, but the route of the offerings cannot be traced with confidence farther north than Dodona.

Excavation on Delos has revealed that the graves of the Hyperborean maidens, as shown in Herodotus' time (5th century B.C.), were actually tombs dating from the mid-2nd millennium B.C.

See M. P. Nilsson, *Geschichte der griechischen Religion,* 2nd ed., vol. i, pp. 380–381, 548–550 (1955); William Sale, "The Hyperborean Maidens on Delos," *Harvard Theological Review,* 54:75–89 (1961).

HYPERIDES (*c.* 390–322 B.C.), an Attic orator who figured prominently in the final struggle of the Athenians against Macedonia. He was the son of Glaucippus, of the deme of Collytus. He belonged to a wealthy family, was probably a pupil of Plato and of Isocrates and started as a forensic speech writer. He was one of the ten orators of which biographies survive, dubiously attributed to Plutarch (*q.v.*). His defense of the courtesan Phryne (*q.v.*) is famous. From 346 to some time before 324 he firmly supported Demosthenes in the struggle against Macedonia. In the affair of Harpalus (323) he appeared as one of the ten public prosecutors of Demosthenes (*q.v.*). He had probably come to consider Demosthenes too tame an opponent of Alexander the Great. During the Lamian War Hyperides was the leader of the patriotic party and pronounced the funeral oration over the men who fell for Athens. After the Athenian defeat at Crannon (322), he fled but was captured and put to death by Antipater.

In ancient times 77 speeches were attributed to him of which 52 were considered genuine; of these only 6 survive, in fragmentary state: *Against Philippides* (winter 336/5), *For Lycophron* (333), *For Euxenippus* (*c.* 330), *Against Athenogenes* (after 330), *Against Demosthenes* (323) and the funeral oration (322). Of these fragments that of *For Euxenippus* is the most complete.

For a critical edition with French trans., *see* G. Colin, *Hypéride* in the "Budé Series" (1946).

HYPERION, in Greek mythology, one of the Titans (*q.v.*), son of Uranus and Ge and father of Helios (*q.v.*), the sun-god. The name is often used as an epithet of Helios, who is himself sometimes called simply Hyperion. Its meaning may be "son of Hyperos"; *i.e.*, of him who is above (heaven).

HYPERSTHENE: *see* PYROXENITE.

HYPERTHYROIDISM, a medical condition of unknown cause characterized by excessive secretion of hormones by the thyroid gland. The symptoms may include an elevated rate of basal metabolism and exophthalmos. *See* THYROID GLAND, DISEASES OF.

HYPERTROPHY AND HYPERPLASIA are descriptive terms commonly used in medical terminology with no uniformly accepted precise meaning. They are used in both noun and adjective forms to describe changes in cells, tissues, organs and structures. Hypertrophy generally implies excessive size of a cell, tissue, organ or structure, whereas hyperplasia implies an increase in number of cells, with no connotation of cell abnormality. These terms are not commonly used to describe tumours or inflammatory swellings.

The causes are varied and manifold and the resultant hypertrophy and hyperplasia may be within physiologic limits, but ordinarily some abnormal condition exists. (F. L. A.; X.)

HYPNOSIS (HYPNOTISM) is the term applied to a unique, complex form of unusual but normal behaviour which can probably be induced in all normal persons under suitable conditions and also in many persons suffering from various types of abnormality. It is primarily a special psychological state with certain physiological attributes, resembling sleep only superficially and marked by a functioning of the individual at a level of awareness other than the ordinary conscious state; for convenience in conceptualization, this is called unconscious or subconscious awareness. Functioning at this special level of awareness is characterized by a state of receptiveness and responsiveness in which inner experiential learnings and understandings can be accorded values comparable with or even the same as those ordinarily given only to external reality stimuli.

When hypnotized, or in the hypnotic trance, the subject can think, act and behave in relationship to either ideas or reality objects as adequately as, and usually better than, he can in the ordinary state of awareness. In all probability this ability derives from intensity and restriction of attention to the task in hand, and the consequent freedom from the ordinary conscious tendency to orient constantly to distracting, even irrelevant, reality considerations.

The subject is not, as is commonly and wrongly believed, without will power, or under the power of the hypnotist. Instead, the relationship between the subject and the hypnotist is one of interpersonal co-operation based upon mutually acceptable and reasonable considerations. Hence, the subject cannot be forced, as a function of hypnosis itself, to do things against his will, as is sometimes claimed. He can be aided in achieving possible desired goals, but frequent failures in hypnotherapy attest the limitations of hypnosis in accomplishing even wanted purposes, and extensive and reliably controlled studies discredit the possibilities of antisocial use of hypnosis.

The history of hypnosis is as ancient as that of sorcery, magic and medicine, to the armamentaria of which it belonged. Its scientific history began in the latter part of the 18th century with Franz Mesmer (*q.v.*), a Viennese physician who used it in the treatment of patients. Because of his mistaken belief that it was an occult force, which he termed "animal magnetism," that flowed through the hypnotist into the subject, he was soon discredited; but mesmerism, as it was named after him, continued to interest medical men. Extensive use was made of it by a number of clinicians, without adequate recognition of its nature until the middle of the 19th century when the English physician James Braid (*q.v.*) studied its phenomena and coined the terms hypnotism and hypnosis.

Thereafter many scientifically trained men studied hypnosis, but not until after World War I was much progress made. This progress derived from the recognition of the re-educative possibilities afforded by hypnosis. World War II gave further impetus to its study, greatly extended its recognition and utilization and freed it from many of the superstitions, fears and misconceptions that had hampered its scientific acceptance and investigation. The next significant developments in the history of hypnosis occurred in the mid-1950s when both the British and American Medical associations formally approved its medical use and discountenanced its use by the laity. At that period also was organized the American Society of Clinical Hypnosis, with international scientific societies.

Hypnotic Technique.—Popular belief still ascribes significance to magical devices and rituals such as "making passes" or stroking the body, the use of "hypnotic crystals," the "eagle eye" and the "hypnotic command," all of which belong to the charlatan's stock in trade. Actually, the important consideration in inducing hypnosis is that the subject be willing, co-operative and interested in learning a new experience. To such a subject a trusted operator can progressively, persuasively and repetitiously suggest tiredness, relaxation, eye closure, loss of interest in externalities and an increasingly absorbing interest in inner experiential processes, until the subject can function with increasing adequacy at the level of unconscious awareness. The length of time required to induce a trance differs greatly with subjects and with trance situations, and the time spent should be in reasonable accord with both the importance and the specific character of the hypnotic work to be done. The charlatan boasts of his speed; the scientist considers time an important variable. Thus, the dentist might need only a few minutes to induce the trance state requisite to permit a simple tooth extraction; the psychologist might need an hour to effect those psycho-neuro-physiological responses needed for a long, involved laboratory experiment; and the hypnotherapist, because of his patient's needs, might distribute over a period of months the development of a trance state otherwise possible in a short period of time.

Another essential element in technique—for either investigative or therapeutic work—is the utilization of the subject's own patterns of learning and response, rather than an attempt to force upon him by suggestion the hypnotist's limited comprehension of what constitutes experiential validity for the subject. Failures in hypnotic experimentation and therapy often derive from treating the subject as an automaton, expected to execute commands in accord with the hypnotist's understanding, rather than as a personality with individual patterns of response and behaviour.

Hypnotic Phenomena.—Hypnotic phenomena differ from one subject to another and from one trance to another, depending upon

the purposes to be served and the depth of the trance. Hypnosis is a phenomenon of degrees, ranging from light to profound trance states but with no fixed constancy. There are, however, certain basic manifestations, the extent and clarity of which vary. Foremost among these is rapport, which signifies the limitation of the subject's awareness to that which is included in the hypnotic situation. Usually the subject responds only to stimuli from the hypnotist, who may limit or direct the subject's awareness or responsiveness as is desired or needful. However, in accord with personality needs or the demands of the situation, the subject may remain in or actively establish contact with part or all of the circumstances surrounding the trance.

Catalepsy, another hypnotic manifestation, is properly tested only indirectly, since direct tests may elicit it as a responsive rather than as a spontaneous phenomenon. Catalepsy is a state of balanced muscle tonicity which permits great economy of effort, allowing the subject to maintain postures and positions for unusually long periods of time.

Suggestibility, a state of greatly enhanced receptiveness and responsiveness to suggestions and stimuli, constitutes the central phenomenon of hypnosis. It is characterized by the remarkable facility with which the subject can respond to either external stimuli or those deriving from inner experiential acquisitions. However, suggestions must be acceptable to the subject, and rejection of them can be based upon whim as easily as upon sound reasons. By acceptance of and response to suggestions, the subject can become psychologically deaf, blind, hallucinated, amnesic, anesthetic or dissociated, or he can develop various special types of behaviour regarded by him as reasonable or desirable in the given situation.

The psychological processes involved are essentially those of vivification of memories, ideas, understandings, emotions—indeed, any type of experiential acquisition—so that they are experienced subjectively as deriving from external events rather than from internal processes. This is the feature of hypnosis most often abused by the charlatan, and it is also the feature that permits the greatest accomplishments in psychology, dentistry and medicine. (*See* also SUGGESTION AND SUGGESTIBILITY.)

A most fascinating manifestation, also of great scientific importance, is that of posthypnotic suggestion and behaviour. By this is meant the execution, at some later time, of instructions and suggestions given in a trance and intended to become a part, either interpolated or integrated, of a later activity. For example, a pregnant patient may be instructed posthypnotically to develop, at some future time when labour begins, an obstetrical anesthesia to meet the needs of childbirth. Such use of posthypnotic phenomena offers extensive opportunities for direction and guidance of behaviour in terms of the individual's needs and patterns of response without dependency upon immediate guidance and relationships.

Amnesia of any degree of selectiveness or comprehensiveness may be developed in hypnosis, either spontaneously or by instruction. It may include all the events of the trance state or only selected items, or it may be manifested in connection with matters unrelated to the trance. Hypnotic amnesia is reversible; it may be induced, abolished, reinduced or altered by the operator or by the subject if adequate personal motivation develops. It is very useful in both experimentation and therapy and can be used in a variety of ways. For example, otherwise uncontrollable pain in malignant disease has been partially controlled by use of amnesia.

Conversely, hypermnesia, an ability to remember that transcends the everyday ability is another aspect of hypnotic behaviour that is valuable experimentally and therapeutically. For example, in the trance state, the subject, by virtue of an uncritical willingness to make the effort and a freedom from inhibitions deriving from preformed judgments, can remember vividly long-forgotten, even deeply repressed experiences, recount them in extensive detail and still maintain an amnesia for them at the ordinary level of consciousness. This remarkable ability permits the recovery of memories otherwise unavailable, makes possible extensive exploration of the experiential past, and offers opportunities for studies of basic processes underlying learning and memory.

A striking phenomenon of the profound trance is somnambulism. This is a state of deep hypnosis in which the subject can present the outward appearance and behaviour of ordinary awareness but is able to manifest readily and often spontaneously any type of hypnotic behaviour within his personal capabilities. Some subjects never achieve this state, some reach it with a minimum of effort. It is of great value in certain specialized procedures and studies. Experience and training are often required even to recognize the somnambulistic state, and even more experience is necessary to induce it readily and to utilize it adequately.

Ordinarily all trance behaviour is characterized by a simplicity, a directness and a literalness of understanding, action and emotional response suggestive of childhood. This is the phenomenon of regression, which can be enhanced so that the subject experiences a retrogressive loss of memories, learnings and responses, and those belonging to an earlier age are re-established. When developed carefully, this regression is not a re-enactment or a revivification of the past in terms of current understanding, but a restoration of previous response patterns through a process of amnesic loss of subsequent learning. This manifestation permits extensive exploration of the developmental aspects of the subject's experiential past.

Dissociation, a detachment or separation of subjective from objective values, another highly complicated phenomenon, is of particular significance in effecting specialized learnings (for example, anesthesia or emotional objectivity) without arousing impeding or obstructing subjective reactions—the hypnotized subject, that is, can be made insensitive to a needle prick because the dissociation phenomenon prevents a subjective reaction (pain) from occurring.

Time distortion, first elaborated as a specific scientific concept in the mid-1940s, has proved to be useful in both hypnotic therapy and experimentation. It is essentially a function of speed of cerebration, as a result of which the passage of time is perceived subjectively in terms of inner experiential processes and events. As a consequence, time as a personal experience may be "expanded" or "condensed" with resulting alterations in subjective values and psychological and physiological functioning.

Among other interesting hypnotic manifestations are enhanced visual and auditory imagery, automatic writing, depersonalization, various types of disorientation, and acceleration or inhibition of physiological functions.

Autohypnosis.—Autohypnosis, or self-hypnosis, is both possible and feasible, but it is often a sterile procedure because of misconceptions of its nature and use. Usually the autohypnotist tries too hard to direct *consciously* the activities he wishes to take place at the hypnotic level of awareness, thus nullifying the effort.

Acceptance of autohypnotic processes, rather than attempted direction of them, leads to productive results. Usually autohypnosis is best learned through supervised instruction.

Related Questions.—Certain questions are repeatedly asked about hypnosis. Among these is the possibility of employing hypnosis to commit crimes. The better scientific studies deny this possibility and therapeutic experience discredits it, but a few experimental studies, either inadequately controlled or in protective situations, have resulted in pretended crimes. However, pretense is not reality, nor is hypnosis an essential in pretense.

Concerning harmful effects, none have been reported by earnest students of long experience, but the inexperienced and the armchair theorist are often emphatic in affirming such possibilities. Occasionally an amateur will hypnotize a person suffering from a personality disorder and mistake the evidence of that disorder for hypnotic effects. In this connection may be mentioned the harmfulness of lay hypnosis. This derives not from the hypnosis itself but from the misconceptions promulgated and from the discredit and disrepute that always attend dabbling by the uninformed in, and exploitation by the charlatan of, any field of beneficial learning.

Can hypnosis be induced without the subject's willingness or awareness? Hypnosis is based upon willingness and co-operation, but this may be concealed behind a superficial attitude of unwillingness; similarly, superficial willingness may conceal deep-seated unwillingness, with a consequent failure of trance induction. A

trance state cannot be maintained without the subject's consent, actual or implied.

Then there is the question of what would happen if the subject could not be awakened, or if in some way the hypnotist were to be removed, leaving the subject in a trance state. The reply is simply that the trance state, being dependent upon an interpersonal relationship of mutual co-operation, would terminate upon the cessation of that relationship. It is possible to arrange with a subject to remain in a trance in the absence of the hypnotist, but this is merely a form of continued co-operation. Occasionally a subject may refuse through a whim to arouse immediately from a trance, but this is a problem only for the inexperienced and is not significant.

See also references under "Hypnosis" in the Index.

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See also the *American Journal of Clinical Hypnosis*, quarterly (July 1958 *et seq.*). (M. H. Ex.)

HYPOCAUST, in architecture, an open space below a floor to allow the passage of hot air and smoke in order to heat the room above. This type of heating was developed to a high degree by the Romans who used it not only in the warm and hot rooms of the baths (*q.v.*), but also almost universally in private houses in the northern provinces. Many examples of such hypocausts exist in villa and house foundations in Roman centres in Germany and England. The usual custom was to lead the smoke from a hypocaust into a single vertical flue through which it escaped into the open air. Where greater warmth was desired, several flues would lead up from the hypocaust in the side walls of the room; at times these wall flues consisted of hollow oblong tiles, set close together, entirely around the room. The usual construction of a hypocaust consisted of a layer of tiles, two feet square, laid continuously in a bed of concrete for the bottom surface. Piers approximately eight inches square and about two feet apart were used as the supports. A floor above was made of concrete or of large square tiles supporting a bed of concrete, on which the finished floor of marble, tesserae or mosaic was laid.

HYPOCHONDRIASIS, a morbid mental preoccupation in one's own health with a tendency to find evidence of disease from insignificant signs. The person may become convinced that diseases exist even though they are absent. The idea of ill-health relates essentially to the internal organs and predominantly to the functioning of the heart, gastrointestinal tract or genital structures. Such a symptom may occur in many forms of mental illness. It is frequently noted in hysterical anxiety and neurasthenic neuroses; in melancholic states, especially those of later years; in dementia praecox; and in the initial stages of such organic psychoses as arteriosclerotic dementia and general paresis. In other cases hypochondriasis seems to present itself without any other symptom; and the assurance, based on an examination, that no physical abnormality exists usually has only a temporary effect on the false belief, which may lead to self-centredness, depression and insomnia.

It is probable that the hypochondriacal type has a greater sensitivity to sensations emanating from the internal organs, is therefore more easily aware of any change that may occur therein and so is more affected by any possible alteration in their functioning.

Any treatment naturally depends on the associated disease. In the more pure manifestation of the condition, some form of psychotherapy is indicated, but results are often disappointing.

(C. S. R.)

HYPOTHALAMUS is the inferior part of the diencephalon, the portion of the brain that forms a bridge between brain stem and cerebral hemispheres. The pituitary body is attached to its middle portion. The hypothalamus contains nerve fibres and neurons, the latter forming nuclear groups that have elaborate and extensive fibre connections. Information on the physiology of the hypothalamus is largely based on animal experiments, but many of these findings have support from clinical observations in human beings. There is evidence that some of its neurons produce substances that theoretically regulate the secretory activities of the anterior pituitary, as well as provide the antidiuretic and oxytocic (childbirth-hastening) hormones of the posterior pituitary. After certain specific hypothalamic lesions there may be increased appetite and obesity, while lesions in other areas of the hypothalamus reduce appetite. The hypothalamus is concerned in regulation of blood pressure, gastrointestinal activity, dilatation of the pupils, etc., as well as other autonomic manifestations that are characteristic of emotional states. It is also concerned with bodily behaviour patterns of emotional type (*i.e.*, rage and fear), and is at the upper end of the reticular formation of the brain stem, which, together with the sensory systems, aids in maintaining the cerebral cortex at a level of activity consistent with consciousness.

Experimental work indicates further that the hypothalamus is connected with the little-known rhinencephalic systems as well as with more recently developed cerebral regions. This adds weight to theoretical concepts that this small region is involved in very extensive neural patterns concerned with the regulation of autonomic and endocrine activity as well as emotional expression.

See BRAIN; ENDOCRINOLOGY; HORMONES, VERTEBRATE; THALAMUS; *see* also references under "Hypothalamus" in the Index.

(W. R. Im.)

HYPOTHEC is a general principle of the law of Scotland, recognized also by the law of Rome, that a security over movables cannot be constituted without transfer of possession of the movable object from the debtor to the creditor. (The law of England is different; thus the floating charge, so well known in English law, is not recognized in Scotland, since the property covered does not change hands but remains in the possession of the debtor.)

To this general rule the law of Scotland recognizes some exceptions, and most prominent among them is the "hypothec." This may be described as a security constituted over movable property which remains in the possession of the debtor. The cases, however, in which a hypothec arises by force of law—cases of so-called legal hypothec—are limited, although it is competent for the parties covered to assent by express contract to a "conventional" or contractual hypothec. The following paragraphs relate only to legal hypothecs.

The best-known legal hypothec is that of the landlord over movables in leased premises. Similar is that of the superior for his feu duty. A solicitor has a hypothec, for expenses incurred by him, over expenses awarded to his client by the court. His rights have been extended by statute to cover also property recovered in the action.

In maritime hypothecs a ship and its cargo may be hypothecated by bond granted by the master—a bond of bottomry over the ship and a bond of respondentia over the cargo. Hypothecs, more commonly called liens, also exist over a ship for seamen's wages, salvors' claims, repairs and necessaries incurred abroad, and collision damage. (A. D. G.)

HYPOTHESIS, something supposed or taken for granted, with the object of following out its consequences (Gr. *hypothesis*, "a putting under," the Latin equivalent being *suppositio*).

In planning a course of action, one may consider various alternatives, working out each in detail. Though the word hypothesis is not actually used here, the procedure is just the same as that of an investigator of crime considering various suspects or of a scientist working out various possible explanations of some set of facts, however different the methods used for deciding between the various alternatives may be. What is fundamental is the consideration of a supposal as if it were true, without actually accepting it as true. One of the earliest uses of the word in this sense was in geometry. It is described by Plato in the *Meno* (86e–87a).

The most important modern use is in relation to scientific investigation. A scientist is not merely concerned to accumulate such facts as he can discover by observation: he wants to discover the linkages between facts. He is guided by some problem that

puzzles him; but he needs to have some clue as to what facts will help him to solve his problem. His best guide is a tentative hypothesis, which fits in with the existing body of doctrine and which is so framed that with its help he can deduce that under certain factual conditions ("initial conditions") certain other facts would be found if the hypothesis were correct.

The concepts involved in the hypothesis need not themselves refer to observable objects. But the initial conditions should be able to be observed or to be produced experimentally, and the deduced facts should be able to be observed. William Harvey's researches on the motion of the heart and blood in animals show how greatly experimental observation can be helped by a fruitful hypothesis.

While a hypothesis can be partially confirmed by showing that what is deduced from it with certain initial conditions is actually found under those conditions, it cannot be completely proved in this way. What would have to be shown is that no other hypothesis would serve. Hence, in assessing the soundness of a hypothesis, stress is laid on the range and variety of the facts that can be brought under its scope. Again, it is important that it should be capable of being linked systematically with hypotheses which have been found fertile in other fields.

If the predictions derived from the hypothesis are not found to be true, the hypothesis may have to be given up or modified. The fault may lie, however, in some other principle forming part of the body of accepted doctrine which has been utilized in deducing consequences from the hypothesis; or it may lie in the fact that other conditions, hitherto unobserved, are present beside the initial conditions, affecting the result. Thus the hypothesis may be kept, pending further examination of facts or some remodeling of principles. A good illustration of this is to be found in the history of the corpuscular and the undulatory hypotheses about light.

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HYPOXANTHINE: *see* PURINES.

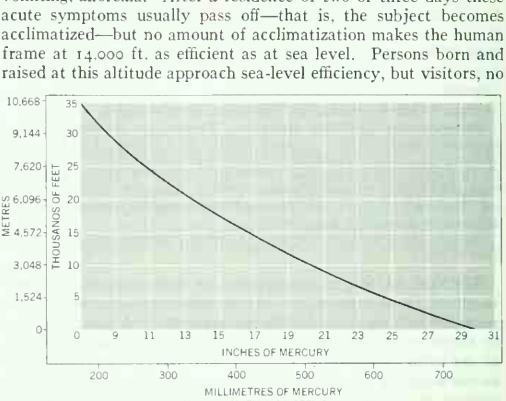
HYPOXIA (also called ANOXEMIA or ANOXIA) is a general term comprising those conditions of the body under which the tissues are starved of oxygen. There are four types: (1) the hypoxemic type, in which the oxygen pressure in the blood going to the tissues is too low to saturate the hemoglobin; (2) the anemic type in which, though the hemoglobin is fully charged, there is too little of it, and hence the capacity of the blood to carry oxygen is too low; (3) the stagnant type in which the blood is or may be normal but in which the quantity of blood running through the organ is too small; and (4) the histotoxic type in which—as the term suggests—the tissue cells are poisoned (for example, by cyanide) and are, therefore, unable to make proper use of the oxygen.

Diseases of the blood, the heart and circulation and the lungs may all produce some form of hypoxia.

Hypoxemia.—Apart from disease conditions, hypoxia is frequently encountered at high altitudes, either in airplanes or on mountains. Between the two there is this distinction—the aviator reaches the rare air suddenly, the mountain climber gradually. Moreover, the aviator reaches it without physical effort, the mountain climber usually as the result of considerable muscular effort. For these reasons the symptoms from which the two classes suffer are different.

The airman loses his faculties if he goes too high. This may amount merely to a loss of judgment or manipulative power, or it may extend to complete loss of consciousness. Because the brain symptoms are the first and most baffling, the use of some system to maintain oxygen pressure is universal in high-flying aircraft.

A person traveling to a high altitude suffers from a somewhat different series of symptoms comprising the condition known as mountain sickness or, in the Andes, *seroche*. In the case of a person traveling by train up to the mining districts about Cerro de Pasco in Peru or up Pikes peak in Colorado (both approximately 14,000 ft.) the symptoms usually appear a few hours after arrival, frequently during the night. They are generally a selection from the following: (1) symptoms of the brain—headache, lassitude, fatigue, sleeplessness, visual and auditory impairment and mental depression—symptoms very much like those of an acute attack of migraine; (2) cardiac symptoms—pain in the chest, palpitation, sinus arrhythmia (*i.e.*, irregularity of heart beat); (3) circulatory symptoms—cold hands and feet, blueness, throbbing; (4) respiratory symptoms—shortness of breath on exertion, change in pattern of breathing, sighing; (5) gastrointestinal symptoms—nausea, vomiting, anorexia. After a residence of two or three days these acute symptoms usually pass off—that is, the subject becomes acclimatized—but no amount of acclimatization makes the human frame at 14,000 ft. as efficient as at sea level. Persons born and raised at this altitude approach sea-level efficiency, but visitors, no matter how long their stay, probably never reach the performance of which they are capable at lower altitudes.



BY COURTESY OF THE CONTROLLER OF H.M. STATIONERY OFFICE

FIG. 1.—MEAN ATMOSPHERIC PRESSURE (ABSCISSA) AT DIFFERENT ALTITUDES (ORDINATE)

The hurtful results of ascent to high altitudes, whether on a mountain or in an aircraft, are governed by condition of the blood. The processes of oxidation on which life and health depend take place within the tissues of the actual organs concerned—the heart, the brain, the muscles, the glands, etc. Of these, undoubtedly the most vulnerable is the brain. It not only carries out the processes of thought but governs the condition of the rest of the body; *e.g.*, the rate of the pulse, the depth of respiration, etc. Therefore the study of the conditions that produce trouble at high altitudes resolves itself into a study of the adequacy of the oxygen supply of the brain.

Oxygen is transported from the lungs to the brain by the blood. The hemoglobin or red pigment has the ability to form a loose compound with oxygen. Of each 100 g. of hemoglobin leaving the lung, the number of grams that transport oxygen depends upon the pressure of oxygen in the alveoli (air cells of the lung), which in turn depends upon its pressure in the air. Oxygen at any altitude is 21% of the local atmospheric pressure, hence the higher the subject ascends the lower will be the oxygen pressure in the air cells of his lungs.

At ordinary atmospheric pressures the oxygen pressure is sufficient nearly to saturate the hemoglobin.

Acclimatization.—The human body is able to make adjustments to a hypoxic condition provided it is not too severe. These adjustments are best understood in relation to hypoxemic hypoxia, most simply seen in ascent to altitude. Some of the adjustments to hypoxia begin the moment the ascent from sea level is started; others appear as the height or the duration of exposure increases. Adaptation enables the organism to withstand better the stress of the hypoxic condition. There are persons in the Chilean Andes who have their homes at 17,500 ft. altitude and who work in the mines at 19,000 ft. In these persons the process of adaptation has gone more or less to its completion, and it can be said that they are well acclimatized to their hypoxic environment. It is possible that the Andean residents represent not only an individual adjustment but also represent the nearly complete acclimatization of a people.

In the process of acclimatization the disturbing symptoms of exposure to hypoxia disappear as the acclimatization becomes com-

plete. The latter state is characterized by a few simple properties: a normal appetite and with it the maintenance of growth in the immature and stable body weight in the adult; a normal reproductive capacity; and finally, the general well-being common to all healthful living.

In the adjustment to hypoxia of altitude, and in those illnesses associated with hypoxia, processes are set into motion that eventually raise the low oxygen pressure of the body tissues to more compatible levels. The ventilation of the lungs in breathing becomes more effective as acclimatization develops, and this, directly or indirectly, involves the kidneys, the adrenals and the nervous system. Even before ventilation increases, the heart is required to pump more blood in order to compensate for the lower tension of oxygen in the blood. As the respiratory adaptation proceeds, the demands on the heart and circulation diminish, but whenever the demand on the body is increased, as in exercise, the circulatory system has a heightened capacity. Part of the latter apparently is due to an improved distribution of blood to the tissues consequent to either an increase in the calibre of the small vessels or an increase in their number or both.

One of the earlier adjustments to hypoxia is the increase in the oxygen-carrying compound of the blood—hemoglobin. Low oxygen tension stimulates the red bone marrow (the blood-making tissue) to heightened activity, resulting in increases in the number of circulating red blood cells with their hemoglobin. The end result is that each millilitre of blood can carry more oxygen than it did before, and therefore compensate for the deficient oxygen supply.

The average number of red blood corpuscles in each cubic millimetre of blood at various altitudes is given by Maj. R. W. G. Hingston (1924 Mt. Everest expedition) for the people living on the Pamir plateau:

Altitude (in 000 ft.)	7	8	12	15.6	18.2
Red corpuscles (in 000,000 per cu.mm. of blood)	4.5	6.0	6.8	7.8	8.3

The increased ventilation of the lungs, mentioned above as one of the early adjustments to hypoxemic hypoxia, causes the pressure of oxygen in the lungs to rise. Concomitantly the carbon dioxide in the lungs is blown off at a rate greater than normal, and as a consequence the carbon dioxide pressure in the lungs falls. This in turn reduces the carbon dioxide pressure in the arterial blood, which lowers the hydrogen ion concentration.

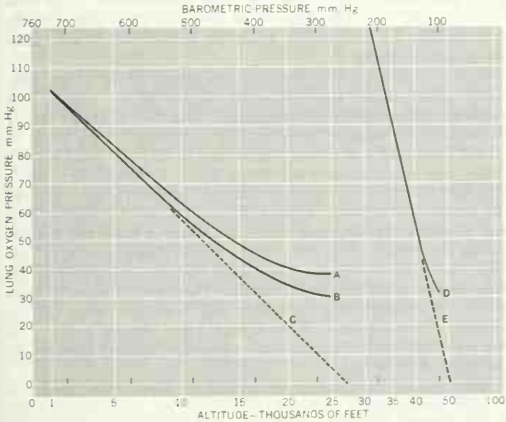


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FIG. 2.—EFFECTS OF THE ADJUSTMENT TO CHANGES IN ALTITUDE IN SUBJECTS BREATHING AIR OR 100% OXYGEN: (A) ACCLIMATIZED SUBJECT BREATHING AIR; (B) UNACCLIMATIZED SUBJECT BREATHING AIR; (C) THEORETICAL RESPONSE IN ABSENCE OF ADAPTATION OF SUBJECT BREATHING AIR; (D) UNACCLIMATIZED SUBJECT BREATHING OXYGEN; (E) THEORETICAL RESPONSE IN ABSENCE OF ADAPTATION OF SUBJECT BREATHING OXYGEN

Since the normal stimulation to breathing is derived from normal carbon dioxide pressure and hydrogen ion concentration in the blood, the stimulation due to the hypoxia will be less effective. However, as the duration of exposure to hypoxia continues, the kidneys secrete increased quantities of alkali in the urine, so that the hydrogen ion condition of the blood is gradually returned to normal. The hypoxic stimulation of breathing then becomes more effective, so that the lung ventilation is increased and the oxygen pressure heightened.

The above points are illustrated in fig. 2. On the left the lines trace the course of the oxygen pressure in the lungs with ascent to increasing altitude. It is apparent that for the higher altitudes, particularly, the oxygen pressure in the lungs is increased by the heightened lung ventilation in those acutely exposed (compare line B with line C). It may be seen also that for these same altitudes the acclimatized person (line A) has a still higher oxygen pressure. The pressure of oxygen in the arterial blood is quite dependent upon that in the lungs. The respiratory adaptation just outlined ensures that the supply of oxygen to the working tissues of the body is improved as the process progresses.

The lines on the right of fig. 2 (D and E) illustrate that ascent can be made to much higher altitudes while breathing 100% oxygen rather than air. Advantage was taken of this fact by the members of the British Everest expedition in 1953—indeed it made possible the reaching of the peak.

Lines D and E also show that the altitude to which ascent can be made by the use of auxiliary oxygen is definitely limited. The lung oxygen pressure (approximately 40 mm. Hg) is about the same at 44,000 ft. breathing oxygen as it is at 17,000 ft. breathing air. In the unacclimatized person either exposure is hazardous because the alveolar oxygen tension is so low.

For airmen who must ascend to altitudes above 44,000 ft. pressurized cabins or suits must be used to provide sufficient air and oxygen pressure.

Anemic Hypoxia.—In this condition there is too small a quantity of functional hemoglobin in the blood to supply the oxygen needs. (1) The most obvious form is anemia in which the actual quantity is too small (*see* ANEMIA). In severe anemia, such as pernicious anemia, the red blood cells may be so reduced in number that the normal complement of oxygen cannot be carried. (2) After severe bleeding there may not be enough blood in the body to support its needs adequately. Under such circumstances the body makes the effort to maintain the blood supply to the brain; other organs are in a measure denied their share. In other areas of the body there is a general narrowing of the vessels (vasoconstriction) that brings this about.

Three important conditions exist in which the hemoglobin present is temporarily put out of action; carbon monoxide (coal gas) poisoning, methemoglobinemia and sulfhemoglobinemia. Of these the first two are the most important.

Carbon monoxide is found in many gases other than coal gas. It is a frequent source of danger in underground mines of all kinds. Incompletely combusted gases, particularly those from the exhaust of internal-combustion engines, have been a cause of numerous fatalities.

Most cases of accidental carbon monoxide poisoning, however, are due to poorly adjusted, unflued space heaters, which can produce fatal concentrations of carbon monoxide from the incomplete combustion of gas which contains none.

In order for a person to lose consciousness, over half of all the hemoglobin in the body must be united with carbon monoxide, thus preventing oxygen transport. A concentration of less than 0.1% of the gas in the atmosphere can bring this about. (*See* fig. 3, based on the observations of John Scott Haldane.) However, the absorption of an absolute volume of about 500 c.c. of carbon monoxide is required; this will take perhaps 60 minutes. The effect on different persons varies greatly, but speaking in rough terms a saturation of 30% to 40% means a headache afterward, 50% to 60% means unconsciousness and 75% saturation is probably fatal.

Carbon monoxide in the blood is gradually eliminated when air free from the gas is breathed, and is eliminated at a much

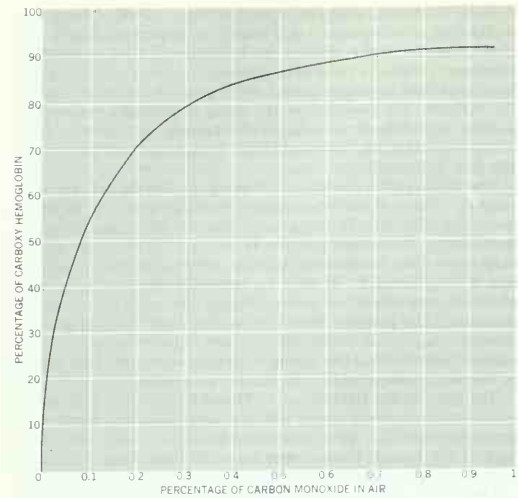

FIG. 3.—PERCENTAGE OF CARBON MONOXIDE IN THE AIR WHICH, IF BREATHED INDEFINITELY, IS CAPABLE OF SATURATING THE BLOOD TO ANY GIVEN DEGREE

greater rate when pure oxygen is inhaled. If a subject has been exposed to a dangerous concentration of carbon monoxide, but recovers consciousness, some cells in the brain may have sustained irreparable damage, and, depending upon the amount of cellular destruction, he may later experience noticeable changes in personality or suffer a grave mental disorder. (*See* also CARBON MONOXIDE POISONING.)

Methemoglobinemia is another condition in which a part of the hemoglobin is thrown out of action. The simplest form is produced by the inhalation of aniline, volatile nitrites, nitrobenzene, etc., causing a conversion of oxyhemoglobin into methemoglobin (which has no respiratory value) within the blood, with injury to the corpuscles. The conversion is only temporary if the impure air ceases to be inhaled and if the poisoning is not too severe. Some other drugs such as chlorates and bromates in addition to producing methemoglobin in the blood also cause an actual destruction of red blood cells, which is a much graver condition.

Sulfhemoglobin is still another form of hemoglobin which is inactive as an oxygen carrier. Sulfhemoglobinemia may occur with the administration of acetanilide, sulfanilamide and other benzene derivatives. Occasionally it may even occur spontaneously.

Stagnant Hypoxia.—This may be general or local. If general, it may result from very different causes: (1) In cases of heart disease, the heart may be unable to pump the blood around the body at the required rate. (2) In cases of impairment of venous return, the back pressure may prevent the blood from circulating as it should. (3) Following severe abdominal wounds or surgical operations that have entailed considerable exposure of the internal organs, a condition known as surgical shock may supervene. The circulation of the blood is greatly reduced, and the tissues, therefore, are not supplied with sufficient oxygen. In the conditions mentioned the difficulty lies in the fact that the blood moves so slowly (or not at all) that practically all the oxygen leaves the blood, and there is not enough freshly oxygenated blood flowing along to sustain the tissues.

Local stagnant hypoxia may be due to any condition that reduces or prevents the circulation of the blood in any area of the body. Examples of this condition are Raynaud's disease and Buerger's disease, which restrict circulation in the extremities; the application of a tourniquet to control bleeding; ergot poisoning; and exposure to cold.

Histotoxic Hypoxia.—In this case the body cells are unable to use the oxygen, although the amount of oxygen in the blood may be quite normal and under normal tension. Although characteristically produced by cyanide, theoretically any agent that depresses cellular respiration may cause it. Some of these agents are narcotics, alcohol, formaldehyde, acetone and certain anesthetic agents. This form of hypoxia has, perhaps, somewhat less clinical significance than do the others; nevertheless, fatal poisonings by some of the above-mentioned agents are not uncommon.

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HYPSIPYLE, daughter of Dionysus' son Thoas, king of the island of Lemnos. She became queen after the women, cursed by their husbands' infidelity for their neglect of Aphrodite's cult, had murdered all the males except her father, whom she hid. The Argonaut Jason became her lover and she bore him two sons. Later, pirates sold her to Lycurgus, king of Nemea, whose son, Opheltes, she nursed. The infant was killed by a poisonous snake while she was guiding the expedition of the Seven Against Thebes to water. Her sons, sent by Dionysus, rescued her from the ensuing danger, and the Nemean games were instituted in memory of the dead child. A fragment of a tragedy, *Hypsipyle*, by Euripides survives. (D. E. W. W.)

HYPSOMETER, an instrument for measuring heights; one type, used to estimate elevation at mountainous altitudes, employs the principles that the boiling point of a liquid is lowered by diminishing the pressure and that the barometric pressure varies with the height of the point of observation. This type is also used in barometry (*see* BAROMETER: *Chief Types of Barometers*). The instrument consists of a cylindrical vessel in which the liquid (usually water) is boiled, surmounted by a jacketed column through which the vapour circulates around a shielded thermometer. Other hypsometers, operating on the principles of triangulation, are used to determine the heights of such objects as trees.

HYRACOIDEA, an order of small hoofed mammals (ungulates), usually called hyraxes or dassies, and including the cony (coney) of the Bible. They are zoologically far removed from the pikas and certain rabbits that are often called conies. The term "rock rabbit," also sometimes used for both pikas and hyraxes, is misleading for the hyraxes, which are neither rabbits nor exclusively rock dwellers.

Hyraxes, with their plump, pointed heads, short necks, relatively short, slender legs and squat, almost tailless bodies, look much more like rodents than ungulates. But their anatomy clearly shows they are related to the hoofed mammals. They occur in Africa south and east of the Sahara and in extreme southwestern Asia. The order contains one living family (Procaviidae), which may be divided into two genera. One, the genus *Procavia*, includes the ground-living forms, especially characteristic of deserts, hills and mountains up to about 10,000 ft., living in holes and fissures among the rocks. A second, similar genus, *Dendrohyrax*, is confined to Africa; the species are almost entirely tree dwelling, the only true arboreal hoofed mammals. They live in holes in trees and move readily along the trunks and branches; some species, however (the subgenus *Heterohyrax*), live among rocks. All species climb easily, clinging even to almost vertical surfaces by the pads on their feet.

The hyraxes have numerous structural peculiarities that distinguish them sharply from any other mammals. The normal adult dental formula is: incisors $\frac{1}{2}$, canines $\frac{0}{0}$, premolars $\frac{4}{4}$ and molars $\frac{3}{3}$ (the upper and lower figures in each case refer to the number of teeth in the upper and lower jaws, respectively, of one side of the mouth). The upper incisors are large, curved in a semicircle longitudinally, and grow continuously throughout life, like those of rodents. Canines are absent. The premolars and molars are in pattern surprisingly like those of some of the typical ungulates,

especially the rhinoceros. The dorsal and lumbar vertebrae are unusually numerous (up to 30 in *Procavia*). On both front and hind feet the three middle toes are well developed. On the forefeet the other two toes are also present, although the first is much reduced; on the hind feet the first toe is absent, the fifth vestigial. The hoof of the inner (second) toe of the hind foot is clawlike, but on all the other toes the hoofs are normal, although small. The wrist bones are arranged serially, the individual bones generally coming in contact with only one bone of the opposite row—an

IM. DE YOUNG © ENCYCLOPÆDIA BRITANNICA

EAST AFRICAN ROCK HYRAX

arrangement typical of the most primitive extinct ungulates but lost in the more specialized modern forms. The alimentary canal is unique in having a pair of large sacs (caeca) opening into the large intestine some distance below the usual one at the junction of large and small intestines. There is a gland on the back marked by light hair.

The relationships of the hyraxes are doubtful. The numerous resemblances to the rodents are all superficial and the fundamental characters indicate affinities with the ungulates, but these affinities must be distant so far as any living forms are concerned. In addition to their many very primitive characters, the hyraxes show some special resemblances to primitive or extinct members of several orders, particularly the Proboscidea, Perissodactyla, some Condylarthra (*Meniscotherium*) and the peculiar South American fossil ungulates. These resemblances suggest that the group is an ancient and unprogressive offshoot derived from the ungulate stem at a time when the modern groups of ungulates were not well differentiated.

Fossil Hyracoidea.—Numerous known extinct hyracoids indicate that the group was formerly much more diversified. Ten extinct genera are recognized, ranging through a long period of geological time. They come chiefly from the Oligocene of Egypt, approximately 30,000,000 years ago, and the more recent Miocene of east and southwest Africa and the Pliocene of Greece. The earliest forms are characterized generally by having a full complement of teeth, $I\frac{3}{3}$, $C\frac{1}{1}$, $P\frac{4}{4}$, $M\frac{3}{3}$, with the last molars relatively larger than in recent forms. In some cases, for instance *Geniohyus* from Egypt, the skull was strikingly elongated. Most of these extinct forms were larger than the recent hyraxes, and some, such as species of *Megalohyrax* or *Titanohyrax* from Egypt or *Pliohyrax* from Greece, were relatively large, the largest perhaps having been as big as a modern horse. *See* UNGULATA.

(G. G. SI.; Jo. E. H.)

HYRAX: *see* HYRACOIDEA.

HYRCANIA, the name of two places known from ancient history.

1. Hyrcania was an ancient district of Asia, called Varkana ("Wolf's land") in Old Persian, lying southeast of the Caspian sea. According to Arrian, its capital was Zadracarta (Astrabad, modern Gurgan). It formed part of the Median, Achaemenid, Seleucid and Parthian empires. Under the Achaemenids it was at certain periods administered as an independent province, an arrangement followed by the Seleucids, and at others joined with Parthia. In the list of Persian satrapies given by Herodotus, the Paricanians, who with the Medes and Orthocorybantes (Saka Tigrakhauda) formed the tenth satrapy, may be the Hyrcanians.

2. The second Hyrcania was a town in Lydia said by Strabo to have derived its name from a colony of Hyrcanians settled there by the Persians. (J. M. M.-R.)

HYRCANUS (YRCANOS), a Greek surname, of unknown origin, borne by several Jews of the Maccabaean period (*see* MACCABEES).

JOHN HYRCANUS I, high priest and king of the Jews from 135 to 104 B.C., was the youngest son of Simon Maccabaeus. In 137 B.C. he, with his brother Judas, commanded the force that repelled the invasion of Judaea led by Cendebeus, the general of Antiochus VII Sidetes. On the assassination in 135 of his father and two elder brothers by Ptolemy, governor of Jericho, his brother-in-law, Hyrcanus succeeded to the high priesthood and the supreme authority in Judaea. While still engaged in the struggle with Ptolemy, he was attacked by Antiochus with a large army (134) and compelled to shut himself up in Jerusalem. Peace was secured at last on condition of a Jewish disarmament and the payment of an indemnity and an annual tribute. He confirmed the alliance his father had made with Rome, and at the same time availed himself of the weakened state of the Syrian monarchy under Demetrius II to overrun Samaria, and also to invade Idumaea, which he completely subdued. About 109 B.C. his sons took Samaria and by his orders razed it to the ground. He died in 104 and was succeeded by Aristobulus I, the eldest of his five sons. The external policy of Hyrcanus was marked by considerable energy and tact, and, aided by favouring circumstances, was so successful as to leave the Jewish nation in a position of great independence and influence.

JOHN HYRCANUS II, high priest from 76 to 40 B.C., was the eldest son of Alexander Jannaeus by his wife Salome Alexandra, and was thus a grandson of the preceding. When his father died in 76 he was appointed high priest, and on his mother's death in 67 he claimed the succession to the supreme civil authority. After a troubled reign of three months he was compelled to abdicate both dignities in favour of his more ambitious younger brother Aristobulus II. In 63 Pompey restored him to the high priesthood, with some semblance of supreme command. He was soon again deprived of his office by the arrangement of the proconsul Gabinius, according to which Palestine was in 57 B.C. divided into five separate circles. For services to Caesar after the battle of Pharsalus he was again proclaimed high priest and ethnarch in 47 B.C. Antipater of Idumaea, however, being at the same time made procurator of Judaea. In 42 B.C. he was practically superseded by Antony's appointment of Herod and Phasael to be tetrarchs of Judaea; and in 40 he was taken prisoner by the Parthians, deprived of his ears that he might be permanently disqualified for priestly office, and carried to Babylon. He was permitted about 36 B.C. to return to Jerusalem, where on a charge of treasonable correspondence he was put to death in 30 B.C.

See H. Graetz, *History of the Jews*, vol. ii (1956).

HYSSOP (*Hyssopus officinalis*), a garden herb belonging to the mint family (Labiatae), formerly cultivated for use in domestic medicine. It is a small perennial plant about two feet high with slender, quadrangular, woody stems; narrowly elliptical, pointed, entire, dotted leaves, about one inch long and one-third inch wide, growing in pairs on the stem; and long terminal, erect, half-whorled, leafy spikes of small violet-blue flowers, which are in blossom from June to September. Varieties of the plant occur in gardens, with red and white flowers, also one having variegated leaves. The leaves have a warm aromatic bitter taste and owe their properties to the presence of a volatile oil.

Hyssop is a native of the south of Europe, ranging eastward to central Asia, and has become naturalized in North America from

Maine to Ontario and southward and also on the Pacific coast. A strong tea made of the leaves, and sweetened with honey, was formerly used in lung and nose and throat affections, and externally on bruises.

The hedge hyssop comprises herbs of the genus *Gratiola*, which belong to the family Scrophulariaceae, and are native of marshy lands throughout Eurasia and North America. *G. officinalis*, of Europe, has smooth, opposite, entire leaves, but the stems are cylindrical, the leaves twice the size of the true hyssop, and the flowers solitary in the axils of the leaves and having a yellowish-red veined tube and bluish-white limb, while the capsules are oval and many seeded. The herb has a bitter, nauseous taste, but is almost odourless. In small quantities it acts as a purgative, diuretic and emetic when taken internally. When growing in abundance, as it does in some damp pastures in Switzerland, it becomes dangerous to cattle.

The hyssop (*'ezob*) of Scriptures, a wall-growing plant used in the ritual cleansing of lepers (Lev. xiv. 6, 7), is not *Hyssopus officinalis*, which is not a native of Palestine. The most probable opinion is that it was a species of caper (*Capparis spinosa*), but it may have been a species of savory (*Satureia thymus*), a plant of very frequent occurrence in Syria and Palestine, whose smell, taste and medicinal properties are similar to those of *H. officinalis*.

HYSTASPES, the Greek form of the Old Persian Vishtaspa.

1. Hystaspes (Gushtasp in later Persian tradition), son of Aurvataspa (Lohrasp), of the Naotara family, was the protector and follower of Zoroaster and is therefore to be dated to the 7th–6th century B.C. He was a local ruler (*kavi*) in a country called in the *Avesta* (the Zoroastrian bible) Aryana Vaejah, which may have been a Greater Chorasmian state abolished by Cyrus II of Persia.

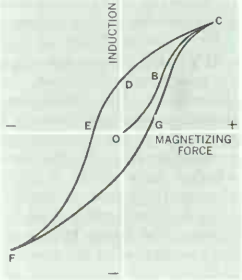
2. Hystaspes, son of Arsames and father of Darius I of Persia. According to Herodotus, he was governor of Persis under Cyrus II and Cambyses and accompanied the former king on his last campaign against the Massagetae in 530 B.C. When Darius seized the throne in 522 B.C., Hystaspes was governor of Parthia and Hyrcania, where, as recorded in the Bisitun inscription, he suppressed a revolt in 521 B.C. Despite the difference in genealogies, his identification with Hystaspes, the protector of Zoroaster, is assumed by Ammianus Marcellinus and some modern authorities.

See, for the first Hystaspes, W. B. H. Henning, *Zoroaster: Politician or Witch Doctor?*, pp. 42–43 (1952). (J. M. M.-R.)

HYSTERECTOMY, the operation of removal of the uterus. It may be total or subtotal. The cervix is not removed in the subtotal operation but is removed in the total operation. Total operation is the more usual one. *See* Gynecology.

(R. W. Tel.)

HYSTERESIS, in physics, is a lag in response to changing forces based on such energy losses as those resulting from internal friction in a material, device or system. Thus, the elongation and contraction of metals tend to lag behind applied changes in stress. Magnetic hysteresis is a commonly offered example of the phenomenon. If an unmagnetized iron bar be subjected to a gradually increasing magnetizing force, and the corresponding values of the magnetic induction (flux density) in the iron be determined, then on plotting the magnetizing force against the induction a curve OBC is obtained. If now the magnetizing force is gradually decreased to zero and the values of the magnetic induction determined, it will be found that the curve obtained does not coincide with OBC but takes the form CD. If now the direction of the magnetizing force is reversed, DEF is obtained, and decreasing the magnetizing force again to zero, reversing, and increasing will give the curve FGC. It will be seen from a study of the complete curve that the magnetic induction (flux density) lags behind the magnetizing force. It was to this property of magnetic materials that J. A. Ewing gave the name hysteresis. *See* Magnetism: *The Magnetization Curve.*



HYSTERESIS CURVE

HYSTERIA is a term applied to a type of psychiatric disorder in which a wide variety of sensory, motor or psychic disturbances may occur. It is classified as a psychoneurosis, and is not dependent upon any known organic or structural pathology. The term is derived from the Greek *hystera*, meaning "uterus," and reflects the ancient notion that the disorder was the result of disturbances in uterine functions. Actually, hysterical symptoms may develop in either sex and may occur in children and elderly people, although they are observed most commonly in early adult life.

Hysteria, in pure form, seems to occur more often among the psychologically naïve than among sophisticated persons. Studies have indicated that hysterias tend to be commoner in persons in the lower ranges of intelligence than among those in the higher ranges. There is reason to believe that the incidence of hysteria has been diminishing over the years in England and America, probably because of cultural factors that include increasing psychological sophistication, diminishing sexual prudery and inhibition and a less authoritarian family structure. Cases of classical hysteria, like those so often described by 19th-century clinicians, have become rare. Most psychoneuroses in actual clinical practice are apt to be "mixed" forms in which hysterical symptoms may be found interspersed with other varieties of neurotic disturbances. Isolated hysterical symptoms may occur in psychotic disorders also.

Manifestations.—The sensory and motor manifestations of hysteria take many forms and are designated as conversion reactions, in line with the theory that in such instances the underlying anxiety has been "converted" into a physical symptom. Sensory disturbances may range from paresthesias ("peculiar" sensations) through hyperesthesias (hypersensitivity) to complete anesthesias (loss of sensation). They may involve the total skin area or any fraction of it. In medieval times, and as late as the end of the 17th century, the finding of small discrete areas of anesthesia on the body of a person was considered to be definite proof that the person was a witch. Hysterical sensory disturbances generally do not follow any anatomic distribution of the nervous system. Thus, in "glove" or "stocking" anesthesias, the patient feels no sensation in the parts of the limbs corresponding to those covered by gloves or stockings, but such sensory loss does not follow the distribution of specific nerve pathways. Similarly, in hysterical hemianesthesia (loss of sensation over half the body), the nonfeeling area stops abruptly at the midline, while in organic hemianesthesias the transition from anesthetic to normal sensation is gradual and does not terminate at the midline. Other hysterical sensory disturbances may encompass the special senses of vision, hearing, taste or smell; or they may involve the experiencing of severe pain for which no organic cause can be determined.

Motor symptoms vary from complete paralysis to tremors, tics, contractures or convulsions (hystero-epilepsy). In each instance neurological examination of the affected part of the body reveals an intact neuromuscular apparatus with normal reflexes and normal responses to electrical stimulation. In hystero-epilepsy the electroencephalogram reveals essentially normal electrical activity of the brain, even at the height of the convulsion. Other motor disturbances which are at times hysterical in origin are loss of speech (aphonia), coughing, nausea, vomiting or hiccoughing.

Psychic symptoms may be equally varied and are usually classified under the broad heading of dissociative reactions. Attacks of amnesia, in which the person is unable to remember who he is or anything about himself, are among the more striking of these. Occasionally the amnesia may last for weeks, months or even years, during which time the person may begin an entirely new life pattern; such protracted reactions are called fugue states. Sleepwalking (somnambulism) is also considered to be a hysterical dissociative reaction, as are also the occasional dramatic cases of multiple personality.

Causation.—Numerous theories have been advanced to ac-

count for hysteria. Prior to the work of Pierre Janet (*q.v.*), most clinicians believed it to be an essentially physiological disturbance. Janet, however, considered it to be a mental malady which he attributed to an inherent weakness in the capacity of the personality to synthesize or integrate experiences. As a result of this, he believed, certain ideas became split off from the personality, and in this "dissociated" state produced the hysterical symptoms. Janet's theory failed to explain, however, why a patient develops a particular symptom in preference to any other. The most fruitful explanation for hysterical phenomena came from Sigmund Freud (*q.v.*), the founder of psychoanalysis. Both the method and theory of psychoanalysis were derived largely from Freud's study and treatment of hysterical patients. Freud advanced the theory that all psychoneuroses are the result of conflict between unconscious wishes and prohibiting forces within the personality. The unconscious wishes are generally concerned with sexual impulses (Freud's concept of sexuality embraced all impulses concerned with biological pleasure) or aggressive ones. The forbidding or repressing forces are the result of internalizations (introjections) of parental or surrogate parental attitudes, which make the person experience anxiety in the presence of the forbidden impulse. In anxiety states this anxiety is felt by the person but he is not aware of its origin. In anxiety hysteria (phobia) the anxiety is "displaced" from its original, unconscious source to some other object, which then becomes the apparent source of the anxiety. In conversion hysteria, according to Freud, the anxiety is "converted" into a somatic symptom. This would explain the apparent lack of anxiety, *la belle indifference*, which characterizes many hysterical patients. The exact mechanism by which this conversion takes place is uncertain. The specific form taken by the hysterical symptom was attributed by Freud to the particular nature of the unconscious conflict situation. The symptom may express in disguised form either the repressed impulse, the repressing counterforce or a compromise between the two. Thus, a hysterical convulsion might be a symbolic expression of a forbidden sexual wish, a hysterical paralysis the manifestation of self-punishment for a hidden aggressive impulse, or a hysterical contracture the fusion of the wish to carry out some forbidden act with the counter-impulse which is prohibiting it.

In general it may be said that the symptoms of hysteria represent reactions to stress. They are apt to appear during life situations involving stress, and sometimes disappear spontaneously after the stress subsides. With his symptom the person is often expressing in "body language" his reaction to an intolerable life situation. Thus hysterical vomiting may be saying, "I cannot stomach this any longer"; hysterical blindness, "I cannot bear to see what is going on"; hysterical false pregnancy (pseudocyesis), "I wish to have a baby," etc. Often the hysterical symptom may serve the person as a justification for avoiding certain responsibilities or for controlling and manipulating the people in his life. This is sometimes referred to as the secondary gain of the illness.

The question of why a person develops one type of neurosis rather than another is one of the major unsolved problems of psychiatry. It is probable that multiple factors, including constitutional ones, are involved. Freud believed that hysterical disorders originated in conflicts which developed in the so-called Oedipal period of personality development (ages three to five), and were due to failure adequately to resolve the Oedipus complex (based on love for the parent of the opposite sex and rivalry with the parent of the same sex). Although it is undoubtedly true that such factors can be found to be present in most hysterics in our culture, subsequent studies have indicated that this formulation is probably too narrowly based. There is reason to believe that, in many hysterics, the first roots of the personality disturbance date back to an even earlier period, the pre-Oedipal, when the basic security system of the young infant is taking form within the matrix of the primal parent-child interrelationship. Given a certain kind of constitutional predisposition, it would appear that some children, feeling unloved or insecure in their early environments, gradually develop the kind of personality structure that later, under conditions of stress, may incline them to hysterical symptom formation. This personality structure is characterized by emotional immaturity, apprehensiveness, suggestibility, feelings of inadequacy, passivity, a strong dependency on the approval of others for self-esteem, a compulsive need to be loved and admired, and an inability to express hostile or aggressive feelings directly.

Treatment.—In the treatment of hysteria a distinction must be made between the management of the hysterical symptom and that of the underlying personality disorder. The symptom is much more easily treated than is the personality disorder. Because of the suggestibility of the hysterical patient, the hysterical symptom is often responsive to any technique involving suggestion. The dramatic manipulations and theatrical equipment of medical charlatans have their greatest success with hysterical patients, as do various forms of faith healing and hypnosis. If the underlying hysterical character structure is not altered, however, there is a strong likelihood that the symptom will sooner or later return, either in its original form or in some substitutive expression. Rational therapy of the underlying personality problem requires a form of psychotherapy which is aimed at uncovering the underlying conflicts and adaptive patterns of the patient, and which, by bringing these to his awareness, will enable him gradually to learn more effective techniques of coping with his life problems and interpersonal relationships. Psychoanalysis (*q.v.*) is generally regarded as one of the most effective psychotherapeutic approaches for this purpose.

See also NEUROSES.

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HYTHE, a market town and seaside resort, one of the Cinque Ports (*q.v.*) and a municipal borough of Kent, England, 65 mi. E.S.E. of London by road. Pop. (1961) 10,026. It lies on the coast at the east end of Romney marsh and on either side of the Royal Military canal (23 mi. long), built as a defensive moat when Napoleon threatened invasion. Modern Hythe extends from the canal to the coast; the old town climbs the hill inland from the canal. The church of St. Leonard is partly late Norman, with an Early English chancel and a tower rebuilt about 1750. In a vaulted processional path under the ambulatory are hundreds of human skulls and bones believed to have been transferred from the churchyard during the 14th and 15th centuries. Lionel Lukin (1742–1834), the lifeboat pioneer, is buried in the churchyard. The guildhall was founded 1794. St. Bartholomew's hospital was founded by Hamo, bishop of Rochester, in 1336; that of St. John (rebuilt 1802), even older, was founded for reception of lepers.

As a port Hythe owes its origin to the silting-up of the Roman Portus Lemanis, where Lympne (pronounced lim) and West Hythe now stand about 2 mi. W. of the town. There ends the Roman Stone street from Canterbury; on the hillside substantial remains of the Roman fortress adjoin the castellated mansion known as Studfall castle. The church at Lympne is Early English and has a Norman tower with Roman material in its walls. There is an airfield at Lympne. A short distance east is Shipway or Shepway Cross, where important assemblies relating to the Cinque Ports were held. A mile north from Hythe is Saltwood castle, rebuilt in the 14th century. It was granted to the see of Canterbury in 1026 and there the murder of Thomas Becket is said to have been planned. It remained a residence of the archbishops of Canterbury until the time of Henry VIII, and was restored as a residence in 1882. About 2 mi. N. of Saltwood are remains of the fortified 14th century manor house of Westenhanger, quadrangular and surrounded by a moat.

Hythe (landing place), a port in Saxon times, was granted by a Saxon thegn to Christ Church, Canterbury. In the Domesday survey the borough is entered among the archbishop's lands as appurtenant to his manor of Saltwood, and the bailiff of the town was appointed by the archbishop. King John in 1205 confirmed the liberties which the townsmen of Hythe had under Edward the Confessor. The liberties of the Cinque Ports were confirmed in 1278

by Edward I in a general charter which was confirmed, often with additions, by subsequent kings down to James II. These charters were granted to the Cinque Ports in return for the 57 ships which they supplied for the royal service (the Ports were thus "the germ of the Royal Navy"). The Cinque Ports were first represented in the parliament of 1265, to which they each sent four members. Hythe, with Folkestone, was a parliamentary borough returning one member until 1949, since when it has formed part of the Folkestone and Hythe division of the county of Kent. Hythe was incorporated by Elizabeth I in 1575, when a fair for the sale of fish, etc., was granted. With the silting-up of its harbour, Hythe lost its importance as a port. A marine parade more than four miles long links Hythe with Folkestone.

West of the town is the School of Small Arms of the British army. Hythe is the northern terminus of a miniature railway (15″ gauge) that runs to Dymchurch and New Romney.

I THIS letter corresponds to Semitic 𐤉 (*yod*), which may derive from an early symbol for hand, and to the Greek ι (*iota*, whence Eng. "jot"). Early Greek forms from the island of Thera were ϟ and S, which obviously resemble the Semitic more than the later single vertical stroke. In Attic inscriptions also the form ϟ appears, while in early Corinthian inscriptions the forms ⋚, ⋚, ⋚ are found. The Chalcidic alphabet had the form ι, and this was the form in all the Italic alphabets, including the Etruscan. The Lydian alphabet, besides the form i, also shows a form ◖ (written from right to left).

NAME OF FORM	APPROXIMATE DATE	FORM OF LETTER
PHOENICIAN	1200 B.C.	𐤉
CRETAN	1100-900	ϩ ⋚
THERAEAN	700-600	ϩ ⋚
ARCHAIC LATIN	700-500	(ι)
ATTIC	600	⋚ ι
CORINTHIAN	600	⋚
CHALCIDIAN	600	ι
IONIC	403	ι
ROMAN COLONIAL	PRECLASSICAL AND CLASSICAL TIMES	ι
URBAN ROMAN		ι
FALISCAN		ι
OSCAN		ι
UMBRIAN		ι
CLASSICAL LATIN AND ONWARD		I

THE DEVELOPMENT OF THE LETTER "I" FROM THE PHOENICIAN THROUGH CLASSICAL LATIN TO THE PRESENT FORM

The minuscule letter is merely a shortened form of the majuscule. The dot first appears in manuscripts of about the 11th century and was used to distinguish the letter and assist reading in words in which it was in close proximity to letters such as *n* or *m* (*inimicis*, for example). The dot frequently took the form of a dash, *e.g.*, ί. It became the custom in medieval manuscripts to distinguish an initial or otherwise prominent *i* by continuing it below the line, and it was from this habit that the differentiation of the letters *i* and *j* arose. The initial letter, nearly always lengthened, had most frequently a consonantal force, and this led to *j* representing the consonant, *i* the vowel. The two letters were not considered as separate until the 17th century.

In Semitic the letter represented a sound akin to the English *y*. In Greek, Latin and the Romance languages it has represented a high front vowel similar to English long *e*, as in "be." In Latin short *i* represented a considerably more open sound than long *i*, as is evidenced by the fact that in late Latin it ran together with long *e*. In modern English the sound of short *i* is almost identical with what it was in Latin; *e.g.*, in the word "pit." Long *i* has become a diphthong (*ai*, *e.g.*, in the words "ice," "hire"), its former sound as a high front vowel having been assumed by long *e* as its position shifted forward and upward. *See* also ALPHABET.

(B. F. C. A.)

In words such as "fir" the letter represents the neutral vowel, while in certain foreign words it retains its continental sound, identical with that which it represented in Middle English and previously; *e.g.*, in the words "pique," "emir." The combinations *ei* and *ie*, as in "receive," "believe," have in the great majority of cases the sound of the long *e* in "precede," although the long *i* sound of "tide" is found in many local and personal names of German origin and in a few other foreign borrowings; *e.g.*, "eider." The vowel sound in "either" is optional.

In chemistry, I is the symbol for iodine.

(B. F. C. A.; J. W. P.)

IAMB, in metre, a foot or metron. The Greek and Latin quantitative iambic metron consists of anceps, long, short, long: ⏓ – ⏑ –. Either or both longs may be resolved into two shorts: ⏓ ⏑ ⏑ ⏑ ⏑ ⏑. Most of the spoken dialogue of Greek drama is in iambic trimeters. In the trimeter there is caesura either after the second anceps (penthemimeral) or after the second short (hephthemimeral). In Aeschylus and Sophocles there is sometimes caesura after the third long (*caesura media*). If the third anceps is long, it may not be the last syllable of a word (Porson's law, law of the final cretic):

⏓ – ⏑ – ⏓ ‖ – ‖ ⏑ ‖ – ⏓ ⌒ – ⏑ –

When a long syllable is resolved into two shorts, the first short must not be and the second usually is not the last syllable of a word; *e.g.*, ⏓ ⏑⏑⏑ –. In Euripides' later plays resolution is used very freely. In comedy, resolution is still freer and Porson's law is not observed.

The choliamb ("limping iamb"), or scazon, a trimeter in which a long syllable is substituted for the short in the last metron, was used by Hipponax (6th century B.C.).

The iambic is one of the most common metres of Greek lyric. Lyric iambic metra may be modified by syncopation, *i.e.*, the omission of anceps to produce – ⏑ – (cretic), or of short to produce ⏑ – – (bacchiac) or, rarely, – – – (molossus). Resolution is also permitted.

In Latin, quantitative trimeters of Greek type are found in Horace, Seneca, etc. Porson's law is not observed:

⏑ – ⏑ – | – ⏑ – | – ⏑ – |

dehisce tellus tuque coniunx ultimo (Seneca)

Resolution is comparatively infrequent. Horace, in *Epodes* i–x, uses alternate trimeters and dimeters:

⏑ – ⏑ – | – ⏑ – | ⏑ – ⏑ – |

Beatus ille qui procul negotiis

– – ⏑ – | – – ⏑ – |

ut prisca gens mortalium

In *Odes*, ii, 18 he uses alternate syncopated dimeters (cretic,

iambic) and catalectic trimeters (of which the last metron is a bacchiac):

non ebur nequ(e) aureum

mea renidet in domo lacunar

Catullus (iv and xxix) uses "pure" iambic trimeters (in which all ancipitia are short):

Phaselus ille quem videtis, hospites,

and (xxv) catalectic tetrameters:

deprensa navis in mari vesaniente vento

Catullus and Martial use choliambs:

fulsere quondam candidi tibi soles (Catullus).

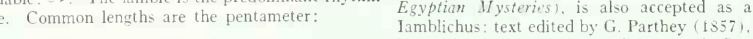
On the iambics of Roman comedy *see* PROSODY, CLASSICAL.

In English, the iambic foot consists of an unstressed followed by a stressed syllable: ⏑ ´. The iambic is the predominant rhythm of English verse. Common lengths are the pentameter:

The curfew tolls the knell of parting day (Gray)

and the tetrameter and trimeter, which, combined in quatrains, form the common ballad metre:

There lived a wife at Usher's Well,



And a wealthy wife was she.

Substitutions of other types of foot, especially anapaestic (as in the second line above), are common in basically iambic verse.

(L. P. E. P.)

IAMBLICHUS (*c.* 250–*c.* 330), founder of the Syrian school of Neoplatonism (*q.v.*), was born at Chalcis in Coele-Syria. He studied under Porphyry and afterward established his own school in Syria. He died at some time during the reign of the emperor Constantine the Great (306–337), before the brief court career and execution at Constantinople of his pupil Sopater. Those works of his which survive (*see* below) are of minor philosophical importance; his major metaphysical works are lost. But a fairly good idea of the main lines of his philosophy can be formed from the references to his teaching in Proclus together with the fragments preserved by Stobaeus and such philosophical ideas as can be discovered in the theurgic treatise *On the Egyptian Mysteries*. So far as can be discovered, it was Iamblichus who did more than any other single philosopher to transform the Neoplatonism of Plotinus into the stiff and complicated (though often subtle and profound) pagan scholasticism known best from the works of Proclus. He began the attempt to build up on a Neoplatonic basis a complete and coherent theology encompassing all the rites, myths and divinities of later syncretistic paganism. It was with him that theurgy, the magical conjuration of the gods, began first to play an important part in Neoplatonic religion and to push into the background the purely spiritual and intellectual mysticism of Plotinus.

It was Iamblichus, moreover, who not only began but carried a very long way that process of splitting up and subdividing the great realities of the spiritual world of Plotinus and inserting intermediaries between them which produced the late Neoplatonic view of reality as a many-storied structure of complex orders of beings mirroring each other on different levels. It seems to have been Iamblichus who devised the structural principles according to which this splitting up of the spiritual world was carried out: (1) the "law of mean terms," according to which two doubly unlike realities must always be connected by an intermediate term resembling one in one respect and the other in another (*AB* must be connected to not-*A*-not-*B* either by *A*-not-*B* or by *B*-not-*A*), which forms a triad with them and without which they cannot be directly related; and (2) the triadic order of "remaining," "procession" and "return," according to which effects proceed from their cause and return to it again. Beyond "the one" of Plotinus which is identical with "the good," he introduced a higher "one" which is absolutely ineffable and beyond all qualifications. He split the intelligible world of Plotinus into two spheres of complex construction, the intelligible and the intellectual; and he introduced similar complications into his account of the sphere of soul.

In ethics Iamblichus took over Porphyry's classification (based on Plotinus) of virtues into "political," "purifying" and "exemplary" but inserted a fourth category, the "contemplative," between the last two and placed above all four the "priestly" or "unifying" virtues by which we are united in ecstasy to "the one."

Five genuine works of Iamblichus, parts of a sort of encyclopaedia or comprehensive treatise on Pythagoreanism, are extant: *On the Pythagorean Life*, edited by L. Deubner (1937); *The Exhortation to Philosophy* or *Protrepticus*, edited by H. Pistelli (1888); *On the General Science of Mathematics*, edited by N. Festa (1891); *On the Arithmetic of Nicomachus*, edited by H. Pistelli (1894); and *Theological Principles of Arithmetic*, edited by V. de Falco (1922). *The Reply of Abammon to Porphyry's Letter to Anebo*, commonly known as the *De Mysteriis (On the Egyptian Mysteries)*, is also accepted as a genuine work of Iamblichus: text edited by G. Parthey (1857), English translation by T. E. Taylor (1821; new edition 1926), German translation and commentary by T. Hopfner (1922).

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IAPETUS, in Greek mythology, son of Uranus and Ge, one of the Titans (*q.v.*), father of Atlas, Prometheus, Epimetheus and Menoetius. As a punishment for having revolted against Zeus, he was imprisoned in Tartarus (according to the *Iliad*) or underneath the island of Inarime off the coast of Campania (according to Silius Italicus). Hyginus makes him the son of Tartarus and Ge, and one of the giants. The etymology of the name is doubtful, and it may be connected with the Hebrew Japhet.

IAŞI (JASSY), a town and administrative centre of Iaşi *regiunea* (administrative region) of Moldavia, Rum., lies on the Bahlui river, northeast of the Carpathians and about 10 mi. from the frontier of the U.S.S.R. Pop. (1960 est.) 123,172. Important buildings are the Galata monastery (1578); the Byzantine church of the Trei Ierarhi (Three Hierarchs) built by Vasile Lupu (1639); the Cetăţuia monastery (1672); the Al. I. Cuza university, founded in 1860; the administrative palace (1897), now housing the town's museums and conference and exhibition halls; and the Vasile Alecsandri theatre (1894).

The town is linked by rail and road with Bucharest and Galaţi and with Chernovtsy, Kishinev and Odessa in the Soviet Union. After World War II it became a centre of the chemical industry, with an antibiotic plant, and there are timber and textile industries.

The first mention of the town is in 1408 and it probably derives its name from the Cuman *Jazges* or bowmen. In 1434 Stephen the Great, prince of Moldavia, built there the church of St. Nicholas. From 1565, under Alexandru Lăpuşneanu, Iaşi became the capital of the Rumanian principality of Moldavia until 1859, when the union of the Rumanian principalities took place. The peace of Iaşi (1792) ended the Russo-Turkish War of 1787–92. The town was already famous as a cultural centre in the 16th century. In 1643 the first printed book published in Moldavia was issued there from a press established by Vasile Lupu, who also founded a school, the first in which the mother tongue took the place of Greek. The first theatrical performances in the Rumanian language took place there in 1816, and in 1846 the national theatre was founded. There are a polytechnic institute and institutes of agronomy, medicine and pedagogy, and a branch of the academy of sciences.

IAŞI REGION (*regiunea*) has an area of 4,286 sq.mi. and a population (1960 est.) of 1,015,652 and is divided into seven administrative districts. Besides Iaşi the chief towns are Bîrlad (34,368), Huşi (19,137), Paşcani (15,896) and Vaslui (15,748). The main wine producing area is Cotnari. The region's relief is characterized by the Jijia depression and the Bîrlad plateau. It has a steppe climate with average annual rainfall of less than 20 in. It is watered by the Prut, Siretul, Jijia and Bîrlad rivers.

Industries include mechanical engineering (Bîrlad), chemical production, timber and food processing, building materials and textiles. Half the region is given over to grain, especially wheat and maize (corn), with sunflower, sugar beet, hemp and tobacco. There are vine and fruit growing and cattle breeding.

IATROCHEMISTRY (coined from Gr. *iatros*, "physician"), a stage in the history of chemistry during which the object of this science was held to be "not to make gold but to prepare medicines." This doctrine dominated chemical thought during the 16th century, its foremost supporters being Paracelsus, J. B. van Helmont and Franciscus Sylvius. But it gave way to the new definition formulated by Boyle, viz., that the proper domain of chemistry was "to determine the composition of substances."

See CHEMISTRY: *Emergence of Alchemy*.

IAZYGES, a Sarmatian tribe whose original home was around the Sea of Azov. Moving westward across Scythia, they were on the lower Danube by the time of Ovid, and about A.D. 50 occupied the plains between the Theiss (Tisza) river and the Danube. There, under the general name of Sarmatae, they were a perpetual cause of trouble to Dacia (*q.v.*), and even to the Roman provinces south of the Danube. The Iazyges were divided into freemen and serfs, the latter of whom were probably an older settled population enslaved by nomad masters. They rose against their masters in A.D. 337, and civil war continued for 20 years. Nothing is heard of Iazyges or Sarmatae after the invasions of the Huns.

IBADAN, the capital of Western Nigeria and the largest town in west Africa, lies about 70 mi. from the coast and 89 mi. N.N.E. of Lagos by road. Pop. (1960 est.) 600,000. The town is set on seven hills at an average elevation of 748 ft.; the mean annual rainfall is 48 in. and the temperature varies between 18.3° and 35° C. (65° and 95° F.), with the rainy season from May to October. The name comes from the Yoruba *Eba-Odan* ("beside the field"), indicating a situation between the coastal forest and the more open northern country.

Ibadan was originally the war capital of the Yoruba (*q.v.*), and traces of the old town wall exist. During the intertribal wars of the 18th and 19th centuries many Yoruba families settled in the town which gradually spread. Conspicuous eminences are Mapo hill, on which stands Mapo hall (the town hall), and the hill about 1 mi. N. surmounted by the Bower memorial tower. From either of these Ibadan presents a vista of corrugated-iron roofing covering traditional single-story and modern two-story houses constituting the bulk of the town, relieved by tall commercial buildings of contemporary design. In the northeast, reached by wide roads, is the university teaching hospital, formally opened in 1957, where doctors and nurses are trained, and close by, the Agodi reservation contains the Western Nigeria parliament buildings, including house of assembly, house of chiefs and modern ministerial and government offices. About 3 mi. N. on the road to Oyo are the buildings of Ibadan university, founded in 1948, just west of which is a branch of the Nigerian college of arts, science and technology. About 3 mi. W. of the town, on the Abeokuta road, the Moor plantation accommodates several federal research departments and the headquarters of the regional agricultural department.

Ibadan is the nodal point of Western Nigeria and for traffic between the coast and the north. The railway from Lagos, completed in 1901, was later linked with that from Kano. The main trunk road from Lagos passes through Ibadan, branching north to Ilorin (99 mi.), Jebba on the Niger river and ultimately Kano (634 mi. N.E.) and eastward to Ife (54 mi.), Benin (234 mi.) and the ferry across the Niger at Asaba (321 mi.). From the airport on the Oyo road regular services link Ibadan with other centres in the federation.

Ibadan's prosperity was built on its importance as a transit point through which produce (chiefly cocoa) was channeled and imported goods distributed. It has developed as a trading centre and many of the people are employed in commerce; the market is one of the largest in Nigeria. Nevertheless a large proportion of the population is engaged in agriculture on the farms which stretch for considerable distances into the suburbs. Industries include the manufacture of cigarettes, furniture, plastics and tiles, fruit canning and tire resoling (retreading). (W. H. I.)

IBAGUÉ (SAN BONIFACIO DE IBAGUÉ), capital of the department of Tolima, Colombia, about 60 mi. W. of Bogotá and 18 mi. N.W. of the Andean volcano, Nevado del Tolima. Pop. (1961 est.) 143,590. Ibagué is built on a plain between the Chipalo and Combeima, small affluents of the Coello, a western tributary of the Magdalena. Its elevation, 4,300 ft. above the sea, gives it a mild, subtropical climate. The plain and the neighbouring valleys produce cacao, tobacco, rice and sugar cane. It is an important commercial centre, being on the road which crosses the Quindío pass, or *paramo*, into the Cauca valley.

Ibagué was founded in 1550 by Andrés López de Galarza on the site of an Indian village and was moved to its present location because of Indian attacks. It was the capital of the republic for a short time in 1854. The rapid expansion of coffee planting on the slopes above the city contributed to its growth, especially after 1890. It is the seat of the Colegio San Simón. (Js. J. P.)

IBAN (SEA DAYAKS), a proto-Malay people of southwest Borneo. The name Sea Dayak (though still in official use) is a misnomer, for the Iban are primarily a riverine and hill people. The local name Iban was introduced to anthropological literature by A. C. Haddon in 1901. Haddon classified the Iban as Oceanic Mongols. They are brachycephalic (average cephalic index, 83), of short stature (average height, 5 ft. 2½ in.), with dark eyes, broad noses, full lips, black, lank hair and cinnamon-coloured skin. The Iban of Sarawak (pop., 1961, approximately 235,000; about one-third of the mixed population) are scattered throughout the undeveloped, interior zone of the colony, major areas of settlement being the Lupar, Saribas and Rajang rivers. Other Iban tribes live in the headwaters of the Kapuas river in Kalimantan, or Indonesian Borneo.

The Iban are an agricultural people; their subsistence economy is based on shifting cultivation, dry rice being grown on hillside clearings in the tropical rain forest. By the second half of the 20th century, rubber had been widely adopted as a cash crop. Settlements are scattered (average density of population about ten per square mile) and almost invariably built on the banks of rivers navigable by dugout canoes. Many of these canoes are nowadays equipped with outboard motors. The Iban live in long houses, each consisting of from under 10 to as many as 50 or more privately owned one-family apartments joined together. Each family (containing an average of six persons) is an independent unit, owning land and property. Iban society is classless and egalitarian, and its members are marked individualists; their kinship system is cognatic. There is general equality between the sexes.

The Iban language is closely akin to Malay. Although the majority of the Iban people are still preliterate, education services have been greatly extended during the past ten years: schools have been established, an Iban newspaper, *Pembrita*, is published monthly by the government of Sarawak and Radio Sarawak broadcasts daily programs in Iban. The highly developed and complex indigenous religion of the Iban is still widely practised. There is an extensive pantheon of named, anthropomorphic gods and goddesses who are invoked in poetic language and concerning whom there is a rich "oral literature." Elaborate rituals, which confer social prestige, are a main activity. However, following mission activity, many Iban have become Christians.

Formerly the Iban were the most inveterate head-hunters in Borneo; martial virtues are still prized, and many young Iban men have served with British Commonwealth forces in Malaya. The traditional Iban are a virile, spirited, self-confident people, immensely proud of their own distinctive culture. The necessary but difficult transition from their traditional culture to the modern world, by which the Iban are taking their proper place with Chinese, Malays and others in the plural society emerging in Sarawak, was still in process at the beginning of the 1960s. *See* also BORNEO: *The People*; DAYAK; SARAWAK.

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IBÁÑEZ, VICENTE BLASCO: *see* BLASCO IBÁÑEZ, VICENTE.

IBÁÑEZ DEL CAMPO, CARLOS (1877–1960), Chilean politician and soldier, commonly referred to as Chile's "Man-on-Horseback," was born at Linares, Chile, on Nov. 3, 1877. After a military career, which he began in 1894, he became involved in politics in 1924. In September of that year he participated in a revolt against the government of Arturo Alessandri Palma (*see* ALESSANDRI PALMA, ARTURO) and four months later led a coup that ousted a conservative military junta. In 1927 he became minister of interior and vice-president, from which posts he forced the resignation of Pres. Emiliano Figueroa Larraín and had himself elected president, a position he held until 1931. His regime was directed to material development, financed by heavy borrowing from abroad. Discontent with his authoritarianism and the economic depression led to his overthrow and exile. He returned from exile in May 1937 and with Chilean-Nazi support attempted a coup against the government. He was involved in numerous plots and failed as a presidential candidate (1942) before he was elected to the Chilean senate in 1949. He ran successfully for the presidency in 1952 under the slogan "Larger Loaves of Bread," an appeal directed to the depressed urban elements and the emergent rural workers.

He attracted foreign capital in an effort to create a viable economy, but this objective failed and at the end of his regime (Nov. 1, 1958) Chile was in desperate straits. Ibáñez died at Santiago on April 28, 1960.

See also CHILE: *History*. (J. J. J.)

IBARAKI, a prefecture (*ken*) in the northwest of the Kanto (Kwanto plain) district, central Honshu, Japan. Area 2,351 sq.mi.; pop. (1960) 2,047,024. The prefecture is basically agricultural, the chief products being cereals, potatoes and tobacco. Mechanization of agriculture is advancing rapidly.

Coal is produced at the Ibaraki mines in the Jôban coal field, and copper at the Hitachi mines.

Many of the cities were castle towns. Mito (*q.v.*), the prefectural capital, was developed under the Mito branch of the Tokugawa family; its Kairaku-en is one of the most celebrated gardens in Japan. (R. B. H.)

IBARA SAIKAKU: *see* IHARA (IBARA) SAIKAKU.

IBERIANS, a prehistoric people of southern and eastern Spain, who later gave their name to the whole peninsula. The waves of migrating Celtic peoples from the 8th to the 6th century B.C. onward settled heavily in the north and the central Meseta lands, penetrated Portugal and Galicia, but left the indigenous Bronze Age people of the south and east intact. Greek geographers give the name Iberian, probably connected with that of the Ebro river, to tribes settled on the southeastern coast, but by Herodotus' time (mid-5th century) it was applied to all the peoples between the Ebro and Huelva rivers, who were probably linguistically connected and whose material culture is distinct from that of the north and west. There were, however, areas of overlapping between Iberian and Celtic peoples, as in the Celtiberian tribes of the northwestern Meseta and in Catalonia and Aragon (*see* CELTIBERIA).

Of the Iberian tribes mentioned by classical authors, the Bastetani were territorially the most important and occupied the Almería region and the mountainous Granada region. They were bounded on the north by the Mastieni (centred on Mastia, later Carthago Nova [Cartagena]) and the Dietani (Archena, Murcia, Elche and Alicante). A large and partly celticized tribe of Edetani stretched from the plains of Valencia to the eastern foothills of the Pyrenees, with the Ilergetae occupying the coastal strip around the Iberian city of Tarragona and the Gimnetae and Contestani on their southern flank. The tribes to the west of the Bastetani are usually grouped together as "Tartessian" after the name Tartessos given to the region by the Greeks. The Turdetani of the Guadalquivir valley were the most powerful of this group. Neighbouring tribes were the Olbisinii of the Huelva basin, Ileates on the plains north of the Guadalquivir, Cilbiceni of Cádiz province, Etmanei of Córdoba province, and other tribes which stretched northward into the central Meseta.

Culturally the tribes of the northeast and of the Valencian coast were greatly influenced by the Greek settlements at Emporion (modern Ampurias) and in the Alicante region, and those of the southeast by a vague Phoenician influence emanating from the Carthaginian settlements at Malaca (Málaga), Sexi (Almuñecar) and Abdera (Adra). It was doubtless from the Carthaginians that the technique of the dark-on-light painted Iberian pottery was first acquired, for this in its early stages bears some relation to Carthaginian shapes and simple painted decoration.

The chronology of Iberian pottery, on which much knowledge of Iberian cultures rests, is not fully worked out. Local styles of painting can be recognized, however, such as that of Elche-Archena in the 4th–3rd centuries, which employs bird and floral motifs, and the older style of the Valencia region, originating in the 5th century and continuing till the 3rd, found chiefly at San Miguel de Liria and Oliva, which is elaborate and includes scenes of hunting, ritual dances and battles on land and sea. Pottery with painted decoration similar to that of Valencia was produced in Catalonia and in the 3rd–2nd centuries evolved into a distinctive Catalan foliage style paralleled in the Ebro region by the beautiful 3rd-century pottery of Azaila. A severe style of schematized anthropomorphic pottery painting evolved in Aragon and was passed on to the Celtiberians. In Andalusia and the southwestern region pottery shapes remained angular and decoration simpler; pots were covered with red wash and pendant concentric semicircles painted on relief zones. Concentric semicircular design in friezes was used by all Iberians in the pottery painting of the 2nd–1st centuries.

Striking pieces of monumental stone carving survive in a distinctive style more oriental than Greek. These include statues of priestesses from the sanctuary of Cerro de los Santos (Albacete) and the famous "Lady of Elche," now in the Prado museum, Madrid. There are carved sphinxes from Agost (Valencia) and Villacarrillo (Jaén), lions from Córdoba and Cortijo del Álamo (Jaén), and also bulls (Alicante) and horsemen (Albacete). A number of well-planned villages are known, particularly in Aragon, but remains of monumental architecture are few and more southern and consist of pilasters and reliefs and moldings. The only complete buildings are monumental chamber tombs like that at Tútugi (Granada).

The Iberian alphabet has an older (6th–5th century) western phase called Tartessian and a derived eastern phase called Iberian. There are both Greek- and Phoenician-derived letter forms in the alphabet, most of which is of unknown origin. Many inscriptions exist, but few words except place names on the coinage struck by many cities in the 3rd century can be read. There was undoubtedly a written literature, including poetry.

Little is known of politics, but a contrast can be drawn between the Tartessian tribes who were often linked under strong kings and the Iberian tribes who remained grouped around independent city-states. Religious sanctuaries with votive bronzes and terra cottas were almost all in mountainous parts such as Cerro de los Santos, Despeñaperros and La Serreta de Alcoy.

Agriculture, mining and metallurgy were the mainstays of Iberian economy. There are plenty of Greek imports, and exported Iberian pottery has been found in southern France, Sardinia, Ischia, western Sicily and north Africa.

Iberians was also the name given by the ancient Greeks to the inhabitants of modern Georgia; Iberia was equivalent to the regions of Kartalinia and Kakhetia in the Georgian Soviet Socialist Republic.

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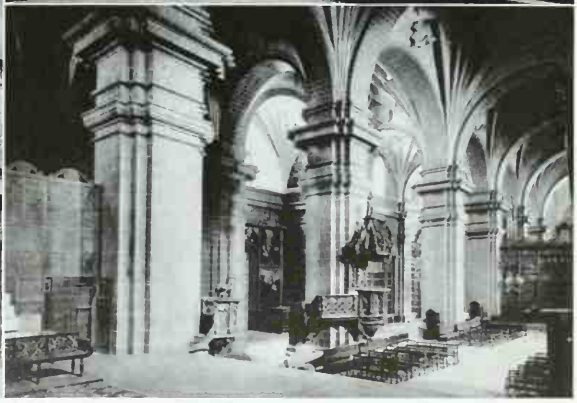
IBERO-AMERICAN ARCHITECTURE. In Spanish America the high quality as well as the great quantity of colonial architecture establish it as a major contribution of the new world to civilization. The zeal and power of the Spanish church were abetted by the wealth of the colonies in the construction of sumptuous ecclesiastical buildings. Skilled Indian labour also contributed to the early development of large-scale programs in both religious and domestic architecture. Types of buildings



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16TH- AND 17TH-CENTURY RELIGIOUS ARCHITECTURE

Top left: Façade of Augustinian church (c. 1570), Cuitzeo, Mex. Renaissance style

Top centre: Façade of the Jesuit church at Cuzco, Peru. Baroque style (1664)

Top right: Cloister with Renaissance piers and Gothic vaults, Augustinian monastery (c. 1560), Yuriria, Mex.

Centre right: Exterior (1560) of Augustinian monastery at Acolman, Mex.

Bottom left: Façade of cathedral of Santo Domingo, Ciudad Trujillo, Dominican Republic. Spanish Renaissance (1514–40)

Bottom right: Interior of Cuzco, Peru, cathedral (1598–1654). Spanish Herreresque with Tuscan piers and Gothic vaults

IBERO-AMERICAN ARCHITECTURE

BY COURTESY OF HAROLD E. WETHEY

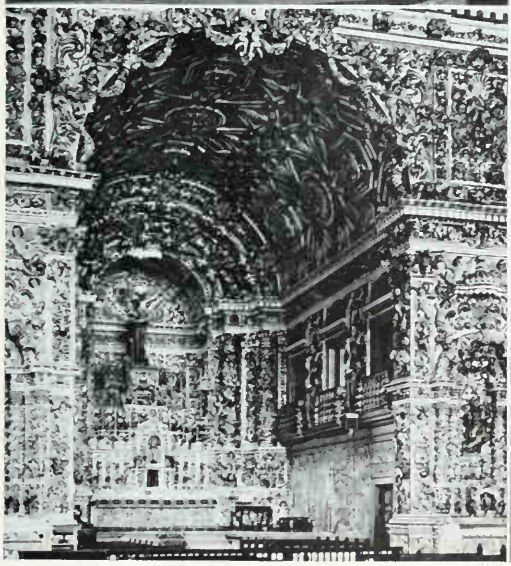
17TH- AND 18TH-CENTURY ARCHITECTURE

Top left: Façade of La Valenciana (1765–88), Guanajuato, Mex. Late Baroque (Mexican) with tapering pilasters

Top right: Torre Tagle palace, Lima, Peru (1735). Baroque portal and closed wooden balconies of near eastern tradition

Bottom left: Façade of San Lorenzo church (1728–44), Potosi, Bolivia. Style intermingled formalized patterns of both European and Indian themes

Bottom right: Church of Santiago, Pomata, Peru. Detail of lateral portal (*c.* 1720); mestizo style showing Indian influence



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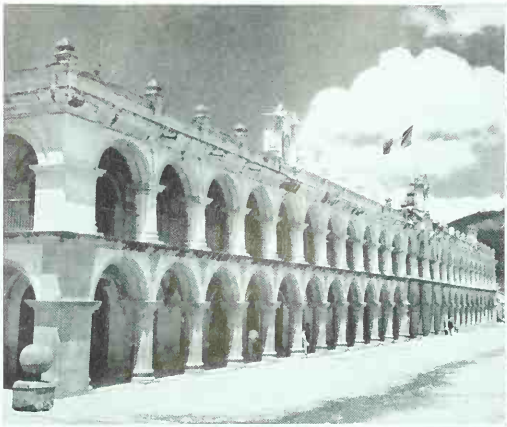
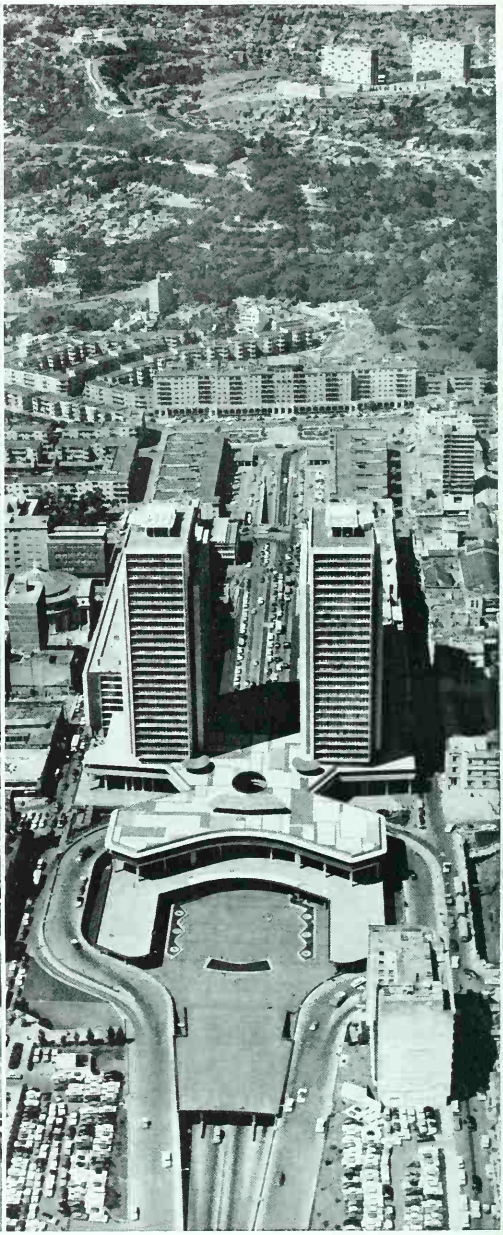
RELIGIOUS ARCHITECTURE OF BRAZIL AND MEXICO

Top left: Façade of São Francisco, São João del Rei, Brazil; about 1770
Top right: San Francisco Xavier, Tepotzotlán, Mexico; 1582–1760
Bottom left: Interior of São Francisco, Salvador, Brazil; middle of the 18th century
Bottom right: Cathedral, Salvador, Brazil; 1657–72

IBERO-AMERICAN ARCHITECTURE





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SECULAR ARCHITECTURE

Top left: Government palace, Antigua, Guatemala; 1764

Right: Simón Bolivar centre, Caracas, Venezuela; the focal point of the 20th-century redevelopment of the city. In the background are modern housing units

Centre left: Jai alai courts of University city, Mexico; 1950–52

Bottom left: Palace of the Dawn, residence of the president, Brasilia, Brazil. Oscar Niemeyer, architect; 1959

and styles were Spanish in origin, although local conditions produced modifications. In centres of European culture, such as Santo Domingo, Mexico City, Quito, Lima and Cuzco, architectural styles were contemporary with those in Spain. Medieval traditions survived, however, especially in monastic structures; even in the 17th century, late Gothic ribs persisted in the vaults of churches. Spanish-Moorish elements (Mudejar), such as wooden ceilings in geometric patterns, coloured tiles, the rectangular frame of an arch *(alfiz)*, and the trefoil arch, were popular throughout Spanish-American architecture.

Spanish America.—*16th Century.*—In Santo Domingo, site of the first Spanish settlement, is preserved the earliest cathedral (1514–40), which has a superb Spanish Renaissance façade and a Gothic interior. In Mexico large building campaigns (*c.* 1550–1600) were carried out by Franciscan, Augustinian and Dominican friars. Their monasteries generally have a huge vaulted church, cloister and monastic buildings, based upon Spanish prototypes. The large atrium yard and the "open chapel" for outdoor religious services are special features developed in America to accommodate crowds of Indians, as at Acolman, Cuernavaca and Huejotzingo. Portals display a wide variety of styles, including medieval and Renaissance elements and occasional Indian influences. The largest Mexican cathedrals, those of Mexico City (1563–1813) and Puebla (1575–1690), have the rectangular basilican plan and other features of the Andalusian Renaissance.

Important early monuments of Peru were destroyed by earthquakes; the surviving structures, of modest character, are found in Ayacucho, on the shores of Lake Titicaca and in Sucre, Bol. Vaulted churches were virtually unknown in South America until the 17th century. In Quito, Ecuador, the Franciscan and Dominican monasteries are notable for their cloisters and Mudejar ceilings, and the cathedral (1562–72) is an example of Andalusian Gothic-Mudejar construction.

17th Century.—The architecture of the first half of the 17th century preserves the late classical style of the Spanish architect of the Escorial, Juan de Herrera. Austerity characterizes San Agustín and Santo Domingo in Puebla, as well as the façade of the cathedral.

Most awesome is the cathedral (1598–1654) of Cuzco, Peru, rectangular in plan, and Herreresque in its sobriety except for the early baroque portal. The Jesuit church in Cuzco, whose handsome façade was designed in 1664 by Diego Martínez de Oviedo, constituted the first late baroque architecture in the Americas. The city abounds in handsome churches and palaces, built of Andean stone in the second half of the 17th century, and it is in many respects unrivaled in America. At Lima, Peru, the rebuilding of the monastery of San Francisco (1657–73) brought a new wave of Mudejar influence in the geometric designs of the plasterwork. The main portal (1674) of the church inaugurated in that city the late baroque type of façade, closely resembling a carved altarpiece.

In Bolivia the chief architectural centre was Sucre, where Gothic vaults persisted, but otherwise both religious and domestic buildings adhered to simple classical designs. The Jesuit church in Bogotá, Colombia, owes its Italianate classicism to the Italian architect Father Coluccini. The greatest masterpiece of Jesuit architecture in America is, however, the church in Quito. There the Mudejar patterns, which stand out in gold against a red background, make the interior (1605–89) of the church unforgettably sumptuous. More provincial though extremely colourful Mudejar interiors are characteristic of the monastic churches of Tunja, Colombia. Due to the splendid designs of its monastic buildings, Quito stands with Cuzco as one of the major schools of architecture in South America.

18th Century.—The first stage of baroque architecture in Spanish America is generally distinguished by richly sculptured façades, whereas the interiors often remain sober settings for resplendently carved and gilded altarpieces. The late baroque altar of spiral columns was imported from Spain about 1650–60. Its translation into stone on the façade of a church first occurred (1697–1704) in South America in La Merced at Lima, to be followed by San Agustín there and three churches in Cajamarca, Peru.

In this period appeared in southern Peru and Bolivia a school of architectural decoration characterized by native Indian contributions in the primitive manner of carving and in the introduction of non-European ornament. The crossbred style is known as mestizo, because it, like the people, is compounded of European and native Indian stock. Evidences of Indian contribution are also found in Mexico throughout the colonial period, and there exist parallel phenomena in Central America. The first examples of the independent Peruvian-Bolivian style are preserved in Arequipa, Peru, where the façade (1698) of the Jesuit church is carved like a tapestry in stone. Other famous examples are Santiago at Pomata, Peru (*c.* 1690–1722), San Lorenzo (1728–44) and the Jesuit church (1700–07) at Potosí, Bol., and San Francisco (1753–72) at La Paz, Bol.

Argentina lay in the outer periphery of the Spanish colonies, and its early architecture consisted of provincial chapels of rubble and adobe, with the exception of the Jesuit monastery (1654–79) at Córdoba. In the 18th century two Italian Jesuit architects, Blanco and Primoli, established the spacious style of the Italian baroque in the Jesuit estates of Alta Gracia and Santa Catalina near Córdoba and in El Pilar at Buenos Aires.

Baroque architecture reached its climax in Mexico with lavishly carved façades in which the tapering pilaster *(estípite)* was a distinguishing feature. Introduced in the capital in the Sagrario façade (1749–68) under the architect Lorenzo Rodriguez, it spread rapidly and appeared in La Santísima, in the Jesuit seminary at Tepotzotlán, in the churches of Guanajuato and elsewhere. The school of Puebla maintained independence in producing an extraordinary array of brilliantly coloured exteriors of glazed tiles, both in churches and in countless palaces. Mixtilinear contours in doorways, windows and roof levels created highly picturesque effects in Mexican buildings of this period.

Throughout Spanish America, cities were built on a gridiron plan, with a rectangular plaza in the centre and covered sidewalks *(portales)* of Mediterranean tradition. Houses, large or small, were arranged about a central patio. Handsome domestic buildings exist throughout the continent; special mention should be made of those in Mexico City, Puebla, Tunja, Potosí and Cuzco. Most remarkable civil edifices, such as the customhouse and viceregal palace, survive in Mexico City, whereas elsewhere only the royal mint at Potosí (1753–73) and the government palace (1764) in Antigua, Guat., are comparable in importance. Spanish colonial architecture came to an abrupt end with the triumph of neoclassicism (1800).

Brazilian Architecture of the Colonial Period.—The architecture, language and culture of Portugal were transplanted to Brazil, which was the only major area of non-Spanish origin throughout Latin America. The first cities were built upon hills in medieval style, unlike the unified Spanish settlements. Little of importance survives from the 16th century, when buildings were mostly of wattle and palm thatch.

The Jesuits brought to Brazil the first significant ecclesiastical style, a severe and undecorated architecture, in which the rectangular façade with angle pilasters has a pedimental gable and windows in the second story (Olinda, 1592). This type with variations persisted in Brazil until 1750. Plans are rectangular with square sanctuary and sacristy directly behind, and basilican structures are few. Long lateral chapels parallel with the nave are an unusual feature, derived from Portugal. Vaults and domes are rare, and decoration is limited to the occasional use of imported blue glazed tiles.

Salvador, the viceregal capital until 1763, had the closest ties with Lisbon, and its architecture reflected contemporary Portuguese models. The former Jesuit church, now the cathedral of Salvador (1657–72), has a late Mannerist façade of stone in two principal stories, decorated with Doric pilasters and topped by a large attic story. The prominent windows in the second story are typical of Portuguese and Brazilian ecclesiastical and domestic design. The more exotic church façades began in the 18th century; great volutes over the centres between square towers created extraordinarily ingenious effects. This development can be traced at Salvador, Deodoro, Penedo, Olinda, João Pessoa and elsewhere.

in a series of Franciscan churches with arched open narthex, three windows in the second story and fantastic volutes crowning the top.

In the last period of Brazilian colonial architecture (1750–1822) the court style of Lisbon took hold in Belém and the new vice-regal capital (1763) at Rio de Janeiro. The neo-Palladian church of the Candelaria (1775) there is the most important monument in the early neoclassical style. The late rococo was, however, still well entrenched, and in the mining country of Minas Gerais it found its most original expression after 1750. There the great sanctuary of the Bom Jesús at Congonhas do Campo is approached by terraces, a provincial version of the shrines at Braga and Lamego in Portugal. The oval and octagonal plans, which had been earlier introduced at Rio and Recife, reached a new development in São Pedro dos Clérigos at Mariana and in the double oval plan of the Rosario at Ouro Preto (1785), where they are combined with round towers and curving façades. Curving exteriors in various forms in the Franciscan churches at Ouro Preto (1766) and São João del Rei, designed by Aleijadinho, and in other monuments established the keynote of this late period.

Extreme decorative luxuriance characterized the altars and church furnishings in the 18th century, and often the walls of chapels and churches were overlaid with carved ornament. Rio, Salvador and Minas Gerais became the chief centres of interiors in which gilding, spiral columns, late baroque ornament, and illusionistic painting combined to create extraordinary decorative ensembles. An equal flowering of late rococo ornament distinguished portals, windows and profiles of both ecclesiastical and domestic buildings. With the arrival of the French commission in 1816 to establish an academy of fine arts the neoclassical style was definitively implanted in Brazil, and French taste prevailed thereafter.

Modern Developments in Ibero-America.—Revivals of traditional historical styles of building held sway throughout the 19th century in Ibero-America and well into the early years of the 20th century. In the 1930s North American skyscrapers and modern functionalism in homes and apartment buildings were introduced at Buenos Aires. However, the great development of modern architecture in Ibero-America occurred in Brazil in the same period. The Swiss architect Le Corbusier was invited to Rio de Janeiro in 1936, and under his direction the Brazilian architects Lúcio Costa and Oscar Niemeyer worked upon plans for the ministry of education (1937–43). A great rectangular structure raised upon exposed cylindrical piers in pure Le Corbusier style, it established the new Brazilian school. The invention of adjustable blinds to counteract the intensity of the sun was a feature which was also widely adopted subsequently. The rapid expansion of the cities of Rio and São Paulo as well as smaller centres, such as Belo Horizonte, was one of the great phenomena of the first half of the 20th century. Office buildings and apartment houses in the form of skyscrapers abound. Private houses, schools, hospitals and airports all followed the traditions of the international style of Le Corbusier, with Brazilian variations in the extensive use of tiles and stucco exteriors and in a propensity to curving plans.

Brasília (*q.v.*), on a vast remote plateau 580 mi. N.W. of Rio, was an epoch-making event of contemporary architecture. The city plan, shaped like two great wings, with complicated levels, terraces and approaches, was conceived by Lúcio Costa; and construction began in 1957 under the direction of Oscar Niemeyer, who designed the presidential palace and the government buildings, which were largely completed in 1960.

After World War II, numerous tall buildings were built everywhere in Ibero-America, notably in Caracas, Venez., and Mexico City. In the expansion of the former alone was a uniform city plan followed. Remarkable new university cities were built at Santiago de Chile, Rio de Janeiro, Caracas and Mexico City. The last (1950–52) was designed by a group of artists collaborating on the vast complex of buildings, including the Olympic stadium. The use of mosaics on exteriors and the adoption of pre-Columbian architectural traditions, especially in the stadium, gave the Mexican style a high degree of individuality within the general conventions of the modern international style of glass and concrete. Domestic architecture of the luxurious region of Pedregal also incorporated similar native elements.

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(H. E. W.)

IBERO-AMERICAN LITERATURE. With the discovery of new lands beyond the ocean, Iberian Spain and Portugal embarked on a Christian crusade three centuries long that was to stamp its colonial seal on vast sprawling areas of the Americas. This bold adventure was chronicled fully from the very day Christopher Columbus set sail out of Palos, Spain. His letters to King Ferdinand and Queen Isabella marked the beginnings of a rich body of colonial writings. Conquerors of the sword and cross alike spelled out the story of the discovery and the conquest, of natural wonders and ancient civilizations, in countless letters, chronicles, histories, polemic tracts, dictionaries, grammars, religious pieces and epic poems that comprise this "literature of the conquest." The most fascinating and the most vital of these writings are those vibrant still with the high hopes and lusty spirit of the men who participated actively in the great crusade for church and crown.

This article is a chronological account of this body of literature. Biographies of many of the Ibero-American writers mentioned below may be found in articles under their names.

THE COLONIAL YEARS (1492–1826)

Literature of the Conquest (1492–1600).—For the thrill of first contacts, of epic adventure and of new vision there are the five dispatches, or *Cartas de relación*, sent by Hernán Cortés (1485–1547), the courageous, calculating conqueror of the Aztecs, to his emperor Charles V; the inimitable and disarming account of the indignant and doughty Bernal Díaz del Castillo (*c.* 1492–*c.* 1581), who spoke for the common soldier in his *Historia verdadera de la conquista de la Nueva España;* the incredible odyssey of the first white man to cross America on foot from Florida to the Mexican Pacific as told by Alvar Núñez Cabeza de Vaca (*c.* 1490–*c.* 1560) in his *Naufragios y comentarios;* the impassioned pages of that impetuous "apostle of the Indies," the Dominican friar Bartolomé de las Casas (1474–1566), whose *Brevísima relación de la destruición de las Indias* (*c.* 1542) became the cornerstone of the "black legend" of colonial Spain; and finally, the nostalgic reminiscences of a mestizo born of an Inca princess and a Spanish conqueror, Garcilaso de la Vega (1540?–1616), embodied in his imaginative and exciting history, *Los comentarios reales que tratan del origen de los Incas* (1609–17).

The conquerors were not content, however, with chronicling their deeds in prose alone. Fired by the heroic fervour of their age and by the example of Ariosto, Tasso and the Latin masters, they sang in epic measures the whole story of adventure that lured them from distant Antarctica to the upper reaches of the Río Grande. *La Araucana* (1569–89), the first of these epic poems and the best of the many written in the closing years of the 16th century, and sporadically throughout the later colonial period, was begun on scraps of paper and bark by the young captain and courtier Alonso de Ercilla y Zúñiga (*q.v.*; 1533–94) while serving with the Spanish armies pitted against the indomitable Araucanians of Chile. Tremendously popular in its time, this national epic inspired other participants elsewhere to do for northern South America what Ercilla had done for Chile: Juan de Castellanos (1522–1607?), *Elegías de varones ilustres de Indias* (1588); for the Plate river region, Martín del Barco Centenera (*c.* 1535–1605), *La argentina;* and even for the northern outposts of New Spain, Gaspar de Villagrá (*c.* 1555–1620), *Conquista de la Nueva México* (1610). These later poems pale in poetic import as they gain in documen-

tary significance. Only the *Arauco domado* (1596) of Pedro de Oña (1570–1643), Chile's first outstanding native poet, approaches the Ercilla epic in artistic achievement. In *La cristiada* (1611), written in Lima, Peru, by the Dominican Diego de Ojeda (1571–1615), America was also to produce the best sacred epic in the Spanish language. And finally there is the brilliant and ambitious Bernardo de Balbuena (1562–1627) whose work best represents the rich and varied literary expression of the dawning baroque age. His vast epic, *Bernardo, o victoria de Roncesvalles* (1624), and his eclogues are overshadowed by his *La grandeza mexicana* (1604), an effusive paean that placed him among the best descriptive poets of colonial America.

The discovery and conquest of the tropical heartland of America did not produce a like rich body of Brazilian counterparts to the spirited epics in prose and verse of the Spanish conquerors. The Portuguese found no centuries-old native civilizations upon which to build a new society. Indians were few. Rather than resist, they retreated into the interior, leaving the invaders to settle at widely scattered points along the extended narrow coastal plain. There was, then, no epic clash of which to sing. But there was the beautiful and bountiful land and nature's children of coast and forest, and these, beginning with the very day of discovery, were described and extolled by the Portuguese explorers and missionaries and by others of many lands. Brazil's "literary baptism," like that of colonial Spain, is to be found in the letter of discovery sent to Dom Manuel I of Portugal by the scribe Pero Vaz de Caminha, who accompanied the explorer Pedro Álvares Cabral in 1500. The missionary labours were largely in the hands of the Jesuits, and to one of their number, José de Anchieta (1534–97), linguist, historian, poet, dramatist and educator, befell the distinction of being hailed as the father of Brazilian literature. For the period, however, there is only one epic, and this, except for some descriptive passages that give voice to *brasilidade*, or love for the new land of Brazil, sings of Portuguese exploits against the Moors in feeble imitation of Luís Vaz de Camões. The epic *Prosopopéa* (1601), by Bento Teixeira Pinto (*c.* 1540–1618), is commonly regarded as the first book by a Brazilian-born writer.

The Flowering of Colonial Letters (1600–1808).—By 1600 the day of the conqueror was past and the new world began to adjust to a less spectacular development for two more long centuries under Spanish-Portuguese dominion. Institutions and manners evolved and flourished under patterns already set in the latter half of the 16th century. The first printing press in the Americas was established in Mexico City about 1539, to be followed by another in Lima in 1584, and both cities were granted university charters as early as 1551. Such, however, was not the case in Brazil where not a single university was founded during colonial years and where printing was not permitted until the close of the period. But everywhere in the Americas a growing leisure class could devote more time to intellectual and artistic pursuits, and close ties maintained with the homeland through men and books encouraged the development of parallel literary patterns. In convent and court, life and letters became a pallid reflection of trends across the Atlantic, and there was little in these two centuries that could lay claim to originality or to distinction as the product of a genuine American art.

The theatre, barely emerging from its medieval forms at the time of the conquest, served largely during the 16th century as a missionary medium in the Indian tongues for the conversion of the native masses. But for the creoles and the growing mestizo class the dramatic repertoire was mainly Spanish and Portuguese, and even those plays that were written in America, but rarely published, were patterned after the flourishing drama of the Golden Age. The plays of the greatest of these native dramatists, the Mexican Juan Ruiz de Alarcón (*c.* 1581–1639), more properly belong to Spain.

No true novel was written during the entire colonial period. Prose fiction as such continued to yield to works of historical and biographical import. One of the most readable of these pieces is the entertaining travelogue, *El lazarillo de ciegos caminantes*, written sometime about 1773, by the still unidentified Calixto Bustamante Carlos Inca, of Peru, better known under his pseudonym Concolorcorvo.

That poetry was the most popular form may be inferred from a contest held in Mexico in 1585 in which more than 300 versifiers took part. But these rhymesters did little more than produce a flood of mediocre poetry as indifferent disciples of the cult of the Cordovan genius Luis de Góngora y Argote (1561–1627). Most of their work remains mercifully buried and almost forgotten. Samplings of their blighted art may be found in the curious and entertaining anthology, *Ramillete de varias flores poéticas* (1675), gathered by Jacinto de Evia (b. 1636) of Ecuador. One name alone stands out above them all, that of the famed Mexican nun and "tenth muse," Sor Juana Inés de la Cruz (*q.v.*; 1651–95). Thirsting after knowledge, she had at 17 sought refuge in a convent where she hoped to be able to dedicate her talents entirely to meditation and writing. But her admirers all over the western world kept her in the intellectual and social limelight, where she added further to her stature as Mexico's first feminist. Her fame was enhanced not a little through her critique of one of the sermons of the most eloquent Jesuit missionaries of the day, António Vieira (1608–97). Vieira's vigorous writings in defense of the Indian and Negro and against the exploitation of Brazil by Portugal attest to the fact that, protest as he did against current literary licence, he too like Sor Juana and others could not free himself entirely of the fateful attraction of Góngora. Sor Juana's plays, religious tracts, a revealing autobiographical piece (the product of her contact with Vieira), but above all her sacred and profane lyrics of simple beauty and emotional appeal, amazingly free of Góngorist excesses, constitute one of the greatest single colonial literary legacies of Ibero-America.

As the colonial period ended only an occasional voice protested against the artificiality and decadence of viceregal life and letters. Among the earliest of these were the mordant Peruvian wit Juan del Valle y Caviedes (*c.* 1652–92) and his contemporary Gregório de Mattos Guerra (1633–96), the epigrammatic "devil's mouthpiece" of Brazil. Both stemmed directly from the Quevedo tradition in Spain and both were extremely popular, their verse circulating widely from manuscript to manuscript, not to be collected and published until long after their deaths.

Literature of Rebellion (1808–26).—Protest and general political unrest began to spread as the 18th century advanced and French letters and ideas broke through the relaxed controls indifferently held by Spain and Portugal over new world thought and expression. Early stirrings became more purposeful when French revolutionary doctrines were put to the test by the bold action of Britain's colonies to the north. Printing presses and periodicals sprang up everywhere to convey the new ideas and ideals quickened in the flourishing literary societies founded by Ibero-America's young liberals returning from fruitful contacts abroad.

One of the earliest, most immediate fruits of these contacts with foreign thought was the abortive Brazilian *Inconfidência Mineira* of 1789, a "conspiracy of poets," headed by Joaquim José da Silva Xavier, called Tiradentes (the "tooth puller"), and supported by a number of exceptional writers who were members of the *escola mineira*. This "Minas school" of epic and Arcadian (neoclassic) poets had no equal in the Spanish colonies of that day. Inspired by Camões and Ercilla, José Basílio da Gama (1740–95), author of *O Uruguay* (1769), and Friar José de Santa Rita Durão (*c.* 1737–84), author of *Caramúru* (1781), composed two great native epics of Brazil. Love of country and the appearance of the Indian as a literary character stamped both works as forerunners of Brazilian intellectual independence. The outstanding lyrist, Tomás António Gonzaga (*q.v.*; 1744–1810), author of the delicate love songs to *Marília de Dirceu* (1792), is still the most popular love poet in the Portuguese language. Gonzaga was to die in exile in far-off Mozambique, and a somewhat similar fate awaited most of the conspirators of that ill-starred revolt. When, after a bloodless victory in 1822, Brazil finally emerged as an empire under Dom Pedro I (1822–31) and Dom Pedro II (1840–89) only one literary figure, José Bonifácio de Andrada e Silva (*c.* 1763–1838), stood out as the patriarch of Brazil's struggle for inde-

pendence. As the author of such vigorous, passionate verse as *Poesías*, published in Bordeaux (1825), he clearly reveals his affinity to Byron; he is also acclaimed Brazil's first romantic poet.

The pioneer Venezuelan Francisco Miranda (*q.v.*; *c.* 1750–1816) left a remarkable journal that reveals how he profited from firsthand contacts in the United States with the "great American experiment." His compatriot, the liberator Simón Bolívar (1783–1830), was later christened "the thinker of the Revolution." Through his prophetic analyses of the sociopolitical scene filtered some of the best and most applicable of French thought, particularly that of Montesquieu and Rousseau. Bolívar's dream of a confederation of Ibero-American states received ardent support from the fiery Argentine pamphleteer Bernardo de Monteagudo (1785–1825), onetime secretary of his country's national hero, José de San Martín.

But brilliant and decisive as was their contribution to the cause, the Mexican propagandist and journalist José Joaquín Fernández de Lizardi (1776–1827), referred to as *el pensador mexicano* (the Mexican thinker) after the revolutionary journal founded by him in 1812, was the only one of that patriotic band of "liberators" to be remembered as a man of letters. His present fame rests largely on the picaresque tale *El Periquillo Sarniento* (1816), generally conceded to be the first authentic Ibero-American novel.

The revolution found its most popular form of expression in balladry and heroic verse. Only an occasional national anthem, such as that of Argentina written in 1813 by Vicente López y Planes (1784–1856), remains as a symbolic reminder of that time. The more enduring patriotic poetry came with the flush of victory and represents but a phase of the total output of three outstanding poets whose significance transcends the brief violent period of the struggle for independence. Only the work of the Ecuadorean José Joaquín Olmedo (*q.v.*; 1780–1847) was limited almost exclusively to the themes and spirit of revolutionary years. His best-known poem, "La victoria de Junín, Canto a Bolívar" (1825; London and Paris, 1826), composed at Bolívar's request, is generally considered to be the finest example of heroic poetry in the classical style written in America. In his Virgilian "Silva a la agricultura de la zona tórrida" (1826), worthy companion piece to Olmedo's battle-inspired ode, the serene and encyclopedic poet and scholar Andrés Bello (*q.v.*; 1781–1865) of Venezuela, exhorted his fellow Ibero-Americans to turn their swords into plowshares and live the good and abundant life that rich tropical America held out to all free men. In his later years Bello was to distinguish himself as a grammarian, literary critic, translator, lawgiver and educator and as the revered father of Chile's own first intellectual generation.

José María de Heredia y Campuzano (1803–39), Ibero-America's first great lyric poet and romanticist, lived most of his life in exile (Venezuela, New York, Mexico) where nature in its grander moods inspired the rebellious nostalgic poet of enslaved Cuba to write his widely acclaimed poems "En el Teocalli de Cholula" (1820) and "Al Niágara" (1824). In Mexico, as was the case with Bello in Chile, Heredia was to participate actively in the new literary movement of romanticism with which the young Ibero-American nations were born to political independence.

THE FORMATIVE YEARS (1826–1910)

The Romanticists (1826–70).—Victory brought immediate political independence from Spain and Portugal (except for the island countries of the Caribbean) but not freedom from the despotism of political anarchy that beset the young nations in their early formative years. Economic and political stability would not be realized for most of the new nations until the closing years of the century. American themes had fired the imagination of the "liberators," but neoclassic forms were still too sacred to be violated even by the tempestuous romantic Heredia. European romanticism was to show the political liberals the way to cultural independence also, even though that way lay largely along the route marked out by France (Chateaubriand, Lamartine and Hugo), England (Scott and Byron), and Spain (Espronceda and Zorilla). Neoclassic form and restraint yielded to the romantic tenets of freedom, individualism and emotional intensity, tenets ideally suited to fit Ibero-American temperaments and conditions.

The most illustrious group of early romanticists was that of the Argentine political refugees who fled from the tyranny of Juan Manuel de Rosas (1793–1877). Their leader was Esteban Echeverría (1805–51), who, shortly after his return from a four-year stay in France (1826–30) when romanticism was at its height, indicated the way by writing "La cautiva" (1837), his best poem and the earliest example of the wedding of native themes and scenes to new and more appropriate verse forms. The pampa had been discovered. It remained for Domingo Faustino Sarmiento (*q.v.*; 1811–88), who rose from rural schoolmaster to be his country's first civilian president, to present in *Facundo* (1845), written in Chile in passionate denunciation of Rosas, the first serious study of the pampa and of gaucho lore. It was this emphasis on the national scene that gave birth to an indigenous literary genre without European prototype, the so-called gaucho literature of Argentina and Uruguay. The gaucho had long been the subject of folk tale and ballad. He then became the subject of some of the best verse of the century, his romantic story finding, in part, its highest artistic expression in Rafael Obligado's (1851–1920) three poems (1887) on the legendary minstrel Santos Vega. He was acutely portrayed in the humorous gem *Fausto* (1866) by Estanislao del Campo (1834–80). And, finally, he aroused the national conscience and received epic treatment in the classic *Martín Fierro* (1872–79) by José Hernández (1834–86).

These "primitive" poems written in imitation of the gaucho minstrel's ballads and speech are one of two of Ibero-America's original contributions to western letters. The other springs from the romanticist's interest in the search of national roots: the past of the "noble savage" of Utopian pre-Columbian days and of the victim of Spanish colonial tyranny, the past of a hardy epoch of discovery and of clash of conqueror and conquered, the past of the romance and intrigue of later viceregal days and finally the past of the glorious epic of the struggle for self-determination and self-expression. Echeverría was one of the first to exploit this past in *La cautiva*, the poetic narrative of the legend of the ill-starred lovers of the pampa. This romantic evocation mothered a growing brood of poems and plays that reached its poetic climax in the elegiac *Tabaré* (1886) in which the Uruguayan Juan Zorrilla de San Martín (1855–1931) sings of the sad fate of the aboriginal Charrúas forever vanquished by the Spanish invaders. In prose this past produced the *tradición*, the other unique Ibero-American genre patterned after the historical anecdote and perfected by the Peruvian Ricardo Palma (1833–1919), one of the greatest Ibero-American masters of piquant, humorous prose. Palma's *Tradiciones peruanas* (1872–1910) has been imitated by many, but no one has yet succeeded in matching his entertaining and artistic re-creation of the past, especially of colonial years.

The Brazilian romantics had no great Indian past and a relatively uneventful colonial era. They therefore continued to extol the beauties of their tropical homeland and to exalt the simple living of the idealized Indian, always with languid nostalgia, or *saudades*, and not infrequently with marked religious fervour. Domingos José Gonçalves de Magalhães (1811–82) is generally credited with having launched the romantic movement in 1836 with the publication of the patriotic and deeply religious poems, *Suspiros poéticos e saudades*. The earlier phases of the movement found their best and most representative expression, however, in the inspired and richly variegated writings of Antônio Gonçalvez Dias (1823–64), one of Ibero-America's truly outstanding poets of the romantic period. Later phases of romanticism are best exemplified in the poetry of doubt and despair of the would-be Byronic, soulsick, short-lived Manuel Antônio Alvares de Azevedo (1831–52) of the so-called "Satanic school" and author of *Uma noite na taverna* (*c.* 1851) and in the Hugoesque sociopolitical verse of the abolitionist and intensely Brazilian Antônio de Castro Alves (1847–71), author of *Os escravos* (1876).

The Realists and the Naturalists (1855–1900).—The romanticist's interest in the picturesque and unusual helped him discover types and customs in the living present that gave evidence of a budding national way of life. The sketch of contemporary manners, or *cuadro de costumbres*, closely modeled after those

of the Spanish *costumbristas*—Larra, Estébanez Calderón, Mesonero Romanos—developed into the realistic novel of manners shortly after mid-century. From that date on, the novel began to assume a more commanding role in Ibero-American letters. Contrary to its development elsewhere, however, it appeared almost concurrently in the several types representative of successive literary trends in Europe whose masters (Scott, Dumas, Balzac, Pereda, Pérez Galdós, Eça de Queirós) provided the molds in which were poured Ibero-American themes. José Mármol (1817–71), the most virulent anti-Rosas poet of the Argentine exiles, is remembered for *Amalia* (1851–55), a highly romantic novel of contemporary political events that afforded the outside world a dramatic depiction of life in Argentina under the tyranny of Rosas. Across the Andes the realist Alberto Blest Gana (1830–1920) began producing a series of *costumbrista* novels on Chilean life of which *Martín Rivas* (1862) is generally considered his best. At about the same time, the Colombian Jorge Isaacs (1837–95) gave Ibero-America its most popular and most representative novel of the 19th century in the tragic idyll of *María* (1867), while Juan León Mera (1832–94) of Ecuador contributed *Cumandá* (1871) to the growing number of highly romantic fictional portrayals of idealized Indian life.

Except for a scattering of prose pieces of dubious novelistic stamp, the true novel did not put in an appearance in Brazil until 1844, the date of publication of the perennially popular and romantically sentimental *A moreninha* by Joaquim Manuel de Macedo (1820–82). From that time on, however, the form enjoyed a more orderly and more continuously progressive growth than in the other sister republics. Still one of the most widely read of his country's novelists, José Martiniano de Alencar (1829–77) initiated the vogue of the Brazilian *Indianista* novel by contributing two of the most popular works to the genre, *O Guarany* (1857) and *Iracema* (1865). But these romantic tales of love between Indian and white represent only one aspect of Alencar's varied literary activity. In attempting to novelize the whole of his country's past, he turned to the *sertão* (hinterland) to depict the life and customs of Brazil's backlands. His *O gaúcho* (1870) and *O sertanejo* (1876), although still markedly romantic in spirit, were among the forerunners of a flourishing regional genre that set the stage for the flowering of a truly national novel. Two exceptional contributors to this transitional genre were Alfredo d'Escragnolle Taunay (1843–99), whose *Inocência* (1872), an unusual love idyll set in the backlands of Mato Grosso, became a universal favourite, and Bernardo Guimarães (1827–84), whose frankly abolitionist *A escrava Isaura* (1875) was a decisive step forward in the direction of the novel of social protest.

True realism—with a definite leaning toward naturalism—had made an early and isolated bow in the long-overlooked *Memórias de um sargento de milícias* (1854–55), a Balzacian novel of early 19th-century types and customs by Manuel Antônio de Almeida (1831–61). But it was not until the mid-1870s that the novel began to cut deeply under the surface of rural and urban national life to expose the cankers of social and psychological maladjustments to a rapidly changing economic scene. Aluizio de Azevedo (1857–1913) was to become the forerunner of the 20th-century novelist of social protest by virtue of such favourites as *O mulato* (1881) and *O cortiço* (1890). Less concerned with the external aspects of Brazilian life, Joaquim Maria Machado de Assís (1839–1908) pried with piercing irony and refined humour into the psychological complex of the Brazilian soul to distinguish himself as a master craftsman and as his country's most original and gifted writer. His trilogy, *Braz Cubas* (1881), *Quincas Borba* (1890) and *Dom Casmurro* (1900), is a landmark in Ibero-American letters. *A carne* by Júlio Ribeiro (1845–90) and *O ateneu* by Raúl de Avila Pompéia (1863–95), both published in 1888, revealed two additional writers of note who helped set the Brazilian novel on a course not to be similarly charted by novelists of the other Americas until almost a generation later.

The struggle against the old tyrannies that survived political separation from Spain and Portugal gave birth to a mass of polemical writing notable more for its passion and invective than for profundity of thought or style. After mid-century, however, several of these late romantic "liberators" distinguished themselves in the manner and content of their writing, significantly distinctive in the essay form. Juan Montalvo (1832–89) became the symbol of uncompromising opposition to political tyranny. He is best remembered as the stylist and essayist of the philosophical *Siete tratados* (1882). Eugenio María de Hostos (1839–1903) of Puerto Rico, inspired teacher and essayist, led the way for social reform and independence for Caribbean lands. The abolitionist Joaquim Nabuco de Araujo (1849–1910) and the cosmopolitan statesman Ruy Barbosa (1849–1923) were the two civic-minded intellectual giants of Brazil in mid-passage from empire and slavery to republicanism and the new way of life. It was, however, relentless attacks against all forces of repression that marked Peru's most dynamic and colourful essayist, Manuel González Prada (1844–1918), as the intellectual leader of successive generations of zealous youthful reformers. His ironic experimental verse, too, paved the way for the full-flowering of the "new" poetry that came into being with the younger rebels who sought to break once and for all with the aesthetic shackles that held them captive to old world writing.

The Modernists (1888–1910).—Political stability and a measure of economic security vouchsafed the emergence of a growing leisure class dedicated to cultural pursuits and to a cosmopolitan awareness of life and letters. This new attitude found its best expression in the revolt against the sentimental strains of romantic versifiers whose clichés began to fill the bulging pages of national anthologies. The romanticist's striving for national expression was largely responsible for the development of a sterile, cloying product in which the potential of a rich new world and a complex social scene degenerated into a meaningless mass of banal lines. Ibero-American writers were suffocating in the stagnant confines of excessive nationalism. The revolt began when young writers, independently of one another over the Americas, withdrew temporarily from the local whirlpool to immerse themselves in the mainstream of world thought and writing. These new horizons broadened their perspective and afforded them a revitalized vision of how to achieve the cultural independence they had so long sought. At first, then, there were the young despondents and pessimists, those who attempted to shut themselves out from their immediate environment in artificial worlds of their own making. They were the transition group, or precursors, disparagingly labeled *modernistas* (modernists) by the older generation. They experimented in metres and in language. They wrote on themes exotic and rare—the ancient past, the distant orient, lands of childhood fancy and opiate creation. Beauty was their goddess and "art for art's sake" their creed, a creed nurtured largely in the French Parnassian and Symbolist schools but one that derived strength and richness from sources representing the range of western poetics.

Foremost among the modernists of early transition years were the Mexican Manuel Gutiérrez Nájera (1859–95), whose elegiac verse and restrained rhythmical prose sketches and tales best represent the trend from romanticism to modernism; the Colombian José Asunción Silva (1865–96), whose metrical experimentation and romantic reminiscences left a small but influential body of poems that were widely imitated and even parodied; the morbid Julián del Casal (1863–93), probably the first full-fledged modernist, and his compatriot José Martí (1853–95), martyr and symbol of Cuba's struggle for freedom from Spain, whose inspired prose style and deceptively simple, sincere verse set his work above and apart from all schools and movements. Martí's life and writings have a special meaning for all Americans for all time.

But these modernists all died too young to witness the full-flowering of the movement under the leadership of Rubén Darío (*q.v.*; 1867–1916) of Nicaragua, whose collection of verse and prose, *Azul*, published in Chile in 1888, is the cornerstone of Ibero-American modernism. Darío's next significant work, *Prosas profanas* (1896), represents the high point of the escapist, cosmopolitan, "precious" phase of the movement. When Spain's empire crumbled completely in 1898 and mutual understanding and sympathy swept away much of the centuries-old distrust and antipathy between the mother country and her former colonies,

Darío abandoned the ivory tower to sing new songs of life and hope for Spanish-speaking peoples everywhere. His *Cantos de vida y esperanza* (1905) are the fruit of a process of blending the best of modernist form with the more enduring and more universal themes of Hispanic lands. Darío's influence was far-reaching, his imitators legion. The imitators, particularly those who exploited his early experimental escapist phase, were responsible for the emergence of a cult that bore his name, *rubendarismo*, a phenomenon that had its classic counterpart in the cult to which Góngora had given unwitting birth. But many of Darío's contemporaries stood out as individual artists of exceptional merit. The titles alone of their best-known and most appreciated individual pieces or collections often suggest the content and tone of their major contributions to the movement. This is especially so in the case of Mexico's Amado Nervo (1870–1919), whose mystic serenity is reflected in *Serenidad* (1914) and *Elevación* (1916); of Peru's José Santos Chocano (1875–1934), whose exalted Americanism gave birth to *Alma América* (1906); of Bolivia's Ricardo Jaimes Freyre (1872–1933), who drew upon Scandinavian mythology for the exotic measures and themes of his *Castalia bárbara* (1899); of Colombia's Guillermo Valencia (1873–1943), whose classic bent is manifest in *Ritos* (1898); and of Uruguay's philosopher and essayist José Enrique Rodó (1872–1917), whose overly polished appeal in *Ariel* (1900) for the cultural integrity of Hispanic lands but lately humiliated by the northern colossus, the United States, distinguished him as the leading critic and exponent of modernist ideals.

Long after Darío's death several of his contemporaries continued to contribute to the evolving trends of postmodernist years, including Leopoldo Lugones (1874–1938) of Argentina, whose philosophy and aesthetics kept pace with the vanguard of thought and expression to maintain him in a position of national leadership from early modernist days to the later phases of an arbitrarily pronounced nationalism; Enrique González Martínez (1871–1952), whose call to wring the neck of the modernist swan signaled his emergence as a serious and sensitive pacesetter of later poetic trends in his native Mexico; and finally, the poet's poet, Julio Herrera y Reissig (1875–1910) of Uruguay, the outstanding symbolist of modernism, whose daring imagery paved the way for the neo-Góngorist cult of the 1920s. But such poets as Lugones and González Martínez, who adjusted or gave direction to the trends away from modernism after 1910, were the exception. The vast majority of Spanish-American modernists, and their younger satellites, continued to be spellbound by the verbal magic and brilliance of the Darío of *Prosas profanas*.

In Brazil the reaction against romantic verse set in somewhat earlier than in the rest of Ibero-America, but it never produced the richly variegated mosaic of Spanish-American modernism. The Brazilian Parnassians owed as much to their Portuguese colleagues as they did to the French masters. They remained, then, essentially Brazilian, and though the more formal aspects of their poetry were challenged by a number of poets attracted to French symbolism, a symbolist movement as such never materialized in Brazil. Parnassianism as epitomized in the poetry of Raimundo Corréia (1860–1911), Alberto de Oliveira (1857–1937) and Olavo Bilac (1865–1918) reached its high point in the mid-1880s, and continued to dominate the stage, virtually supreme and relatively unchanged, until the "stirring 1920s" of Brazilian modernism. But the ivory tower of the escapists and the formalists was soon to topple under the pressure of world-shaking events already in the offing as the period drew to a close.

THE MATURE YEARS (1910–)

Vanguard Literature (1918–30).—The Mexican revolution of 1910, World Wars I and II and the Spanish civil war served to confirm the conviction of thinking men everywhere in Ibero-America that drifting and dreaming on the roseate waters of the modernist swan would not help them to meet the multiple challenges arising out of local and international conflicts that shook their tottering social, political and economic structure to its very foundations. The horror and bloodshed of the Mexican revolution shocked a complacent intellectual minority into a realization of the sad plight of their country's submerged masses. The Indian and the mestizo everywhere found able champions of their cause. Ardent youthful liberals broke away sharply from modernist tenets and from the wordy descriptions of local scenes and types, largely imitative of European realist and naturalist techniques, to create a body of writing that in theme, form, spirit and even language was unequivocal testimony to the fact that Ibero-American literature had at last come of age. The Spanish civil war and World Wars I and II gave continental and international perspective to America's attempt to define her lot, place and mission among the nations of the world. World-wide depression and dollar diplomacy encouraged the emergence of radical economic philosophies that seemed to offer hope of deliverance from the bondage of imperialism. From this ferment of self-discovery and self-assertion, Ibero-America produced a literary portrait that in composition, colour and complexity was a remarkable tribute to the land and to the men whose dramatic story was told therein.

Shortly after 1900 the modernist leaders (Darío, Nervo, Lugones) turned away from the more formal and exotic aspects of the movement to initiate a return to traditional forms and to sincerity and simplicity of expression. Their follows, however, never wholly rejected the blessings of modernist experimentation —enriched versification and language and the revelation of countless new thematic sources. Of these postmodernists one group stands out sharply, an extraordinary band of women whose lyrics were more widely read and enjoyed than that of the majority of male poets in the first half of the 20th century. Love in all of its impassioned and transcendental manifestations, maternal longing and social protest are the themes of Delmira Agustini (1886–1914), Alfonsina Storni (1892–1938), Juana de Ibarbourou (1895–) and Gabriela Mistral (1889–1957). Their contribution was recognized in the honour accorded Gabriela Mistral, winner of the Nobel prize in literature for 1945.

Stemming directly from the modernist tradition and representative of a number of more pronounced trends are the unpretentious lyrics of Enrique Banchs (1888–); the deceptively experimental verse of the deeply subjective Mexican Ramón López Velarde (1888–1921); the wholesomely mystical expression of the Guatemalan Rafael Arévalo Martínez (1884–); the brilliant sonnet sequence of the tropical scene in *Tierra de promisión* (1921) by the Colombian José Eustasio Rivera (1889–1928); and the intensely racial rhythms of Cuba's "nativist" mulatto poet Nicolás Guillén (1904–).

While the postmodernists signaled a return to a poetic expression less markedly divorced from traditional forms and themes, other groups, caught up by the nihilistic waves of post-World War I "isms," sought to wrench poetry loose from its age-old moorings. Free verse and daring imagery that more often than not defied objective analysis and gave the mistaken impression of a coldly intellectual mood were the salient features of Ibero-American vanguard experimentation. Not a few *ultraístas*, as members of these vanguard coteries were collectively labeled, wrote with sociopolitical overtones.

Under the banners of *creacionismo*, Vicente Huidobro (1893–1948) of Chile launched one of these ephemeral movements in Spain in 1918. His continued denial of the entire poetic past was offset somewhat by the classical leanings and love of the national past that rendered the novel imagery of Argentina's Jorge Luis Borges (1900–) less vulnerable to the charges of obscurity usually leveled at all vanguard groups, including those who joined the *ultraísta* movement launched by Borges in Buenos Aires in 1921. César Vallejo (1895–1938) of Peru best represents the shift from modernism to the later Marxist emphasis of the *ultraístas* of the 1930s. It was, however, upon the intensely subjective Pablo Neruda (1904–) of Chile that the mantle of Ibero-America's most gifted living poet fell. His influence upon his contemporaries bids fair to equal that of Darío and of Góngora in their time.

Upon the auspicious occasion of the *Semana de Arte Moderna* (Modern Art week) held in São Paulo in 1922, the vanguard revolt in Brazil, usually referred to as modernism, careened off to a noisy destructive break with academicism and colonial cul-

tural bondage until the world depression of 1929 and the new political order (1930) under Getúlio Vargas (1883–1954) sobered its aggressive flaunting of all convention. Although incited by European iconoclasts, the Brazilian modernists were primarily bent on bringing national thought and life abreast of modern times. It was a high-pitched, often theatrical, self-searching period of aesthetic re-evaluation and of analysis of the immediate Brazilian present. However, as in the case of the Spanish vanguard movements, there was little of enduring value that came of it. But it did serve as a sorely needed purge and produced a number of men whose names became fixed in Brazilian literary history, such as the movement's high priest, the gifted and many-faceted poet and musicologist Mário de Andrade (1893–1945); his lieutenant, the genial and unpredictable Oswaldo de Andrade (1890–1954); the perceptive critic and Whitmanesque bard Ronald de Carvalho (1893–1935); and the nation's greatest living poet Manuel Bandeira (1886–). Certain modernist techniques, a highly sensitive preoccupation with social and metaphysical problems, but above all an imperative urge for untrammeled self-expression characterize the poetry of such outstanding modernist contemporaries or followers as Jorge de Lima (1893–1953), Cecília Meirelles (1901–) and Augusto Frederico Schmidt (1906–).

Literature of Social Protest (1930–).—The Spanish-American modernists, and later the Brazilian modernists as well, made their best contribution in verse and in poetic prose pieces. Contrary to its exceptional development in Brazil, the Spanish-American novel had been left largely to the unwieldy pens of uninspired realists, among them some who aspired to apprenticeship under Émile Zola and his naturalist followers. Federico Gamboa (1864–1939) of Mexico and Baldomero Lillo (1867–1923) of Chile gave both strength and a measure of artistic balance to the vehement protests of their fiction of social reform. The later novelists, essayists and short-story writers who took up the battle shortly after the turn of the 20th century developed new and more effective techniques from the modernists and from such more revolutionary stylists of other lands as Joyce, Proust, Romains, Steinbeck and Kafka. As this literature of protest moved forward from 1910 to mid-century it gained in profundity, strength, clarity and form as it continued to probe into the causes that make for injustice and inequality.

Martí and González Prada had advanced the essay to a prominent place in the realm of ideas and effective expression. And both came to be hailed as the intellectual and literary progenitors of succeeding generations of men acutely aware of their responsibilities as leaders in the move to interpret and to guide America in a rapidly changing world. Rufino Blanco Fombona (1874–1944) of Venezuela, more widely known for his prose fiction in which he assailed his country's tyrants with more passion than poise as in *El hombre de hierro* (1907) and *El hombre de oro* (1916), became the ardent spokesman for dynamic pan-Hispanism. He was also among the first to attack "Yankee imperialism," a role in which he was abetted by the militant Argentine, Manuel Ugarte (1878–1955) whose *El porvenir de América latina* (1911) and *El destino de un continente* (1923), together with *Les démocraties latines de l'Amérique* (1912) and *La creación de un continente* (1913) by the Peruvian Francisco García Calderón (1883–1953), envisioned Ibero-America as the future guardian of the Latin tradition. Ricardo Rojas (1882–1957), outstanding literary critic and historian of Argentine letters, and José Vasconcelos (1882–1959), controversial philosopher and educator of Mexico, were more concerned with racial and cultural aspects of national development within the American family of nations. Under the classic touch of Alfonso Reyes (1889–1959), poet, scholar and literary critic of Mexico, the essay became a vital intimate force, engaging in form and universal in appeal. One of America's most representative humanists, Reyes is generally recognized as the dean of a younger generation of writers—Jorge Luis Borges (1900–) of Argentina, Germán Arciniegas (1900–) of Colombia, Mariano Picón-Salas (1901–) of Venezuela—for whom the essay gives every promise of a rich fulfillment.

It was in both the short story and the novel, however, that the panoramic grandeur of the American scene and the human conflict in all of its dramatic interest were best to be described and interpreted.

The disheartening years that followed the abolition of slavery in Brazil in 1888 and the establishment of a republic in 1889 posed a number of agonizing questions to which serious-minded Brazilians at the turn of the century sought answers through an analysis of their troubled homeland as the raw product of an extraordinary amalgam of man, land and climate. It remained for an army engineer and journalist, Euclides da Cunha (1866–1909), to lay bare the very bedrock of Brazilian life, to create in the unclassifiable epic, *Os sertões* (1902), a work that has been called the "bible of Brazilian nationality." The author and his work became a cult. It was the first written protest in behalf of Brazil's forgotten man—the cornerstone of all later efforts, no matter what the form—to probe the nation's weaknesses and strength. Da Cunha focused *Os sertões* on the emerging Brazilian of the backlands. In a novel of ideas, *Canaan*, also appearing in 1902, José Pereira da Graça Aranha (1868–1931) focused on the problem of the effects of recent European immigration upon this evolving Brazilian type. Somewhat later, in 1918, the publication of a remarkable collection of short stories, *Urupês*, by José Bento Monteiro Lobato (1883–1948), made it apparent that talented intellectuals were continuing to probe for native types and traits in a search that gave direction and impetus to the modernist outburst of the 1920s and birth to a new cultural regionalism that achieved full flowering after 1930 in the fiction of Brazil's northeastern backlands. The region produced a remarkably gifted and dedicated group of prose writers. A number of them, such as Gilberto Freyre (1900–), whose *Casa grande e senzala* (1933) is fundamental to an understanding of the region, distinguished themselves as sociologists. Two of the more prominent novelists of this "Northeastern school" are José Lins do Rêgo (1901–57), who in a highly personal evocative style depicted the clash of the old and new way of life in his classic "sugar cane" cycle (1932–34) and in such other novels as *Pedra Bonita* (1938) and the symbolic *Fogo morto* (1943), and Jorge Amado (1912–), whose convincing manipulation of mass minds and movements gave Brazil some of America's best "proletarian" literature in such novels as *Cacau* (1933), *Jubiabá* (1935) and *Terras do sem fim* (1943). *Angústia* (1936) by Graciliano Ramos (1892–1953) attests to the fact that the individual inner struggle has also been adroitly plumbed by these new "regionalists." Constantly experimenting in technique and ever abreast of themes that reveal deep preoccupation with the individual in time and in a changing social structure, Erico Veríssimo (1905–) ranks high as one of Ibero-America's few cosmopolitan writers of distinction. Much of his work is available in English and in other languages: *Caminhos cruzados* (1935), Eng. trans., *Crossroads* (1943); *Olhai os lírios do campo* (1938), Eng. trans., *Consider the Lilies of the Field* (1947); *O resto é silêncio* (1943), Eng. trans., *The Rest Is Silence* (1946); and *O tempo e o vento* (1950), Eng. trans., *Time and the Wind* (1951).

Mexico's bitter bloody rebellion of the masses gave birth to memoirs, chronicles, sketches, short stories and novels—kaleidoscopic, journalistic, staccato-pitched—of which the earliest and the most widely acclaimed was *Los de abajo*, a novel conceived in 1915 over the campfire and on forced marches by Mariano Azuela (1873–1952), an army doctor of one of Villa's bands. Azuela alone chronicled almost every aspect of the revolution from its preliminary rumblings to its later social implications. From the late 1920s on, Martín Luis Guzmán (1887–) in *El águila y la serpiente* (1928), Gregorio López y Fuentes (1895–) in *El indio* (1935) and José Rubén Romero (1890–1952) in *La vida inútil de Pito Pérez* (1938) took up the challenge to give breadth and scope to Azuela's treatment.

The Mexican revolution focused attention on the sad plight of the Indian. This 20th-century Indian was not the uncompromising hero of the epic *La Araucana*, nor yet the symbol of colonial revolt against tyrannical Spain, and much less the "noble savage" of America's untamed romantic wilderness. More discerning minds

came to realize that he was the victim of centuries-old political and economic forces that kept the masses in abject bondage to colonial institutions that would not disappear with political panaceas alone. This new *Indianista* literature, in which the Indian is presented as a pressing social problem, had already found favour in fiction in the novel *Aves sin nido* (1889) by the Peruvian Clorinda Matto de Turner (1854–1909). And the Indian's cause had been advanced by González Prada, the spiritual precursor of the militant pro-Indian, social-reform party Apra (Alianza Popular Revolucionaria Americana) that from its founding in 1923 became a vital political and intellectual force in Andean America. Out of the early sociological novels, *Pueblo enfermo* (1909) and *Raza de bronce* (1919), by the Bolivian Alcides Argüedas (1879–1946) came the sombre short stories *Cuentos andinos* (1920) by Enrique López Albújar (1872–) of Peru; the prize-winning novel of Indian life in the Peruvian highlands, *El mundo es ancho y ajeno* (1941) by Ciro Alegría (1909–); and the brutally realistic pages of an entire school of Ecuadorean writers whose internationally heralded spokesman, Jorge Icaza (1902–), skirted dangerously close to aesthetic suicide in his mass-minded, vernacular-ridden novels, *Huasipungo* (1934) and *En las calles* (1935 national award).

The long struggle between man and nature became more critical as more powerful economic forces brought the primitive way of life into sharper conflict with the demands of modern civilization. The clash between the forces of "barbarism" and "civilization," the pampa and the city, described by Sarmiento in his classic account, *Facundo*, had by no means receded into history with the passing of 19th-century *caudillos* (local chiefs). Subtler and less tangible international forces changed the colour and pace of the aging colonial system. Land and nature's gifts were more zealously sought after and fought over than ever before: cattle on the pampas and the llanos, tin and copper and nitrates in the mountain fastnesses and desert wastes, oil in areas long neglected by modern man, rubber and bananas in the "green hell" of the tropics. Nature resisted man's inroads into its romantically conceived domain. And the struggle between the two became more violent as man fought against man, selfishly, to possess nature alone. These same forces were at work too in the growing urban centres where modern industrial economy exerted an even more insidious control over the destiny of the masses and where the traditional way of life and man's attitude toward man and toward himself were subjected to ever increasing pressures of all kinds.

The clash between the old and the new on the pampas of Argentina and Uruguay created a rich literature that runs the gamut from the sombre descriptive pages of Uruguay's early outstanding short-story writer Javier de Viana (1872–1926) and the keen psychological portrayal of rural types in *El terruño* (1916) by Carlos Reyles (1868–1938), also of Uruguay, to the simple humorous narrative of gaucho life so engagingly depicted in *El inglés de los güesos* (1924) by Argentina's Benito Lynch (1885–1951) and the image-studded, evocative prose epic of the gaucho, *Don Segundo Sombra* (1926), by the Argentine Ricardo Güiraldes (1886–1927), a classic and perfect example of the application of modern technique to the treatment of a regional theme. In *Doña Bárbara* (1929) Rómulo Gallegos (1884–), one of Ibero-America's masters of plot technique, gave a dramatic and poetic depiction of similar forces at work on the Venezuelan llanos.

For the tropics appeared two artists who spoke for a growing number of younger writers who had discovered the *selva*, or jungle, where cotton and bananas and oil outdistanced rubber in pitting man against nature and man ever more sharply against man: Horacio Quiroga (1878–1937) of Uruguay, consummate short-story artist and worthy disciple of Poe and Kipling, who excelled in his dramatic descriptions of the Chaco and the jungle of Misiones, Arg.; and the Colombian poet, José Eustasio Rivera (1889–1928), whose sole prose work, *La vorágine* (1924)—probably the best novel on the American tropics yet written—is a powerful denunciation of the type of exploitation that marred the lives of the rubber gatherers in the upper Amazon during the boom days of the early 1900s.

Man's conflict with man in urban society has been the subject of a growing body of novels since the turn of the century when Gamboa exposed the social ills of his time. His popular *Santa* (1903), a melodramatic picture of prostitution in his homeland, is the Mexican counterpart of Zola's *Nana*. In *Nacha Regules* (1919) Manuel Gálvez (1882–), distinguished Argentine novelist of a varied and rich production, did for metropolitan Buenos Aires what Gamboa had done for Mexico City. And in *La maestra normal* (1914) Gálvez has captured forever the universal pettiness and monotony of life in the smaller provincial centres before the quickening pace of modern mechanized manners shattered the old colonial ways. Urban Santiago and Chile's underprivileged everywhere have two powerful champions in the novelist Joaquín Edwards Bello (1888–) and in Manuel Rojas (1896–), one of Ibero-America's truly gifted short-story writers. Man's struggle with the deeper forces within and beyond himself has found commendable expression in the psychological novels of the Chilean Eduardo Barrios (1884–) and in the existentialist approach of the Argentine Eduardo Mallea (1903–).

In their soul-searching for a key to individual and collective existence in the Americas, writers have continued to turn to a record of the past as well. *La gloria de Don Ramiro* (1908) by the accomplished stylist Enrique Rodríguez Larreta (1875–1961) of Argentina is generally considered the best historical novel yet written in the Spanish language.

Ever since colonial times the Ibero-American theatre has shown a decided preference for peninsular productions and for plays borrowed from other tongues. Only one native dramatist, Florencio Sánchez (1875–1910) of Uruguay, succeeded in obtaining minor prominence on the international stage, and his relative success was due largely to the *criollo* (creole) content of his plays rather than to anything indicative of an emerging new world dramatic technique. The favourable reception the outside world accorded *Deus lhe pague* (1932) by Brazil's Joracy Camargo (1898–) only served to accentuate the fact that in spite of a rapidly swelling native repertoire and of the heartening and continued efforts of experimental groups everywhere, Ibero-America had not yet produced a dramatist who could claim the universal recognition bestowed on a growing number of her distinguished sons in the fields of poetry and prose fiction.

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(J. E. EK.)

IBERT, JACQUES FRANÇOIS ANTOINE (1890–1962), French composer known for his skilled orchestration, was born on Aug. 15, 1890, in Paris. He was a pupil of Gabriel Fauré and Paul Vidal at the Conservatoire, and won the Prix de Rome in 1919. Among his best-known orchestral works are *Escales*, *La Ballade de la geôle de Reading*, based on Oscar Wilde's poem, the flute concerto, the concerto for cello and wind instruments and the suite *Paris*. "Le Petit âne blanc" from the suite *Histoires* became his most popular piano work. Ibert was director of the French Academy in Rome, 1937–61. He died in Paris on Feb. 5, 1962.

See J. Feschotte, *Jacques Ibert* (1958).

IBERVILLE, PIERRE LE MOYNE, SIEUR D' (1661–1706), French-Canadian soldier and founder of the first permanent colony in the French territory of Louisiana, was born in Montreal on July 16, 1661. He was one of 11 sons of Charles le Moyne, all of whom performed distinguished service in the extension of the French empire in America. The eldest son, Charles le Moyne,

baron de Longueuil, later became governor of Canada. A younger son, Jean Baptiste, sieur de Bienville, became Iberville's lieutenant in founding the Louisiana colony and later first governor of that province. At the age of 14 Iberville was appointed midshipman in the French navy and sent to France. After four years' service on French ships he returned to Canada. In 1686 he led a detachment on the overland expedition under De Troyes against the English forts on Hudson bay. This was the first of a series of successful forays by Iberville against the English during the next ten years.

When the treaty of Rijswijk (1697) temporarily halted the Anglo-French dispute over Hudson bay, Iberville was called to France and commissioned by the marine minister, Pontchartrain, to found a settlement at the mouth of the Mississippi river. He left Brest in Oct. 1698 with four vessels and 200 colonists and reached Mobile bay in Jan. 1699. There the colonists were left while Iberville and a number of men searched the coast for the Mississippi, which they entered at the delta and ascended probably to the mouth of the Red river. No favourable site for a colony was found along the river, and, it being late, Iberville built Ft. Maurepas on the present site of Biloxi, Miss., and there left his colonists. This was the first permanent French settlement on the Gulf coast.

Returning the next year Iberville built a post on the Mississippi river near New Orleans and explored much of the lower valleys of the Red and Mississippi rivers. Returning a third time in 1701, he found his colony badly reduced by disease and transferred most of the colonists to the Mobile river. He returned for additional colonists, but France was again at war, and Iberville was retained for naval service. He was given command of the West Indian fleet, and in 1706 invaded the islands of Nevis and St. Kitts, forcing them to surrender and capturing 30 ships and 1,750 men. While outfitting at Havana, Cuba, for an expedition against the Carolinas, Iberville fell ill with fever and died July 9, 1706.

See N. M. Crouse, *Le Moyne d'Iberville* (1954).

IBEX, the name given to several species of wild goat of the genus *Capra*. The Alpine wild goat (*Capra ibex*) is a typical representative. Formerly common throughout the higher ranges of the Alps, it is now greatly reduced in numbers, being protected locally in the Italian Alps. It measures about 4½ ft. in length and stands about 36 in. at the shoulder. In summer the short fur is ashy gray, but in winter this is concealed by long, yellowish-brown hairs. The horns are long, curved backward and ridged on the front surface. The forelegs are somewhat shorter than the hind limbs. The agility of the ibex on its native mountains is astounding. It inhabits the line of perpetual snow, descending at night to graze in the highest woods. The ibex is gregarious, living in small herds, but the old males are usually solitary. The female, after a period of gestation of about 90 days, produces a single young that is at once able to follow her. The flesh resembles mutton, but with a flavour of game.

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ALPINE IBEX (CAPRA IBEX)

The name ibex has been extended to include allied species, of which the Siberian ibex (*C. sibirica*), ranging over central Asia, is the finest and may possess horns 60 in. long. Other species, differing in the thickness of and ridges on the horns, occur in Arabia, Ethiopia, the Caucasus, the Himalayas and the Pyrenees.

The Nilgiri ibex, from the hills of southern India, is *Hemitragus hylocrius*, more closely related to the Himalayan tahr (*q.v.*).

IBIBIO, a people with a common language and culture numbering about 1,500,000 in 1961 and inhabiting the Calabar province of the Eastern region of Nigeria. Their language has some tonal affinities with Ibo but has been classified as semi-Bantu. They fall into the following cultural and dialectal divisions: Northern, Southern, Delta, Efik (*q.v.*), Anang (Western) and Ibibio proper (Eastern)—the last two containing the bulk of the population. The Anang were originally known to Europeans as the Kwa-Ibo; the Ibibio proper and the Southern Ibibio as the Egboshary. All are rain forest cultivators of yams, taro and cassava and their main export products are palm oil and kernels. They live patrilocally in homesteads (compounds) which are grouped into village sections (*ekpuk*) which are also patrilineages and which federate into villages averaging 100–200 persons. These villages form part of larger territorial units (clans) which are united by traditions of descent from a single parent village or village group and by the possession of a common tutelary spirit (*idem*) and a common totem (*nkpo ibet*). Secret societies are very prominent in Ibibio village organization and some of the Anang masks used by the *ekpo* ("ghost") societies are among the finest in western Africa (*see* SECRET SOCIETIES, PRIMITIVE).

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IBIS, any one of several species of medium-large birds, related to the spoonbills but with a slender, down-curving, curlewlike bill, comprising the subfamily Threskiornithinae. With the spoonbills they form the family Threskiornithidae (or Plataleidae, in Britain) in the order Ciconiiformes. Ibis are found throughout the warm temperate and tropical regions except the South Pacific islands. They wade in shallow lagoons, lakes, bays and marshes, feeding on small fishes and soft mollusks. They fly with neck and legs extended, alternately flapping and sailing. Ibis often nest in vast colonies, building compact stick nests low in bushes or trees and laying three to five eggs, usually dull white mottled with brown. The oldest known and the emblem of Osiris' secretary, the sacred ibis (*Threskiornis aethiopica*) of Africa, is 25 in. long, white with black in its wings and has a bare black head and neck. The glossy ibis (*Plegadis falcinellus*), a rich chestnut colour, ranges the world; the white-faced ibis (*P. chihi*) occurs from Oregon to Argentina. The scarlet ibis (*Eudocimus ruber*) lives in tropical America; the white ibis (*E. albus*) ranges from Central America to South Carolina, but occasional individuals wander even as far north as Quebec. (G. F. Ss.; X.)

ALLAN D. CRUICKSHANK FROM NATIONAL AUDUBON SOCIETY

WHITE IBIS (EUDOCIMUS ALBUS) ON NEST

IBIZA (IVIZA or IVICA), an island in the western Mediterranean sea, belonging to Spain, and forming part of the archipelago known as the Balearic Islands. Pop. (1960) 34,502. Area 541 sq.km. (209 sq.mi.). Ibiza lies 80 km. (50 mi.) S.W. of Majorca and about 96 km. (60 mi.) from Cabo de la Nao on the Spanish coast. Its greatest length is about 40 km. (25 mi.) and its greatest breadth about 21 km. (13 mi.). The highest points are La Atalaya (1,558 ft.) and Puig Fornas (1,337 ft.). The island's hilly relief is truncated in the central northern coast to give a *costa brava* ("rugged coast") with cliffs exceeding 800 ft. in height and penetrated by *calas* (small coves). There are several irrigated lowlands (*huertas*) and the hillsides are intensively terraced. Agriculture is mainly of a subsistence nature, but almonds and dried figs and apricots are exported. Salt produced by the evaporation of sea water has been for centuries the main export (about 70,000 tons annually). Fish and charcoal surplus to local needs are also sent to the mainland. Most of the people live in farms and small villages scattered throughout the island. Ibiza city (11,259) being the only urban settlement. This fortified and walled city and port on the southeast coast was founded by the Carthaginians. It is the focus of all the main roads and the island's chief administrative, commercial and industrial centre. Nearby on the Puig des Molins is the Phoenician-Carthaginian necropolis of Ereso, containing about 3,000 tombs. San Antonio Abad on the north coast is an important tourist resort.

South of Ibiza lies the smaller island of Formentera (pop. [1960] 2,671; area 32 sq.mi.). Terrain and vegetation are more monot-

onous than in Ibiza. Cereals and vines are the principal products cultivated, but 20,000 tons of salt are exported annually.
(G. J. B.)

IBLIS, in Islamic religion the personal name of the devil. In the Koran he is mentioned by name 11 times as an angel who rebelled against God when man was created; his punishment was postponed until the Judgment Day, and meantime he is allowed to tempt men to evil (Koran vii. 2 ff.). He is the counterpart of the Jewish and Christian Satan; in Arabic this Hebrew word has become the generic term for devil (Shaitan). Iblis is identified with "*the* devil" (references to whom occur 68 times in the Koran), but "devils" in general are also freely mentioned.

See "Iblis" and "Shaitan" in *Shorter Encyclopaedia of Islam* (1953), with bibliography. (W. C. Sh.)

IBN 'ABD RABBIHI (Abu 'Umar Ahmad ibn Mohammed ibn 'Abd Rabbihi) (860–940), Arab poet, celebrated for his anthology of Arabic literature, *'Iqd al-Farid* ("The Precious Necklace"; edited by Ahmad Amin *et al.*, 1940), which resembles the *'Uyun al-Akhbar* of Ibn Qutaybah (*q.v.*), from which it borrows largely. He was born at Córdoba in Spain in 860, and won a great reputation for learning and eloquence. Selections of his own poems are included in the *Yatimat al-Dahr*, vol. i (1887).

IBN ABI-USAYBIAH (Muwaffaq-al-Din abu-al-'Abbas Ahmad ibn abi-Usaybi'ah) (1203–1270), Arab physician, was born at Damascus, the son of an oculist, and studied medicine at Damascus and Cairo. In 1236 he was appointed by Saladin physician to a new hospital in Cairo, but resigned in 1237 to serve the amir of Damascus in Salkhad. There he lived and died. His great work, *'Uyun al-Anba* ("Lives of the Physicians"), contains biographies of over 400 physicians and scientists and is probably the most important source for the history of Islamic medicine.

IBN AL-ATHIR (Ibn Athir), the family name of three brothers, all famous in Arabic literature, who were born at Jazirat ibn Omar in Kurdistan.

The eldest, Majd-al-Din ibn al-Athir (1149–1210), made a special study of the Koran, the tradition and Arabic grammar. His *Kitab al-Nihaya* ("Book of the Utmost Effort," pub. 1904) is a dictionary explaining obscure terms in the traditions. He also wrote a dictionary of family names *Kitab al-Murassa* (ed. by C. F. Seybold, 1896). Having long been in the service of the amir of Mosul he died at Mosul in 1210.

Abu al-Hasan 'Izz-al-Din ibn al-Athir (1160–1234), the most distinguished of the brothers, was a historian whose chief work is *al-Kamil fi-al Ta'rikh* ("The Complete in History"; ed. by C. J. Tornberg, *Ibn al-Athiri Chronicon*, 14 vol., 1851–76). It extends to 1231, the first part, up to 923, being an abbreviation of the work of al-Tabari (*q.v.*) with additions. He also wrote a history of the atabegs of Mosul (pub. by the Académie des Inscriptions in *Recueil des historiens des croisades*, vol. ii, 1906); an account of 7,500 companions of Mohammed, *Usud al-Ghaba* ("The Lions of the Forest"; pub. in 5 vol., 1869–71); and a compendium of Sam'ani's *Kitab-al-Ansab* ("Book of Genealogies") entitled *al-Lubab* (pub. 1938–49; *cf.* F. Wüstenfeld, *Specimen el-Lobabi*, 1835). He died at Mosul in 1234, having also been in the service of the amir.

The youngest brother Diya-al-Din ibn al-Athir (1163–1239) was outstanding as a literary critic and was author of a book on rhetoric, *Kitab al-Mathal* ("The Book of Example," pub. 1939; *cf.* I. Goldhizer, *Abhandlungen zur arabischen philologie*, vol. i, 1896). He entered the service of Saladin and later became vizier to his son al-Malik al-Afdal. He died at Baghdad in 1239.

IBN AL-FARADI (Abu-al-Walid 'Abdullah ibn al-Faradi) (962–1013), Arab historian, best known for his history of Andalusian scholars, *Ta'rikh Ulama' al-Andalus* (edited by F. Codera, 1891). He was born at Córdoba, Spain, Dec. 22, 962, and studied law and the prophetic tradition. In 992 he made the pilgrimage to Mecca and thereafter lived in Egypt and Tunis. After his return to Spain (1009) he became *qadi* (judge) in Valencia, and was killed in Córdoba, April 20, 1013, when the Berbers sacked the city. He also wrote a history of the poets of Andalusia.

IBN AL-FARID (Sharaf al-Din Abu Hafs 'Umar ibn al-Farid) (1182–1235), Arab poet and mystic, whose verse is accounted the finest expression of mystical aspiration in Arabic, was born at Cairo, Egy., son of a public notary. Intended for a legal career, he abandoned his studies for the religious life and wandered about the Muqattam hills overlooking Cairo. For some years he lived in Mecca, and it was there that he met the famous Baghdadi mystic Shihab al-Din al-Suhrawardi. He spent the last years of his life in Cairo, and is buried in a mausoleum in the Muqattam hills.

The *diwan* of his poems, collected after his death, consists mainly of formal odes cast in the form of a lover's yearning for reunion with his beloved, said to reside in Arabia; their esoteric meaning is the mystic's desire to be assimilated into the pre-eternal spirit of Mohammed, the first projection of the Godhead. This idea is developed at great length and with profound metaphysical subtlety in the famous *Ta'iya*, a veritable epic in 761 couplets all rhyming in *ati*. Numerous commentaries were written on this poem and on the *diwan* as a whole, the most valuable being those of al-Farghani (d. *c.* 1300), al-Kashani (d. 1334), al-Burini (d. 1615) and 'Abd al-Ghani al-Nabulusi (d. 1730). Several Arabic editions of the *diwan* have been printed; an edition in Roman transcription, based upon the oldest extant manuscript, was published in 1952 by A. J. Arberry, who also translated and annotated *The Mystical Poems* of Ibn al-Farid (1952). Ibn al-Farid's style is highly mannered and exhibits all the rhetorical embellishments of the *badi'* school of poetry (*see* Arabic Literature); nevertheless his poems contain many passages of striking beauty and deep religious emotion.

Bibliography.—C. Brockelmann, *Geschichte der arabischen Litteratur*, vol. i (1898) and suppl. i (1937); R. A. Nicholson, *Studies in Islamic Mysticism* (1921); Muhammad Mustafa Hilmi, *Ibn al-Farid wa'l-hubb al-ilahi* (1945). (A. J. Ay.)

IBN 'ARABI (Abu Bakr Mohammed ibn 'Ali Muhyi al-Din al-Hatimi al-Qai al-Andalusi ibn-'Arabi) (1165-1240), Muslim theologian and mystic, was born in Murcia, Spain, on July 28, 1165, and educated in Seville. He traveled in Egypt, Arabia, Baghdad, Mosul and Asia Minor, and then settled in Damascus, where he lived for the rest of his life. He died in Oct. 1240.

In law Ibn 'Arabi was a Zahirite, in theology a mystic of the extreme order, though professing orthodox Ash'arite theology and combating in many points the Indo-Persian mysticism (pantheism). He claims to have had conversations with all the prophets past and future, and reports conversations with God himself. Of his numerous works about 150 still exist. The most extensive is the 12-volume *al-Futuhat al-Makkiya* ("Meccan Revelations"; 1274, 1329), a general encyclopaedia of Sufistic beliefs and doctrines.

See C. Brockelmann, *Geschichte der arabischen Litteratur*, vol. i, pp. 441–448 (1898); R. A. Nicholson, *A Literary History of the Arabs*, pp. 399–404 (1907).

IBN BATUTAH (Mohammed ibn 'Abdullah ibn Batutah) (1304–1368), the greatest of Muslim travelers, whose journeys extended from the Niger basin to China from 1325 to 1355, was born at Tangier in 1304.

He set out from his native town in 1325 to make the pilgrimage to Mecca, traveling by caravan to Alexandria and Cairo. As the Red sea crossing from Aidhab to Jidda was blocked, he returned to Cairo, journeyed to Damascus and thence to Medina and Mecca. The lure of travel had already begun to beckon him, and before the next pilgrimage he toured southern Persia and Iraq. His next journey took him to Yemen, and from Aden down the east coast of Africa to Mombasa, Kilwa and Mogadishu (Mogadiscio), received everywhere by the local sultans as an honoured guest. He sailed back to Dhofar, and thence to Oman and Hormuz (on the new island site to which it had been transferred from the mainland about 1315) and back through the pearl fisheries and Qatif to Mecca for another pilgrimage.

His ambition was now set on going to India, of the generosity of whose sultan, Mohammed Tughluq, to newcomers fabulous tales were told. But no ship was available, and for some reason he recrossed the Red sea and made through Egypt and Syria to Asia Minor, then partitioned between numerous Turkish baronies. His eyewitness account of these, including the infant Ottoman state, is of outstanding value. Crossing the Black sea to the Genoese

port of Kaffa (his first experience of a Christian city, in which he was at first perturbed by the church bells), he traveled to the court of the Mongol khan of the Golden Horde, Mohammed Uzbeg, in the Caucasus. At this point he inserted two detours the veracity of which has been challenged: one to the city of Bulghar, on the middle Volga, the other to Constantinople in the company of a Greek princess married to the khan. The latter is a vivid narrative, especially the descriptions of interviews with the emperor Andronicus III and the former emperor Andronicus II, but is difficult to reconcile with his chronology. After returning to the khan's capital at New Sarai on the Volga, he crossed the steppes to Khwarizm and Bukhara, and made an extensive tour in Khurasan before crossing the Hindu Kush into Afghanistan, whence he reached the Indus in Sept. 1333.

Sojourn in the East.—The immensity, variety and wealth of India made an indelible impression on Ibn Batutah's mind. Everything aroused his curiosity, and about one quarter of his book is devoted to descriptions of its (to him) strange customs and institutions, the diversity and abundance of its products and the manners of its rulers and peoples. On arrival at Delhi, he was in due course presented to Sultan Mohammed and appointed to the sinecure of *qadi* (a judge in a Muslim court) of the Malikis. He has much to relate of the mixture of tyrannical cruelty and extravagant generosity in the sultan's character, and when he himself eventually fell under suspicion he feared for his life, with just cause. In the meantime he had made several journeys in the north, but mentions them only incidentally. In 1342 he was restored to favour and ordered to accompany an embassy to the Mongol emperor of China. The party traveled to Cambay and then by ship down the Malabar coast to the great port of Calicut (Kozhikode), where they were to embark in junks for China; but he was accidentally hindered from embarking, and the junks were wrecked. Left destitute, he spent many months on the Malabar coast, taking part in various adventures, including the capture of Sandabur (Goa), and finally sailed to the Maldive Islands, where he again became *qadi* and a personage of importance. A year later, probably in 1345, he left for Ceylon, where he climbed Adam's peak to visit the venerated "footprint of Adam."

After a short visit to the Coromandel coast and revisiting Malabar and the Maldives, Ibn Batutah sailed to Bengal, visited a Muslim saint in Sylhet and embarked near Dacca for Sumatra, whence he sailed to the trading port of Zayton in China. He visited also Canton and claims to have been in Kinsai (Hangchow) and Cambaluc (Peking).

His Return and Later Journeys.—On his way home Ibn Batutah saw the great bird *rukh* (evidently from his description, an island lifted by refraction), passed rapidly through Sumatra, Malabar, Dhofar, Oman and southern Persia to Baghdad, where he learned of his father's death 15 years before. He gives a gruesome account of the ravages of the Black Death of 1348 in Syria and Egypt, through which he traveled to Mecca for his last pilgrimage. Back in Cairo, he decided to return to Morocco, sailed to Tunisia and then by Catalan ship to Mostaganem, calling at Sardinia on the way, and reached Fès in Nov. 1349. Then, after a brief stay in Tangier, he crossed to Gibraltar to take part in the holy war against Castile, but only visited Granada and its dependencies and returned to Marrakech. In 1352 he set out from Tafilelt in southern Morocco on his last and probably most adventurous journey across the Sahara to the Muslim Negrolands in the Niger basin. Here again his narrative is the fullest (indeed, almost the only) firsthand account of the Mandingo kingdom of Malli and the Songhai capital at Gogo. On orders from the sultan of Morocco he returned from Gogo through the Tuareg country of Ahaggar mountains and Tuat to Tafilalt and Fès, so ending 75,000 mi. of travel. His narrative was dictated to a royal secretary, Ibn Juzayy, at Fès, and his remaining years were spent as a *qadi* in Morocco.

An English translation of later abridgments of his narrative was published by S. Lee in 1829 for the Oriental Translations fund. The complete text with French translation was issued by C. Defremery and B. Sanguinetti in 1853–59. Mahdi Husain has published an annotated translation of the travels in India and Ceylon (1953). The first volume of a complete translation by H. A. R. Gibb, published by the Hakluyt society, was issued in 1958.

See H. F. Janssens, *Ibn Batouta, "le voyageur de l'Islam,"* (1948).

(H. A. R. G.)

IBN DURAID (ABU-BAKR MOHAMMED IBN AL-HASAN IBN DURAYD) (837-934), Arab philologist, was the author of a large-scale dictionary, the *Jamhara fi 'l-lugha*. He was born at Basra of south Arabian stock, but fled to Oman in 871, during the revolt of the *Zanj* or Negroes. In 883 he went to Persia, and remained there until he settled in Baghdad in 920. In his dictionary (published in Hyderabad, India, 4 vol., 1926–30) the author retained the anagrammatical arrangement of Khalil (*q.v.*) though using the normal alphabetical order of the letters. The work is, however, marred by the addition of many chapters on rare word forms, which include a large number of words listed in no particular order. Another work, the *Kitab al-ishtiqaq* ("Book of Etymology," edited by F. Wüstenfeld, 1854), deals with the etymology of Arab tribal names.

See F. Krenkow, "The Beginnings of Arabic Lexicography, Till the Time of al-Jauhari, With Special Reference to the Work of Ibn Duraid," *Journal of the Royal Asiatic Society*, centenary supplement, p. 255 (1924); Carl Brockelmann, *Geschichte der arabischen Litteratur*, vol. i (1898), suppl. vol. i, p. 172 (1937). (J. A. Hd.)

IBN EZRA, ABRAHAM BEN MEÏR (ABENEZRA) (*c.* 1090–1164), Jewish Bible commentator, grammarian, philosopher, astronomer and poet, was born in Tudela, Spain, about 1090. In his youth he lived for some time in Muslim Spain, but there is no detailed information about this period of his life. It is known, however, that he was on friendly terms with the poet and philosopher Judah Halevi and that he traveled to north Africa and possibly to Egypt. In 1140 he was in Rome, in 1144 in Lucca and in 1145 in Mantua. In 1155 he went to southern France and later to northern France, from which he visited London in 1158; in 1160 he was in Narbonne and he died in 1164, probably in Spain. His books were written or at least finished in the second half of his life; most of the known dates in his life are derived from his habit of indicating the dates at which his various books were completed.

Ibn Ezra's fame is due chiefly to his biblical commentaries, in which he paid attention to the simple sense of the text and its grammatical explanation as well as finding in it indications to philosophical doctrines. For some books commentaries are extant in two versions, but some are lost. They are available in the great editions of the Hebrew Bible or in modern scholarly editions. In his grammatical treatises he popularized in Hebrew the work of the Hispano-Hebrew grammarians who had written in Arabic; he also translated into Hebrew some works by one of its main representatives, Judah Hayyuj. On philosophy he wrote only a few short treatises, but he often expounded his views (of Neoplatonic inspiration) in his biblical commentaries. His mathematical, astronomical and astrological works are in Hebrew and Latin; one of his Hebrew works was translated into Old French. His secular poetry is not voluminous, but he wrote many liturgical poems; in both he chose to use the strophic form of the *muwashshah* (*q.v.*).

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See also M. Steinschneider, "A. ibn Esra," *Gesammelte Schriften*, vol. i, pp. 407–88 (1925); I. Friedländer, "Essays on the Writings of A. Ibn Ezra," *Commentary of Ibn Ezra on Isaiah*, vol. iv (1877); W. Bacher, *A. Ibn Esra als Grammatiker* (1882); D. Rosin, "Die Religionsphilosophie A. ibn Esras," *Monatschrift für Geschichte und Wissenschaft des Judenthums*, 42nd and 43rd years (1898–99); L. Orchansky, *A. ben Esra als Philosoph* (1900); G. Sarton, *Introduction to the History of Science*, vol. ii, pp. 187–189 (1931).

(S. M. STN.)

IBN FALAQUERA (SHEMTOB BEN JOSEPH IBN FALAQUERA or PALQUERA) (*c.* 1225–*c.* 1295), Spanish-born Jewish philosopher and translator, propagated a reconciliation between Jewish orthodoxy and philosophy and defended Maimonides' *Guide of the Perplexed* against the attacks of the traditionalists. His numerous works include a *Dialogue Between a Philosopher and a Man of Piety;* an ethical treatise, *The Balm of Sorrow;* an introduction to

the study of the sciences entitled *Reshit Hokhmah* ("The Beginning of Wisdom"), which reproduces al-Farabi's *The Aims of the Philosophy of Plato and Aristotle* and was translated into Latin at the end of the 15th century; the *Sefer ha-Ma'alot* ("The Book of Degrees"), which advocates the Neoplatonic ideal of the contemplative life; a commentary on Maimonides' *Guide* under the title *Moreh ha-Moreh;* and an abstract of Ibn Gabirol's *Fons Vitae,* in Hebrew.

Bibliography.—L. Venetianer, *Das Buch der Grade* (1894); M. David, *Schemtob ibn Falaqueras Reschit Chokmah* (1902); R. Klibansky, *The Continuity of the Platonic Tradition,* p. 39 (1939); and *Alfarabius: De Platonis Philosophia,* ed. by F. Rosenthal and R. Walzer (1943), being vol. ii of *Plato Arabus.* (A. An.)

IBN GABIROL (Solomon ben Judah ibn Gabirol; in medieval Latin and Romance languages Avencebrol or Avicebron) (*c.* 1020–*c.* 1050 or 1070), Jewish poet and philosopher, was born at Málaga, Spain. His early years were spent at Saragossa, where he enjoyed the patronage of the statesman, scholar and poet Samuel ha-Nagid. At the age of 16 he began writing Hebrew poetry, using various Arabic metres and following both Spanish and Palestinian Hebrew tradition. Developing a style of his own, he wrote some of the finest pieces of medieval Hebrew poetry. They include the *'Anaq,* a poem on grammar, partially extant; about 400 lyric poems, religious and secular; and the *Azharot,* liturgical compositions for the festival of *Shebhu'ot.* His *Keter Malkhut* ("The Royal Crown"), a didactic poem on the nature of God, the universe and man's destiny, concluding with a confession of sin, has been adopted into the Jewish liturgy for the Day of Atonement.

Ibn Gabirol's chief philosophical work was written in Arabic and is preserved only in a Latin translation by Johannes Hispanus and Dominicus Gundisalvi entitled *Fons Vitae.* It exercised a considerable influence on the schoolmen but was less fortunate among Jewish medieval philosophers. It was not translated into Hebrew except for an abstract made by Ibn Falaquera (*q.v.*). The only traces left by it are found in Abraham ibn Daud's strictures upon its metaphysical doctrine and in quotations from it in Ibn Falaquera's *Moreh ha-Moreh* and Moses ibn Ezra's *'Arugat ha-Bosem.* Isaac Abrabanel (d. 1508) and his son Judah (Leone Ebreo) knew Ibn Gabirol as the author of the *Fons Vitae,* but so much had the work fallen into oblivion that the 17th-century Joseph Solomon Delmedigo shared the schoolmen's view that its author was an Arab. This view prevailed until S. Munk discovered a manuscript of Ibn Falaquera's Hebrew abstract in 1846 and proved that Avicebron, the author of the *Fons Vitae,* was identical with Ibn Gabirol.

Ibn Gabirol's metaphysical system is Neoplatonic but has features which according to Ibn Falaquera derive from pseudo-Empedoclean writings but would seem to be much nearer the (lost) pseudo-Aristotelian source on which Isaac Israeli and the longer (Arabic) version of the so-called *Theology of Aristotle* drew. It depicts the universe as a hierarchy of substances in the following order: universal (spiritual) matter emanates from the essence of God, and universal form from His will or word; then follow intellect (the Plotinian *nous*), soul and nature, which represent the three spiritual or simple substances, and finally the lower world of corporeal or composite substances. Ibn Gabirol assigns to the will of God a much more dynamic role (similar to that which Philo attributes to the *Logos*) than it possesses in the literary sources before him. Another novel feature of his system is the doctrine that all beings, spiritual and corporeal, are composed of matter and form. The attribution of matter to spiritual beings such as the angels became a point of conflict between Franciscans and Dominicans and was opposed, on the Jewish side, by Abraham ibn Daud.

Texts include: the *Fons Vitae* in Latin, edited by C. Bäumker (1895), on which the Hebrew translation by J. Bluvstein and A. Zifroni (1926) and the Spanish translation by F. de Castro y Fernández (1902) are based; Ibn Falaquera's abstract, *Liqqutim,* edited by S. Munk in his *Mélanges de philosophie juive et arabe* (1859); an ethical treatise, *Kitab Islah-al-Akhlaq,* edited by S. S. Wise (1902); a collection of moral maxims translated from Arabic into Hebrew by Judah ibn Tibbon under the title *Mibhar ha-Peninim* and edited with English translation by B. H. Ascher (1859); and the poems, edited by H. N. Bialik and J. H. Rawnitzki, 3 vol. (1924–29). *See* also the selected religious poems edited by I. Davidson and I. Zangwill in Hebrew and English (1923).

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IBN HANBAL (Ahmad ibn Mohammed ibn Hanbal) (780–855), Islamic theologian, the founder, involuntarily and after his death, of one of the four great schools of Islamic law (the Hanbalite), was born at Baghdad in Nov. 780 of parents from Merv but of Arab stock. He studied the Koran and its traditions in Baghdad and on a student journey through Mesopotamia, Arabia and Syria. After his return to Baghdad he studied under al-Shafi'i between A.D. 810 and 813, and became, for his life, a devoted Shafi'ite. But his position in both theology and law was more narrowly traditional than that of al-Shafi'i; he rejected all reasoning, whether orthodox or heretical in its conclusions, and stood for acceptance on tradition (*naql*) only from the Fathers. In consequence, when the caliph al-Ma'mun and, after him, al-Mu'tasim and al-Wathik tried to force upon the people the rationalistic Mu'tazilite doctrine that the Koran was created, Ibn Hanbal, the most prominent and popular theologian who stood for the old view, was imprisoned and scourged. Under al-Mutawakkil the Koran was finally decreed uncreated, and Ibn Hanbal, who had come through this trial better than any of the other theologians, enjoyed an immense popularity with the mass of the people as a saint, confessor and ascetic. He died at Baghdad on July 31, 855, and was buried there.

Ibn Hanbal's great work was the *Musnad,* an encyclopaedia of nearly 30,000 traditions compiled by his son Abdullah from his lectures, which is still widely read.

See also Islamic Law.

Bibliography.—On the *Musnad,* see I. Goldziher in *Zeitschrift der Deutschen Morgenländischen Gesellschaft,* vol. l, pp. 465–506. For his life and works generally, *see* W. M. Patton, *Ahmed ibn Hanbal and the Mihna* (1897); D. B. MacDonald, *Development of Muslim Theology, Jurisprudence and Constitutional Theory* (1903); H. A. R. Gibb and J. H. Kramers (eds.), *Shorter Encyclopaedia of Islam,* pp. 20–21 (1953).

IBN HAZM (Abu Mohammed 'Ali ibn Ahmad ibn Said ibn Hazm) (994–1064), Muslim theologian, was born in a suburb of Córdoba, Spain, on Nov. 7, 994. He studied history, law and theology and became a vizier as his father had been before him, but was deposed for heresy, and spent the rest of his life quietly in the country. Little is known of his later life. In legal matters Ibn Hazm belonged first to the Shafi'ite school, but came to adopt the views of the Zahirites, who admitted only the external sense of the Koran and tradition, disallowing the use of analogy and appeal to the authority of an imam, and objecting altogether to the use of individual opinion. Ibn Hazm extended the application of these principles from the study of law to that of dogmatic theology. His chief work is the *Kitab al-fasl fi al-milal wa al-ahwa wa al-nihal,* or "Book of Sects," in which he particularly attacked the Ash'arites.

IBN HISHAM (Abu Mohammed 'Abd-al-Malik ibn Ayyub al-Himyari) (d. 834), Arab grammarian, whose recension of *Kitab Sirat Rasul Allah* (edited by F. Wüstenfeld, 1858–1860; Eng. trans. by A. Guillaume, *The Life of Muhammad,* 1955), the chief source for the life of Mohammed, written by Ibn Ishaq (*q.v.*), is the only version extant. Ibn Hisham was born at Basra, studied in Kufa and later lived in Fostat (old Cairo), where he gained a name as a grammarian and student of language and history.

IBN ISHAQ (Mohammed ibn Ishaq) (d. *c.* 768), Arab historian, author of *Kitab Sirat Rasul Allah,* the most important source for the biography of the prophet Mohammed. He lived in Medina, where he interested himself to such an extent in the details of the Prophet's life that he was accused of skepticism. He con-

sequently left Medina in 733, and went to Alexandria, then to Kufa and Hira, and finally to Baghdad, where he wrote *Kitab Sirat Rasul Allah,* which is now lost in its original form and is known only in the recension of Ibn Hisham (*q.v.*). The work has been attacked by Arab writers (as in the *Fihrist* of Er-Nedim) as untrustworthy.

IBN JUBAYR (Abu al-Husayn Mohammed ibn Ahmad ibn Jubayr), Arabic travel writer (1145–1217). Born at Valencia, he studied in Granada and became secretary to the Almohad governor of that city. In the years 1183–85 he performed his first pilgrimage to Mecca and Medina, going by sea to Alexandria, thence up the Nile and across the Red sea, and returning home by way of Iraq, Syria and Sicily. The lively account he has left of this journey is one of the most precious sources of information about conditions in the Islamic world at that time.

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IBN KHALDUN ('Abd-al-Rahman ibn Khaldun) (1332–1406), Arab historian and sociologist, is celebrated as a pioneer in the philosophy of history. He was born on May 27, 1332, at Tunis, the descendant of a Seville family which claimed to have come originally from the Hadramaut. In 1352 he entered the service of the sultan of Fez, but in 1356, his integrity having been suspected, he was imprisoned for two years. Later he emigrated to Granada, but returned to Africa (1364) and entered the service of the sultan of Tlemcen. After various vicissitudes, including further imprisonment and a period of residence in a monastery, he obtained employment with the sultan of Tunis. Subsequently, while on a pilgrimage to Mecca, he was persuaded by the sultan of Cairo to remain in that city and was appointed grand *qadi* (1384). He was removed from and re-installed in this office no fewer than five times. In 1400 he was taken to Damascus with the Egyptian army which vainly attempted to oppose Timur and had several interviews with him. He died in Cairo on March 19, 1406.

His *Kitab al-'Ibar,* a universal history (pub. 1867), is prefaced by one volume, the *Muqaddimah* (ed. by E. Quatremère, 1858; crit. ed. by Ali Abdel Wahid Wafi, 1957; Eng. trans. by F. Rosenthal, 3 vol., 1958). This is followed by four volumes of general Islamic history, and two of the history of the Berbers (ed. by M'G. de Slane with French trans., *Histoire des Berbères . . .*, 3 vol., 2nd ed. 1925–1934). Included in the history is an autobiography (French trans. by M'G. de Slane in his *Prolégomènes historiques d'Ibn Khaldoun,* 1862–1865). The *Muqaddimah* is more important than the history itself. In it Ibn Khaldun, with great insight and originality, tries to explain the pattern of history. Taking a scientific view of the rise and decay of human societies he argues that such phenomena obey certain laws which can be discovered empirically. According to his analysis the basis of society is group-feeling and many of his conclusions have a remarkable relevance to modern problems.

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IBN KHALLIKAN (Shams-al-Din Ahmad ibn Mohammed ibn Khallikan) (1211–1282), Arab author of a famous biographical dictionary, was born in Arbela, Mesopotamia, on Sept. 23, 1211. After studying jurisprudence he went to Cairo, where he became deputy chief *qadi* ("judge"). In 1261 he became chief *qadi* of Damascus and, except for one interval (1271–78) when he taught jurisprudence in Cairo, he held this appointment until his death on Oct. 21, 1282. His *Wafayat al-a'yan* (first pub. by F. Wüstenfeld, 1835–43; incomplete edition by Ahmed Farid Rifa'i, 6 vol., 1936 *et seq.;* English translation with introduction by M'G. de Slane, 4 vol., 1842–71) is a brilliant alphabetical biographical dictionary, dealing with all types of men famous in Islamic history. Mohammed, his companions and their followers and the caliphs, were excluded, since adequate literature concerning them already existed. The work deftly sketches the characters of its subjects by interesting anecdotes.

See E. V. Lucas, *A Boswell of Baghdad* (1917). (J. A. Hd.)

IBN QUTAYBAH (Ibn Kutaiba; Arabic, Abu-Mohammed ibn Muslim ibn Qutaybah) (828–899); Arab writer of Khurasani stock, born in Kufa, Iraq, specialized in theology, philology and literature and spent his later years teaching these subjects in Baghdad. In philology, he is said to have drawn on both Basran and Kufan ideas (*see* Arabic Literature: *Technical and Scientific Literature: Philology*); but his grammatical writings have been lost. His *Adab al-Katib* ("Secretary's Guide," edited by M. Grünert, 1900) is a compendium of Arabic usage and vocabulary, classified under word patterns and subject-headings. He opposed the pro-Persian *shu'ubiya* movement, and wrote the *Kitab al-'Arab* to show the pre-eminence of the Arabs. His theological works have not been printed; but he was orthodox and old-fashioned. He disliked the subtleties of professional theologians and philosophers, and thought that the traditions (*hadith*) were the only authoritative source for Islamic jurisprudence. In his *Kitab al-shi'r wa' l-Shu'ara* ("Poetry and Poets") he laid down canons of criticism. The important introduction has been printed with French translation by M. Gaudefroy-Demombynes, *Ibn Qotaiba—Introduction au livre de la poésie et des poètes* (1947). His *'Uyun al-Akhbar* (edited by Carl Brockelmann, 1900–03) deals with such subjects as war, nobility, character, eloquence and friendship. Its chief value lies in its illustrations from history, poetry and proverb. The *Kitab al-Ma'arif* ("Book of Knowledge," edited by F. Wüstenfeld, 1850) deals with history.

See Ishaq Musa Huseini, *The Life and Works of Ibn Qutayba* (1950). (J. A. Hd.)

IBN RASHID (dynasty). The great Bedouin Shammar tribe of north-central Arabia was united under the leadership of the Rashid family in 1835, when the dynasty of the Rashidi amirs (governors) of Ha'il (Hayil) was established, in return for notable services rendered, by the grandfather of the subsequent founder of Saudi Arabia (*see* Ibn Saud). There were 12 amirs, beginning with Abdullah—all descended from Ali al-Rashid. Each one in turn was known as "Ibn Rashid." Their rule (1835–1921) was marked by family feuds, revolutions and assassinations. The first three amirs of Ha'il were vassals of their benefactors, the Wahhabi-Saudi rulers of Najd. But the fourth and greatest amir, Mohammed ibn Abdullah al-Rashid (1869–97), conquered the Saudis (then weakened by family feuds) and eventually drove them from their capital, Riyadh (1891). His realm included the Jawf-Sakaka oases and Wadi Sirhan, with their strategic caravan routes, as well as Jabal Shammar and the oasis-dotted Al Qasim. Amir Mohammed acknowledged Turkish suzerainty.

After 1897 the Rashidi dynasty declined, and Ibn Saud was able to reconquer Riyadh in 1902. The later Rashidis received Turkish aid against the Saudis before and during World War I. In the final stages of the Rashidi-Saudi duel, Nuri al-Sha'lan of the Ruwala Bedouin helped Ibn Saud by fighting the Rashidis in the Syrian desert.

Mohammed ibn Talal, last of the Rashidi amirs, surrendered in Nov. 1921. He ended his days in Riyadh (1954), having been a guest and having become the father-in-law of his conqueror Ibn Saud. His capitulation resulted in the assimilation of the Rashidis of Jabal Shammar into Saudi Arabia.

See H. St. J. B. Philby, *Arabia* (1930), *Sa'udi Arabia* (1955). (C. P. H.)

IBN SA'D (Abu Abdallah Mohammed ibn Sa'd Ibn Mani' al-Zuhri) (d. 845), Arab biographer, often called Katib al-Waqidi, "Secretary of Waqidi," after one of his instructors in the Prophetic tradition, was the author of *Kitab al-Tabaqat al-Kabir* ("The Great Book of the Classes," edited by E. Sachau *et al.,* 1904–21). This work in eight volumes contains the life stories of Mohammed, his companions and successors down to Ibn Sa'd's own day. He lived chiefly in Baghdad.

See O. Loth, *Das Classenbuch des Ibn Sa'd* (1869).

IBN SAUD ('Abd al-'Aziz ibn 'Abd al-Rahman ibn Faisal al Sa'ud (*c.* 1880–1953), founder, in 1932, of the kingdom of Saudi Arabia (*q.v.*), and imam (religious leader) of its people, was born in the Saudi capital of Riyadh in Najd. In the turbulent patriarchal society of Arabia, occasional tribal leaders have been men of sufficient stature not only to influence radically the destinies of the Arabian peninsula but also to play a part on the world scene. Such a man was the prophet Mohammed; and such a man was 'Abd al-'Aziz, known outside Arabia as King Ibn Saud.

In the mid-18th century the founder of the house of Saud, in alliance with the puritanical Muslim revivalist leader Mohammed ibn 'Abd al-Wahhab, had revolted against the sultan-caliph of the Ottoman empire. After pushing victorious campaigns to the gates of Baghdad and Damascus, and after capturing Mecca and Medina (in the Hejaz), the Saudi ruler was defeated by Egyptian armies acting on behalf of the Turkish sultan. In the early 19th century the defeated Saudis sank into relative obscurity; after 1834 the star of the Rashidi dynasty of Ha'il (Hayil) rose in northern Arabia (*see* Ibn Rashid); and in 1891 the father of Ibn Saud, 'Abd al-Rahman, fled before the Rashidi conquerors of Riyadh. A little earlier (1871) the Turks had effectively re-established control over the Persian gulf province of Al Hasa. 'Abd al-Rahman and his family briefly visited the sheikh of the Bahrain Islands, and eventually settled down as honoured guests in the British-protected principality of Kuwait. From this base at the beginning of the 20th century, the youthful Ibn Saud with 200 comrades-in-arms undertook the reconquest of his Saudi patrimony. In 1902 Ibn Saud and 15 warriors took Riyadh in a dramatic surprise attack. During the next decade, he proceeded to reconquer Najd and other provinces from the Rashidis.

Before he could become solidly established Ibn Saud had to solve three complex problems: the hostility of neighbouring Arab rulers; Ottoman opposition, supported by the Rashidis and Sharif Husain (appointed amir of Mecca, 1908); and the British policy of maintaining the *status quo* in the Persian gulf.

The first move of Ibn Saud, a devout Muslim, was to revive the ancient bond between his dynasty and the religious descendants of the 18th-century Wahhabis—followers of the fundamentalist Sunni sect founded primarily on Hanbalite teachings. He then created a militantly religious pantribal organization of *Ikhwan* ("Brethren"), with the twofold purpose of settling Bedouin as agriculturists in suitable oases and welding them into a nationally conscious community. The first *Ikhwan* colony (Artawiya, 1912) became the prototype of nearly 100 agricultural settlements. The Wahhabi *Ikhwan* formed élite contingents of over 50,000 men in the new Saudi army. The *Ikhwan* levies, in their first major operation, expelled the Turks from Al Hasa (1913) and gave Ibn Saud all the commercial advantages of direct access to the Persian gulf.

Ibn Saud's expansionist activities were checked by the outbreak of World War I because one of his bitter enemies, Sharif Husain, early joined the British against the Turks. However, by a treaty with Britain in Dec. 1915 he accepted protected status (on the Persian gulf model), agreed on the one hand to refrain from hostilities against Husain in the Hejaz or against any British-protected principality in the Persian gulf, and on the other committed himself to war against the pro-Turkish Ibn Rashid. From 1916 to 1924 Ibn Saud received arms and a monthly subsidy of £5,000 from the British government. During 1921–22 Ibn Saud conquered Ha'il and all the Rashidi territories and assumed the title of sultan of Najd and its dependencies. Thus, through possession of the strategic trade routes of Wadi Sirhan and the Jawf-Sakaka oases in the southern Syrian desert, Ibn Saud first came into direct contact with Britain's postwar mandates of Iraq and Trans-Jordan. Sporadic border raids by his headstrong, fanatical *Ikhwan* caused recurrent crises, even after the Anglo-Saudi boundary agreements of Bahra and Hadda (1925).

Meanwhile, Saudi relations with Sharif Husain (who became king of the Hejaz during the war and self-proclaimed caliph in 1924) had rapidly worsened. Ibn Saud determined upon military action. His invasion of the Hejaz, begun by an *Ikhwan* massacre of the townsmen of Ta'if (At Ta'if), culminated in a protracted siege of Jidda. King Husain abdicated, his son and successor Ali eventually surrendered and on Jan. 8, 1926, Ibn Saud was proclaimed king of the Hejaz in the Great Mosque of Mecca. A year later he became king of Najd, but not until Sept. 1932 did he unify his two kingdoms under the name of Saudi Arabia.

Immediately after becoming king of the Hejaz, Ibn Saud convened an Islamic congress at Mecca, to conciliate adverse sectarian opinion, and he there gave guarantees for the future welfare and honest treatment of Muslim pilgrims to the holy cities. Thereafter, effective public security was maintained throughout his domains, except when the king was forced to put down a serious *Ikhwan* rebellion (1929–30). Between 1926 and 1931 Ibn Saud was accorded diplomatic recognition by all the major European powers, including the U.S.S.R., and finally by the United States. In a new Anglo-Saudi treaty, signed at Jidda (May 1927), Ibn Saud recognized the special position of Great Britain in the Persian gulf principalities in return for British recognition of his "complete and absolute" independence. At the end of his life, however, Ibn Saud embarked upon a long drawn-out dispute with Britain over the possession of Buraimi, a strategic group of eight oasis villages in southeastern Arabia near the Persian gulf. In this dispute the British were technically acting on behalf of the sheikh of Abu Dhabi (Trucial Oman) and the sultan of Muscat and Oman.

Ibn Saud added one more province to his realm when he incorporated therein the northern half of the Red Sea principality of 'Asir (1930), over which he had recently established a protectorate. Repeated Yemeni aggressions thereafter, against 'Asir and against the desert frontier district of Najran, precipitated a seven-weeks' war between Yemen and Saudi Arabia (1934). Ibn Saud won a brilliant victory over the imam of Yemen, but he crowned his victory with a settlement that left the imam completely independent, despite the fact that Imam Yahya had been the aggressor in the war. This chivalrous peace inaugurated a new, good neighbour policy. After 30 years of warfare, Ibn Saud became unreservedly a man of peace. He opened his era of constructive statesmanship by *rapprochement* with Kuwait and Bahrain, Iraq and Trans-Jordan—the last two ruled by sons of his ancient enemy Husain of Mecca. The famous Saudi-Iraqi "treaty of Arab brotherhood and alliance" (1936) was later adhered to by Yemen. Ibn Saud mediated in the Palestine Arab "national strike" of 1936 (jointly with the rulers of Iraq, Trans-Jordan and Yemen). In 1936 the Saudi king also negotiated a treaty with Egypt, at the latter's invitation.

In 1933 Ibn Saud took the momentous step (upon the advice of Charles Crane) of granting a 60-year oil concession to a U.S. oil company (known as Aramco after Jan. 1944). This and a subsequent concession (1939) allocated 440,000 sq.mi. of territory for oil exploitation and filled the Saudi treasury with vast, steadily increasing royalties. During and after World War II, when Ibn Saud entered into close relations with the United States (he met Pres. Franklin D. Roosevelt in Egypt in 1945), a veritable social and economic revolution was inaugurated in Saudi Arabia. Before his death Ibn Saud had launched, with the help of foreign technicians, his first medical program and irrigation and flood-control projects; built new ports, roads, the Dammam-Riyadh railway (about 300 mi.) and an excellent quarantine station for the Mecca pilgrims; and initiated the first semisecular school program, a radio communications network and air force training. In 1945 Ibn Saud became a founding member of the Arab league and subsequently took Saudi Arabia into the United Nations. He died on Nov. 9, 1953, near Mecca. *See* also Arabia: *History;* Saudi Arabia.

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IBN TAIMIYA (1263–1328), Muslim theologian and jurist, was born in Harran (near modern Urfa, Turk.) on Jan. 22, 1263, and was active mainly in Damascus, where his father had taken refuge from the Mongols. Schooled in the Muslim sciences (koranic studies, tradition, law and theology), he succeeded his

father at the age of 19 as professor of Hanbalite law (*see* ISLAMIC LAW). He quickly became a controversial figure because of the freedom of his polemics. In 1299 his reply to a question about the attributes of God caused him to lose his post, and in 1306–07 he was imprisoned in Cairo on a charge of anthropomorphism. Released after a year and a half, he was subsequently imprisoned in Alexandria and finally in Damascus, both for political reasons and for his theological and legal opinions. During imprisonment he continued to write: a commentary on the Koran, pamphlets against his opponents and books dealing with the questions which had resulted in his condemnation. Finally he was deprived of his books and writing materials, fell ill, and died 20 days later, on Sept. 27, 1328.

Although he belonged to the Hanbalite school, Ibn Taimiya exercised considerable independence in his opinions. He accepted no authority other than that of the Koran and the tradition and practice of the Islamic community, and he fought against innovation, saint worship, Sufi practices and theology, and vows and pilgrimages to shrines. His principles and example greatly influenced the puritanical and revivalist Wahhabi movement which arose in central Arabia in the 18th century. (H. B. PA.)

IBN TIBBON, the name of a Jewish family of translators, emanating from Spain, that flourished during the 12th and 13th centuries in southern France. The most distinguished members of this family are discussed below, in chronological order.

JUDAH BEN SAUL IBN TIBBON (1120—after 1190) was born in Granada but was compelled, because of persecution by the Muslim Almohad dynasty, to leave his native city in 1150. He settled in Lunel, southern France, where he is mentioned in 1160 as practising medicine. His outstanding translations from the Arabic original into Hebrew are those of Saadia ben Joseph (*Sefer ha-Emunot weha-De'ot*), Solomon ibn Gabirol (*Tikkun Middot ha-Nefesh*), Bahya ibn Pakuda (*Torat Hobot ha-Lebabot*) and Judah Halevi (*Sefer ha-Kuzari*), as well as the grammar and half of the Hebrew dictionary of Jonah ibn Janach. He is also noted for the lengthy ethical will which he wrote for the guidance of his son Samuel and in which, among other subjects, he has a great deal to say about the art of translation.

SAMUEL BEN JUDAH IBN TIBBON (*c.* 1150–*c.* 1230) was born in Lunel. Like his father, whose extensive library he inherited, he was a medical practitioner. His chief claim to fame is his accurate and faithful rendering into Hebrew of Maimonides' *Guide of the Perplexed,* which made this magnum opus of the foremost Jewish thinker of the middle ages accessible to persons interested in Jewish thought who were not familiar with Arabic. To carry out his assignment he entered into personal correspondence with the author, who dissuaded him from visiting him in person. He also translated Maimonides' treatise on resurrection and his Mishnah commentary on *Pirke Aboth,* besides the works of several Arabic commentators on the writings of Galen and Aristotle. Samuel ibn Tibbon died at Marseilles.

MOSES BEN SAMUEL IBN TIBBON (fl. 1240–83), the son of the aforementioned, was born in Marseilles. From the range of his literary productivity it appears that he must have reached a great age. Besides original works, which included commentaries on the Pentateuch, the Song of Songs and haggadic passages of the Talmud and the Midrash, he translated Arabic works on philosophy, mathematics, astronomy and medicine. Following the tradition of his family he translated a number of the Arabic writings of Maimonides that had not as yet been rendered into Hebrew, notably portions of Maimonides' commentary on the Mishnah, his treatises on hygiene, poisons and logic, and his *Sefer ha-Mitzvot,* an enumeration of the 613 commandments of the Torah. Moses, too, was a physician by profession.

JACOB BEN MACHIR IBN TIBBON (*c.* 1236–*c.* 1304), a grandson of Samuel ben Judah, was born in Marseilles. He was highly regarded as a physician and astronomer, and his original astronomical works, translated into Latin, were quoted by Copernicus, Reinhold and Clavius. He translated into Hebrew a considerable number of Arabic scientific and philosophical works, including Euclid's *Elements* and Ptolemy's *Almagest.* Together with his relative JUDAH BEN MOSES IBN TIBBON, who was a rabbi in Montpellier and a translator of note in his own right, Jacob took an active part in the dispute between the followers and the opponents of Maimonides, taking the side of the former. He died at Montpellier.

See M. Waxman, *A History of Jewish Literature From the Close of the Bible to Our Own Days,* 3 vol. (1930–36); M. Steinschneider, *Jewish Literature From the Eighth to the Eighteenth Century* (1857). (S. RO.)

IBN TUFAIL (ABU-BAKR MOHAMMED IBN 'ABD-AL-MALIK IBN TUFAIL; Lat. ABUBACER) (d. 1185/86), Moorish philosopher and medical writer, was born at Guadix, Spain, in the first decade of the 12th century. He became court physician and general adviser of the Almohad ruler Abu Yaqub Yusuf (1163–84), to whom he introduced his younger friend Averroës (*q.v.*). Ibn Tufail died at Marrakech in 1185/86.

Ibn Tufail wrote a number of medical works in Arabic, both in prose and in verse; but his reputation rests on the *Risalat Hayy ibn Yakzan* ("The Treatise on Hayy ibn Yakzan"), a kind of philosophical novel in which he describes the self-education and gradual philosophical development of a man who passes the first 50 years of his life in complete isolation on an uninhabited island. The author does not follow the emanationist Neoplatonic astronomy which al-Farabi and Avicenna had introduced into their otherwise Aristotelian description of the world above the moon and which Avempace and Averroës accepted without criticism. He rather inclines toward Islamic theology in this respect and does not establish any "secondary causes" as the powers ruling the different celestial spheres. God, the highest being, is the only efficient cause. Philosophy is by no means the highest aim in life. Mystic contemplation is superior to it, and the hero of the novel succeeds eventually in staying in an almost uninterrupted mystical union with God.

Moses of Narbonne in the 14th century translated the *Risalat Hayy ibn Yakzan* into Hebrew and provided a Hebrew commentary, and Pico della Mirandola in the 15th century had a Latin version made from this translation. From the Arabic, E. Pococke made a Latin translation, *Philosophus autodidactus* (1671), and Simon Ockley an English translation, *The Improvement of Human Reason* (1708), new edition, *The History of Hayy ibn Yaqzan* (1929). For the text with French translation *see* Léon Gauthier (ed.), *Hayy ben Yaqdhân, roman philosophique d'Ibn Thofaïl,* 2nd ed. (1936). (R. R. WR.)

IBN TUMART (ABU 'ABDULLAH MOHAMMED IBN TUMART) (? 1078–1130), founder of the Almohad movement (*see* ALMOHADS), was a Berber from the Anti-Atlas mountains of south Morocco. From his youth all his interests were centred on religion. After learning everything that could be taught him in his own country he went to the east to attend the school of the most learned men of the time. He became deeply attached to doctrines, particularly those of al-Ash'ari and al-Ghazali, which seemed to him a condemnation of the dry teaching of the Malikite school of Islam then in vogue in the Maghreb and Muslim Spain. He evolved a doctrine which combined a strict conception of the unity of God with juridical reform, based on a study of the Koran and of Tradition, and with puritanical moral reform. To this he added, in practice, certain elements of Shi'ite origin. He proclaimed himself *mahdi* and impeccable *imam,* the infallible and all-powerful guide of rejuvenated Islam.

Returning from the east in 1118 he tried to spread his doctrine in the Berber towns of North Africa, but failed to win acceptance for his moral reforms. At Marrakech, the Almoravid capital, he became suspect with the authorities and was compelled to flee to his native mountains. He quickly succeeded in rousing his fellow tribesmen in the Anti-Atlas and Great Atlas against the Almoravid foreigners and established a curious Muslim Berber state in the form of a Berber confederation, with its capital at Tinmel.

Ibn Tumart died in 1130 without having been able to defeat the Almoravids. He had designated as his successor his favourite pupil, Abd-al-Mumin, who after a long and bitter struggle succeeded in founding a vast empire which remained officially faithful to the Almohad doctrine.

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(H. L. E. T.)

IBO (IGBO), the largest ethnic group in Nigeria with a population of over 5,000,000 in the 1960s. Their language, Igbo, is in the Kwa group of West African languages and they fall into the following cultural divisions: Northern or Onitsha, Southern or Owerri, Western or Ika, Eastern or Cross river and Northeastern or Abakaliki. The first two contain three-quarters of the population. The Ibo have no traditions of migration from elsewhere, nor of conquest of or by other peoples. They appear to have developed undisturbed in the adjacent Akwa and Orlu divisions of the Eastern region and to have gradually expanded outward from this centre, mainly to the south and east but also westward across the Niger river into what were formerly the Benin and Delta provinces of the Western region. They have no strong chieftaincies and until the advent of colonial rule the largest unit capable of coherent political action was a local community averaging about 5,000 people and consisting of a federation of internally autonomous villages. The villages shared a common market and meeting place, a common tutelary deity and ancestral cults which supported a tradition of descent from a common founding ancestor or group of ancestors. Eastward there is a tendency for these village groups to expand or to come together to form larger units usually referred to as tribes or clans.

The Ibo live patrilocally in homesteads (compounds) dispersed in the territory of their village which is primarily composed of a patrilineage or a clan. Apart from the Northeastern Ibo they live in rain-forest country. Their main food crops are yams, taro and cassava which men and women combine to cultivate. They have a complex organization of markets and of internal and external trade. Their principal exports were originally slaves and later palm oil and kernels.

The Northern Ibo were also much noted for their masked plays (*mau*) and for their Ozo and other title societies. The Ibo have a well-developed system of migration to temporary employment in other parts of Nigeria.

See also AFRICA: *Ethnography (Anthropology)*: *West Africa;* SECRET SOCIETIES, PRIMITIVE.

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(G. I. J.)

IBRAHIM (1615–1648), Ottoman sultan of Turkey, was born in Istanbul on Nov. 4, 1615, and succeeded to the throne on Feb. 8, 1640. He retook Azov from the Russian Cossacks and in 1645 sent an expedition to Crete, then in Venetian hands. Of weak and unstable character he was a prey to self-indulgence and superstition. He put his grand viziers to death and his extravagance necessitated the introduction of new taxes. Ibrahim finally came to believe in his own infallibility. He was dethroned on Aug. 8, 1648, by the army in league with the *ulema* and was strangled ten days later. He was known as "Ibrahim the fool." (E. Z. K.)

IBRAHIM MUTEFERRIQA (1674–1744), Turkish diplomat, writer and printer, established the first printing press in Turkey (1727). A Hungarian by origin, having been born at Kolozsvar (Cluj) in Transylvania, he was captured by the Turks *c.* 1692. Sold as a slave in Istanbul he later became a Muslim and regained his freedom. He then served the Porte as a diplomat in negotiations with Austria and Sweden, on the staff of Francis Rakoczy, and as ambassador to Poland (1737). He made an important contribution to the westernization movement in Turkey by his books and translations and especially by the introduction of the printing press. He died in Istanbul in 1744. (E. Z. K.)

IBRAHIM PASHA (d. 1536), Ottoman grand vizier (1523–36) in the reign of Suleiman I (*q.v.*) the Magnificent, was born of Christian parents at Parga in Epirus. Made captive while still a young child, he was educated at the Porte during the reigns of Bayazid II and Selim I, being assigned in due course to serve in the household of Suleiman, the son of Sultan Selim, then governor of Sarukhan in western Asia Minor. Ibrahim, having won the almost unbounded trust of Suleiman, who became sultan in Sept. 1520, was elevated to the office of grand vizier in June 1523 and then, in the following year, married to the sister of Suleiman. Ibrahim Pasha went on a mission to Egypt in 1524 and, while at Cairo, established on a more solid and durable basis the Ottoman administration of that province. He accompanied the sultan on the great Danubian campaigns of 1526, 1529 (siege of Vienna) and 1532, and also had a large role in the war against Persia (1533–36), which led to the Ottoman conquest of Iraq. Throughout those years he exercised almost complete control over the internal affairs and the foreign relations of the empire. His domination gave rise, however, at the Porte to animosities that became strong enough at last to undermine his hold on the confidence of Suleiman, with the result that he was executed, in March 1536, on the order of the sultan. (V. J. P.)

IBRAHIM PASHA (1789–1848), viceroy (*vali*) of Egypt under Ottoman rule and general of outstanding ability. A son, or adopted son, of the famous *vali* Mohammed Ali (*q.v.*), Ibrahim was born at Kavalla in Thrace. In 1805 he joined his father in Egypt and was made governor of Cairo and, in 1810, controller of land revenue. During 1816–18 he successfully commanded an army against the Wahhabite rebels in Arabia, capturing their leader in his stronghold at Dar'iya. Mohammed Ali sent him on a mission to the Sudan during 1821–22 and on his return he helped to train the new Egyptian army, the *nizam al-jadid*, on European lines. When the Ottoman sultan Mahmud II asked for Egyptian assistance to crush the Greek revolt, an expedition commanded by Ibrahim landed in Greece in 1824 and subdued the Morea, but the destruction of the Ottoman and Egyptian fleets at Navarino in Oct. 1827 by a combined British, French and Russian squadron compelled the Egyptian force to withdraw.

It was in Syria that Ibrahim and his French chief of staff, O. J. A. Sève (Suleiman Pasha al-Faransawi), won military fame. In Nov. 1831, after a disagreement between Mohammed Ali and his sovereign, Ibrahim led an Egyptian army into Palestine, stormed Acre on May 27, 1832, and defeated an Ottoman army at Homs. On July 29 he forced the Bailan pass and entered Iskenderun, then, crossing the Taurus, gained a final victory at Konya on Dec. 21. By the convention of Kutahya, signed on May 4, 1833, Syria and Adana were ceded to Egypt, and Ibrahim became governor general of the two provinces.

Ibrahim's administration was relatively enlightened. At Damascus he created a consultative council of notables. He suppressed the feudal regime and, with the advice of his Lebanese intendant of finance, Hanna Bahri Bey, imposed a uniform taxation. But his measures were harshly applied and roused sectarian opposition; several risings were with difficulty suppressed. Sultan Mahmud resented the Egyptian occupation and in 1839 an Ottoman army invaded Syria. At Nizip on June 24 Ibrahim won his last and greatest victory; the Ottoman fleet deserted to Egypt. Fearing the disintegration of the Ottoman empire the European Powers negotiated the treaty of London in July 1840 by which Mohammed Ali forfeited Syria and Adana in return for the hereditary rule of Egypt. British naval forces threatened the Egyptians, who evacuated the occupied territories in the winter of 1840–41. By 1848 Mohammed Ali had become senile and Ibrahim was appointed viceroy. He ruled for only 40 days and died in Cairo on Nov. 10, 1848.

See P. Crabitès, *Ibrahim of Egypt* (1935); M. Weygand, *Histoire militaire de Mohammed Ali et de ses fils*, 2 vol. (1936). (R. L. HL.)

IBSEN, HENRIK JOHAN (1828–1906), Norwegian dramatist and poet, was the creator of the modern realistic prose drama and one of the greatest dramatists of all time. Honoured (and in some quarters vilified) by his contemporaries and those who immediately followed him as the source of what G. B. Shaw called "Ibsenism," *i.e.*, a critique in dramatic form of conventional morals, he is now valued by posterity for other and less time-bound aspects of his work—his supreme technical mastery, his penetrating psychological insight, his symbolism and the concealed poetry of his prose.

Life.—Ibsen was born on March 20, 1828, in Skien (Vestfold), the second child of a family of five boys (one of whom died in

infancy) and one girl. In an unfinished autobiographical fragment written in 1881, he described how as a boy he saw from his window "only buildings, nothing green"—he remembered particularly the church, the pillory, the jail and the madhouse—and remarked how the many sawmills filled the air all day with a sound like the noise of whining, moaning, shrieking women. His father, Knud Ibsen, had been a prosperous businessman at the time of his marriage to Marichen Altenburg in 1825; but in 1834 he failed and had to sell out, whereupon the Ibsens in their straitened circumstances had to move a few miles out of town to Venstøp, where they remained for the next eight years. This social withdrawal, together with the ignominy attaching to it, drove the already withdrawn character of the young Ibsen still further in on itself and he found compensation in daydreams, in reading and in his puppet theatre. Impressions and memories from these early years inform many of his later plays: Skien provided the small town background of *De unges forbund* (*The League of Youth*); the attic at Venstøp suggested the Ekdals' attic in *Vildanden* (*The Wild Duck*) and the other members of his family often served later as models for his characters.

Progressive detachment and alienation from "home"—his childhood home, his home town and his home country—is a conspicuous part of the pattern of Ibsen's life. At the age of 15, he left Skien behind with the same feelings of release, the same sense of escape, as filled him about 20 or so years later when he left Norway to live for long years abroad; and even as an old man nearing 70 and recently returned to Norway, he could still write to a friend: "Up here by the fjords is my native land, but . . . where do I find my homeland?" In Grimstad—later to re-appear as the background of *Samfundets støtter* (*Pillars of Society*)—where he first went to live, he worked as a chemist's assistant. When he was no more than 18, one of the servant girls in the house, who was a good ten years older, bore him an illegitimate child; for 14 years he supported his son, but it was an incident which he ever after kept as one of the darker secrets of his life. In spare hours he studied for his matriculation examination and he also found time for writing. His first drama *Catilina* derived part of its spirit from the year of revolutions, 1848, in which it was begun, and part from the Latin texts set for his examination.

In April 1850 he moved to Christiania (later Oslo), calling in on the way at Skien to take final leave of his family; there, in the capital, he lived for 18 rather frugal months. He studied at a crammer's; but at his examination in August he was not wholly successful—he failed in arithmetic, Greek and oral Latin—so that he never became a fully matriculated student, although he participated in a number of ways in student life. In particular he contributed to, and helped to edit, a periodical called *Andhrimner*. In 1851 he was offered a job with the theatre in Bergen, originally as producer only; but then he was also commissioned to write annually one original drama to be performed each Jan. 2 on the anniversary of the founding of the theatre. He was too reserved by temperament ever to be a good producer, but the experience he gained of the theatre—not the least of which was the study tour he made in 1852 of theatres in Denmark and Germany—was invaluable; in these years, he had some part in the production of no fewer than 145 different plays.

In 1853 he fell in love with Rikke Holst, who was then not quite 16; he addressed a number of poems to her, and they became "engaged" by tying their rings together and throwing them into the sea—an echo of which is heard later in *Fruen fra havet* (*The Lady From the Sea*); but her father would have none of it and literally chased Ibsen away, with raised fists. In 1856 he became engaged to Susannah Thoresen, but it was another two years before they could afford to marry; their son and only child, Sigurd, was born on Dec. 23, 1859.

He had returned to Christiania in Sept. 1857 to take up an appointment as artistic director of the Norwegian theatre, but his high hopes were not fulfilled; the theatre, never very sound financially, was forced by economic circumstances to include a great deal of farce and vaudeville in its repertory, which gave little scope to an ambitious artist, and in 1862 it went bankrupt. Ibsen found a temporary job as literary adviser to another theatre, the Christiania theatre, but this was abysmally badly paid. To these disappointments were added many other frustrations—mounting debts, attacks of depression, public indifference and even hostility—which brought him almost to the point of despair. In 1863 he was awarded a small state bursary; with some financial aid from his friends he paid what he could of his debts and in April 1864 he left Norway for Rome. For the next 27 years he lived abroad, mainly in Rome, Dresden and Munich; and only twice during this time, in 1874 and 1885, did he return to Norway for short visits.

With this a change came over his life. *Brand* (1866; Eng. trans. 1891), the first fruit of exile, was a considerable success in Scandinavia; in the same year, moreover, his application for an official "author's annuity" was finally successful; thereafter he astonished his friends in Rome by the new elegance of his dress, the new cut of his beard, the new dignity of his manner and even the new firmness of his handwriting. After nearly four years in Rome, he moved in 1868 to Dresden, then in 1875 to Munich; but by the late autumn of 1878 he was back in Rome where—apart from a short period of residence in Munich in 1879–80—he made his home until 1885; between 1885 and 1891, he lived again in Munich. During all these years, it was his usual habit to spend the summer months away from the town, his favourite spot being Gossensass (Colle Isarco) in Tirol. It was there in 1889 that he met both the young Helene Raff from Munich (who was subsequently a frequent guest in the Ibsen household, much to the jealous irritation of his wife) and also Emilie Bardach, an 18-year-old Viennese girl, whom he later described as his "May sun in a September life." The episode, the precise significance of which for Ibsen is difficult to define, left its mark both on *Hedda Gabler* and on *Bygmester Solness* (*The Master Builder*).

In 1891, by now a world-famous author, Ibsen returned to Norway for good and took up residence in Christiania. In the years that followed, the person probably closest to him was the daughter of one of his friends, Hildur Andersen, who was studying to be a concert pianist; it was with her he seemed able to discuss his literary plans most freely.

On Oct. 11, 1892, Ibsen's son married Bergliot Bjørnson, daughter of Norway's other great poet of these years. Ibsen's attitude toward the very different Bjørnstjerne Bjørnson (*q.v.*) had for nearly 40 years been a mixture of admiration, envy, contempt and affection; on this occasion, Ibsen had a diplomatic illness and did not attend the ceremony. A stroke in 1900 and another a year later left him an almost helpless invalid; he died in Christiania on May 23, 1906.

Works.—The span of Ibsen's authorship, from the pseudonymous publication (under the name of Brynjolf Bjarme) of his first play *Catilina* in 1850 to the appearance of his last work *Når vi døde vågner* (*When We Dead Awaken*) in the last days of Dec. 1899, corresponds almost exactly with the second half of the 19th century. Of this creative career, the first half was given over to experimentation in many different styles, while the second was taken up with the more characteristically and controversially "Ibsenite" plays—works which, by their exploration of the nature of truth and falsity and what is spurious and what is genuine in the individual and in society, achieved a progressive development and enrichment of the naturalist prose drama.

Catilina (1850; Eng. trans. 1921) created little sensation when it appeared; but, as Ibsen himself explained in the preface to the second edition of 1875, it touched on a theme he later frequently returned to: "the contradiction between ability and ambition, between what is willed and what is possible, that which is mankind's and the individual's tragedy and comedy at one and the same time." The first performance of any Ibsen play was of *Kjæmpehøien* (*The Warrior's Barrow*), a historical play with a strongly nationalistic element in it, on Sept. 26, 1850, in Christiania; the following year he published in several successive numbers of *Andhrimner* a dramatic satire called "Norma." During his time in Bergen, five of his plays were produced there: in 1853, *Sankthansnatten* ("Midsummer Eve") which was a fiasco (Ibsen would not allow its publication during his lifetime); in 1854, *The Warrior's Barrow* was given its second production; in 1855 there was *Fru Inger til Østrât* (*Lady Inger of Ostraat*), a prose drama; in 1856

Gildet på Solhaug (*The Feast at Solhoug*), which was inspired in part by Ibsen's reading of Norwegian folk songs; and in 1857 there was *Olaf Liljekrans* (Eng. trans. 1921), a romantic drama in three acts.

On an altogether higher level of attainment are the three dramas he completed in Christiania between 1857 and 1864: *Hærmændene på Helgeland* (1858; *The Vikings at Helgeland*), inspired by Ibsen's reading of *Volsungasaga*, which attempted with some measure of success to find a modern approximation to the strong and purposeful language of the sagas; *Kjærlighedens komedie* (*Love's Comedy*), a verse drama about love and marriage, which contemporary criticism found both immoral and unpoetic and which Ibsen later regretted having published at this particular time; and *Kongsemnerne* (1863; *The Pretenders*), a historical play in prose which, especially in its analysis of the doubting mind of Earl Skule, is possibly the profoundest of all the early works.

It was while Ibsen was in his late 30s and early 40s and after leaving Norway behind him that he wrote what are in many respects the most impressive works of his whole career. *Brand*, first conceived as a dramatic poem and then rewritten as a verse drama, was completed near Rome in the summer of 1865 and published in Copenhagen the next year; it was followed in 1867 by its complement, *Peer Gynt*. Both of them are in a sense polemic pieces directed against what Ibsen felt was the narrowness of Norwegian life and the complacency of the Norwegian character. The former play takes for its hero an unbending, uncompromising figure sternly dedicated to the principle of "All or Nothing"; the latter follows the career of a person wholly unprincipled, buoyant and yielding, and content to take for his way of life the motto "To thine own Self be—enough"; where the one is admirable but unlovable, the other is lovable but reprehensible, yet both can in part be thought of as portraits of the author himself.

After the publication in 1869 of *De unges Forbund* (*The League of Youth*) (which although intrinsically weak nevertheless in some respects anticipates the style and form of the later plays) and the appearance of his *Digte* (*Poems*) in 1871, Ibsen went on to complete his enormous "double" drama in ten acts, *Kejser og Galilæer* (1873; Eng. trans., *Emperor and Galilean*, 1876), a work based on the career of Julian the Apostate; in following the conflict between paganism and Christianity, the play puts forward the concept of "the third realm," a realm of great mystery linked equally with the Tree of Knowledge and with the Cross. Ibsen's own view seems to have been that this play represents his greatest achievement.

Samfundets støtter (*Pillars of Society*), the first of the so-called "social" plays by which Ibsen became generally known, appeared in 1877, followed by *Et Dukkehjem* (*A Doll's House*) in 1879. The former was the play that properly established his wider fame in Germany (within two months of its original publication, it was, in Feb. 1878, being played at five different theatres in Berlin alone, in three quite different translations), while *A Doll's House* at its London production in 1889 started off the vehement debates about "Ibsenism" that characterized literary controversy in the 1890s.

Gengangere (1881; *Ghosts*), on its author's admission a more "extreme" play than its two predecessors, for which they acted as a kind of introduction or preparation, came to be linked with the establishment of Europe's "independent" theatres—the Freie Bühne in Berlin (1889), the Théâtre Libre in Paris (1890) and the Independent theatre in London (1891), each of which selected *Ghosts* for its opening production. The hostile reception given to this play by the Norwegian public and critics (mild, however, in comparison with the vitriolic comments of much of the London press in 1891) can be seen as the point of origin that served Ibsen's next three plays: *En Folkefiende* (1882; *An Enemy of the People*), *The Wild Duck* (1884) and *Rosmersholm* (1886) all bear upon the varying destinies of those who dare, or who cannot forbear, or who fear, to tell the truth. The shift of emphasis in the next plays is partly suggested by the individual references their titles make: *The Lady From the Sea* (1888), *Hedda Gabler* (1890), *The Master Builder* (1892), *Lille Eyolf* (1894; *Little Eyolf*) and *John Gabriel Borkman* (1896). They mark a development from an expressly social or moralist or problematical mode of drama to a more psychological, a more visionary and more symbolic style. Finally, *When We Dead Awaken* (1899), "a dramatic epilogue" as its author subtitled it, incorporated in the figure of Rubek a final and merciless piece of self-analysis and brought Ibsen's creative career to a close.

Ibsen was a most meticulous artist; his usual practice in later life was to allot two years to each play, working it out by way of preliminary notes, scenarios and repeatedly revised draft versions until it reached its final form; these drafts, many of which have survived, not only provide a fascinating account of the genesis of the plays but also uniquely document the nature of dramatic composition in general.

Earlier argument about the nature of Ibsen's achievement generally plotted its course—in the English-speaking world, at least—by reference to two main co-ordinates of debate: the Shavian line, which commended the plays as embodiments of a "lesson," as exercises in moral persuasion; and the opposing view that dismissed the "ideas" as commonplace and emphasized instead Ibsen's massive technical skill. Common to both, however, was a tendency to argue mainly from the social dramas of the late 1870s and early 1880s, and any distortion that Ibsen's reputation suffered in the past probably had its source in this fact. From a better vantage point in time, other and rather different merits in his work were noticed: chiefly the poetic quality of some of the earlier "non-theatrical" plays, especially *Brand* and *Peer Gynt*, and the concentrated power of the later symbolic plays of the 1890s. In consequence, the suggestion is often made that Ibsen's real fame rests less on his innovations as a social realist than on his achievements in the field of poetic drama.

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IBYCUS (6th century B.C.), of Rhegium in Italy, one of the nine lyric poets recognized by later Greek criticism. Polycrates, tyrant of Samos (*c.* 535–22) was his patron, but the only contemporary allusion in his surviving words is ambiguous (it may be to Cyrus I of Persia or to Cyaxares of Media). In 1922 a considerable part of a poem addressed to one Polycrates (*Oxyrhynchus papyri* 1790) was published; the relationship of this Polycrates to the tyrant is not certain, and the main interest of the poem lies in the light which it throws on Ibycus' use of metre and language, and on his attitude to mythology. Ancient authorities found it hard to distinguish his work from that of Stesichorus, but even in the few fragments of Ibycus' narrative lyrics there are signs of marked individuality. Later writers speak of Ibycus mainly as a writer of convivial and erotic poetry: Aristophanes names him with Anacreon as a "seasoner of harmony," and Cicero regards him as even more devoted to love poetry than Alcaeus and Anacreon.

A late legend relates how he called a flock of cranes passing overhead to witness as he was being murdered by robbers near Corinth. One of the robbers later saw the cranes over Corinth and involuntarily referred to them as the avengers of Ibycus, a remark which led to the unmasking of the murderers. This provided Goethe with the subject of his poem, *Die Kraniche des Ibykos*.

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(J.N. A. D.)

ICA, a department in southern Peru, bounded on the west by the Pacific ocean, on the north by the department of Lima, on the east by Huancavelica and Ayacucho, and on the south by Arequipa. Area 8,205 sq.mi. Pop. (1961) 243,887. The capital is the city of Ica (*q.v.*).

The department comprises the western slope of the Andes, the arid coast and the north end of the coastal range. Included in the department are the Viejas and Chincha Islands, famous as sources of guano.

Ica is thinly inhabited except in four separate river valleys, from north to south the Río Chincha, Río Pisco, Río Ica and Río Grande, where irrigation is practised. The largest irrigated areas are in the Chincha and Ica valleys. Cotton occupies the largest acreage, and the Pisco valley was where Fermín Tanguis originated the indigenous white long-stapled Tanguis cotton that proved to be highly productive in the irrigated lands of the Peruvian coast. In addition to cotton, fruitgrowing and viticulture are important, the latter especially in the Ica valley. Although the grapes produce an inferior wine, this is distilled into a famous brandy, which takes its name from the port of Pisco, through which it is exported. The department also includes the iron ores at Marcona, which are brought to the port of San Juan for shipment to the steel plant at Chimbote. There is some gold mined at Nazca, and fishing is important at Pisco and San Andrés.

(P. E. J.)

ICA, a city near the coast of Peru and capital of Ica department, located 160 mi. S.E. of Lima, with which it is connected by an all-weather highway. Pop. (1961) 38,347. It is the commercial centre of the department and has numerous small industries. Its chief outlet is by rail to the port of Pisco, 46 mi. N.W. Ica is in the midst of an irrigated area about 1,300 ft. above sea level, where the chief products are grapes and cotton. The famous Pisco brandy, well known along the Pacific coast of both North and South America, is produced in Ica. The city was founded in 1563 and was twice destroyed by earthquakes. (P. E. J.)

ICARIA: *see* CABET, ÉTIENNE; NAUVOO.

ICÁ RIVER: *see* PUTUMAYO RIVER.

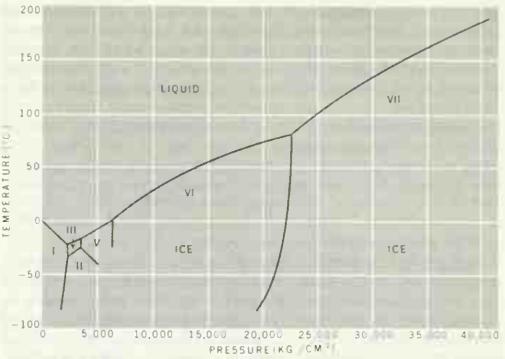
ICE is the solid form of water. Although practically colourless, ice often appears white as a result of included air bubbles, and in large masses—*e.g.,* glaciers—it takes on a blue or blue-green colour.

Ice in its several forms (snow, lake ice, sea ice, glaciers) occurs abundantly. Of the estimated 22,000,000 cu.km. of ice occurring on earth, 87% lies on the antarctic continent and 12% on Greenland, with only 1% elsewhere. If all this ice melted, the sea level would rise about 50 m. and change the face of the earth. This could happen if the climate of the polar regions should get much warmer. Yet melting would be slow because ice has a very high heat of fusion, equal to 79.8 cal. per gram. This is the amount of heat necessary to change ice at 0° C. to water at the same temperature. (The zero point temperature of the Celsius or centigrade scale is defined as the temperature of a mixture of water and ice exposed to ordinary air at a pressure of one atmosphere.)

Ice has a density of 0.917 g. per cubic centimetre and will float on water with about 10% of its volume above the surface. However, ice containing air or brine may have a lower or higher density and will sink to different depths. As water cools it passes through a maximum density at 4° C. before any of it will freeze, for above this temperature convection currents carry the heavier cooled water to the bottom. Ice can form on the surface only after all of the water has reached 4° C. This is the reason why shallow lakes freeze over before deeper ones.

Another unusual characteristic of ice is that its melting temperature decreases when it is subjected to pressure. Under a pressure of 134 atm. ice melts at −1° C. The low friction of most materials on ice can be accounted for, in part, by this phenomenon, for even moderately loaded surfaces will be under high pressures in the neighbourhood of edges and irregularities. Near 0° C. melting will occur at the points of high pressure, and the water formed can provide a lubricating film. At lower temperatures ease of sliding may be due mainly to local melting by frictional heating.

The flow of ice under stress, as in glaciers, has often been explained in terms of regelation. In this process, pressure is relieved by the flow of water formed by the lowering of the freezing point. Thus, an object can pass through ice by progressive melting ahead and refreezing behind. This type of flow can occur only near 0° C.; at lower temperatures a visco-plastic flow takes place, in which ice crystals are deformed without breaking.



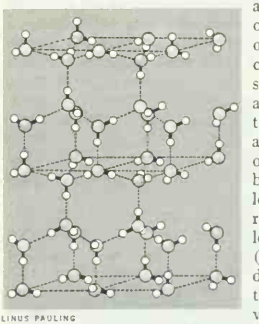
AFTER P. W. BRIDGMAN

FIG. 1.—PHASE DIAGRAM FOR WATER AND ICE SHOWING FIVE HIGH-PRESSURE MODIFICATIONS OF ICE ALONG WITH ORDINARY ICE (ICE I)

Modifications.—There are several modifications of ice, one of which may be amorphous. Five different crystalline modifications were made in the laboratory of P. W. Bridgman (fig. 1); they are stable only at pressures in excess of 2,000 atm., and all have densities higher than one gram per cubic centimetre. Only one modification occurs in nature—ordinary ice—which crystallizes in a hexagonal structure; but ice crystals rarely exhibit symmetrical shape unless grown from the vapour.

Crystal Structure.—Masses of ice are aggregates of single crystalline grains. In quickly frozen ice these may be only a few millimetres to a few centimetres in size. Under slower rates of growth, as occur in temperate glaciers, single crystals are often found having dimensions of several decimetres. Although lake ice crystals may grow as large, they are less perfect. In neither case is the symmetry shown in exterior form. Crystals, several centimetres in size and displaying the hexagonal habit, often grow from the vapour on ceilings and walls of unheated buildings in the arctic. The beautiful and varied patterns of snow crystals manifest the symmetry of ice grown from the vapour.

Boundaries between neighbouring crystals in polycrystalline ice are usually irregular and can be observed under crossed polaroids or by etching. Etching can be accomplished by evaporation of the surface or by melting with radiant heat. When the surface water is removed the grain boundaries become visible. Orientation of the individual ice crystals can be determined by X-ray crystallography. Because ice is doubly refracting, optical methods can locate the position of the C-axis (hexagonal axis), but they do not distinguish between directions in the plane normal to it. A convenient method for determining the orientation of ice is by observing the vapour (Tyndall) figures produced in the body of the crystal by radiant heating. These flat hollow figures have the shape of snowflakes displaying hexagonal symmetry, and their axes of symmetry are parallel to those in the host crystal.



LINUS PAULING

FIG. 2.—CRYSTAL STRUCTURE OF ICE: LARGE SPHERES REPRESENT OXYGEN ATOMS; SMALL SPHERES REPRESENT HYDROGEN ATOMS

The oxygen atoms, being considerably larger than the hydrogen atoms, determine the basic structure of ice. Each oxygen atom is surrounded tetrahedrally by four others at a distance of 2.76 Å

(fig. 2). The two hydrogen atoms can occupy any of the four tetrahedral directions with the limitation that only one can be between any pair of oxygen atoms. Because of the uncertainty concerning the position of the hydrogen atoms, the symmetry class of ice is not known. Both polar and nonpolar symmetries have been proposed.

For the manufacture of ice *see* REFRIGERATION: *Manufacture of Water Ice*. *See* also references under "Ice" in the Index.

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(HI. B.; J. K. LR.)

ICE AGE: *see* PLEISTOCENE EPOCH.

ICEBERG, a floating mass of ice broken from the end of a glacier or a polar ice sheet. Icebergs drift according to the direction of the sea currents, frequently from the polar regions to navigable waters, and they are therefore occasionally encountered far beyond the polar regions. When a glacier descends to the sea and is pushed outward into water of greater depth than the thickness of the ice, the ends are broken off and the detached masses float away as icebergs. Only one-ninth of the mass of ice is seen above water. Many bergs are overturned, or at least tilted, as they set sail, as the result of the wave cutting and melting which disturb their equilibrium. The disintegration of an arctic ice sheet is a simpler matter, as the ice is already floating. The ice sheet cracks at the end, and masses break off, owing to the upward pressure of the water upon the lighter ice. This is accomplished with considerable violence. Icebergs, especially those of glacier origin, carry a load of debris which they gradually strew upon the sea floor; glacial material found in dredgings shows that icebergs occasionally transport their load for a considerable distance.

ICEBOATING. The sport of sailing and racing ice boats, once a rich man's hobby involving boats costing several thousands of dollars and professional skippers and crews, became, in the second half of the 20th century, confined almost entirely to small, light but extremely fast boats, often built by their owners and costing from $500 to $1,500 apiece. By taking advantage of modern highways and car-top carriers and trailers, iceboatmen were able to widen the area and lengthen the season for iceboating. The most active regions in North America are Wisconsin, Minnesota, Illinois, Michigan, Ontario, southeastern New York, northern New Jersey, Connecticut and eastern Massachusetts. European areas where the sport is active include Sweden, the Netherlands and Germany—in general, the Baltic basin region.

The Dutch seem to have been the first iceboaters, although the Finns, Latvians and others living around the Baltic sea no doubt contrived some sort of "sailing sleigh" at a very early date. A drawing of a Dutch iceboat dating from 1768 shows a typical sloop-rigged Dutch sailboat with a cross plank under the hull near the bow, a runner at each end and a sharp iron shoe at the stern, on the bottom of the boat's regular rudder.

In North America the earliest iceboat on record was a three-runner wooden box with a single spirit sail, built by Oliver Booth and sailed on the Hudson river at Poughkeepsie, N.Y., in 1790. Within a few years iceboats were sailing the frozen waters around Red Bank and Long Branch, N.J.

Interest in the sport increased toward the middle of the 19th century; the Poughkeepsie Ice Yacht club was formed in 1861, followed within a few years by the New Hamburgh and Hudson River Ice Yacht clubs. In 1900 the fleet of the Hudson River club mustered over 50 yachts, including 6 giants of the first class, each having over 600 sq.ft. of sail. The development of the sport at Long Branch and Red Bank followed the same pattern and the boats were similar to those on the Hudson.

After 1902 activity shifted to these Jersey rivers and to the midwest, where the sport flourished on the large inland lakes of Michigan, Minnesota and Wisconsin, especially at Kalamazoo, Mich., and Madison and Oshkosh, Wis. The boats in use were almost all of the basic Hudson river pattern, consisting of a single fore-and-aft spar, called the backbone, mounted just ahead of its midpoint on a broad, flexible wooden crosspiece called the runner plank, which had a runner mounted at each end. The steering blade was mounted under the after end of the backbone and controlled by a tiller. The helmsman and his one-man crew rode on a shallow, elliptical tray just ahead of the steering runner. The mast was stepped on the backbone, several feet forward of the runner plank. The lateen rig, with a single sail carried between the legs of an A-frame, was very successful and enjoyed a 20-year period of popularity, but the ever-present sloop rig eventually won out, and remains virtually unchanged for the Hudson River type of boat to this day. The only changes since the 1880s have been to higher, narrower mainsails and smaller jibs, and of course, the use of high-strength stainless steel rigging, Dacron sails and tool steel runners in place of iron wire, cotton canvas and cast iron runner blades. "Mary B.," built in Madison (1947) and "Vanguard" of Red Bank (1959) represent the most modern racing designs of the midwest and the east, and both follow this type exactly.

Some of the speeds recorded by the older boats were notable. The "Scud" sailed at 107 m.p.h. on the Navesink river at Red Bank (1885); the "Clarel" reached 140 m.p.h. on the Shrewsbury river at Long Branch (1907); the "Wolverine" of Kalamazoo, Mich., sailed 20 mi. to windward and return, from a standing start, in 39 min. 4 sec. (1908). Clearly, in those days, the iceboat was the fastest vehicle man had yet produced.

The iceboat can reach approximately four times the speed of the wind propelling it. This phenomenon is accounted for by the facts that (1) the boat is sailing across the wind and is not being pushed along by it and (2) by its very motion the boat creates an increase in the velocity of the wind it sails with. These principles were only vaguely understood in the early days, and the traditional jib-and-mainsail rig with stern rudder was firmly entrenched in spite of the fact that the forward thrust sometimes lifted the stern rudder from the ice, sending the whole boat into a spin. Perfect tuning of the boat and perfect handling could minimize but never eliminate this tendency to become unmanageable in strong winds.

About 1931 Starke Meyer of Milwaukee, Wis., designed a hull with the steering runner at the bow and the runner plank at the stern. The downward and forward thrust of the mast, now located between the two points of support, served to increase rudder traction. His bow-steerer easily defeated all competition and it was clear that it was correctly balanced and directionally stable—and would not spin.

Smaller versions, with a sail of only 75 sq.ft., showed they could sail safely and fast. By 1940 the design had crystallized and the 75-sq.ft. class enjoyed a rapid growth. By 1950 boats of this class were winning not only 75-sq.ft. class races, but also open and free-for-all events. The less expensive DN60, designed in the hobby craft shop of the *Detroit News* in 1937 and having a sail area of 60 sq.ft., also became popular. Other classes continued to exist, but very few boats were built in them, and as the older large boats were discarded, they were not replaced.

Iceboats are classified for racing purposes by sail area. The classes of the Hudson River Ice Yacht club before 1900 were: first class, over 600 sq.ft.; second class, 450 to 600 sq.ft.; third class, 300 to 450 sq.ft.; fourth class, 225 to 300 sq.ft.; fifth class, under 225 sq.ft. In 1935 the classes recognized by the Northwestern Ice Yachting association were: class A, 250 to 350 sq.ft.; class B, 175 to 250 sq.ft.; class C, 125 to 175 sq.ft.; class D, 75 to 125 sq.ft.; class E, up to 75 sq.ft.

In 1937 seven eastern clubs formed the Eastern Ice Yachting association, patterned after the Northwestern association (founded in Oshkosh in 1912) and recognizing the same classes. Membership in both associations varies as their member clubs prosper, but in general the Eastern association includes a group of clubs in the New York-New Jersey-Connecticut area, and the Northwestern association includes clubs from eastern Wisconsin, northern Illinois, Michigan and Ontario. Both the Northwestern and the Eastern associations conduct an annual championship regatta, to which member clubs may send their best boats in all recognized classes.

The growth of the "skeeter," or class E, at 75 sq.ft. was so rapid that by 1939 there was a need for an organization devoted to this class alone and the International Skeeter association was founded, with headquarters in Chicago. Most racing skeeters are single-seaters, precluding the possibility of carrying a passenger for pleas-

ure sailing or for instruction. The need for a two-seater was felt strongly and crystallized in the founding in 1948 of a second one-design class in the east. This new class was, appropriately, called the "Yankee," and had an orthodox two-seater as the accepted design. Yankees compete on even terms with single-seater racers.

In 1951 the New Hamburgh Ice Yacht club, inactive for 25 years, turned over custody of the famous Ice Yacht Challenge Pennant of America, first put up in 1881, to the Eastern Ice Yachting association. This trophy is open to any type or size boat and to any club in the world. The first open invitation regatta was held at Greenwood Lake, N.J., Feb. 18, 1951, to which all known clubs in the world were invited. The Fox Lake (Ill.) Ice Yacht club, represented by Ed Rollberg's "Black Magic," won a close series from Elmer Millenbach's "Renegade" of Detroit. On March 1, 1953, Fox Lake lost the trophy to Pewaukee Ice Yacht club at Lake Geneva, Wis., which club became dominant in pennant competition.

In the midwest, interest in the larger boats was kept alive by competition for two cups, by tradition open only to the boats of class A and larger, the Stuart cup, put up in 1903, and the Hearst cup, put up in 1904 by William Randolph Hearst for competition in the 450-ft. class (later opened to class A at 350).

Before World War II, European iceboating was very active and well organized under the European Ice Yachting union. Member nations included Sweden, Latvia, Estonia, Germany and Austria. Competitions were held annually in several classes, and a one-design class of 15 sq.m. sail area. Rigs were almost universally single-sail, or "cat"; the backbone was a hull, or fuselage, with pilot and passenger sitting upright, and steering done by a wheel.

Although contact was never formally established across the Atlantic, correspondence and comparisons of ideas went on with the result that Americans, borrowing freely the efficient cat rig, fuselage backbone and safe, comfortable pilot's position, developed the modern fast racer when they made it into a bow-steering design. On the other hand, Europeans have steadfastly refused to use the bow-steerer.

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ICEBREAKERS, powerfully built vessels specially designed and equipped to clear a path through ice in harbours, rivers or other navigable waters. Since late in the 19th century many maritime nations have used icebreakers to keep their ports and shipping lanes open. More recently, icebreakers have also proved valuable to exploring parties in the polar regions.

Ice encountered in the navigable waters of North America and Europe is of the annual type, which forms in sheets varying in thickness up to about 36 in. on the Great Lakes. Under the action of wind and seas such sheet ice often breaks and forms into windrows which attain great thicknesses, occasionally extending to the bottom of the lake.

Polar ice is composed of glacial ice, floes and annual ice, and is often too thick to break. Icebreakers follow open leads in navigating polar ice or force openings between floes. Modern icebreakers successfully use radar and helicopters for locating leads in the ice pack.

Icebreakers have generally been designed for use in particular areas of operation, such as the Baltic sea, Great Lakes or the Arctic. Dutch ice plows, so named because they turn ice up and out onto the surrounding unbroken ice, were developed for the shallow harbours and rivers of the Netherlands.

A number of icebreakers have been fitted with bow propellers in addition to stern propellers. The action of the bow propeller creates turbulence in the water, which assists the breaking action of the bow and also moves broken ice out of the way. Bow propellers are particularly successful in breaking annual ice.

Design Characteristics.—The designs of icebreakers built during and since World War II have incorporated most of the following major characteristics.

High Beam-to-Length Ratio.—This is an important element because a short vessel performs better when forcing tortuous leads in the ice pack. Such a vessel can turn better and does not risk becoming wedged in a narrow lead as would a long vessel. The large beam is required to cut as wide a channel as possible for conventionally built merchant ships to follow. A narrow beam would require the icebreaker to make a second pass at the ice to cut a channel wide enough for a following ship.

High Horsepower-Displacement Ratio.—Modern icebreakers have ratios of 1.75 to 2.4 shaft horsepower per ton of ship's weight. These high ratios permit a vessel to make sustained progress in ice of varying thicknesses without the need for continually stopping, backing and ramming.

The Russian nuclear-powered icebreaker "Lenin," launched in 1957, was designed with a ratio of 2.75 shaft horsepower per ton, higher than all other icebreakers then in service. It was estimated that the "Lenin" would be able to make sustained progress in unbroken ice fields up to 6½ ft. thick and to cruise for a year without entering port.

Flared Hull Shape.—The use of flare-shaped transverse sections has been widely adopted in icebreaker design. The flare of the sections permits the ship to lift rather than be crushed when under ice pressure during the forcing of leads or when operating between floes. The angle of flare at midships is between 10° and 20°. This design feature also adds to the ship's icebreaking capability, because the sloping sides at the bow create a downward force on the ice. This characteristic, in combination with the common feature of cutaway bow or forefoot, produces a bending action on the ice. This action occurs not only as the forefoot meets the ice, but also as the hull moves along and the sloping sides of the bow and forward part of the hull meet areas of unbroken ice.

The hull shape resulting from the use of flared sections makes the icebreaker a heavy roller in open water. The absence of bilge (rolling) keels on most icebreakers, due to their vulnerability to ice, contributes to the rolling. Angles of 40° to 50° in heavy seas are not uncommon. The Canadian icebreaker "Labrador" is fitted with retractable stabilizing bow fins to dampen the roll.

Electric Propulsion.—An icebreaker must be able to develop its maximum power from a standing start. This characteristic requires machinery capable of providing approximately full power at reduced propeller shaft revolutions. Electric drive has this ability and is the most common type of propulsion for icebreakers, using diesel or steam turbines to drive generators that supply the direct-current propulsion motors. Ships of the U.S. coast guard "Northwind" class (*see* fig. 1) and the "Mackinaw" were constructed with two stern propellers and a bow propeller. The diesel-electric propulsion plant was designed to transmit all the power developed either to the stern propellers or to divide the power between the stern and bow propellers. In polar regions, the bow propeller is usually removed from icebreakers so designed.

BY COURTESY OF U.S. COAST GUARD

FIG. 1.—THE "NORTHWIND," U.S. COAST GUARD ICEBREAKER

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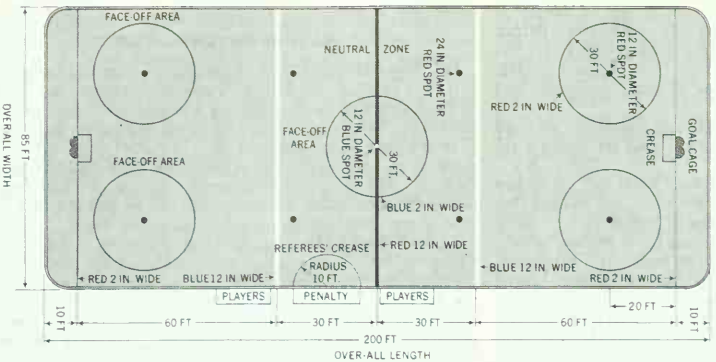

DIAGRAM OF A PROFESSIONAL ICE HOCKEY RINK

in. and must not exceed 3 in. The blade of the goalie's stick must not exceed 3½ in., except at the heel, where it must not exceed 4½ in. The widened portion of the goalie's stick extending up the shaft from the blade must not exceed more than 24 in. from the heel and must not exceed 3½ in. in width.

The Game.—The game starts with a face-off, the referee's dropping the puck between the opposing centres, who face each other in the exact centre of the rink. Each of the centres seeks to gain possession of the puck, and the one who does contrives to advance it, either by himself or by passing to a teammate, to the region of the opposing team's goal. Icing the puck, that is, passing the puck from the defensive zone beyond the opponent's goal line, results in a special face-off at the end zone spot of the offending team. The passing between members of the same team may be intercepted at any time by the opponent.

A face-off is held to restart play whenever it is stopped for any reason, such as when an off side is called, a puck is shot out of the rink, an infraction of a rule is committed by both sides, or a puck is held against the boards or otherwise cannot be played by either team. National Hockey league rules require that the two players facing off be at least seven feet apart.

The three periods of 20 minutes each have 10-minute intermissions between them. In case of a tie at the end of that time the United States National Collegiate Athletic association rules decree that at the end of the third period there shall be a 5-minute intermission, after which ends shall be changed and a "sudden death" 10-minute overtime period played. In this "sudden death" period, the team that scores first wins, and the game is ended. If no score is made in the overtime period, the game is ended and results in a draw.

The National Hockey league rules decree that if, at the end of the three regular 20-minute periods, the score shall be tied, the game is over and shall be called a tie. However, "sudden death" applies in Stanley cup play. (J. C. Ns.; E. J. J.)

TECHNIQUE

Skating.—Ordinary pleasure skating, figure skating and speed skating count for little in ice hockey. The novice must practise hours, days and months to master the stop-turn-and-start. Ice hockey is played in a series of short dashes—fast starting, sudden stopping, feinting, dodging, shifting, weaving and even hurdling being parts of the puck chaser's routine.

For fast starting and breakaway purposes, the short, choppy stride is used to propel a player rapidly away from opponents. After getting the "jump" on his opponents, the player lengthens out his stride to get the maximum speed benefit of every stride. This lengthening-out stride is more of a hip-striding movement and gives the player a smooth, rhythmic, powerful appearance. The next point is to confine the skating stride to as narrow a path of ice as possible. The professional player rushes a puck in a path as narrow as three feet.

Stick Handling.—After the player has learned the art of good hockey skating technique, he must learn the art of puck control. This includes the almost instinctive reaction of taking a quick, wide lateral dribble with the puck as the player nears an opponent; it is known as the protective dribble, whereby the puck carrier keeps his body between the puck and the opponent so that the opponent cannot poke-check the puck from the stick blade. The protective dribble is very effective when it is made with a quick, wide movement—the quickness for deception and the width for safety.

Many mediocre skaters have held positions on good teams through their clever stick handling and scoring ability. By such tricks as the delayed dribble (throwing the opponent's timing off by suddenly stopping to "shake" an opponent and then just as suddenly starting off again), a player can baffle opponents who attempt to steal the puck and thereby check the play. Years of constant practice are necessary to crown the efforts of the expert stick handler.

Professional players stick-handle the rubber puck in a manner that is uncanny—pushing, dribbling and flipping the small rubber disk about the ice between a maze of sticks and skates with a speed and accuracy too bewildering for the human eye to follow.

Methods of rushing or "carrying" a puck along the ice vary. Some push the disk ahead at stick's length when the play is open; others play the puck from side to side as they approach dangerously close to an opponent. Some flip the rubber against the sideboards, depending on the rebound for recovery of the disk behind the opponent, while others attempt to poke the puck between the opponent's feet and skate around the man to regain possession of the disk while the opponents are off balance or too befuddled to hamper the play effectively.

Checking.—Stick checking calls for quick thinking and clever action on the part of the checker. The poke, sweep and hook checks are effective means of taking the puck away and stopping opposing forwards in their rush toward the goal.

The body check is an effective means of body blocking which, in a sense, disconnects the puck carrier from the puck and thereby interrupts his dash to the goal. A legal body check is one with the hip or upper body from the front or straight from the side and limited to two steps, and only the puck carrier can be body-checked. In the United States the National Collegiate Athletic association rules permit body checking only in the defensive zone. The National Hockey league rules permit body checking in all three zones.

Playing the Game.—With skating and stick handling perfected to a point where they are combined into one mechanical operation, the player can direct his whole attention to playing the game. A good hockey player never looks at his feet, stick or puck during the progress of the play. His eyes are focused on his opponents at all times in order to size up the confronting situation and react intelligently. Once he comes into possession of the puck he has the three forwards, two defense men and goal tender to beat before he can register a score by shooting the disk into the goal net guarded by the opposing team.

Left wing, centre and right wing, commonly known as the forward line, practise passing the puck from one to the other across the ice, while skating at top speed, to perfect their combination play to a point that enables them to beat the opposing forwards, swoop past the opposing defense and set up a man in the best scoring position for a shot at the net. Individual rushes by self-styled stars seldom result in tallies going up on the scoreboard. Left- and right-wing players play their positions in their respective lanes and leave the centre lane or mid-ice section to the centre player. Members of the forward line try to score goals when the

opportunity is presented and never at the cost of allowing the opposing forwards to break away for a two- or three-man combination attack on the home team's net. When not participating in an offensive attack, defensive men position themselves within a 20-yd. radius of the goal net and never leave their goal tender unguarded. The good defense player holds, at all times, a position between his goal tender and the opposing forwards who attempt to carry the puck close enough to the net for a shot that may mean a score. Defense players adopt various forms of checking the forward-line attack. Some use a stick check (part of the stick must be on the ice, or the foul of cross checking is committed) or body check or a combination of the two; others crowd the incoming forwards to the sideboards; or both defense men simultaneously body-check the puck carrier when he attempts to go between them. The purpose is to intercept the puck, spoil the forwards' shots, keep them out of shooting range of the goal net or force them to shoot from impossible angles.

A goalkeeper has four by six feet of open net to protect and must study the shots from all angles and positions on the ice. He must cover as much of his net as possible with his body and shift his position between the posts continuously in such a manner that he will cut down the shooting angle and thereby eliminate as much vulnerable opening behind him as possible. Such movement by an experienced goal tender hampers the target range of the opposing sharpshooters. If an opposing left-winger or right-winger goes around the defense for a shot the net guardian crowds the corner of the goal nearest to the shooting wing and edges out to cut down the far corner angle. When a forward skates through the defense and looms up directly in front of the net for a shot, the goalie edges out directly at the shooter and thereby cuts down the shooting angle on both sides. The four most vulnerable spots for scoring are the two upper corners and the two lower corners of the net. Only the most skilful shooters can hit these four vulnerable spots, and only the most skilful of goalies can block these spots.

(J. Fi.; E. J. J.)

UNITED STATES AND CANADA

History.—Despite the introduction of international play in Europe, Canada took the lead in establishing the sport firmly through organization. In 1887 the Amateur Hockey Association of Canada was formed and this body soon came to be recognized. Under its guidance, hockey flourished throughout the entire dominion.

The game was not played in the United States until the winter of 1894–95. In that year a group of U.S. students visited Canada, saw some games and participated in others. On their return home, their enthusiasm prompted them to organize hockey clubs. According to the *Official Hockey Guide* of the Amateur Hockey Association of the United States,

> The first official league or association ice hockey game on record in the United States was played by the St. Nicholas Skating Club and the Brooklyn Skating Club in New York's St. Nicholas Rink on December 15, 1896, and was won by St. Nick's 15 to 0. The other teams in this four club circuit were the New York Athletic Club, winner of the Amateur Hockey League title for 1896–97, and the Crescent Athletic Club of Brooklyn.

In a short time many colleges were attracted to the sport with the result that it soon became an important winter game. Not long after the colleges had accepted the game, club teams were formed, and eventually hockey was organized for professional play. A number of leagues employing paid athletes were formed, the strongest of which, the National Hockey league, came into being on Nov. 22, 1917, as an outgrowth of the National Hockey association founded in Montreal, Que., Dec. 2, 1909. This league in the beginning embraced only four teams, the Toronto Arenas, Montreal Wanderers, Montreal Canadiens and Ottawa Senators. It was successful from the start and in 1924 it expanded to include teams in the United States.

At one time ten teams, representing cities in Canada and the United States, were in the circuit. In 1942 the "loop" was reduced to six—the Toronto Maple Leafs, the Montreal Canadiens, the New York Rangers, the Boston Bruins, the Chicago Black Hawks and the Detroit Red Wings. Players are purchased by the teams for thousands of dollars. The National league season of 70 games, exclusive of the play-off games, runs from mid-October to April.

The Stanley Cup and Other Trophies.—The highest prize in professional hockey is the Stanley cup, a trophy put up for competition in Canada in 1893–94 by Lord Stanley, governor general of Canada. Until 1912 only amateur teams played for the cup, but thereafter professionals competed for it exclusively. The winner of the Stanley cup is regarded as the year's hockey champion.

The pattern of the National Hockey league's play-offs is an involved one. Six teams play one another through the regular season, and the teams occupying the first four places in the final standing qualify. The first-place team meets the third-place team, and the second-place meets the fourth-place. These survivors then oppose each other, strictly speaking, for the Stanley cup. All of these postseason series are decided on the basis of the best four out of seven games.

The Hart trophy, awarded to the player voted the "most useful" to his club in the league, was donated in 1923–24 by David A. Hart, father of Cecil Hart, who was coach of the Montreal Canadiens for many years. The Vezina trophy, awarded to the goalkeeper who allows the least number of goals to be scored on him during the regular season, was donated by the Montreal Canadiens in 1926–27 in memory of Georges Vezina, a great goal tender for the Canadiens, who suddenly collapsed in a game on the night of Nov. 28, 1925, and died a few months later of tuberculosis. The Art Ross trophy, donated in 1917 by the former manager and coach of the Boston Bruins, is given to the leading scorer. The Calder Memorial trophy, awarded to the player voted the "outstanding rookie" in his first year of professional hockey, was established in 1936–37 by Frank Calder, first president of the National Hockey league (1917–43). The Lady Byng trophy, instituted in 1925 and awarded the first time by the wife of Canada's governor general for whom it was named, is given to the player who best exemplifies clean play. The James Norris Memorial trophy, awarded to the defense man who is deemed the best at that position through a season, was first presented at the end of the 1953–54 season as a memorial to James Norris, owner of the Detroit Red Wings. The O'Brien trophy, awarded to the losing team in the Stanley cup finals, was donated in 1909 by Ambrose J. O'Brien. The Prince of Wales trophy, awarded to the team that finishes on top of the National Hockey league at the end of the regular schedule, was donated in 1924–25 by the prince of Wales (later King Edward VIII). In Aug. 1961 the Hockey Hall of Fame was opened at the Canadian National Exhibition grounds at Toronto.

(J. C. Ns.; E. J. J.)

EUROPEAN ICE HOCKEY

The following European countries hold membership in the International Ice Hockey federation: Austria, Belgium, Czechoslovakia, Denmark, East Germany, Finland, France, Great Britain, Hungary, Italy, Norway, Netherlands, Poland, Rumania, Sweden, Switzerland, the Soviet Union, West Germany and Yugoslavia.

In the 1960s the Big Three in European ice hockey were the Soviet Union, Sweden and Czechoslovakia. Many nations with established ice-hockey tradition, such as Great Britain, France, Austria and Switzerland, fell behind the Big Three.

Czechoslovakia.—Ice hockey has been a leading sport in Czechoslovakia since its introduction in 1909 by a group of field-hockey players. During the first 25 years the sport showed a slow but steady growth. In 1933 the National league was organized with a few teams of varying abilities competing. The calibre of play in the National league improved greatly in the late 1930s and 1940s, insuring the Czechs of strong representation in international competition.

In the 1960s, 12 teams of evenly matched ability comprised the first division of the National league. Games in this division were very popular with the public, and attendances exceeding 10,000 per game were commonplace. Senior and intermediate players numbered more than 35,000, while about 30,000 players competed in the junior and juvenile class. Formerly the sport had to depend upon the vagaries of the weather concerning natural ice, but later

many artificial ice rinks were built.

Great Britain.—A bandy-type game, similar to ice hockey, was played in England as early as 1895. It was known as shinty (shinny or shinney) in Scotland and as ice hurling in Ireland and was a crude game played on frozen lakes and rivers with curved sticks (bandies) and a ball (not a puck), with few rules and considerable bloodshed. It was not until the winter of 1902–03 that ice hockey was introduced into England at the Prince's Skating club in London, primarily through the efforts of resident Canadian students.

Until about 1926 the game remained a hobby for the participants and created limited public interest. During the next decade the sport passed from the hobby stage to one supported by the public. Club competition prospered and touring Canadian and U.S. teams awakened public interest. Soon the commercial possibilities of the game were realized and teams comprised entirely of imported Canadian players were formed and organized into senior-class British and Scottish leagues. The British league operated with clubs from both England and Scotland. In addition to the top-ranked British league, there were dozens of intermediate, junior and juvenile teams composed entirely of native English and Scottish players.

Scotland's ice-hockey development closely paralleled that of England except that the Scots produced better native players than England. Both countries were hampered in the development of players because of the lack of natural ice and the limited amount of artificial ice available.

Soviet Union.—Ice hockey as an organized sport was introduced to the Soviet Union in 1946 and showed a phenomenal growth. As in the Scandinavian countries the time-honoured game of bandy was gradually being replaced by ice hockey. In the 1960s, according to the Soviet Ice Hockey federation, about 105,000 players were actively engaged in competition in the Soviet Union.

Although the National club of the Soviet Union began competing in world tournaments as late as 1954, it made an enviable record and threatened Canada's supremacy in amateur ice hockey. Players forming the National team were groomed through the ranks of the Group A league. The Group A league, centred in the Moscow-Leningrad area, was composed of two divisions, the first division with nine clubs and the second with six. Sixty-three teams were divided into several divisions to form Group B. In addition to the Group A and B teams there were thousands of teams in the intermediate, junior and juvenile classes.

Sweden.—Sweden was first represented by an ice-hockey team in 1920 when a group of bandy players, under the guidance of the Swedish Soccer association, entered the unofficial Olympic ice-hockey matches at Antwerp, Belg. As in other northern European nations ice hockey in Sweden was replacing bandy as the popular winter sport.

After World War II the game made tremendous progress and in the 1960s there were 4,100 teams and an estimated 60,000 players, many of whom were not registered members of the Swedish Ice Hockey federation. The construction of numerous artificial ice rinks aided considerably in fostering the sport.

The best calibre of play was in the First Division league, composed of 16 teams, divided into north and south sections. Players from this league formed the Swedish National club, which established a distinguished record in international competition.

(D. M. C.)

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ICELAND (LÝÐHVELDIÐ ÍSLAND), an island in the North Atlantic ocean close to the Arctic circle. The area of the land mass is 39,698 sq.mi., excluding islands and skerries (58 sq.mi.), giving a total area of 39,756 sq.mi. The mainland lies between latitude 63° 24′ and 66° 33′ N. and between longitude 13° 30′ and 24° 32′ W. The shortest distance to Greenland is 155 nautical mi. and to Scotland 430 nautical mi. The capital is Reykjavik.

PHYSICAL FEATURES

Geomorphology.—Geologically Iceland is a young country as no rocks preceding the Tertiary period have been found. The main bedrocks are the basalt and the palagonite formations, each covering about one half of the country's area. The Icelandic plateau or flood basalts outcrop in the west, northwest and east. They are a part of the vast Brito-Arctic basalt province. The oldest visible flood basalts are of Eocene age. The underlying formations are not known, but seismic measurements indicate a total absence of a continental (granitic) layer beneath Iceland.

The Icelandic flood basalts were poured out mostly from fissure volcanoes and formed extensive, nearly horizontal sheets with an average thickness of *c.* 30 ft. The basalt formation in eastern Iceland is at least 20,000 ft. thick. Intercalated between some of the basalt sheets are sedimentary and pyroclastic beds (*see* VOLCANO). Numerous dikes cut through the lava sheets. Rhyolitic rocks, sills, stocks, laccoliths and lava beds, also occur within the basalt in the east. Gabbroic intrusions are also found. In the older basalts infillings of quartz, jasper and zeolites are common. The famous transparent Icelandic spar is found at Helgustadhir at Reydharfjördhur. The oldest parts of the basalt formation are, in many places, especially in the northwest, separated from the overlying basalts by layers of sandstone and shale in which plant remains, leaf impressions and thin layers of lignite (Ice. *surtarbrandur*), dating probably from the Eocene period, are found indicating a warm-temperate climate. Fossiliferous layers have been found within the younger strata of the basalt formation reaching into the Upper Tertiary (Pliocene). Beds of tillite are found within these basalts.

Near Húsavik in the north there are layers of marine shells, the Tjörnes formation, more than 1,500 ft. thick, belonging to the Upper Pliocene period.

The palagonite formation covers a broad median zone running northeast to southwest across the country. This zone widens toward the south so that it covers most of the central highland and the whole south coast from Breidhamerkursandur to Faxaflói. It also outcrops on the Snæfellsnes peninsula in the west and Skagi in the north. The most characteristic rock facies is a brownish tuff breccia rich in hydrated basaltic glass known as palagonite. Pillow lavas and breccias of globular basalt are abundant. These rocks, which the Icelanders call *móberg*, were formed by subglacial eruptions during the glacial periods of the Pleistocene. During the interglacials large areas were covered by flows of basaltic lava lighter in colour and coarser in texture than the Tertiary flood basalts. Glacial, fluvial and aeolian deposits are also common within the palagonite formation and plant-bearing and shell-bearing deposits have been found in several places, indicating a warmer interglacial climate.

During the glacial periods of the Pleistocene much of Iceland was covered by inland ice, but there were some marginal areas where plants and insects could survive. Neither the Westmann Islands (Vestmannaeyjar) nor the islands off the Reykjanes peninsula were covered by the last inland ice sheet. The isostatic uplift since the last glacial period amounts to at least 400 ft. in the interior and 100–160 ft. in the coastal areas. Marine terraces are found at different heights but are most common and extensive at the level 130–160 ft.

Volcanoes and Earthquakes.—In Iceland volcanism continued without interruption from the glacial into the postglacial periods, but the areas with active volcanoes have gradually become more limited in extent. In the postglacial period they have been limited to a median zone somewhat narrower than the zone of palagonite formation, as well as a small zone in western Iceland running from western Snæfellsnes to Nordhurárdalur, and the Öræfajökull district in the southeast. In all, the new volcanic areas cover about 13,500 sq.mi. Within these areas 150–200 volcanoes have been active in this period. Since the settlement of the country in the 9th century A.D. about 30 volcanoes have been active, and during the last few centuries eruptions have occurred on average every fifth to sixth year. It has been estimated that one third of the total output of lava on the earth since A.D. 1500 has come from Iceland's volcanoes. Besides their great productivity,

Player trying to get control of puck while closely guarded from behind by an opponent

Recovering the puck after a missed goal shot by the opposing team, player at right is coming from behind the net. The player at left is skating to intercept him

Teamwork at the net. The player in the left foreground has just received the puck from a teammate and shoved it past the goalie to score

Scoring a goal. The puck is entering the net after being shot between the legs of the goalie

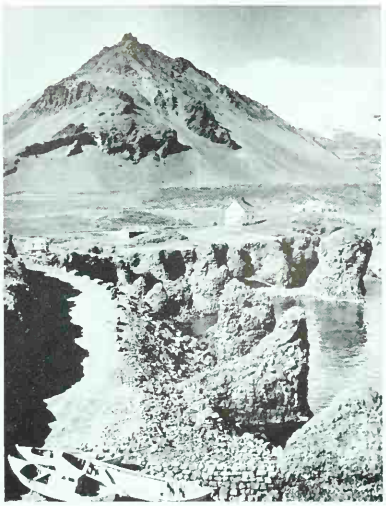
Goalie making a stop of an attempted goal

View of a hockey rink, showing play and the position of the two goals

ACTION OF PLAY IN ICE HOCKEY

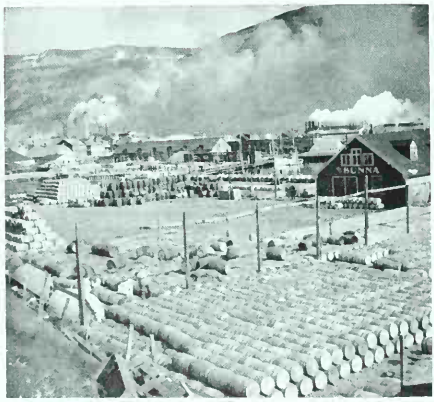
PHOTOGRAPHS, (TOP LEFT) INTERNATIONAL NEWS SPEEDRAY PHOTO, (TOP RIGHT) INTERNATIONAL, (OTHERS) ACME

ICELAND



Isolated farmhouses at Stapi on the Snæfellsnes peninsula with the Snæfellsjökull, a glacier that rises on an extinct volcano, in the background

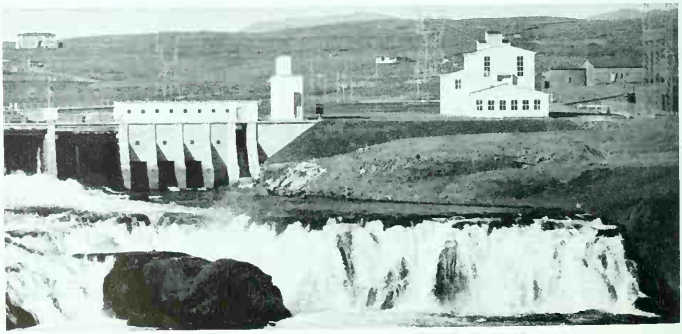
Aerial view of Reykjavik on Faxaflói (Faxa bay), the capital and only large town of Iceland. The tanks in the foreground are used for storing hot water drawn from natural thermal springs



The herring port and processing plant of Siglufjördhur in northern Iceland

Old Icelandic farm buildings at Glaumbær in Skagafjardharsýsla

ICELANDIC SCENERY



Irafoss (Irishman's waterfall) and dam, site of a modern power station, on the Sog river

BY COURTESY OF (TOP LEFT, CENTRE RIGHT) ICELAND TOURIST INFORMATION BUREAU, (CENTRE LEFT) ICELANDIC AIRLINES, INC., (BOTTOM) "PEPSI-COLA INTERNATIONAL PANORAMA", PHOTOGRAPH, (TOP RIGHT) CLAUDE JACOBY—PIX

the new volcanic areas of Iceland are also unique as regards the variety of volcanic phenomena. Located there are most of the morphological types of volcanoes found on the earth.

Postglacial volcanism has been predominantly effusive, producing mainly basaltic lava. The most common types of the lava-producing volcanoes are crater rows and shield volcanoes. A crater row is the result of a single eruption from a linear vent or fissure, producing both lava and tephra (pyroclastic material) that forms a chain of craters usually less than 300 ft. high along the fissure. The Laki fissure southwest of Vatnajökull extends nearly 20 mi. and embraces about 100 separate craters. In 1783 the biggest lava flow produced by any eruption within historical time outpoured from this fissure, covering 218 sq.mi. The shield volcanoes are central volcanoes of the Hawaiian type, shield-shaped cupolas composed entirely of layers of lava and with a large crater on top. The angle of slope is usually about 7°. A typical example is Skjaldbreidhur near Thingvellir. No shield volcano has erupted in Iceland since the beginning of settlement.

PHYSICAL FEATURES AND PRINCIPAL TOWNS AND VILLAGES OF ICELAND

Another type of central volcano in Iceland is the stratovolcano of the Fuji type built up by many eruptions producing both lava and tephra. This type is not common, but to it belong the larger volcanoes such as Öræfajökull, Iceland's highest mountain (6,950 ft.), Eyjafjallajökull (5,464 ft.), Snæfellsjökull (4,730 ft.). The eruption of Öræfajökull in 1362 was the biggest explosive eruption in Iceland since the beginning of settlement. The highest cone volcanoes are icecapped as also are two of the most active volcanoes, the Katla volcano, hidden beneath the ice cover of Mýrdalsjökull and Grímsvötn in the centre of Vatnajökull. Their eruptions are accompanied by tremendous floods, the so-called glacier bursts (Ice. *jökulhlaup*). The maximum discharge of the glacier bursts from Katla may exceed that of the Amazon river. The most famous volcano, Hekla, has been built up by many mixed fissure eruptions that have formed a vaulted ridge, which now has a maximum height of 4,892 ft. During eruptions the ridge is split lengthwise forming a 3.5-mi.-long fissure. The last eruption cycle of Hekla started with a disastrous rhyolitic explosive eruption in A.D. 1104, destroying vast areas. Since then Hekla has erupted at least 15 times. At the beginning of its eruption in 1947 the eruption column rose to 100,000 ft. and the lava covered 25 sq.mi. In the highland northeast of Hekla there are numerous explosion craters or *maare*, with crater lakes. A violent explosive eruption which took place within the Askja *caldera* in the northern highland in 1875 caused great damage in the east. In Nov. 1963 a volcanic eruption resulted in the formation of a small island 10 mi. S.W. of the Westmann Islands. Postglacial lavas cover about 10% of the total area of the island. Icelanders discern between two types of lava field, *helluhraun*, corresponding to the Hawaiian pahoehoe, and *apalhraun*, corresponding to the aa lava and block lava (*see* VOLCANO: *Lava Flows*). The largest unbroken lava field in Iceland is Ódádhahraun, about 1,800 sq.mi., formed by numerous eruptions from fissures and shield volcanoes. The largest single postglacial lava flow is the great Thjórsá lava, which reaches the south coast between Thjórsá and Ölfusá. It covers 300 sq.mi. Earthquakes are frequent in Iceland, especially in the western part of the south Iceland lowland and in the Skjálfandi region in the north.

Thermal Activity.—Iceland is very rich in natural heat. Thermal activity can be divided into two types, high-temperature activity (solfatara; *q.v.*) and low-temperature activity or natural hot water activity. High-temperature activity is limited to the new volcanic median zone where there are 14 solfatara fields. They are characterized by steam holes, mud pools and precipitation of sulfur; their subsurface temperature may be affected by intrusions of Recent Age. The main high-temperature areas are Torfajökull, east of Hekla, and Grímsvötn in Vatnajökull. Next in order of size are Hengill, Kerlingarfjöll, Námafjall and Kverkfjöll. Low-temperature areas with hot springs are found everywhere but they are sparse in the east Iceland basalt area. There are about 250 thermal areas of this type with a total of more than 600 major springs. Their water is mostly alkaline, precipitating silica. The springs are associated with dikes and fracture lines, their water being percolated ground water. Some of them are spouting springs or geysers, the most famous of which is Great Geyser (Geysir, whence geyser; *q.v.*) near Haukadalur.

The exploitation of natural-heat resources in Iceland was initiated in 1925; now more than 45,000 people live in houses heated in this way. Greenhouses and swimming pools are heated and there is potential utilization of natural steam for generation of electric power.

Glaciers, Lakes and Rivers.—Glaciers cover 4,556 sq.mi. or 11.5% of the country's area. The glaciation limit is lowest (about 2,500 ft.) in the northwest, and highest (about 5,000 ft.) in the interior north of Vatnajökull. Nearly all types of glaciers occur, from small cirque glaciers to extensive plateau icecaps, drained by broad lobe-shaped outlets or by valley glaciers of alpine type. The major area of plateau ice is Vatnajökull, 3,240 sq.mi. and up to 3,300 ft. thick. One of its southern outlets, Breidhamerkurjökull, reaches 350 ft. below sea level. Other major plateau icecaps are Langjökull (394 sq.mi.), Hofsjökull (381 sq.mi.) and Mýrdalsjökull (264 sq.mi.).

Iceland possesses a great number of lakes of diverse origin. The largest is Thingvallavatn (32 sq.mi.), formed by subsidence, the second largest, Thórisvatn (27 sq.mi.), is lava dammed, as also is Mývatn in the north, famous for its scenery and rich bird life. Hvítárvatn and Lögurinn (Lagarfljót) fill glacier eroded basins; Grænalón is ice dammed. Small moraine dammed lakes are numerous especially in the high land northwest of Langjökull.

The number of streams of relatively great volume is due to high rainfall and abundance of glacial meltwater. The longest river is Thjórsá (143 mi.), the second longest Jökulsá á Fjöllum (128 mi.). These rivers and other glacier streams are heavily laden with debris and are of yellowish-brown colour, and their variation in

discharge is great, whereas the rivers that drain the postglacial lava fields carry crystal-clear water and have a very constant discharge. Typical of the geologically youthful Icelandic landscape are the many waterfalls, the most famous being Dettifoss (144 ft.), Gullfoss (105 ft.) and Skógafoss (200 ft.).

Landforms.—The landscape bears all the signs of a country that is geologically young and still in the making. Iceland is to a great extent a tableland. Its average height is 1,650 ft. As to the main landscape features there is a great difference between the Tertiary plateau-basalt areas and the young-volcanic ones. The old basalt plateau units have been broken up into a mosaic of blocks. In the north and east these blocks mostly dip toward the interior so that the greatest heights occur near the coasts. These basalt areas are alpine, with crest elevations up to 5,000 ft. In the Vestfirdhir area the original plateau character is better preserved and the landscape of the basalt areas may be characterized as a plateau and fjord landscape. The fjords are the result of glacial deepening and widening of valleys originally eroded by more or less tectonically guided rivers. The surface of the basalt blocks is mostly bare and desolate. The fjord sides are steep and with a characteristic trap appearance.

The palagonite tuff areas form a tableland but of quite another type. In the south there are extensive lowland plains stretching inland from the coast. They were formed as a strand-flat or wave-cut platform. A smaller lowland plain is found at the head of Faxaflói. Inland is a plateau 1,000–2,000 ft. high, and above that plateau rise the massifs covered by the major glaciers and numerous postglacial volcanoes as well as Pleistocene table mountains and tuff ridges, built up by central and linear subglacial eruptions. In the south practically all young fracture lines as well as tuff ridges and crater rows run northeast–southwest; in the north they run north–south. The axis of highest elevation of the country stretches from Hvammsfjördhur in the northwest to Hornafjördhur in the southeast. The coasts of the basaltic areas are rock coasts, irregular in outline. The southeast and south coasts are almost entirely sandy and smooth in outline, with extensive bars backed by lagoons. Parts of the coasts of Breidhafjördhur and Faxaflói have island-fringed coasts (*Skärgård*).

In Iceland endogenic forces work rapidly together with the exogenic agents which include glacial and fluvial erosion, marine abrasion, frost weathering and wind erosion. The soils are mainly of two types, peat and loess. The destruction of the loess by wind erosion increased rapidly after the arrival of man and vast areas have been laid bare of soil cover.

Climate.—The climate is cold temperate and oceanic, influenced by the country's situation on the boundary zone between two different air masses (the polar front) and by the confluence of two different ocean currents. Because of the submarine ridge between Iceland and Scotland a branch of the North Atlantic drift is deflected westward and flows clockwise along the south and west coasts of Iceland where the harbours consequently are ice free the whole year round. The north and northeast coasts are washed by arctic water brought mainly by a branch of the East Greenland Polar current. This current sometimes brings drift ice to these coasts especially in April and May, occasionally blocking them until late summer. Because of a climatic amelioration there has been no blockade by drift ice since 1920.

In Reykjavík the mean annual temperature is 4° C. (40° F.), the mean January temperature −6° (31°) and July 11° (52°). Corresponding figures for Akureyri in north Iceland are 3° (37°), −2° (28°) and 11° (52°). The wettest regions are in the south and southeast. The mean annual precipitation in Vik on the south coast is 82 in.; on the southern slopes of Vatnajökull and Mýrdalsjökull it is at least twice as high, whereas in the high land north of Vatnajökull it drops to 16 in. The weather is on the whole very changeable and depends mostly on the routes of the depressions crossing the North Atlantic. The passage of a depression south of Iceland brings relatively cold and dry weather, whereas one passing northeastward between Iceland and Greenland brings mild weather, very rainy in the south and moderately dry in the north. Fogs are rather rare except in the Austfirdhir area. Thunderstorms are also rare. (S. Th.)

Vegetation and Animal Life.—The flora and fauna are predominantly of Palearctic origin although a small contingent of Nearctic (American) elements have reached the island from the west. The flora is largely subarctic in character. The phanerogams (seed-producing plants) and vascular cryptogams (plants that do not produce seeds) are represented by about 500 species. The small number of species is partly due to Iceland's insularity after the Ice Age. Vegetation is characterized by an abundance of grasses, sedges and related species. Grasslands, bogs and marshes are extensively distributed and there is much moorland and heathland. The unstable climate, volcanic activities, glacier movements and overgrazing have all contributed to prevent the vegetation from reaching its highest development. Consequently only about one quarter of Iceland's total area has a continuous plant cover. Even in the low-lying inhabited districts there are large areas of bare rocks, stony deserts, sandy wastes and lava streams. The vegetation has been greatly modified during the ten centuries of human occupation. The once extensive birch-woods were destroyed by ruthless cutting and grazing so that only remnants of them survive. Since about 1930 reafforestation experiments with conifers have been made on a substantial scale.

At the time of the settlement the arctic fox was the only land mammal in Iceland. The brown rat, the house mouse and the field mouse were later accidentally introduced by man. Reindeer were imported in the 18th century, and mink, originally introduced for fur farming, have reverted to the wild state. In years of excessive drift ice polar bears occasionally visit Iceland. About 200 species of birds have been known in the island; of this number 70 species are regular breeding birds, 6 transient migrants, 30 are regular drift migrants or winter visitors, and the others are accidentals. Sea birds, waterfowl and waders are the most abundant indigenous birds. The best known include the Iceland falcon, rock ptarmigan (the only game bird) and the eider duck, the object of the ancient industry of eider duck farming and rigidly protected by law. There are no reptiles or amphibians but about 800 species of insects are known. Rivers abound in salmon, and trout and char are plentiful in lakes and streams. Plankton in Icelandic waters provides optimum conditions for a rich marine fauna. There are about 15 species of whales and 2 species of indigenous seals (the common seal and the gray seal); four other species of seal visit Iceland in winter. Salt-water fish number about 150 including cod, haddock, herring, Norway haddock, halibut and plaice, which together form the basis of large-scale coastal fisheries. (F. Gu.)

THE PEOPLE

The Icelanders are of Nordic origin, with considerable early blending of Celtic blood. From A.D. 874-930 onward the introduction of foreign elements has been negligible. Although persons of related nationalities have occasionally settled in Iceland, their descendants have been completely assimilated into the population, which has been homogeneous from the beginning. In appearance the Icelanders are similar to the Scandinavians, but there is a higher percentage of dark-haired types than is to be found in Norway and Sweden. There are no Eskimos in Iceland.

Icelandic is one of the Scandinavian group of languages and is of Germanic origin. (*See* ICELANDIC LANGUAGE; ICELANDIC LITERATURE.)

The Evangelical Lutheran Church is the established church of Iceland. From the late 19th century there has been full religious freedom. In the 1950 census report the membership of religious groups per thousand of the population was as follows: established church and other Lutherans 974.3; other religious denominations 10.1; no religious denomination 15.6. Sectarian bodies are few; only the Roman Catholics and the Adventists have formed their own congregations. Iceland forms one bishopric with its see in Reykjavík, with two suffragan bishoprics in Reykjavík and Akureyri. There are about 280 parishes served by about 100 ministers.

Icelandic missionaries have worked in China and in the mid-20th century were in Ethiopia.

The culture of Iceland is primarily known in connection with the golden age of literature in the 12th and 13th centuries, when

the Icelanders' Sagas were written. After 1300 Icelandic literature suffered a severe decline and it was not until the 19th century that there was a real reawakening.

Wood carving, goldsmiths' work, weaving and drawing are old crafts, painting is more recent. Reykjavík has a national theatre and a symphony orchestra. (VA. K.)

Population.—Approximately 20% of the total area of Iceland is inhabited. The interior, considerable peripheral mountain areas and the glacial outwash plains are uninhabitable. Except for the lowland plains in the south and southeast the settlements are limited to a narrow coastal belt and to valleys. The rural settlement pattern has always been one of single farms. During the first centuries of settlement the inhabited areas extended farther into valleys than they do now; most modern farms are situated below 650 ft. and only four farms lie above the 1,300 ft. level.

The population of Iceland, then entirely rural, is estimated to have been about 70,000 in A.D. 1100. At the first census taken, in 1703, the population numbered only 50,338; in 1801 it was 47,240 but since then has steadily increased and was estimated at 183,478 on Dec. 1, 1962. The birth rate is still high (27.9 per thousand 1951–55) and the death rate is among the lowest in the world (7.3 per thousand 1951-55). Until the middle of the 19th century the population was entirely rural but the removal of the Danish trade monopoly in 1854 and the rapidly increasing importance of the fishing industry toward the end of the century initiated an urban development, and in 1957, 78% of the people lived in towns and villages with more than 300 inhabitants.

The capital, Reykjavík (*q.v.*), had a population of 71,037 in 1959. Other towns are Akranes, Akureyri (8,589), Hafnarfjördhur (6,881), Húsavík, Ísafjördhur (2,808), Keflavík, Kópavogur, Neskaupstadhur, Olafsfjördhur, Saudhárkrókur, Seydhisfjördhur, Siglufjördhur (3,015) and Vestmannaeyjar (4,609). (S. TH.)

HISTORY

Seafarers had some idea of the existence and position of Iceland as early as the 4th century A.D., but no settlement is known to have been there before the 9th century, when Irish hermits set up their dwellings in a few places. Little is known of these people and old Icelandic authorities say that they went away when pagan settlers began to arrive.

Ingólfur Arnarson, a chieftain from west Norway, began the settlement of Iceland when he moved there with his family and dependents in A.D. 874. He established himself on the site of what is now the capital, Reykjavík. For 15 years the flow of new settlers went on slowly and increased in volume toward the end of the century, probably because Harald Fairhair became king of Norway after the battle of Hafrsfjord, about 885 (sometimes dated 872) and extended his rule over the Shetland and Orkney islands about 890. The settlement of Iceland, followed by the discovery of Greenland and Vinland (mainland of North America) from there, may be said to be consequent on the upheaval of the viking age. The earliest settlers, who were doubtless of mixed descent, came from the countries and districts where the vikings had been dominant for centuries, from the west coast of Norway, from Ireland, Scotland, Orkney, Shetland and the Hebrides.

Some of the first settlers, such as Ingólfur Arnarson, Skallagrímur Kveldúlfsson, the father of Egill Skallagrímsson, Auður, the widow of Ólafur the White, king of Ireland, and her kinsman Helgi the Lean, appropriated large areas of land which they distributed later to their friends, followers and protégés. Later settlers secured smaller areas. Until the end of the 10th century the country kept the characteristics of recent settlement, the landholdings were large with few and widely scattered buildings; each homestead contained a large number of people and was practically a self-supporting, economic whole.

In the beginning, the people lived mostly by fishing, but sheep farming soon became the second most important industry. By about 1100 economic conditions were satisfactory. The population at about the time when the tithe laws were passed (1096) was between 70,000 and 80,000, a total which was not exceeded until about 1900.

The Icelandic Commonwealth.—Before a general system of legislation and organized government could be achieved a kind of local government was evolved by which the people of each district who had most dealings together formed into groups under the leadership of the most important or influential man of the district; he acted as judge and mediator in the disputes of his neighbours and took the lead in communal activities such as the building of places of worship and the performing of religious rites. These leaders were called *godhar* (sing. *godhi*) and it is thought that the word derives from this religious function, but in the age of settlement in Iceland the word *godhi* primarily meant "chief", although it occurs in its older meaning in Danish and Swedish runic inscriptions. Local assemblies such as *Kjalarnesthing* and *Thorsnesthing* were heard of before the establishment of the *thing* (general assembly) and they show the way in which the local chiefs tried to organize law and order for their own districts, which in turn led to the co-operation of all the chiefs in founding a national parliament (*althing*) and the adoption of a general system of law for the whole country. The Icelandic commonwealth was established in 930 and the first session of the *althing* was held, probably on the site of the *Kjalarnesthing*, near Reykjavík, but it was soon moved to Thingvellir by the Öxará river. The oldest code of laws, called Úlfljóts laws from the name of the man who compiled them, may have been founded partly on the laws then in force in the Gaulathing district of Norway.

The old Icelandic commonwealth was based on the first foundations of government laid in the age of settlement. Its main instrument was the *godhordh* (chieftancy). The *godhar* became the rulers of the country and together with their advisers constituted the *lögrétta* (legislature) of the new *althing*. The *godhar* administered justice in their own districts and matters not settled there were referred to the *althing*. In this way they held both the legislative and the judicial power. There was no national executive power, but to the *godhar* fell the duty of seeing that such men as accepted their leadership received their rights, and to this extent they held the executive power.

The extent of the *godhordh* was not fixed by territorial boundaries. Those who were dissatisfied with their chief could attach themselves to another *godhi*. His power was therefore in direct proportion to his personal prowess and ability. As a result rivalry arose between the *godhar*, as may clearly be seen from the Icelandic sagas. The position of *godhi* could be bought and sold, as well as inherited; consequently, with the passing of time the *godhordh* for large areas of the country became concentrated in the hands of one man or a few men. This was the principal weakness of the old form of government: it led to a struggle for power and was the chief reason for the ending of the commonwealth and for the country's submission to the king of Norway (1262–64).

The old form of government became modified in the course of time. The laws of the commonwealth that remain (the Grágás code) show organizing ability, farsightedness and accuracy, and skill in resolving procedural and legal difficulties. Modifications were, for instance, the division of the country into quarters and the setting up of courts of justice for each quarter after the middle of the 10th century, and the establishment of the fifth court, *i.e.*, a court of appeal, about 1000.

Toward the end of the 10th century Christian missions came to Iceland. After great disputes which nearly led to civil war, the *althing* enacted a law in 1000 that all inhabitants of the country should be Christian, primarily for political reasons in order to preserve the commonwealth. The old pagan gods were sacrificed to expediency but the power of the *godhi* remained as before. The place of the temples of the gods was taken by the old Icelandic church, the church of the *godhi*. Until the end of the 12th century it was a common practice for the lay chieftains to have a scholarly education and to receive ordination and the bishops of the country until the end of the 12th century were men of this kind. In 1056 the first Icelandic bishop Isleifur Gissurarson of Skálholt was ordained at Bremen; until then Iceland had only known missionary bishops. After 1106 the country possessed two bishoprics, at Skálholt and at Hólar. In 1096 the tithe laws had been passed, thus ensuring the church's financial security. Yet even after this many churches in the country were privately owned by farmers

or chiefs, and disputes arose when the clerics began to try to undermine the secular power after the end of the 12th century. These disputes were not settled until after the fall of the commonwealth, when the church emerged the victor in the struggle.

The traditional culture was fostered in the centres of learning of the old church, at Haukadalur, Oddi, Skálholt, Hólar, and in the monasteries. Slavery was abolished before 1100. Despite the distinction conferred by power and wealth, men were honoured for their personal qualities. Sports and trials of skill and strength were popular, and from the early days of the commonwealth it was customary for all, even the chiefs themselves, to take part in the labours of husbandry. The people's daily lives were shaped by their occupations of agriculture, fishing, spinning and weaving and boatbuilding. There was great social activity, especially at midsummer, in the autumn and at Christmas, when there were feasts and drinking sessions.

Lack of progress in economic life after 1200 was chiefly due to the fact that the main industry, sheep farming, had reached its peak with the methods then followed. The increased severity of the climate also had some effect, as did the internecine quarrels, which became frequent after 1200. Trade grew more difficult because in the latter part of the commonwealth period it fell more and more into the hands of Norwegian merchants and Icelandic shipping disappeared gradually, largely because of lack of shipbuilding timber in the country.

It is stated in medieval writings that, already in early times, the kings of Norway entertained the idea of gaining control of Iceland. King Olaf (995–1030) the Saint may, in particular, be mentioned as an example. When the archiepiscopal see was established in Nidaróss (Trondheim) in 1152, Iceland was included in the Norwegian province and the Norwegian archbishops soon began to interfere in the affairs of the Icelandic church, increasingly so after 1200. At the same time, the balance of power between the lay chieftains of Iceland was disturbed, and the resulting internal conflict prompted the kings of Norway to intervene in Icelandic politics. The final stage in this struggle began in 1237; Norwegians occupied the episcopal sees of Iceland from 1238 onward and supported the authority of the king. After a bloody struggle between most notable Icelandic families, Haakon IV, the Old (1204–63), succeeded in forcing the Icelanders to submit to his authority. Thus the Icelandic commonwealth came to an end.

The 14th, 15th and 16th Centuries.—Iceland, with Norway, fell under the sovereignty of the king of Denmark in 1380 and they were formally united in the union of Kalmar in 1397. The conduct of Icelandic affairs went from bad to worse. From the early 14th to the mid-15th century, foreigners occupied the sees of Iceland. Some of them were efficient ecclesiastical leaders, but most of them thought chiefly of amassing wealth for themselves and of advancing their own power and that of the church. The royal agents were often foreigners as well; some of them were so unpopular and tyrannical that on occasion the people rose in rebellion and put them to death. In addition to these issues there were conflicts: first, between English and German merchants competing for the Iceland trade; and second, between the merchants and the royal agents. The king claimed the exclusive right to control trade with Iceland and the government was apprehensive lest merchants of other nations should settle there.

When Christian III came to the throne in 1536, he made it his business to introduce two radical alterations in the affairs of Iceland. In the first place, he planned to introduce the Lutheran religion and thus to destroy the ancient authority of the church. Second, he planned to suppress trading by British and German merchants and put the entire Icelandic trade in Danish hands. The Reformed Church was established in Iceland in 1551 after a hard struggle, during which the last Catholic bishop in Iceland, Jón Arason, and two of his sons were beheaded at Skálholt, without trial, in the autumn of 1550.

The Reformation enabled the king to appropriate gradually all the monastic property, as well as some of the church properties and sources of revenue. The king and the church together owned half the landed property of Iceland, until the 19th century. As a result, the royal revenue from Iceland was greatly increased. At the same time, the government fiercely excluded foreign merchants who sought to trade with Iceland. The policy was successful and the Iceland trade became a Danish monopoly in 1602.

The 17th and 18th Centuries.—The history of Iceland in the 17th century continued to be characterized by a rigid mercantile system for the exclusive profit of Denmark but the general economic decline had serious effects by the end of the century. In 1703 the population of Iceland was approximately 50,000, of which about 20% were beggars or dependents. The population sank to about 35,000 from 1707 to 1709 because of a serious epidemic of smallpox. The population again declined below 40,000 in the years 1752–57 and 1783–85 because of famine and natural disasters. The resistance of the people was broken and their sources of livelihood exhausted.

These facts were clear to everyone but at first the chief evil, the monopoly, remained unaltered. An attempt was made between 1751 and 1760, under the leadership of Skúli Magnússon, to introduce improvements and innovations in the various sources of livelihood—in industry, agriculture, livestock breeding and fisheries—but the monopolists felt that their rights were being infringed, and they succeeded in ruining these attempts at rehabilitation. The same may be said of the efforts of Jón Eiríksson, another influential Icelander in the Danish government from 1773 to 1787 who was consulted about economic and commercial affairs. The monopoly was finally modified in 1787 and all subjects of the king of Denmark were given the right to trade in Iceland. This, together with improved seasons at the end of the 18th century helped to revive the economic life of the country, and the conditions of the people slowly improved.

The 19th Century.—In the summer of 1809 an English merchant Samuel Phelps and his confederate Jörgen Jörgensen imprisoned the governor and proclaimed Iceland free under the protection of Great Britain. This revolt was soon crushed by the intervention of Great Britain at the instance of Magnus Stephensen.

Icelandic politics entered on a new era in 1831 when the king of Denmark's move to establish a legislative parliament in his realm led to a movement for the revival of the *althing*, which had ceased to meet in 1800. This movement had become powerful by 1840 when a new Icelandic leader, Jón Sigurdsson (*q.v.*, 1811–79), appeared demanding a complete social, economic and constitutional change in Iceland. The *althing* was restored in 1843. The Iceland trade was opened to all nations in 1854 and led to some progress in communications, agriculture and the fisheries. The struggle for autonomy absorbed most of the energy of the *althing* and of Jón Sigurdsson, but the Danish government remained stubborn. Finally, in 1874, the millenary of the settlement, Iceland was granted a constitution. The *althing* shared legislative power with the king, as well as control of finance. The history of Iceland in the latter part of the 19th century is characterized by the struggle for better government, greater autonomy and, at the same time, improvement in economy and education. The Danish government firmly resisted any change in the administration of Iceland until the 20th century; progress was also impeded by bad seasons in the 1890s. This caused unemployment, and one result was widespread emigration to Canada, so that the population of Iceland hardly increased.

Social and Economic Conditions.—Although the conditions under which the Icelandic people lived in the early 19th century were generally better than they had been for some 200 years, the country was still very backward. No roads had been built and there were only tracks trodden by horses; all transport of men and merchandise between farms, districts and even provinces was by horseback. None of the streams and torrents of the country were bridged; there were no harbour constructions on the coasts, no lighthouses and no regular coastal shipping. All imports, carried by small sailing vessels direct from Denmark, were unloaded in coastal harbours and fjords. Agriculture was on a small scale, and farming methods were still those of the commonwealth. The organization of the fisheries was also primitive, pursued mostly with small rowboats and hand lines. Trade was still mainly in the hands of Danish companies. Standards of education were poor and all Icelandic affairs were dependent on the government offices in

Copenhagen, which were run by men who knew little or nothing about Iceland.

Despite this, the first lighthouses were built during this period, and a start was made with regular coastal shipping. The first roads suitable for wheeled traffic were built and some of the larger rivers were bridged. Great progress was made in agriculture and agricultural colleges were founded. Considerable advances were also made in the fisheries and there was much more fishing from decked ships. At the end of the 19th century trawl fishing began. Icelanders began to have more control over their own trade after 1870. Collaboration between the farmers in many parts of the country had important results; they formed societies for trade on a co-operative basis. Trade was chiefly with Great Britain where, initially, they exported sheep and horses. Development was much impeded by the shortage of capital; the first bank, the National Bank of Iceland (Landsbánki Íslands), was founded in 1885, but for many years it was insignificant. This was partially remedied when a new bank, with some foreign capital, was established, but its purpose was chiefly to foster the new and growing trawler industry.

In 1903 Iceland obtained a new constitution, giving further independence in internal affairs under the control of a native Icelandic minister in Reykjavik. After this change much progress and improvement was made in all branches of life; Iceland was linked by telegraph with other countries in 1906 and fisheries developed speedily with steam trawlers and motorboats. Foreign trade became easier, and fell more under the control of Icelanders. Emigration to North America stopped and the population of Iceland increased, while towns and villages grew up around the chief fishing harbours. Maritime communications, both coastal and foreign, had formerly been in the hands of Danish shipping companies, but in 1914 the Iceland Steamship company (Eimskipafjélag Íslands) was founded and quickly took over most of the work of the foreign companies. Great efforts were made to improve inland communications. The first automobiles were brought to Iceland just before World War I, and since then motor vehicles have formed the chief means of transportation. Much progress was also made in education. A general education act was passed in 1907 and the University of Iceland was founded in 1911 on the centenary of Jón Sigurdsson's birth.

World War I delayed progress. In 1923 new agricultural laws were passed which, with the aid of modern equipment, revitalized Icelandic agriculture. After 1920 factories were erected for fish and fish products. Communications were further improved by means of motor roads connecting most of the inhabited parts and regular coastal shipping services. After World War II communications by air both inland and overseas expanded considerably and there was great progress in industry and agriculture and an improvement in the standard of living.

In 1918 the long-lasting dispute between Iceland and Denmark was settled by a treaty recognizing Iceland as an independent state under the king of Denmark. This treaty was made for 25 years and was terminable by either party. In 1937 the *althing* proclaimed that the treaty would not be renewed on its expiration. After the German invasion of Denmark in World War II, the British and later the Americans occupied Iceland in order to prevent a German occupation, and normal communication between Iceland and Denmark ceased. The executive power was of necessity taken over by the Icelandic ministry after April 9, 1940, with Sveinn Björnsson as regent. In 1941 the *althing* proclaimed that it considered the treaty to be virtually terminated, as the Danes were not in a position to carry out its terms, and announced that a republic would be founded in Iceland as soon as the treaty was formally annulled. But the war continued and it was considered inadvisable to delay the matter any longer. On May 17, 1942, the *althing* passed two resolutions: (1) that Iceland did not intend to continue the union when it expired on Jan. 1, 1944; and (2) that Iceland intended to become a republic. On Feb. 25, 1944, the *althing* proclaimed the treaty terminated and decided to hold a plebiscite with regard both to this action and to the constitution of the new republic. Of the votes cast, 97.35% supported the decision of the *althing*. On June 16, 1944, the *althing* declared the union with Denmark to be at an end and on June 17 the republic was founded at Thingvellir with Björnsson as its first president.

In 1948 Iceland became a member, with Denmark, Norway and Sweden, of a joint northern committee for economic co-operation, and in 1949 it accepted an invitation to join the North Atlantic Treaty organization and took part in the first meeting of the Council of Europe. Two hydroelectric power stations, begun in 1951 with the aid of European Recovery program funds, were completed in 1953. In Jan. 1952 Björnsson died, and in the presidential elections, held the following June, Ásgeir Ásgeirsson was elected for a four-year term of office. Ásgeirsson began a further four-year term of office on Aug. 1, 1960.

Foreign Relations.—On May 15, 1952, Iceland moved the limits of its fisheries outward to a perimeter four miles from lines drawn between its longest promontories and between islets and rocks offshore, enclosing many productive grounds (particularly Faxaflói and Breidhafjördhur) previously open. This terminated the agreement made in 1901 between Denmark and the United Kingdom which made the limit 3 mi. In retaliation British trawler owners at Hull and Grimsby refused facilities to Icelandic vessels.

The U.K. government proposed to submit the dispute to the International Court of Justice, but Iceland demanded that the retaliatory measures be lifted first. The British foreign office declared that these measures had been originated by private industries over which the British government had no control. In 1954 the Icelandic government submitted to the Council of Europe a memorandum on this dispute to which the British government replied in May 1955 asking for a compromise.

The refusal of landing facilities to Icelandic fishing vessels in English ports caused Iceland to search for new markets for its fish and fish products. The Soviet government used this opportunity to conclude on Aug. 1, 1953, a trade agreement of $12,000,000 each way, under which the U.S.S.R. was to take fisheries products in exchange for petroleum products, cement and cereals, it being stipulated that Iceland should take no other foreign petroleum products. This agreement was renewed in Sept. 1955 until the end of 1956, and has since been renewed. The chief result of the embargo on Icelandic fish was that the U.S.S.R. took the place of the United Kingdom in trade with Iceland. When the embargo was lifted in Nov. 1956, it became clear that the sale of fresh fish to the United Kingdom had no longer any real importance for Iceland, because processing fish and the products of the fisheries had so much developed and increased. The extension of the territorial waters in 1952, although less than it should have been, soon showed the results of protecting breeding banks off the coasts of Iceland from trawl fishing. It was necessary to extend the territorial limit still further.

When the congress concerning territorial waters was held in Geneva in 1958, it was made plain that the great majority of the 86 nations who took part rejected the old rule of the 3-mi. limit. Even the British were prepared to accept a 6-mi. limit, but the proposal to extend the limit to 12 mi. won more support than any other, although it did not get the majority necessary to give it force in international law. The Icelanders made the decision to extend their territorial limits to 12 mi. on Sept. 1, 1958, following the example of various other nations, who had already adopted this rule. Many nations protested against this, including the British, who for more than a year had sent warships to accompany their trawlers fishing within the 12 mi. limit. On the other hand, all other nations have respected the limit in practice. The dispute between Iceland and the United Kingdom was settled by an agreement made on Feb. 27, 1961, whereby the U.K. accepted the 12-mi. limit but for a transitional period of three years British trawlers were allowed to fish in a greater part of a 6–12 mi. zone at specified seasons of the year. (T. J.)

ADMINISTRATION AND SOCIAL CONDITIONS

Government and Constitution.—Since June 17, 1944, Iceland has been a republic. The executive power is vested in the president and the government; administration is in the hands of the cabinet; and the legislative power lies with the president and

the *althing* (the national parliament). All citizens over 21 may vote in presidential and parliamentary elections which are held every four years. The judicial power lies with the lower courts and the supreme court.

From mid-1959 the *althing* has been composed of 60 members: 37 chosen from five- or six-member constituencies, 12 from the capital, and up to 11 supplementary members assigned to parties which had not gained seats in proportion to their voting strength. The *althing* meets every year in Reykjavík and is usually divided into two houses, with equal constitutional power: *efri deild* (upper house) and *nedri deild* (lower house), but on certain occasions both houses work together.

No single political party has been able to command a majority of the electorate. The Sjálfstaedisflokkurinn (Independence party) is a conservative grouping which won 24 seats in the 1959 election; the Framsóknarflokkurinn (Progressive party), an agrarian group, won 17 seats; and the Althýdubandalag (People's Union), a socialist front, and the Althýduflokkurinn (Social Democrat party) with a moderate socialist program, won 10 and 9 seats respectively.

The seat of government is Reykjavík. The country is divided into 16 districts (*sýslur*), each of which is administered by a district magistrate (*sýslumadhur*), and 14 towns, each administered by a town magistrate. With regard to justice, the ordinary judicial court has two instances: the lower court, presided over by the magistrates, and the supreme court (*Haestiréttur*) in Reykjavík, consisting of five judges. Juries are never employed in the trial of criminal cases.

Living Conditions and Welfare.—Since before World War II the labour shortage has been partly met by a seasonal import of fishermen and agricultural workers. Wages for fishermen are comparatively high, but over-all real wages are probably lower than in Britain and Scandinavia, there being a smaller wage difference in Iceland. There are several trade unions, the largest being Althýdusamband Íslands (Icelandic Federation of Labour).

The housing situation is good, the shortage being chiefly in Reykjavík. Most houses are modern and nearly all have central heating using oil or natural hot water. The roads are poor and even in Reykjavík gravel streets are more common than paved ones.

A national plan for social insurance, which is compulsory for all citizens, has been in operation since 1947. It covers old age, disability, industrial accidents, maternity benefits, sickness, children's annuities, family allowances, and benefits to mothers and widows. Health coverage, however, is not complete, and patients pay part of their medical care and all dental care. Voluntary movements carry out work in connection with tuberculosis, cancer, the crippled, blind, etc. There are more than 50 hospitals.

Education.—Literacy has been general since the end of the 18th century. There is compulsory education between the ages of 7 and 15 years; children aged 7–13 attend primary schools, and at 14–15 years go to junior schools. The junior school is divided into two parts, in the one emphasis is laid on study from books, in the other more on practical work. Those who wish to continue their education go either to special schools, of which there are many, or to high schools. Four schools have the right to grant a matriculation certificate for entry to the university.

The University of Iceland (Háskóli Íslands) in Reykjavík was founded in 1911. It has five faculties: theology, medicine and dental surgery, law and commerce, philosophy (including philosophy, Icelandic studies, languages, etc.) and engineering. Every year a large number of Icelandic students go abroad to pursue their studies. Various research and experimental stations work in co-operation with the university. The university library is the second largest in the country, after the national library (Landsbókasafn Íslands) which was founded in 1818.

Defense.—Iceland, although an original member of NATO, has no armed forces, only a coastal guard. Under the terms of the U.S.-Icelandic treaty of May 5, 1951, its defense is assured by the U.S. which is entitled to use the air base of Keflavík (35 mi. S.W. of Reykjavík). The U.S. defense force controls radar outposts on four corners of the island.

THE ECONOMY

Iceland's economy, once basically agricultural, is now based almost entirely on fishing.

Agriculture.—The growing season is only 4–5 months, and agriculture is based on cultivation of grass and keeping of livestock. The volcanic loess is fertile and during the growing season it gives a good quality grass which is harvested twice each summer and is either stored dry as hay in barns or in silos for winter feed. The farmers usually derive more than nine-tenths of their income from livestock, and more than half of that from the sale of milk. Considerable quantities of potatoes and turnips are grown. Greenhouse cultivation is extensive in areas where hot springs are utilized to supply heat; tomatoes and flowers are the main crops.

There are more than 6,000 farms, each farmhouse standing apart and isolated. Many of the farms cover relatively large areas; the average size being about 1,250 ac., though only a tiny part of the country is cultivated. About 80% of the farms are under private ownership, and most farmers now possess mechanized equipment.

Most of the birch forests were destroyed in the past but reafforestation is on a large scale using coniferous trees imported from countries with similar climatic conditions.

Fisheries.—Iceland, situated immediately south of the Arctic circle, is at the convergence of warm and cold ocean currents. These conditions make the banks around the coasts among the richest fishing grounds in the world. It was not until about 1890 that decked vessels began to be used extensively by Icelanders for cod-fishing, and soon after that date herring fishing was developed. Cod and herring are now the most important fish caught in Icelandic waters. Before World War I the annual catch amounted to about 60,000 metric tons, but since World War II it has exceeded 500,000 tons. Most of the fish are caught in home waters, but Icelandic trawlers operate also in foreign waters, especially round Greenland and Newfoundland.

The demand for Icelandic fish dates from the 14th century and stockfish remained the chief export until the 19th century. Fish curing became important during the first decades of the 20th century. About 1930 export of fish on ice began to Great Britain and Germany and was the chief export during World War II. After the war the quick-freezing industry expanded greatly and quick-frozen fish is now a major export centred on Siglufjördhur, Reykjavík and the Vestmannaeyjar (Westmann Islands). Although the dispute with Great Britain regarding Iceland's extension of its territorial waters and fishery limit to 12 mi. led to Soviet-Icelandic trade agreements (see *History* above), by the mid-1960s such trade had diminished and trade with western Europe and the U.S. had increased correspondingly.

Power and Industries.—It is estimated that the rivers of Iceland could provide hydroelectric power equivalent to 4,000,000–5,000,000 h.p. Electric lighting is used in all the towns, villages and many rural areas. In industry the use of electric power has greatly increased since 1950, the major consumer being a nitrogen fertilizer plant at Gufunes near Reykjavík, with a capacity for producing 24,000 tons of fertilizer a year. Another large consumer is a cement plant at Akranes producing 110,000 tons of cement per year. Until 1900 there was virtually no mechanized industry, but it has grown more and more important during the 20th century.

Fishing is the major industry, with processing occurring throughout the country (*see* above). There are some factories for producing fish meal and for canning. Other industries include the manufacture of clothing, shoes, carpets, electrical appliances, soap and paints. There is metal-working for the fishing fleet and fish-processing industry. Book production is important. Akureyri is the only town, other than Reykjavík, with any diversification of industry.

Trade and Finance.—Compared with the size of the population the foreign trade of Iceland is larger than that of most other countries. Having a limited range of products, Iceland must depend on imports for a number of necessities. The most important articles imported are oil and gasoline, machinery, ships, motor vehicles, metals, timber, grain and flour. The main exports are quick-frozen fish, cured saltfish, salted herring, fish meal and stockfish.

The chief trading partners in the early 1960s were: U.S.S.R., United States, U.K., Federal Republic of Germany, Denmark and the German Democratic Republic.

The Icelandic monetary unit is the króna (pl. krónur; abbr. kr.) and is divided into 100 aurar (sing. eyrir). From Aug. 1961 the official rates of exchange were £1=120.43 kr. and $1=42.95 kr. The international metric system of weights and measures was introduced by law in 1907.

In the early 1960s the Icelandic state revenue exceeded 1,500,000,000 kr. or about 15% of gross national product. The main items were customs duties, sales tax, income tax and property tax, and net income of state-owned companies (mainly from alcohol and tobacco monopoly). The main items of expenditure were social services, communications and education.

Iceland's foreign exchange is derived mainly from fish exports. An additional important source (about 8%) comes from U.S. defense expenditures at Keflavík and the coastal radar stations.

Transport and Communications.—By the end of the 19th century the first roads suitable for wheeled traffic were made and after that road making progressed rapidly. In the 1920s all the most important country districts had been linked by roads, but winter road communication remains very difficult in many places. The state highways total about 6,000 mi.

There have never been railways or trams in Iceland. Automobiles were introduced in 1913. Private companies run regular coach services throughout the country, and there are bus services in Reykjavík and Akureyri run by the municipalities.

Until World War I most transportation to and from Iceland was in the hands of foreigners. The Icelandic Steamship company was founded in 1914, and there are now other Icelandic companies. Coastal steamers touch practically every port. Icelandic ships provide a regular service to British and continental ports and to New York. A few vessels patrol the territorial waters and are also used as salvage vessels and for ocean research.

Inland air transport began in 1920 but was not fully organized until 1938. The use of aircraft has increased since the end of World War II and a number of airfields have been constructed. Two Icelandic airlines are in operation from Reykjavík, Icelandair and Icelandic airlines (IAL). The former runs services inland and to western Europe, and the latter between Europe and New York.

In 1906 a submarine telegraph cable was laid from the Shetland Islands to Seydhisfjördhur on the east coast of Iceland. In the early 1960s a telephone submarine cable called Scotice (Scotland–Faroe Islands–Iceland) was laid and another called Icecan (Iceland–Greenland–Newfoundland), was planned. The telephone is extensively used also on farms. There has been a regular broadcasting service since 1929. The U.S. air force operates a television service from Keflavík.

See also references under "Iceland" in the Index. (VA. K.)

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ICELANDIC LANGUAGE. The Icelandic settlers came of Norwegian stock and in the early period their language must have been practically identical with that of western Norway. The oldest linguistic forms are found in 10th- and 11th-century poetry, preserved in 13th-century records. Greenland was settled from Iceland, *c.* A.D. 990, but it is not known how the language there developed.

The Latin alphabet was adapted for Icelandic use by 1100. In the earliest manuscripts (*c.* 1150–1200), Old Icelandic can already be distinguished from Old Norwegian: among its significant features are retention of initial *h* before *l*, *n*, *r*, and regular operation of the so-called "younger" *u*-mutation (*e.g., land,* dative plural *lǫndum,* Norwegian *landum*). By about 1300, *e, o* in endings became *i, u* respectively; *ǫ* fell together with *ø* (modern *ö*), *ǫ́* with *á*, *æ* with *æ;* short back vowels were lengthened before *l* plus a labial or guttural (modern Icelandic *hálfur,* Norwegian *halv*). There were sporadic signs of changes fully effected later.

Important phonological changes in the transition period, *c.* 1300–1550, were: *é* became [jɛ], *vá* became *vó* (now usually *vo*); between final *r* and a preceding consonant (other than *r*) *u* was introduced (*maðr,* now *maður*); final *k, t* in weakly stressed syllables became *g, ð* (*mjǫk: mjög; at: að*); there were certain consonantal assimilations and shortenings. Old distinctions of quantity were largely kept until the 16th century, but then gave way to accentual values. Analogical simplifications occurred in accidence, but too few to disrupt the inflectional system.

In the period 1550–1700, some earlier developments were completed and most sounds attained their present-day pronunciation: *á* to [au], *í* to [i:] *ó* to [ou], *æ* to [ai], *au* to [øy]; *y, ý, ey* fell together with *i, í, ei; ll* generally became [dl] in almost all positions, *nn* [dn] after long vowels and diphthongs; *fl, fn* became [bl, bn]. Among analogical changes in accidence were the transformation of masculine *u*-stems to *i*-stems (*fjörður,* accusative plural *firði,* older *fjörðu*); the replacement of plural subjunctive endings, *-im, -ið, -i,* by indicative endings, *-um* (present and past), *-uð, -u* (past); the use of *-i* (older *-a*) in the first person singular ending, past indicative weak verbs and present subjunctive all verbs. The dual pronouns, *við, þið,* replaced *vér, þér* (we, you) in ordinary speech.

Dialects.—Dialectal differences are slight. The chief areas are the Southern (covering about three-quarters of the country) and Northern. Important differences are in the pronunciation of intervocalic *p, t, k* (lenis, Southern; fortis, Northern); of *l, m, n* before *p, t, k* (unvoiced and following consonant unaspirated, Southern; voiced and following consonant aspirated, Northern: *stúlka,* [stuḷka, stulkʰa]); and of *hv-* ([χw], Southern; [kv], Northern). There is some dialectal variation in farming and fishing terms.

Vocabulary.—Loan-words from Celtic and Latin (introduced especially after the Conversion) appear in the early language. In the 13th century, some Romance and German words were borrowed (*e.g., kurteiss, dans, læra*), but there was a strong tendency to translate new terms by native equivalents or compounds. A considerable number of Danish and German words were introduced in the period 1300–1550, although comparatively few remain in use. In the next two centuries, Icelandic was much influenced by Danish. A purist movement, which began toward 1800, has since become all-powerful. Internationally current technical and abstract terms have not generally been adopted, being rendered by direct translation (*framleiða: producere*), by the resuscitation of obsolete words in a special modern sense (*sími* "cord," used in [*tal*]*sími* "telephone"), and by the creation of new words (*berkill* "*tuberculosis*"), generally with happy results.

Icelandic and Norwegian underwent dissimilar phonological developments, and Icelandic, unlike Norwegian, has remained extremely conservative in accidence, vocabulary and orthography; the two languages are no longer mutually intelligible. Icelandic is spoken in Iceland (with about 184,000 inhabitants) and by about 20,000 emigrants in North America. *See* also GERMANIC LANGUAGES; SCANDINAVIAN LANGUAGES; NORWEGIAN LANGUAGE.

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ICELANDIC LITERATURE. Ever since the 10th century the Icelanders have been famous for their literature, first of all for

poetry and later for prose. During many centuries their literature has been as rich and varied as that of any nation in Europe.

Iceland was not peopled by Scandinavians until late in the 9th century, but some of the poetry found in the Icelandic manuscripts must have been composed before that date, whether in Scandinavia, in the Scandinavian settlements of the British Isles, or even further afield. Practically no early poetry written in a Scandinavian language is found in manuscripts other than the Icelandic, and the study of Icelandic poetry is thus the study of Scandinavian poetry.

Much of the oldest poetry is found in a manuscript called the *Poetic Edda* (*see* EDDA). This was written in Iceland during the second half of the 13th century, but was copied from older originals, probably written early in that century. Poetry of the kind found in this manuscript is sometimes called "Eddaic" in order to distinguish it from the "scaldic" poetry, which will be discussed below. The *Poetic Edda* consists of 45 leaves in quarto, and the poems in it fall naturally into two sections, which represent two distinct classes, the heroic lays and the mythological lays.

Heroic Lays.—Many of the legends upon which the heroic lays are based originated in continental Germany, and even among the Goths of southeastern Europe. Heroes who figure in these lays appear also in the poetry of the Anglo-Saxons, in the *Nibelungenlied* (*q.v.*) and other medieval poetry of Germany (*see* also GERMANIC MYTHOLOGY AND HEROIC LEGENDS). The heroic lays of the *Edda* are composed in various styles and belong to various ages. Perhaps the oldest is the *Hamðismál* (Words of Hamðir), which is the last in the book. It is preserved in a poor state and it is plain that it was not clearly remembered by the scribe who first wrote it down. In the *Hamðismál* a story is told of the historical Jörmunrekr (Ermanaric; *q.v.*), emperor of the Goths in eastern Europe (d. 375). Jörmunrekr had married Svanhildr, said to be the daughter of Sigurd (Siegfried) and of his wife, Gudrun (Guðrun). Believing that Svanhildr had committed adultery with his own son, the emperor had caused her to be trodden to death by horses. The poem opens as Gudrun incites Hamðir and Sörli, her sons by a later marriage, to take vengeance for their half sister.

Entering the castle of Jörmunrekr, the brothers fought against overwhelming odds. They cut off the arms and legs of the emperor, failing only to cut off his head. Hamðir and Sörli then fell dead upon a heap of Gothic corpses, rejoicing in their own valour and in the fame which would survive them. In no poem are the Germanic ideals of heroism expressed so clearly and forcefully as they are here.

It is not known when the *Hamðismál* received its present form, but several elements in it are very ancient. The story closely resembles one told by the Gothic historian Jordanes in the middle of the 6th century. Jordanes said that Jörmunrekr was wounded by two brothers, Ammius and Sarus, because he had caused their sister, Sunilda, to be torn to pieces by wild horses. The account given by Jordanes contains more fiction than history, and he appears to be summarizing a poem. If so, the poem that Jordanes knew in the 6th century was one of the ancestors of the *Hamðismál*, written down in Iceland in the 13th century. It is possible that an early form of the *Hamðismál* was brought by a traveler from southeastern Europe to Scandinavia and adapted to the Scandinavian language. The story told in the *Hamðismál* changed little between the 6th and the 13th centuries, although it was combined with legends of Gudrun and of Sigurd, which belong to a later date than the legends of Jörmunrekr.

Another of the older lays is the *Atlakviða* (Lay of Atli), which contains memories of events which took place in western Germany in the 5th century. In the year 437, the Burgundian tribe, then dwelling on the middle Rhine, had been overcome by a Hunnish army and the Burgundian king, Gundicarius (Gundahar), was killed. Atli (Attila) was not engaged in this campaign, but the poet treats it as a personal quarrel between him and Gunnarr (Gundicarius). Atli is said to be married, at this time, to Gudrun, sister of Gunnarr. He invites Gunnarr and his brother, Högni, to his castle with promises of gifts and then treacherously kills them. Gudrun takes revenge for her brothers by killing the sons whom she had borne to Atli and then stabbing Atli in his bed.

This story of Atli's death is not far removed from history. According to contemporary writers, he had married a woman, whose name Hildico (Ildico) shows that she was Germanic, and on the wedding night he died of a hemorrhage. Popular report soon had it that Hildico had murdered him. The story of Atli was rehandled by a later poet in the *Atlamál* (Words of Atli), which was probably composed among the Icelandic colony in Greenland.

A third legend was linked with those of Jörmunrekr and the Burgundians. This was the German legend of Sigurd and Brunhild, which became one of the most popular in Scandinavia and Iceland, although it is not known how early it was introduced.

In the lays of the *Edda* the Burgundian princess, Gudrun, is married first to Sigurd, the spotless, valiant hero. Sigurd had formerly been betrothed to the warrior woman, Brunhild, but Grimhild, the mother of Gunnarr and Gudrun had administered a magic potion, so that he forgot his betrothal and married Gudrun. Brunhild lived in a castle surrounded by flames and had sworn that she would marry none but the man who could ride through them. Gunnarr failed to do this, but Sigurd succeeded in the disguise of Gunnarr. Brunhild then married Gunnarr and was heartbroken to discover that he was the lesser hero. She was stirred by loving hatred for Sigurd, as is most fully described in the *Sigurðar kviða en skamma* (Short Lay of Sigurd). Brunhild incited her husband, Gunnarr, and his brothers to murder Sigurd, but when they had done this, she threw herself on the funeral pyre beside him.

The spiritual conflicts of Gudrun are described in several lays with even greater pathos. In the "First Lay of Gudrun" she is described weeping over his dead body, and in the "Second Lay of Gudrun" she looks back on her past life and dwells upon her sufferings. Her conflict was that of loyalties. She was bound by ties of blood to her brothers, who had murdered her beloved husband, and later she took revenge for these brothers upon her own sons and upon her second husband, Atli, who had murdered them.

Many 20th-century critics hold that the lays of the *Edda* in which the spiritual conflicts of Gudrun and Brunhild are described belong to a later age than such austere poems as the *Hamðismál* and the *Atlakviða*. The lays about these heroines tend to be romantic and sentimental and seem to accord better with the tastes of the Christian middle ages than with those of the pre-Christian dark ages. In their present form these lays are Icelandic, but they may well be derived from lost German poems of the 11th or even of the 12th century.

Nearly all heroic lays in the *Edda* are associated in one way or another with the story of Sigurd, although the heroes of three of them, the Helgi lays, have but distant relationship with Sigurd. These lays have another background and their scenes seem to be laid on the shores of the Baltic during the Viking age. One heroic lay in the *Edda*, the *Völundarkviða* (Lay of Wayland the Smith) is altogether divorced from the story of Sigurd. Its hero is the magic smith, Wayland, who seduces Bödvild, daughter of King Nídud. This story was well known in Anglo-Saxon England, for it is also told in the poem *Deor's Lament*, and is depicted on panels of the Franks casket, probably of the 8th century (*see* also WAYLAND THE SMITH).

The *Poetic Edda* contains only a small proportion of the heroic poetry known in Iceland in the early middle ages. Much has been lost, but several fragments of ancient lays are found in sagas of the 13th and 14th centuries. Among the most important may be counted the "Battle of Goths and Huns," quoted in the *Heiðreks Saga*. The story is of a great battle between Goths, led by Angantýr, and Huns, led by Hlöd. The scene appears to be southeastern Europe, in the region of the Black sea. The events celebrated have not been identified in history, but they may well have taken place in the 4th century, when the Gothic empire was invaded by Huns.

Other heroic lays of which fragments survive were concerned with Danish and Swedish heroes who lived between the 5th century and the 7th. Some of these heroes, such as Hrólf Kraki of Denmark and Adils of Sweden, were also known to the author of the Old English *Beowulf*.

Mythological Lays.—The first half of the *Poetic Edda* consists of lays about northern gods and of wisdom attributed to them. Like the heroic lays, these are of various ages, but it is improbable that any of those which survive originated elsewhere than in Norway, Iceland and the Norse colonies of the British Isles. The most striking lay of this class, the *Völuspá* (Sibyl's Prophecy), is placed first in the *Edda*, and is preserved in another manuscript as well. It is supposed to be spoken by a sibyl, who tells the history of the world, of gods, men and monsters, from the beginning until the Ragnarök (Doom of the Gods), when the gods will fall, the sun turn black, smoke and fire will gush forth and the stars vanish. Many passages in the *Völuspá* are obscure and it has been discussed more than any other Scandinavian poem. Most scholars would probably agree that it was composed in Iceland, for the scenery, which the poet described, is that of Iceland. The poet's background was pagan, but his thoughts were coloured by Christian legends of the end of the world. He probably worked about the year 1000, when the minds of Icelanders were turning from the old religion to the new.

An interesting story of the gods is told in the *Skírnismál* (Words of Skirnir). Sitting in Hlidskjálf, the throne of Odin, the god Freyr gazed into the world of giants, where he saw the giant maiden, Gerd, whose beauty made him sick with love. Freyr sent his faithful messenger, Skirnir, riding into the world of giants to win the maiden for him. The journey of the messenger in darkness over misty hills is described in few but telling phrases. Skírnir seeks to win the maiden, first with offers of gifts and then with threats, until she gives way and agrees to make a tryst with Freyr in the grove Barri. Scholars have seen an ancient fertility myth in this story. Freyr is the god of fertility and sunshine; Skírnir is a ray of sunshine (*cf. skírr*, bright), and Gerd (*cf. garðr*, enclosure, field) is the cornfield held fast in the clutches of the frost giants, demons of winter. The *Skírnismál* is one of the older mythological poems and probably originated in Norway.

The *Þrymskviða* contains a tale of Thor. His magic hammer had been stolen by the giant Thrym, who refused to give it back unless he could have the goddess Freyja as his bride. Since Freyja was enraged at the suggestion that she should be given to a giant, Thor himself was decked as a bride, and went to the house of the giant and recovered the hammer by this ruse. The humour of the *Þrymskviða* is unique in early Scandinavian poetry.

The mythological poems so far mentioned are all narrative, but many of those contained in the *Edda* are didactic. The *Hávamál* (Words of the High One) consists of fragments of at least six poems, all said to be spoken by Odin. In the first section, the god speaks of relations between man and man and lays down rules of social conduct. The precepts are cynical and generally amoral, and evidently date from an age of lawlessness and treachery. This section of the *Hávamál* is altogether devoid of belief in the supernatural or in life after death. No greater misfortune can befall than death, which nothing can survive except good repute.

In other sections of the *Hávamál* Odin discourses on relations between men and women, and tells how the love of women may be lost or won with illustrations from his own experience. The last two sections are about runes and magic power. Odin describes how he hung fasting for nine nights on a windswept tree and thus discovered the runes. He speaks finally of magic songs, by whose force he can help his friends and destroy his enemies. The different poems of which the *Hávamál* is made up belong to different ages, but most of them were probably composed in Norway in the 9th and 10th centuries.

Another didactic poem, placed in an interesting setting, is the *Vafþrúðnismál* (Words of Vafthrúdnir). Odin, as usual in disguise, comes to the house of the giant, Vafthrúdnir, and the god and the giant enter a contest of wits, on which each wagers his head. They ask each other questions about gods, men and giants, until the god asks what Odin had whispered into the ear of his son, Balder (Baldr), when he was laid on the funeral pyre. No one knows the answer to this question except Odin himself, and so the giant forfeits his head. The *Grímnismál* (Words of Grímnir) is a didactic poem of the same kind, and another is the *Alvíssmál* (Words of the All-Knowing), which has rather a different form.

Some important mythological lays are found in manuscripts other than the *Edda*. Perhaps the most beautiful is the *Baldrs Draumar* (Balder's Dreams), which was skilfully translated into English by Thomas Gray as "The Descent of Odin." The poet describes how the god Balder dreamed baleful dreams, which threatened his life. Odin then rode to the grave of a prophetess and awakened her from death by the power of his magic songs, and forced her to tell the fate in store for Balder. In the *Rígsþula* (Song of Rígr) the god Heimdall, who assumes the name Rígr, wanders through the world and begets three sons by three separate women. The first son is called Thræll, the second Karl and the third Jarl, and from these the three classes of men, thralls, freemen and chieftains, are descended. The name Rígr has been associated with the Irish *rí* (king) and it is not improbable that the poem was composed in Ireland, or by a Norseman who worked under Irish influence.

The Eddaic Verse Forms.—Three measures are commonly distinguished in Eddaic poetry, the *Fornyrðislag* (Old Story Measure), the *Málaháttr* (Speech Measure) and the *Ljóðaháttr* (Song Measure). Most of the narrative poems are in the *Fornyrðislag*, which consists of short lines of two beats bound by alliteration in pairs. The number of weakly stressed syllables may vary, but the total number of syllables in the line rarely falls below four. In these things the *Fornyrðislag* resembles the measure used by Anglo-Saxon and early German poets. But, unlike Anglo-Saxon and German poetry, the poems in the *Fornyrðislag* are generally arranged in strophes of eight lines, divided by a deep caesura into half-strophes of four lines. Poems which are considered among the oldest show much irregularity, both in the syllabic length of the line and in the length of the strophes, but the following half-strophe will serve as a typical example (alliterating syllables in italics):

Gengu *i*arlar *a*lsnotrir fram
þeir's *h*arz *h*ugar *h*ána löttu.

The *Málaháttr*, used in the *Atlamál*, differs little from the *Fornyrðislag*, although its lines generally have a greater number of weakly stressed syllables. The *Ljóðaháttr* is the most irregular of Eddaic forms and its origins are the most obscure. It is used chiefly in didactic poems and consists generally of strophes of six lines divided into half-strophes of three lines. The first two lines of the half-strophe contain two beats each and alliterate with each other; the third line is independent, alliterating only within itself. This line may contain two beats or three. The following half-strophe will serve as an example:

*D*eyr fé *d*eyja frændr
deyr *s*iálfr it *s*ama.

Scaldic Poetry.—Besides the Eddaic, the Norwegians and Icelanders of the 9th century to the 13th composed poetry of quite a different kind. This is distinguished as "scaldic" poetry (*cf.* Icelandic *skáld*, poet).

Scaldic poetry differs from the Eddaic in the first place in its form. It is not composed in the free variable measures of Eddaic lays and is quite unlike Anglo-Saxon and early German poetry. It is strictly syllabic and every syllable must be counted and weighed, and every line must end in a given form, trochaic, dactylic or monosyllabic as the case may be. Like the Eddaic lines, the scaldic ones are bound by alliteration in pairs and, besides this, most of them contain some form of internal rhyme or consonance. The strophe is usually of eight lines, divided into two halves by a caesura after the fourth. About 100 scaldic verse forms have been recorded, but the most popular, and probably the oldest, is the *Dróttkvætt* (Court Metre), which consists of strophes of eight lines, each of six syllables, ending in a trochee.

The scaldic poetry differs from the Eddaic, not only in form, but also in syntax and choice of expression. The word order is much freer than in Eddaic poetry and the scalds use many words never found in Eddaic poetry or in prose, besides periphrases, or kennings, of such complexity that their work often sounds like a riddle. They may denote a ship as "the horse of the sea" or "the bull of bow-sprits"; they call gold the "fire of the sea." Kennings are frequently doubled or trebled; *i.e.*, two or more are combined to denote one subject. Thus, the "fjord-elk" is the

"ship," his "field" is the "sea" and its "fire" is "gold."

Little is known about the origins of scaldic verse forms and diction, but there are reasons to believe that they were devised in western Norway during the 9th century. If so, it is probable that the first scalds were influenced by the elaborate metrical forms and diction of the Irish poets of that period. During the 9th century, the Norwegians were in close contact with Ireland.

The Eddaic poetry is all anonymous, but most of the scaldic is assigned to poets whose names are remembered. The oldest of the scalds whose verses survive was Bragi, nicknamed the Old, who probably worked in Norway in the second half of the 9th century. The chief of Bragi's surviving poems is a description of a painted shield given to him by a chieftain. Pictures of gods and legendary heroes were painted on the shield, and among them were the god Thor, struggling against the World Serpent, and Jörmunrekr attacked in his castle by the brothers Hamðir and Sörli.

Much of the scaldic poetry was made in honour of the kings of Norway, nearly all of whom patronized poets. Harald Fair-hair (d. *c.* 945), first king of all Norway, was eulogized by several poets, among whom were Thorbjörn Hornklofi and Thjódólf of Hvin. The first was the author of the *Haraldskvæði* (Lay of Harald), a remarkable poem, partly in Eddaic and partly in scaldic style. It is in the form of a dialogue between a valkyrie and a raven, who followed the king in search of the carrion which he had left on the battlefield, and sang his praises. An unnamed scald made a similar poem, the *Eiríksmál*, as a memorial to Eirík Bloodaxe, who was killed in the British Isles soon after the middle of the 10th century, and another, Eyvind the Plagiarist, commemorated Haakon the Good (d. 961) in the same way.

Although the first scalds were Norwegians, it was the Icelanders who developed the art. The greatest of all was Egill Skallagrímsson (*c.* 910–90), who was born and died in Iceland, but lived much of his life in Norway and the British Isles. Among the best-known of his poems is the *Höfuðlausn* (Head Ransom), which he composed in York about the year 948. He had fallen into the hands of his enemy, Eirík Bloodaxe, then ruling in York, and saved his head by making this poem in honour of his enemy in a single night. The *Höfuðlausn* is in an unusual form with end rhyme, probably due to the influence of hymns in Latin which the poet had heard in England. Egill also made poetry in honour of Aethelstan, king of England (d. 939), but only scraps of it have survived.

Einar Skálaglamm, another Icelander, was the friend of Egill and chief poet of Haakon the Great (d. 995), in whose honour he made the *Vellekla* (Gold-dearth). Einar commemorated the achievements of Haakon and praised him for his loyalty to the pagan gods.

The Christian kings of Norway, Ólaf Tryggvason (d. 1000) and Ólaf the Saint (d. 1030), were praised by many Icelandic scalds. Hallfred, nicknamed the "Troublesome Poet," was the favourite of Ólaf Tryggvason and although his work has no great value as art, it is interesting because the poet describes his conversion to the Christian religion and the spiritual conflicts which went with it. Sigvat, the favourite of Ólaf the Saint, was a more notable poet. In his work he commemorated the chief events in Ólaf's life, from his adventures as a youthful viking to his death in the battle of Stiklastadir. Sigvat's work is simpler and easier to understand than that of most of the older scalds. Many sagas include lives of scalds and contain numerous verses which show that, in Iceland, scaldic poetry was admired as an accomplishment by rich and poor alike.

Scaldic poetry, since it is ornate and difficult to understand, has been little appreciated in modern times. It is a rewarding subject for study, however. Scaldic poems, composed in the 10th and 11th centuries and remembered orally, were among the most valuable sources for the Icelandic historians of the late 12th and 13th centuries.

Histories, Law Codes and Religious Literature.—The Icelanders adopted the Christian religion in the year 1000 and this had far-reaching consequences. Their civilization was not greatly altered at first, but the conversion opened the way for new and powerful influences from Europe.

Details about some of the missionaries who worked in Iceland in the 11th century are recorded, and several of them came from the British Isles, while others were of German origin. Undoubtedly these missionaries taught the Icelanders to use the Latin alphabet. No manuscripts of this period survive, but the oldest preserved, dating from the middle of the 12th century, are written in a script based upon one used in England in the 11th century.

Icelanders soon began to study in the great schools of Europe. Perhaps the first to do this was Ísleif (*c.* 1005–80), who was brought up in the convent of Herford in Westphalia and ordained priest. Soon after the middle of the 11th century, Ísleif was consecrated bishop. He kept a school at Skálaholt, in the south of Iceland, which was for many centuries the chief bishopric and one of the main centres of learning.

Ísleif was succeeded as bishop by his son Gizur (1082–1118), who was also educated at Herford. Historical literature was first written in his time. The oldest historian remembered was Sæmund Sigfússon (1056–1133). Sæmund went to school in France and was the author of a *History of the Kings of Norway*. This book is lost, but references made to it by writers of the later middle ages show that it was written in Latin, and was concerned especially with the chronology of the kings' reigns.

Ari Thorgilsson (*c.* 1067–1148) is regarded as the father of vernacular history. It is not known how many books Ari wrote, but there is a short history of Iceland, the *Libellus Islandorum*, which is signed by Ari. It was written shortly before 1133, although it exists today only in paper transcripts of the 17th century. Ari states in his prologue that he had also written an earlier version of this same work, which contained some account of the kings of Norway and other material not found in the existing book.

The *Landnámabók* (Book of Settlements) has long been associated with Ari's name. It consists of a detailed history of the settlement of Iceland. The settlement is treated district by district and the descendants of the chief settlers are traced. Ari probably compiled the *Landnámabók*, or part of it, in its original form, but the existing versions date from the 13th and 14th centuries and were expanded after Ari's time.

It is not known how early Icelanders began to keep annals of contemporary events. The extant versions of them are not older than the 13th century, but since they contain records of an eclipse, visible in Iceland in 1131, and of a volcanic eruption in 1104, these extant versions of the annals probably derive from an original made early in the 12th century.

The first code of law, applied to the whole of Iceland, was drawn up by a certain Úlfljót about the year 930. This code was remembered by heart and recited by the law-speaker, the president of the national assembly, at regular intervals. In the year 1096, laws of tithe were introduced and perhaps written down at that time. In 1117 it was resolved that parts of the civil law should be written on parchment, and a few years later laws relating to ecclesiastical practices were also inscribed.

The oldest extant religious manuscripts in Icelandic, dating from about 1150, consist of homilies and lives of saints, which evidently formed the most extensive branch of the literature during the 12th century. Large collections of religious literature are also found in the manuscripts of the late 12th and early 13th centuries.

The Icelandic homilies are based largely upon those ascribed to the great apologists of Europe, such as Jerome, Bede, Gregory. Nevertheless, the Icelanders sometimes treated their models freely and added reflections of their own. Popular handbooks of theology, such as the *Lucidarius* of Honorius Augustodunensis and the *Dialogues* of Gregory the Great, were also written in Icelandic versions during the 12th century.

Among the most popular religious books were lives of the apostles and of well-known European saints. The lives of the apostles were based largely upon apocryphal Acts and Gospels and partly upon canonical writings. Literature of this kind is little read today, and its importance is often overlooked, but its composition undoubtedly contributed much to the narrative art, in which the Icelanders of the 13th century were to excel.

The First Sagas.—In Icelandic the word "saga" is used for any kind of story or history, whether written or oral. In English, on the other hand, this word has a narrower sense and is generally applied to biographies of one hero or a group of heroes written in Iceland between the 12th and 15th centuries. Sagas are generally based upon native tradition, whether preserved orally or in writing. The heroes of sagas are most often kings of Norway, Icelandic, or legendary Germanic heroes, said to have lived between the 4th and 8th centuries.

If the word "saga" is used in this restricted sense, the oldest saga known is the so-called *First Saga of St. Ólaf* of which some fragments are preserved. It was written about 1180, probably in the Benedictine monastery of Thingeyrar, in northern Iceland. It is cast in the form of a hagiographic narrative, and greatest emphasis is laid upon miracles worked through the agency of St. Ólaf. Stories about these miracles were preserved in oral tales, both in Norway and Iceland. In spite of its hagiographic tone, the *First Saga* has great value as history. The outline of Ólaf's career was recorded in verses composed in scaldic form by contemporary poets and handed down orally.

The *First Saga* was used as a source, either directly or indirectly, by later biographers of St. Ólaf, by the author of the *Legendary Saga* (*c.* 1200), by Styrmir Kárason (*c.* 1220), and ultimately by Snorri Sturluson.

The monastery of Thingeyrar, which had been founded in 1133, played a great part in the cultural life of the Icelanders during the late 12th and early 13th centuries. About 1190, one of its inmates, Odd Snorrason, wrote a life of Ólaf Tryggvason, king of Norway (d. 1000). Odd was, no doubt, inspired to do this work by the *Saga of St. Ólaf*. Besides oral tales and scaldic poems about Ólaf Tryggvason, Odd used several written sources, including the histories of Sæmund and Ari. He wrote in Latin, but his work was translated into Icelandic soon afterward and was freely quoted by those who wrote about Ólaf Tryggvason in later times.

Ólaf Tryggvason was regarded widely as the apostle of Iceland, for it was at his instigation that the Icelanders had adopted Christianity. Odd's life of him was followed by another, whose author, Gunnlaug Leifsson (d. 1218), also belonged to Thingeyrar. Gunnlaug also wrote in Latin, but his work was translated into Icelandic. It was larger and more ambitious than Odd's life, but does not survive in its original form. Gunnlaug was a man of wide learning. He was also the author of a life of Jón Ögmundarson, bishop of northern Iceland (d. 1121), of a life of St. Ambrose, and of a metrical version in Icelandic of Geoffrey of Monmouth's *Prophecies of Merlin*.

The School of Skálaholt.—The work of the Thingeyrar monks was fanciful rather than critical or realistic. A more critical style of history had been established in the south of Iceland by Sæmund and Ari, and several notable works of history were written at Skálaholt or nearby early in the 13th century. The most remarkable of these was the *Hungrvaka* (Hungerwaker), written about 1206, which is a short history of the bishops of Skálaholt from Ísleif (d. 1080) to Klœng (d. 1176). The *Hungrvaka* is admired for its polished style and for its author's balanced judgment and objectivity. It appears to be designed as a prologue to the *Saga of St. Thorlák*, who was bishop of Skálaholt from 1178–93, and was regarded by many Icelanders as a saint. The *Saga of St. Thorlák* was written a few years earlier than the *Hungrvaka*, but stylistic peculiarities suggest that it was the work of the same author. Another work commonly ascribed to the author of the *Hungrvaka* is the *Saga of Bishop Páll* (d. 1211), who succeeded his uncle, Thorlák, as bishop of Skálaholt. This author was interested in the private lives of his heroes, rather than in their public acts or ecclesiastical policy. He was never extravagant in his praises nor overcredulous of miracles.

Histories of Kings of Norway.—During the latter years of the 12th century some short histories of kings of Norway were written in Norway itself and some of them were brought to Iceland and influenced Icelandic writers. One of these was the *Historia de antiquitate regum Norwagiensium*, which was written in Latin by a Norwegian monk, Theodoricus, about 1180, and was used as a source by Odd Snorrason. Another Norwegian work, which had greater influence, was the so-called *Ágrip* (Summary of the History of the Kings), which was written in Norway in the vernacular about the end of the 12th century. The *Ágrip* was brought to Iceland soon after it was written and exists only in an Icelandic manuscript of the early 13th century. In its original form it must have covered the history of the kings from the 9th century to the late 12th century, but the beginning and the end are missing. The *Fagrskinna* (Fine Skin) covered the same period as the *Ágrip*, but it is more detailed and its author has made greater use of older writings and of scaldic poetry. The *Fagrskinna* was also written in Norway, probably about 1230, but its author must have been an Icelander, for the sources which he used were chiefly those preserved in Iceland. The *Morkinskinna* (Rotten Skin) was probably written rather earlier than the *Fagrskinna*, and covers a shorter period of the history of the kings, from Magnús the Good (d. 1047) to the late 12th century. It was written in Iceland and based partly upon a lost history of the kings of the 12th century, the *Hryggjarstykki* (Backbone Piece), written by the Icelander Eirík Oddsson about 1170. The *Saga of the Orkney Earls* (*Orkneyinga Saga*) should also be included in this class. It was written by an Icelander in the first year of the 13th century, and covered the history of the Norwegian dependency, Orkney, from the 9th century to the latter years of the 12th. It survives only in later redactions.

A work of particular interest was the *Sverris Saga*, the life of King Sverrir (Sverre) of Norway (d. 1202). A part of it was written by Karl Jónsson (d. 1215), who was twice abbot of Thingeyrar, and spent several years in Norway as an attendant of King Sverrir. Karl wrote some chapters of this saga in Norway under the supervision of Sverrir himself and it was completed after he returned to Iceland, probably by others. There is no more intimate and detailed biography of a ruler of Norway.

Snorri Sturluson (1179–1241).—Snorri was the author of literature of many different kinds and played a prominent part in the political wrangles of his age. He was the son of a chieftain of western Iceland, but was brought up in the south by Jón Loptsson, a grandson of Sæmund Sigfússon. Among the works assigned to Snorri are several poems and the so-called *Prose Edda* (*see* EDDA), which is a handbook of prosody and poetic diction, probably written soon after 1220. Snorri illustrates his arguments with stories about pagan gods and ancient heroes, and it is these which give the *Prose Edda* its chief interest for modern readers. They have the charm of fairy tales and are told with admirable delicacy and taste.

Snorri twice visited Norway and much of his work consists of lives of its early kings. The first which he wrote was the *Saga of St. Ólaf*. This was based largely upon the lost life of that saint written by Styrmir Kárason (*see* above), partly upon the work of Ari and other ancient books, and partly upon poems and tales transmitted orally. The chief difference between Snorri's account of St. Ólaf and those of his predecessors was that Snorri wrote neither as a hagiographer nor as an annalist. He depicted Ólaf as a living man, brave but not without faults, who began his career as a typical viking and developed gradually into a statesman, a saint and a martyr.

Snorri probably wrote his *Saga of St. Ólaf* within a few years of his return from Norway in 1220. He afterward combined it with lives of kings who had ruled Norway before and after Ólaf. The complete series is called the *Heimskringla* (Orb of the World). It begins with a short account of the Ynglingar, the ancient kings of the Swedes, from whom rulers of Norway were said to descend. The chief source of this first section is the poem, *Ynglingatal*, which dates from the 9th century. Several of the older kings of Norway are described in close detail and among the most interesting sections of the *Heimskringla* are those about Harald Fair-hair (d. *c.* 945), Haakon the Good (d. 961) and Ólaf Tryggvason (d. 1000). The *Heimskringla* ends with Magnús Erlingsson (d. 1184).

The value of Snorri's lives of the kings as sources of history has long been debated. It must suffice here to say that Snorri was an avid reader of vernacular history and he faithfully reported events about which he had read in older records, many of which are now lost. He also deduced more from the poetry of the scalds than most of his predecessors had done. In outline, Snorri's biographies

of the kings may generally be accepted as true, but it was not his objective to write scientific history. His work was constructive; he portrayed his heroes imaginatively and brought them to life.

Many scholars hold that the *Egils Saga* was also written by Snorri, for both internal and external evidence support this opinion. The *Egils Saga* is the life of Egill Skalla-grímsson, greatest of the scalds. It is among the most stirring and adventurous of sagas about Icelandic heroes.

Icelanders' Sagas.—The terms "Icelanders' Sagas" and "Family Sagas" are commonly applied to sagas about heroes who are supposed to have lived in Iceland in the 10th and 11th centuries. The best sagas of this class excel all others in artistic value; none present characters more vividly, nor show deeper sympathy and understanding of human tragedy.

Questions about the origins and historicity of sagas of this kind have been much discussed. While it is agreed that few, if any, of them were written before the 13th century, many have maintained that the Icelanders' Sagas are faithful records of the history of the 10th and 11th centuries. Consequently, it has been argued that these sagas were composed as early as the 11th century and handed down orally until they were written, almost without alteration, in the 13th century. Although this view was still widespread at mid-20th century, it has been rejected by most modern specialists, who see the individual hand of a literate author in each saga. Nevertheless, it is plain that sagas of this class owe much to tradition, to verses of contemporary poets handed down orally and to oral tales. They also owe much to written works, for their authors drew freely upon the books of Ari, upon the *Landnámabók* and early genealogies. Moreover, the author of one saga would frequently refer to an older one and quote its statements, either with or without acknowledgment.

The historicity of Icelanders' Sagas is difficult to check and few general statements are applicable. Not only the author's sources, but also his aims must be considered. While some of the older ones probably intended to write factual history, others relied rather on the imagination, and thus anticipated the historical novel of modern times.

The first Icelanders' Sagas were written about the beginning of the 13th century and were strongly influenced by the Kings' Sagas. Among the oldest may be counted the *Fóstbræðra Saga* (Saga of the Foster Brothers), whose heroes, Thorgeir and Thormód, were both attendants of St. Ólaf. Many chapters of it are based upon verses which are said to be the work of Thormód. Although somewhat crude in structure, this saga expresses clearly the northern ideals of loyalty and heroism. A great part of the story takes place in the Icelandic colony in Greenland in the 11th century. Both the *Eiríks Saga Rauða* (Saga of Eirik the Red) and the *Grœlendinga Saga* (Saga of the Greenlanders) are also placed in Greenland and contain adventurous tales about voyages to Wineland the Good, as the Norsemen called America.

Another of the older sagas is the *Hallfreðar Saga* (Saga of Hallfred), whose hero, Hallfred, was the favourite of Ólaf Tryggvason. The *Hallfreðar Saga* is partly a love story and is smoother and more highly finished than the *Fóstbræðra Saga*. It was written at, or in the neighbourhood of, Thingeyrar, about 1220.

The scenes of several sagas are laid in the Eyjafjörd and the northeast of Iceland and were probably written in that region. The most perfect is the *Víga-Glúms Saga* (Saga of Víga-Glúm), written about 1230–40, a well-constructed and somewhat conventional story of a grasping peasant. Men of the same district are described in the *Ljósvetninga Saga*, whose central figure, Gudmund the Mighty, is depicted as the wealthy, but cruel and cowardly, tyrant.

Although it is difficult to determine the ages of many sagas, it is possible to see how the art of saga-writing developed in the course of the 13th century. The *Gísla Saga* (Saga of Gísli) was probably written shortly before the middle of that century and is the story of a poet who lived in northwestern Iceland in outlawry, hunted by his enemies and penalized only because of his loyalty in avenging his foster brother. This saga contains some rich descriptions of nature and a large number of emotional verses, said to be composed by the hero.

The scene of the *Laxdœla Saga* (Saga of the Men of Laxárdal), evidently written a few years later than the *Gísla Saga*, is also western Iceland, and the story covers four or five generations, from the end of the 9th century to the 11th. The *Laxdœla Saga* is a tragedy, but it is finer and more delicately worked than the tragedies told in most sagas. Women figure prominently and the most striking of them is Gudrun. Failing to marry the man she loves, Gudrun resorts to loving hatred and causes his death. Her story is plainly influenced by that of Sigurd and Brunhild. The author shows an unusual appreciation of visual beauty.

Many people described in the *Laxdœla Saga* appear also in the *Eyrbyggja Saga*, a work of different stamp. Its author has little sense of structure, but he is an able storyteller and depicts his characters intimately and vividly. He is also an antiquarian and throws valuable light upon popular practices and superstitions, recording many ancient poems.

The scenes of some short sagas are laid in eastern Iceland, a remote, isolated district. Among them is the *Vápnfirðinga Saga*, which takes place in Vápnafjörd, and tells the tale of a family feud which passes through two generations, ending in reconciliation. The *Hrafnkels Saga Freysgoða* (Saga of Hrafnkell Freyr's Priest) takes place in a neighbouring district and is a masterpiece among the shorter sagas. Realistic as it is, the story is the author's creation and the saga contains little historical fact. It is improbable that it was written before 1270.

Among other short sagas of particular interest may be mentioned the *Bandamanna Saga* (Saga of the Confederates), which is a bitter, satirical tale, and the *Gunnlaugs Saga Ormstungu* (Saga of Gunnlaug Serpent Tongue), a love story strongly influenced by foreign romance. The *Hávarðar Saga Ísfirðings* (Saga of Hávard of Ísafjörd) is a spirited tale, which probably dates from the end of the 13th century. Icelandic literature of this period also includes many short stories, or *þættir*, of great value as literature, which describe one event or another in the life of a hero.

As the 13th century drew to its close, the taste for the fantastic and romantic grew stronger. One of the best known of the sagas is the *Grettis Saga* (Saga of Grettir the Strong), which contains numerous motifs drawn from folklore, including stories about ghosts and trolls against whom the hero fights. In its present form this saga must date from about 1300, but it is based upon an older work about Grettir, probably written by Sturla Thórdarson (d. 1284), nephew of Snorri Sturluson.

It is commonly agreed that the greatest of the Icelanders' Sagas is one of the latest, the *Njáls Saga*. It has two heroes, Gunnarr and Njáll. The first is the brave, guileless youth, like Sigurd of the legends, but the second is the wise and prudent man, endowed with prophetic gifts. Njáll faced the terrible death of burning with the resignation of a martyr, but he also had many of the qualities of the traditional Norse hero; he was loyal, upright and resolute. The author of the *Njáls Saga* was influenced by a whole library of early literature, by older sagas as well as books on theology and law.

Sagas About Contemporary History.—Many works on contemporary history were written in the 13th century and most of them were combined about the year 1300 in the *Sturlunga Saga* (Saga of the Sturlungar). This compilation includes the *Íslendinga Saga* (Saga of the Icelanders) of Sturla Thórdarson, which begins with the year 1183 and describes in minute detail the politics, intrigues and battles which took place during the greater part of the 13th century. Among other sagas included in the *Sturlunga* are those about Sturla (d. 1183), the father of Snorri and about Gudmund the Good (d. 1237), the fanatical bishop of the northern Icelanders.

Heroic Sagas.—The growing taste for the fantastic was expressed in the latter years of the 13th century in the Heroic Sagas (*Fornaldar Sögur*), whose heroes were supposed to have lived in Scandinavia and in continental Germania before Iceland was peopled. The best known of these sagas is the *Völsunga Saga* (Saga of the Völsungs), written about 1270, in which the stories of Sigurd, the Burgundians and Jörmunrekr were retold in prose. Its main sources were heroic lays about the heroes, some of which are now lost. Stories of these heroes, as well as of many others, were also told in the *Thiðriks Saga* (Saga of Theodoric), a particularly interesting work. It was compiled in Norway about the middle

of the 13th century, either by an Icelander or Norwegian, and was soon brought to Iceland, where it had great influence. Its sources were not Scandinavian, but German, and probably oral. The *Thiðriks Saga* is, therefore, an important record of German legend of the mid-13th century. The *Gautreks Saga* contains some interesting post-classical poetry and valuable traditions about heroes and pagan practices in Scandinavia. The *Heiðreks Saga* is based on heroic poetry of various ages, much of which is preserved in its text. *Hrólfs Saga Kraka*, although very late in its present form, incorporates exceedingly ancient traditions about Danish and Swedish heroes, who appear also in the Old English *Widsið* and *Beowulf*. The *Ragnars Saga Loðbrókar* has some basis in history, and tells a story about a viking who plundered in France about the middle of the 9th century. The Heroic Sagas have not the same artistic value as the Icelanders' Sagas, but since many of them are based on early legend and lost heroic poetry, they have great antiquarian interest.

Translations From Latin.—A considerable quantity of profane literature was translated from Latin between the 12th and 14th centuries. The *Prophecies of Merlin*, mentioned above, were combined with a complete translation of Geoffrey of Monmouth's *Historia regum Britanniae*, the *Breta Sögur* (Tales of the Britons). In a manuscript of the 14th century the *Breta Sögur* is preceded by the *Trójumanna Saga* (Tale of the Trojans), a rendering of *De excidio Trojae* of Dares Phrygius. The *Alexanders Saga* (Saga of Alexander the Great) was a rendering in prose of a Latin poem of the 12th century written by Philip Gautier. The Icelandic version was made by the Abbot Brand Jónsson (d. 1264).

Romances.—These consist of translations and free adaptations of French and other European romances. This branch of literature originated in Norway early in the 13th century, but it soon took root and flourished in Iceland. The oldest work of this class is probably the *Tristrams Saga* (Saga of Tristram), which was written in Norway in the year 1226 at the behest of King Haakon. The source was the French poem by Thomas of Brittany. The *Karlamagnús Saga* (Saga of Charles the Great) is a collection of prose renderings of the French *chansons de geste*, whose heroes are Charlemagne and his men. A Norse version of the *Chanson de Roland* is included in this collection.

These romances are little read today, but in the 13th century they influenced the tastes of the Icelanders and the authors of historical sagas. This influence can be seen best in the *Laxdœla Saga*, *Gunnlaugs Saga* and *Grettis Saga*. The Icelandic romances are very numerous and exist in countless manuscripts, which give an indication of their popularity in Iceland from the 14th to the 18th century.

Post-Classical Literature.—The classical age of Icelandic literature might be said to have ended in the 14th century. Although literature has flowed richly at all periods during the history of Iceland, comparatively little of that composed between the 14th and the 19th centuries aroused interest outside Iceland itself. During the 14th century, much of the realism and detached objectivity which had characterized the literature during its best period is lost. Sagas and poetry of various kinds continued to be composed, but the fantastic, erotic and sentimental gained the upper hand.

The decline of taste may be attributed to several causes, partly to loss of political independence (1262) and partly to economic straits, resulting in famine and pestilence during the 14th and 15th centuries.

Although literature in the classical style was no longer composed, interest in the great works of the 13th century persisted and the most valuable manuscripts of them date from the 14th century, when great collections were made. Among them may be mentioned the *Hauksbók* (Hauk's Book), written early in the 14th century, containing texts of the *Landnámabók*, the *Völuspá* and the *Fóstbræðra Saga*, and the *Möðruvallabók* (Book of Möðruvellir), written about 1350, which contains texts of *Njáls Saga*, *Viga-Glúms Saga* and other important sagas of Icelandic heroes. The most beautiful of all Icelandic manuscripts is the *Flateyjarbók* (Book of Flatey), written toward the end of the 14th century. This includes versions of the sagas of Ólaf Tryggvason and of Ólaf the Saint, which are combined with texts of sagas about Icelandic and other heroes who were associated with these rulers. Many manuscripts of the classical literature date from the 15th, and some important ones were written as late as the 17th, or even the 18th century.

Post-Classical Sagas.—The prose literature of the 14th century includes several sagas about Icelandic heroes. Among them is the *Finnboga Saga* (Saga of Finnbogi the Strong), an adventurous tale about an Icelander of the 10th century, whose travels brought him to the emperor in Constantinople. The *Víglundar Saga* (Saga of Víglund) is a love story about an Icelandic hero, which is strongly influenced by continental romance. It contains some interesting love poetry in scaldic form. The *Króka-Refs Saga* is of approximately the same age, and equally unrealistic, although it is one of the most successful of the humorous stories in Icelandic.

Sagas about bishops of Iceland had been written early in the 13th century and this branch of literature flourished vigorously in the 14th century. The *Árna Saga* consists of a detailed account of Árni Thorláksson, bishop of Skálaholt (1269–98). It contains much valuable history and was probably written by Árni's nephew, who succeeded him as bishop. The *Laurentius Saga* is no less interesting, and is a life of Laurentius Kálfsson, bishop of Hólar (1324–31).

A number of heroic sagas, about men said to have lived before the settlement of Iceland, must be assigned to the 14th century. Some of them were based upon older traditions and others were largely invented. One of the more interesting is the *Eiríks Saga Víðförla* (Saga of Eirík the Far-traveller), whose hero reaches the *Ódáinsakr*, the land of eternal life, said to lie beyond the farthest India. Lives of foreign saints also flourished in the 14th century. Among the more notable was the *Life of St. Nicholas*, written by Abbot Berg Sokkason (d. 1345). Árni Laurentíusson, a monk of Thingeyrar (b. 1302), compiled a life of the English St. Dunstan. Somewhat later, probably in the 15th century, a short life of St. Oswald was written in Icelandic.

A large collection of *Ævintýri* or *exempla* was also compiled in the 14th century. These consist of tales of foreign origin, illustrating some moral precept. Many of them were said to have been told in Iceland first by Jón Halldórsson, the Norwegian bishop of Skálaholt (1322–39). Others were taken from the well-known *Disciplina Clericalis*, written early in the 12th century by the Christian Jew, Petrus Alphonsus.

Poetry.—After the 13th century no more is heard of Icelandic court poets, patronized by the Norse rulers. Nevertheless, a great deal of poetry was composed in Iceland between the 13th century and the Reformation and many new forms were devised. The most valuable of this poetry was the religious, composed in honour of the Virgin, the apostles, and European and northern saints.

The best-known religious poem of the 14th century is the *Lilja* (Lily), composed by Eysteinn Ásgrímsson (d. 1361), a monk of Thykkvabœr in south Iceland. Using a traditional scaldic measure (*krynhent*), Eysteinn surveys the story of the universe in 100 strophes. He passes through the creation, fall of Satan, the first sin, and the birth, life and passion of Christ.

Many poems of the 14th and 15th centuries were dedicated to the Virgin. They include the *Maríulykill* (Clavis Mariae), an experiment in metrical forms composed by Jón Pálsson (*c.* 1390–1471), and the anonymous *Maríugrátr* (Weeping of Mary). The life of St. Peter is celebrated in the *Pétrsdrápa* (Lay of Peter) and the *Heilagra manna drápa* (Lay of Saints) includes strophes in praise of St. Thomas of Canterbury, St. Edmund and others.

Rímur.—The term *rímur* (singular *ríma*) is used for narrative poetry in forms which developed in the 14th century and were used with undiminished vigour until the 19th century. The *rímur* consist of strophes of lines with end rhyme. Their metrical forms appear to derive from Latin hymns, but they inherit the alliterative system of early Icelandic poetry. The stories told in most of the *rímur* were taken from written texts of sagas and they are especially interesting in cases where the text of the saga itself has been lost. One of the oldest is the *Ólafsríma*, composed by Einar Gilsson (d. 1369), whose subject was the death and miracles of St. Ólaf. The *Griplur* were based upon a lost saga about an ancient

hero, Hrómund Gripsson. Other *rímur* contained stories of the god Thor, the Völsungs and Grettir the Strong. Although the value of the *rímur* as literature is not great, they helped to maintain the interest in sagas and in early literature. They also saved scaldic diction from oblivion and are valuable as sources of linguistic history.

Ballads.—Ballads never attained such popularity in Iceland as they did in other European countries. Nevertheless, a number of ballads in Icelandic, dating from the 14th to 16th centuries, are preserved. Most of them are loose translations of Danish and Norwegian originals. The *Tristrams Kvæði* (Ballad of Tristram) is an exception, for it appears to be based upon the Norse saga of Tristram.

The Reformation.—The Reformation was enforced in Iceland by the Danish rulers in the 16th century. The chief political figure and chief poet of the period was Jón Arason, last Catholic bishop of Hólar, who was beheaded in 1550. In his life Jón showed that he was no less a viking than a martyr. Most of his surviving poetry is religious, including the *Píslargrátur*, the story of the Passion, based largely on St. John, the *Niðurstigningarvísur* (Verses on the Harrowing of Hell) and the *Ljómur* (Rays), which is reminiscent of the *Lilja* in structure.

The Reformation had various results for the development of learning and literature in Iceland and the first of them were not wholesome. Catholic poetry was discarded and attempts were made by the first Lutheran bishops to replace it with hymns poorly translated from Danish and German. Traditional rules of form and measure were ignored.

Lutheran teachers took pains to instruct the Icelandic people in the elements of dogma. Already in 1540, Odd Gottskálksson (d. 1556) had a translation of the New Testament in Icelandic printed in Denmark. In the following years several translations of sermons and books of instruction writen by German Lutherans were printed in Icelandic versions.

Bishop Gudbrandur Thórlaksson of Hólar (1571–1627) was the most energetic and the wisest of the Lutheran teachers and many translations were printed at Hólar under his guidance. Among these was the complete Bible, produced in 1584. The *Sálmabók*, published in 1589, consisted of hymns, mostly of foreign origin. In a remarkable prologue to this volume, Gudbrandur showed his appreciation of the poetic traditions of Iceland, and he adhered to Icelandic conventions of alliteration and form. This respect for tradition is even more pronounced in the *Vísnabók*, verses on religious subjects published by Gudbrandur in 1612.

The 17th Century.—By far the greatest poet of the 17th century was Hallgrím Pétursson (1614–74), a clergyman who struggled for many years against poverty and ill-health. His *Passíusálmar* (Hymns on the Passion of Christ) is among the most popular books in Iceland today. The poet meditates on Christ's sufferings, drawing symbolical meaning from his wounds and words. Another interesting poet of this period was Stefán Ólafsson (*c.* 1620–87), remembered both for religious and profane work.

In Iceland as in other countries, interest in antiquity was stirred in the 17th century, and modern learning may be said to date from that period. Arngrím Jónsson, the Learned (1568–1648), called the attention of Danish and Swedish scholars to Icelandic traditions and to the treasures of Icelandic literature in a series of works in Latin, some of which contain abstracts of sagas now lost. Later in the century, Árni Magnússon (1663–1730) systematically collected the early Icelandic manuscripts. Part of his collection was burned in the fire of Copenhagen (1728), but the remainder passed to the University of Copenhagen, where it is kept.

Although an age of learning, the 17th century was also an age of superstition and witch-hunting. Striking evidence of this is found in the *Píslar Saga* of the clergyman Jón Magnússon (*c.* 1610–96), who described how he was persecuted by magicians. His complaints had led to the burning of two unfortunate victims in 1656. The *Píslar Saga*, in its lurid language, is an interesting example of the prose of the time.

The 18th Century.—The best examples of the prose of the early 18th century are to be found in the *Húspostilla*, a collection of sermons written by Jón Vídalín (1666–1720), bishop of Skálaholt. Jón's style is forceful and his judgments forthright and severe.

Among important writers of the later 18th century may be mentioned Eggert Ólafsson (1726–68), well-known both as a geographer and as a poet. Jón Steingrímsson (1728–91) is remembered for his autobiography and accounts of volcanic eruptions which he had experienced. Jón Thorláksson (1744–1819) was a poet and a scholar, and translated John Milton's *Paradise Lost*, as well as works of Friedrich Klopstock and Alexander Pope into Icelandic.

The greatest historian of the period was Finnur Jónsson (1704–89), bishop of Skálaholt, whose *Historia ecclesiastica Islandiae* (1772–78), written in Latin, covers the history of Christianity in Iceland from the beginning to the author's time. It remains an authoritative work. Jón Espólín (1769–1836) was the author of *Árbœkur Íslands*, a history of Iceland from 1262. His prose style was modeled on that of the classical period. (G. T.-P.)

Modern Literature.—The later literature of Iceland was more flourishing than it had been since the 13th century. Lyrical poetry is by far the largest and most interesting portion of it. The first great poet of the 19th century was Bjarni Thórarensen (1786–1841), a judge and sheriff, who may be credited with the introduction of the romantic movement into Iceland. The forms and diction of his poetry are strongly influenced by those of the Eddaic poets.

One of the favourite poets of Iceland is Jónas Hallgrímsson (1807–45), who succeeded best in his descriptions of nature. His touch is light and he has often been compared with Heinrich Heine. The influence of Jónas Hallgrímsson was still felt in the 20th century and his school was the reigning one up to the end of the 19th century, although then a change seemed to be in sight. The most successful poet of this school was Steingrímur Thorsteinsson (1831–1913). He is especially famous for his splendid descriptions of scenery (as in *Gilsbakkaljóð*), his love songs and his sarcastic epigrams. Equal in fame is Matthías Jochumsson (1835–1920), who, like Jónas Hallgrímsson, successfully revived the old metres of the classical Icelandic poets, whom he resembles in his majestic but sometimes too gorgeous language. He successfully treated subjects from Icelandic history, as in the *Grettisljóð*, a series of poems about the famous outlaw Grettir.

The great religious poet, Hallgrímur Pétursson, found a worthy successor in Valdimar Briem (1848–1930), whose *Songs of the Bible* are deservedly popular. An interesting position is occupied by Benedikt Gröndal (1826–1907), whose travesties of old romantic stories are among the best satirical and humorous productions of Icelandic literature.

There was another school of poets influenced by Jónas Hallgrímsson but keeping alive the traditions of poetry maintained by Sigurður Breiðfjörð (1798–1846). In the middle of the 19th century this school was best represented by Hjálmar Jónsson from Bóla (1796–1875), a poor farmer with little education but endowed with great poetic gifts. In the last decades of the 19th century this school produced two poets of a very high order, both distinctly original and Icelandic. One was Páll Ólafsson (1827–1905). His songs are mostly written in the medieval quatrains (*ferskeytla*) and are generally of a humorous and satirical character. The other was Þorsteinn Erlingsson (1858–1914). His exquisite satirical songs, in an easy and elegant but still manly and splendid language, raised much discussion. Of his poems may be mentioned *Eiðurinn* (The Oath), a series of most beautiful ballads, with a tragical love story of the 17th century as the base, but with many happy satirical allusions to modern life. Near to this school, but standing apart, was Grímur Thomsen (1820–96).

In the beginning of the 1880s a new school arose among the Icelandic students in the University of Copenhagen who had attended the lectures of Georg Brandes. This school was quite different from the half-romantic one of Jónas Hallgrímsson; it was nearer to the national school of Páll Ólafsson and Þorsteinn Erlingsson, but differed from these by introducing foreign elements hitherto unknown in Icelandic literature and—especially in the case of the prose writers—by imitating the style and manner of some of the great Norwegian novelists. Their influence brought Icelandic literature into new roads, and it is interesting to see how

the tough Icelandic element gradually assimilated the foreign. Of the lyrical poets, Hannes Hafstein (1861–1922) was by far the most important. In his splendid ballad *The Death of Skarphedinn* and in his beautiful series of songs describing a voyage through some of the more picturesque parts of Iceland, he is entirely original; but in his love songs a strong foreign influence may be felt.

Among the many later lyric poets Einar Benediktsson (1864–1940) and Stephan G. Stephansson (1853–1927), who lived in Canada, deserve mention, both rather heavy in style but rich in ideas and weighty in thought. Of their younger contemporaries, Davíð Stefánsson and Stefán frá Hvitadal were lighter and more elegant in style; Tómas Guðmundsson and Jón Helgason deserve mention as lyrists.

The chief novelist of the 19th century was Jón Thoroddsen (1819–68). The influence of the realistic school became predominant. The most distinguished writer of that school was Gestur Pálsson (1852–91), whose short stories with their biting satire produced many imitators in Iceland. Jónas Jónasson (1856–1918), a clergyman of northern Iceland, in a series of novels and short stories gave accurate but somewhat dry descriptions of the more gloomy sides of Icelandic country life. Other interesting novelists whose work extended well into the 20th century were Einar H. Kvaran and Gunnar Gunarsson. Guðmundur Friðjónsson, Jón Trausti and Guðmundur G. Hagalín portrayed folk life with skill.

The most important novelist of the 20th century is undoubtedly Halldór Kiljan Laxness, who was awarded the Nobel prize for literature in 1955. A number of his novels, including *Þú vínviður hreini* (1931; English translation in *Salka Valka*, 1936); *Sjálfstætt fólk* (1934–35; English translation, *Independent People*, 1945); and *Atómstöðin* (1948; The Atom Station) have been translated into several languages and widely read abroad. Laxness has drawn his themes largely from the lives of poor Icelandic crofters and fishermen, but also from the history of Iceland. In his trilogy *Íslandsklukkan* (1943; The Bell of Iceland), he described life in the 18th century, and his powerful, cynical *Gerpla* (1952; Heroica) is based on legends of the 11th century. Laxness has displayed strong leftwing tendencies in many works, but especially in *Atómstöðin*, a story of postwar Reykjavík, in which emphasis is laid on the corrupting influences of a financial boom and the presence of a U.S. air force base. His style is universally admired.

Among dramatists Jóhann Sigurjónsson (1880–1919) deserves mention for his powerful *Bjærg-Ejvind og hans Hustru* (1911; English translation, *Eyvind of the Hills*, 1916), which has been produced in many countries.

A great many gifted Icelanders of the 19th and 20th centuries devoted themselves to study and criticism of ancient Icelandic literature. Among these should be mentioned Jón Sigurðsson (1811–79) and Guðbrandur Vigfússon (1827–89), for many years reader in Ancient Icelandic at Oxford university. Finnur Jónsson (1858–1934) was professor of Icelandic in Copenhagen and the author of a detailed history of early Icelandic literature in Danish. A more humane approach to the early literature will be noticed in the works of the later scholars Sigurður Nordal and Einar Ó. Sveinsson. (S. BL.; R. P. Co.; G. T.-P.)

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ICELAND MOSS, a lichen (*Cetraria islandica*) of erect, loosely tufted habit, called moss because in common speech lichens were formerly known as mosses. It varies from deep brown to pale chestnut colour, rarely grayish-white. It grows to a height of from three to four inches, the branches being trough-shaped to strap-shaped, forking into flattened lobes fringed with short hairs bearing the male organs. The female organs are borne on the margins, usually at the tips of the lobes. It grows in alpine areas of mountains of the northern hemisphere, reaching the Alps in Europe, the Appalachians in North Carolina and Tennessee and the Rocky mountains in Colorado. It is common on the lava slopes and plains of Iceland, whence its name. A narrower variety grows in gravelly soils of the coastal plain of eastern and southern New England.

RUTHERFORD PLATT

ICELAND MOSS (CETRARIA ISLANDICA)

A brown dye is sometimes extracted from it. The food processed from it in northern Europe is a light gray substance, resembling gelatin, with a slightly bitter taste. It contains about 70% lichenin or lichen starch, isomeric with common starch.

See also LICHENS. (C. W. DE.)

ICE MANUFACTURE: *see* REFRIGERATION.

ICENI, a British tribe that occupied what is now Norfolk and Suffolk. After the death of their king Prasutagus in A.D. 60 the Romans annexed their territory, causing the revolt of Boadicea (*q.v.*). When the tribe was conquered, it was severely punished, but became eventually a small tribal community with capital at Venta Icenorum (now Caister St. Edmund in Norfolk).

(I. A. RD.)

ICE PLANT, the popular name for *Mesembryanthemum* (or *Cryophytum*) *crystallinum* (family Aizoaceae), a hardy annual most effective for rockwork in mild climates. It is a low-growing, spreading, herbaceous plant with the fleshy stem and leaves covered with large glittering papillae which give it the appearance of being coated with ice. It is a dry-country plant, a native of Greece and other parts of the Mediterranean region, the Canary Islands, south Africa and widely naturalized in California. *Mesembryanthemum* is a large genus (containing more than 1,000 species) of erect or prostrate fleshy herbs or low shrubs, mostly natives of south Africa, and rarely hardy in the British Isles or the northeastern United States, where they are mostly grown as greenhouse plants. They bear conspicuous white, yellow or red flowers with many petals inserted in the calyx tube. The thick fleshy leaves are variable in shape, and often have spiny rigid hairs on the margin. They are essentially sun-loving plants. The best-

known member of the genus is *M. cordifolium variegatum,* with heart-shaped green and silvery leaves and bright rosy-purple flowers.

Ice plant is extensively used for edging flower beds and borders during the summer months. Three other species grow on the coast of California, the sea fig or beach apple (*M. aequilaterum*), with thick, three-sided leaves; the small-leaved fig marigold (*M. nodiflorum*); and also the Hottentot fig (*M. edule*), all of south Africa. The last species yields fleshy, edible fruit and is cultivated as a sand-dune binder along the coast near Los Angeles.

ICE SKATING, a means of self-propelled locomotion over ice on steel blades fastened to the bottoms of shoes. This article, after a general historical consideration of skating, skate design, rinks and ice shows, has separate sections on figure skating and speed skating and finally a section on skate sailing.

Early History.—From frequent allusions to skating in ancient Scandinavian literature, runic antiquaries and other historians assign to skating an antiquity dating back at least to the 8th century. The present-day skate may have had its origin in the primitive Norse snowshoe made of wood, but the earliest known skate is that of the bone runner. Made of cow bones and sometimes of the bones of reindeer, sheep or other large animals, these bones were ground down and shaped until they presented a flat traveling surface. They were bound to the feet with thongs. The earliest dated example is that found at Bjorko, Swed., a town which flourished between the 8th and 10th centuries. A specimen of an ancient skate 11 in. in length was exhibited in 1841 to the London Society of Antiquaries and described as "formed of the bone of some animal, made smooth on one side, with a hole at one extremity for a cord to fasten it to the shoe." This relic was found in the boggy soil in Moorfields. Samples of ancient bones giving evidence of having been used as skates may be seen in the British museum, in the museums of Cambridge, Edinburgh and York and also at Guildhall. Examples of the bone skate have also been found in Norway, Denmark, Scotland, Iceland, the Netherlands, Germany and Switzerland.

The modern Dutch word *schaats,* from which is derived the English word "skates," is at least as old as 1573. The earliest mention of the word in its present sense is found in Henry Hexham's *A Copious English and Netherduytch Dictionarie,* published in 1648, which refers to "Skates, which slide upon the ice in Holland." In the vocabulary of the Moravian educator Johann Comenius (1592–1670), *Orbis sensualium pictus* (1658), wooden skates shod with iron are called *Scrickshoes,* from the German, and in the print at the head of the section in that work they are represented as being quite long and with great curls of iron at the toes.

From the days of the Icelandic tales of the *Elder Edda* the early history of skating can be traced by means of casual reference to it in literature. Some contrivance for gliding over the ice was common in England in the 12th century, for William Fitzstephen's *Description of the City of London* states, "When the great fenne or moore (which watereth the walls of the citie on the North side) is frozen many young men play on the ice . . . some striding as wide as they may doe slide swiftlie; and some tye bones to their feete and under their heels, and shoving themselves with a little picked staffe doe slide as swiftlie as a bird flyeth in the air or an arrow out of a cross-bow." Other references are found in the 14th-century Scandinavian saga *Fornmanna Sogur.* In *Historia de Gentibus Septentrionalibus* (1555) Archbishop Olaus Magnus wrote: "they race swiftly upon the slippery ice, having a plain polished iron or plain Deers or Sheep bones, mainly the shank bones that are naturally slippery by reason of their inbred fatness, and are a foot in length, fastened at the bottom of their feet." Among later writers who made mention of skating were Samuel Pepys, who first mentioned skating as an art, and John Evelyn, both of whom wrote in their separate diaries of watching ice skaters in St. James's park, London, on the same day, Dec. 1, 1662. Commenting on the origin of skating, Charles Dickens wrote in an essay dated March 18, 1876, "It is curious to note that skating is almost unknown in Russia among the people, and is of entirely foreign and recent introduction." However, bone skates made from walrus teeth have been found in Siberia and are in the National Museum of Ethnology at Leiden, Neth.

Skating is widely recorded in art. One of the earliest known pictures of skating and a bladed skate is a woodcut dated 1448, illustrating the skating accident which befell St. Lidwina, or Lydwina, patron saint of skaters, in the year 1396. Pieter Brueghel the Elder, in the 16th century, pictured skaters in striking action in various works and other artists from many lands have immortalized skating. One of the world's first Christmas cards, designed by 16-year-old William Maw Egley, Jr., apprentice to a London engraver, in the 1840s, included a skating scene. A number of countries have honoured skating with special postage stamp issues, among these being Germany, Hungary, the Netherlands, Rumania, Russia, Norway and Japan.

Skate Design.—It is not known when the metal runner was introduced, but early Dutch prints show the metal skate as having an extremely wide traveling surface. Until the middle of the 19th century the metal portion of the skate was fastened to a wooden base or footplate and the whole of the skate was fastened to the foot with leather thongs or straps. Improvement in skate design began in the 1800s with many ideas being patented, every effort being made by the inventor for security in attachment. One of the best developments was that of the Barney and Berry Co. of Springfield, Mass., which appeared in the early 1860s and which utilized screw clamps, fastening the skate to the welt of the sole and heel of the shoe. Another ingenious arrangement of this time was the Acme clamp skate from Halifax, N.S. The final and most satisfactory development in the securing of the skate to the shoe was simply to attach them permanently with screws, a method in continued use.

There were many experiments in the development of the blade of the skate, especially during the period 1830–80. Henry Boswell of Oxford designed an improved skate in 1837 which eliminated the projecting toe and had an elongated, rounded heel especially for figure skating. A major improvement was made in 1850 when E. W. Bushnell of Philadelphia introduced the all-steel skate, which eliminated the cumbersome wooden footplates and proved universally popular. The main developments in the figure skate after 1900 were the addition of sawlike teeth placed at the toe, enabling the skater to obtain better purchase in the ice when doing certain jumps, and the innovation of the "closed-toe" blade of one-piece steel, manufactured in 1914 by John E. Strauss of St. Paul, Minn. The Strauss design gave added strength to the skate and permitted a much lighter-weight blade.

An average figure-skating blade is $\frac{5}{32}$ in. wide and is shaped with a curvature approximating that of a circle having a six-foot radius. The blade is hollow ground when sharpened, emphasizing the two edges of each skate. The hockey skate is also given a hollow grinding which allows better purchase in the ice. The speed skate uses a thinner blade and it is sharpened with a flat surface and a very long radius affording the racer a longer stroke. The popular length of the outdoor racing skate is 16 to 17 in., with the skate cups which hold the blade to the footpiece set low to the ice. For indoor racing the cups are heightened, the blade shortened to about 15 in. and the skates set far over to the left of the shoes to allow for the sharper turns.

Rinks.—The invention of mechanical refrigeration and the development of refrigerated ice rinks started the transformation of ice skating from a seasonal pastime to a major sport and launched the eminently practical skate on its way to theatrical history.

The world's first mechanically refrigerated rink was John Gamgee's "Glaciarium" in Kingsroad, Chelsea, London, built in 1876. It was a studio-type room with an ice surface 40 ft. by 24 ft., frozen by means of a mixture of glycerin and water running through copper pipes, chilled by ether. The first artificially frozen rink in the United States was installed in the old Madison Square Garden, New York city, in 1879 by Thomas L. Rankin and had a surface of 6,000 sq.ft. In 1889 a huge outdoor rink was built in Paris, running the full length of the Rue Pergolese. Other early rinks were opened in Glasgow, Frankfurt am Main, Berlin, Southampton, San Francisco, Baltimore and Pittsburgh. The popularity of these rinks grew steadily and in the second half of

the 20th century there were more than 200 mechanically refrigerated ice arenas in the U.S., more than 200 in Canada, about 30 in Great Britain and many others throughout the world.

These ice arenas, many with large seating capacities, not only gave impetus to skating as a recreation and participant sport but they were also a major factor in establishing ice-show productions as leaders in spectator entertainment.

Ice Shows.—The professional skating spectacles, an outgrowth of the amateur ice carnivals, combined the colourful movement of huge casts of skaters with all the arts of the theatre—brilliant lighting, gorgeous costumes, special music and direction—and by the second half of the 20th century were established as among the most popular forms of entertainment. International tours were arranged, including the major cities of the world. One of the pioneer shows, the "Ice Follies," first produced in 1936 by Oscar Johnson, Edward Shipstad and Roy Shipstad, played to more than 40,000,000 people in 20 years. A trade publication, the *World Ice Skating Guide*, estimated that 11,000,000 people attended skating shows in Canada and the U.S. alone during one year in the mid-1950s, and paid more than $22,000,000 for admissions. Other prominent American shows of the 1950s were "Ice Capades," produced by John H. Harris; the "Hollywood Ice Review," produced by Arthur M. Wirtz; "Sonja Henie Ice Revue," produced by the Norwegian star, Sonja Henie; and "Holiday on Ice Shows," produced by Morris Chalfen, Emery Gilbert and George Tyson. The last were presented on ingenious mobile rinks, complete with refrigeration equipment, which could be transported anywhere in the world and set up indoors or out of doors. In a single year this company had seven separate full-scale productions playing in five continents at one time—North and South America, Europe, Asia and Africa.

Leading producers of skating spectacles in Great Britain were Sir Arthur Elvin, Gerald Palmer and Claude Langdon. Elaborate pantomimes with stories portrayed on ice were tremendously popular throughout Great Britain.

One of the earliest experiments in ice-show production, staged at the huge Hippodrome theatre in New York city in 1915, featured the German ice ballerina Charlotte (Oelschlagel) and an ice ballet imported from Berlin. Called "Flirting in St. Moritz," the show created a skating furore in New York and ran for 300 days, instigating the production of the first skating motion picture ever made, "The Frozen Warning," released in 1916 and starring Charlotte.

FIGURE SKATING

History.—Figure skating is one of the most scientific of all sports, and the most artistic division of skating. It is also the most difficult, requiring skill in plain skating, both forward and backward, a high degree of body control and assiduous practice. The first comprehensive written treatment of figure skating seems to be *A Treatise of Skating* by Capt. Robert Jones, published in London in 1772. Other early textbooks on the sport are *The Art of Skating* by Cyclos (George Anderson), published in 1830, and "The Skaters Manual," 1831.

Soon after the discovery that inside and outside edges and elementary figure-three turns could easily be done with the steel skate, it was found that turns could be made in the opposite direction or counter to the simple three turn. Combinations of various turns naturally developed, and these turns became increasingly more difficult; the style or the manner in which these turns were made was standardized, and when the course of standardization became general, competitions were organized. (See *School Figures*, below.)

Modern figure skating was influenced to a profound degree by the revolutionary style of the American Jackson Haines (1840–76). Haines, known as the "father of figure skating," gave skating a freedom of movement which it had not formerly possessed. He was born in New York city and first came into prominence in the 1860s. A ballet master, Haines combined dance movements with his skating, a novelty in America where figure skating was executed in a stiff and rigid style, and gave exhibitions throughout the eastern states and Canada. After winning the American championship he left for a tour of Europe in 1865. His first appearances in England were not successful; Londoners, like New Yorkers, preferred their own cramped manner to the sensational routines of Haines. It was not until he went to Stockholm in 1866 that his art was fully appreciated and he began a triumphal tour across Europe. In Vienna he was an instantaneous success and there he taught the Viennese to waltz on ice, which resulted in the founding of the Vienna School of Skating. After 11 years abroad Haines planned to return to America but, traveling by sled from St. Petersburg to Stockholm, he contracted pneumonia and died in Finland in Jan. 1876.

The lack of appreciation of Haines in the U.S. and Great Britain was the result of the styles of skating then in vogue. Figures were accomplished by ungainly twisting of the body, together with much kicking of the nonskating leg.

At the continental winter resorts, in Great Britain and to some extent in Canada, a form of figure skating known as the "English" style was popular until the early 1900s. Various modifications of the style were known by other names but the essential features were identical. A branch of this form of skating was the hand-in-hand or "combined" style, in which more than one skater took part, usually four and sometimes six or eight. A member of the group was appointed "caller" and it was his duty to call out to the others moves which the group did simultaneously. Interesting patterns were thus performed.

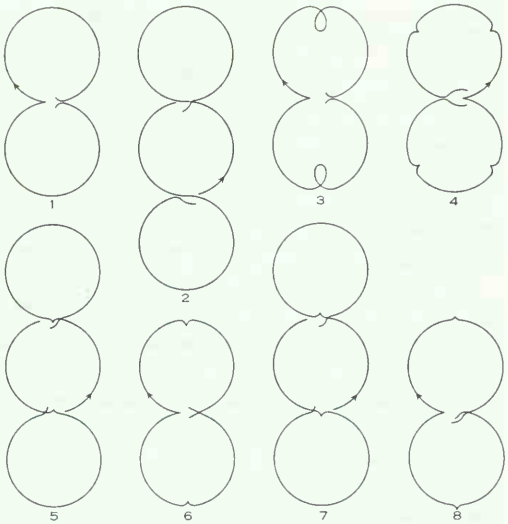
Out of these various styles of skating there developed at the beginning of the 20th century the international style, which became popular and is followed the world over. Irving Brokaw, champion of America in 1906, brought the international method of skating back to the U.S. on his return from a European tour in 1908. Although but little remains of the previously mentioned forms of skating they cannot be easily dismissed, since the present form of skating has its foundations in their essentials and in those set down by Haines.

The development of figure skating from an obscure form of competition in the early 1900s to a major sport was largely the result of control organizations such as the Internationale Eislauf-Vereinigung (I.E.V.; International Skating union) of Europe, the National Skating Association of Great Britain (organized in 1879), the United States Figure Skating association (U.S.F.S.A.; 1921), the Canadian Figure Skating association, and other amateur groups and clubs. The I.E.V., founded July 23, 1892, at Scheveningen, Neth., is the governing body over skating throughout the world. The principal aim of the control organization is to improve and advance figure skating, to provide standards, to prescribe tests and rules for the holding of competitions and generally to take all steps necessary to regulate figure skating through its membership clubs.

The Edinburgh Skating club, instituted in 1642, is the oldest skating club in the world. The Skating Club of London and the Glasgow Skating club were both formed in 1830. A steady increase of interest in the sport has been shown in the U.S. and Canada, especially since the 1930s. The U.S.F.S.A. had 120 member clubs in the second half of the 20th century. Organized in 1849, the Philadelphia Skating Club and Humane society is the oldest skating club in the U.S. Other early groups are the Skating Club of New York (1863) and the Skating Club of Boston (1912). The Canadian Figure Skating association had over 150 member clubs in the 1960s, including the historic Minto Skating Club of Ottawa and the Toronto Skating club.

Divisions.—What is broadly called figure skating is divided into various divisions; these are school figures, free skating, dancing, pairs and fours. In competition, the event for individuals consists of two sections, the prescribed school figures and free skating, or optional routine for a specified number of minutes.

School Figures.—The elements of school figures are simple curves or turns, which are done in the direction of motion, and the so-called forced turns, which are done against the direction of motion. There are four directions in which the skate may go, outside edge, both forward and backward, the inside edge, also forward and backward. Skated first on the right and then on the left skate to form full circles, these simple curves become the fundamental figure eights. A combination of these circles becomes



REPRINTED FROM THE U.S.F.S.A. RULEBOOK WITH THE PERMISSION OF THE UNITED STATES FIGURE SKATING ASSOCIATION, HOLDERS OF THE COPYRIGHT

FIG. 1.—SCHOOL FIGURES: (1) CIRCLE EIGHT; (2) CHANGES OF EDGE; (3) LOOPS; (4) DOUBLE THREES; (5) ROCKERS; (6) THREES; (7) COUNTERS AND (8) BRACKETS

the changes of edge. Following in difficulty are threes, double threes, loops, brackets, counters and rockers. (*See* fig. 1.) Advanced figures are the so-called one-foot figures in which the full figure-eight form is done on the same skate instead of making a transitional change of feet at the point of start, as is done in the elementary figure eights.

There are 69 possible combinations of figures as officially designated by the I.E.V. Each figure is given a factor value from one to five, according to difficulty. The fundamental eights, for example (except the inside back eight), have factor values of one, while the back loop-change-loops and the back bracket-change-brackets have factor values of five.

Definite rules have been set down concerning the correct tracings of school figures on the ice. For example, both circles of the eight should be of equal size when divided by the transverse axis; there should be a symmetrical grouping of the individual parts of the figures about the axes; figures should be skated on the specified edge of the skate without changes of edge or flat edges, except, of course, when the figure calls for a change of edge. (*See* fig. 2.) Three turns, brackets, rockers and counters should be made without changes of edge before or after the turns and the turns should be placed on the long axes.

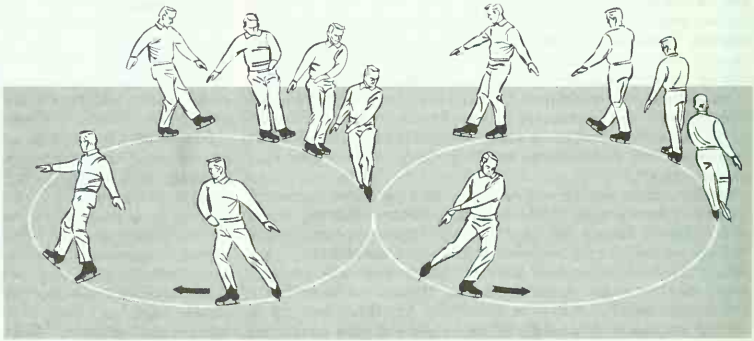
There are also definite rules for the body positions of the skater while performing the figures. The body should be erect, without bending at the hips; there should be a moderate bending of the skating knee; the head should be held erect and the skater should not look at the ice. The free foot (nonskating leg) should have the toe of the foot turned downward and outward with the free knee slightly bent; the free foot is generally held behind the tracing foot. The arms should hang down easily but without raising the elbows or hands far from the body. Everything violent, angular or stiff is to be avoided. There should be no strong effort and the impression should be given that the skating is executed with ease.

Free Skating.—The second section of the singles events is free skating. Generally speaking it is a "free" adaption of the various parts of the circles and the turns which make up school figures, and is skated to music. The design of a free-skating program must be a varied one and should include spirals (exaggerated edges), dance steps, connecting moves, jumps and spins. Jumps are an important element in a program. They are leaps off the ice with from a half turn to triple turns in the air. Many of the jumps are named after their originators, for example, the Salchow, the Paulsen, the Boeckl, the Pat Low (also known as the Walley) and the Lutz. Others are the three jump, the loop, the counter (named after school figures) and the flip. Spins are another element; some of these are the flat-foot spin, the toe scratch, the Haines and the arabesque, which is also called the camel spin. A pair skating program is very similar to the singles program in its content and construction. An important element in this branch, besides the jumps, spins and dance steps, is the lift. In this move the man lifts his woman partner in the air while skating. Many daring and exciting lifts have been devised. Fours consists of two men and two women, and is skated as pairs and as a group. Jumps, spins, lifts, pair and group moves comprise the program.

Dancing.—Although ice dancing has been known for many years, it became, after the 1930s, by far the most popular branch of the sport. Unlike ballroom dancing, in which steps may be improvised, ice dancing is skated in set patterns and with set steps which never vary. The steps are, as in free skating, based on parts of circles. The three turn is mostly used with an occasional bracket, rocker or counter.

Competitions.—Although the actual school figures to be skated in a singles competition are not known to the competitor until 15 minutes before the event, they are drawn by lot from a larger group, which is usually made known at some previous date. There must be an odd number of judges, no two of whom may be from the same club, city or country, depending upon whether the competition is local, national or international. When each skater has completed a particular figure, it is given a mark by each judge independently and represents his numerical opinion as to its value. The correctness of the shape of the figure, the turn, triple repetition, the largeness of the figure and the form with which the figure is skated are the factors upon which judgment is made. The free-skating program is given two marks, one for content, or what the skater has done, and the other for performance, or the manner in which the skating was done. The pairs, fours and dance competitions are judged in a similar manner except, of course, that there are no school figures skated.

The first amateur women's world champion was Madge Syers of England, who held the title for the years 1906–07. Gilbert Fuchs of Germany won the first world championship for men (1896). European skaters held a tight grasp on all the world's



FROM MARIBEL V. OWEN, "THE FUN OF FIGURE SKATING," ILLUSTRATED BY ROBERT RIGER; REPRODUCED BY PERMISSION OF HARPER BROS.

FIG. 2.—EXECUTION OF OUTSIDE FORWARD EIGHT, A VARIATION OF CIRCLE EIGHT (*See* FIG. 1)

titles until Barbara Ann Scott of Canada triumphed in 1947, the first time a world figure-skating championship had left Europe. The men's world title went to America for the first time when Richard T. Button of the U.S. won the championship in 1948. Button was one of the great modern-day skaters and held all the major championships from 1948 to 1952. Tenley Albright, Newton Center, Mass., who won the Olympic title in 1956 and the world's in 1953 and 1955, was the first U.S. woman to win the Olympic championship. (For winners in Olympic competition *see* OLYMPIC GAMES.)

Great Britain dominated the dance championships of the world in the second half of the 20th century with such superb teams as Lawrence Demmy and Jean Westwood; Paul Thomas and Pamela Weight; and Courtney Jones and June Markham. Robert Paul and Barbara Wagner of Canada, always famous for magnificent pair skating teams, won the 1957 world pair title. Among the great pair skating combinations of the world was Canada's Montgomery Wilson and his sister, Constance Wilson Samuel, in the 1930s, both of whom also held many major singles titles.

The most celebrated figure-skating champion of all time was Sonja Henie, who at ten years of age won the national championship of Norway. Henie was three times Olympic champion and ten times world champion. She turned professional in 1936 and skated in personal appearances before millions throughout the U.S., Canada, Europe and South America, producing many of her own shows, and she starred in many motion pictures.

SPEED SKATING

History.—Of the earliest skating races no records have been kept. That racing was a popular pastime in the Netherlands earlier than the 17th century is proved by numerous paintings depicting racing scenes. Women's races took place as early as 1805 at Leeuwarden. Keen interest in ice racing was evidenced in England from the early 1800s, especially in the fens or marshy section of the country. The first recorded skating match in England was that in which Youngs of Mepal beat Thomson of Wimblingdon, both men from the fens, in the year 1814. In Jan. 1823, according to the *Annals of Sporting*, the first amateur match took place between teams of six gentlemen from March and Chatteris, Drake of Chatteris finishing first. In the 1850s the celebrated Smart family entered the racing scene, with William ("Turkey") Smart defeating Larmen Register in 1854 and retaining the championship for more than a decade. His nephew, George ("Fish") Smart, won the championship in 1878 and held it until 1889, only to relinquish it to his younger brother, James. The first amateur championship of England was held in 1880 at Hendon by the newly formed National Skating association and won by F. Norman, a fens skater.

Speed skating was tremendously popular in northern sections of the United States and Canada. Charles June was considered the best U.S. skater for 1838 and many years thereafter, and his place of residence, Newburgh, N.Y., on the Hudson river, became the headquarters of U.S. ice racing. This city also is the birthplace of the Donoghue family, who may be called the Smarts of America. The most noted members of this family were T. Donoghue and his two sons, Tim and Joseph F. Donoghue, each in his day the fastest skater in the world.

J. F. Donoghue went to the Netherlands in 1889 to compete in the Amsterdam races and won the two-mile event, defeating among others the celebrated Russian flyer Alex von Panschin. In 1891 he again competed in the great international races at Amsterdam and on Jan. 6 and 7 won all four events on the program, earning him the title of champion of the world. J. F. Donoghue was the first American to skate one mile under three minutes, his time being 2 min. 59 sec.

The famous Norwegian figure skater Axel Paulsen was also one of the fastest racers of his day. He competed in some of the great American races and in 1884 he won most of the races he entered, first in New York, then in Milwaukee and Washington, D.C.

Norval Baptie, world champion 1905–07, was one of the most colourful skaters of all time. Born at Bathgate, N.D., Baptie was a champion racer, renowned exhibition skater on racing blades and on figure skates and a leading instructor of the sport.

The Stroke.—In speed skating the blade, when planted on the ice with weight upon it, describes a nearly straight line. When stroking, the last few feet only curve slightly outward as the skate leaves the ice. The length of stroke has tended to diminish since the days of the 12–18 yd. stride attributed to the old English champion William Smart on the fen "runners." The modern racing stroke rarely exceeds 10 yd., and is usually 6 or 7. Particular instances vary with conditions of ice, etc., but at St. Petersburg, in 1896, Eden's stroke in the 10,000-m. race averaged about 7½ yd., that of Peder Oestlund at Davos, in 1900, the same (for one lap it was 8 yd.).

J. F. Donoghue's stroke in 1891 was computed at about 9 yd. Irving Jaffee, U.S., former Olympic champion, had a powerful 8-yd. stroke in some of his races. Clas Thunberg of Finland, world amateur champion 1923–25–28–29–31, had a tremendous 27½-ft. stroke. He visited the U.S. in 1926 and in two races at Madison Square Garden in New York city was soundly beaten by Joe Moore, New York city, due in large measure to the fact that his stroke was far too long for the small indoor track and he could not negotiate the turns.

Later in the same year, on outdoor tracks, the "Flying Finn" set two U.S. records which had not been broken by the second half of the 20th century.

Courses.—The international system of ice racing involves a course with straight sides and curved ends of such a radius that no slackening of speed is necessary. The competitors race two at a time on a double track, and the time test is used. Each skater must keep his own course, to prevent either from using the other as pacemaker or windshield. The advantage of inner curve on a continental course is given alternately and a space left open between the tracks at one point for the skaters to cross. The official I.E.V. track measures 400 m.; the official U.S. outdoor track is 6 laps to the mile.

Form.—Competitive speed skating requires skill, strength, muscular co-ordination and great stamina. The body should be poised so that the centre of balance is in the hips. At racing pace the body should follow an imaginary straight line. The stroke should be kept as straight as possible, for swaying widely from side to side results in loss of momentum. To obtain the most effective stroke with minimum effort, the skater must lean forward from the waist and bend the knees. The force of the leg drive is directed forward, not upward; the push should be made toward the side, not backward; and the push is from the centre of the blade, not from the toe.

For winners in Olympic competitions, *see* OLYMPIC GAMES.

SKATE SAILING

Skate sailing is the sport of moving over the ice on skates propelled by the wind. It is probable that skate sailing originated in the Scandinavian countries and was practised in some form or another almost immediately after the invention of the skate. One of the first skate-sailing organizations was the "Ice-Skate Sailing club" formed in Stockholm in 1901. The sport was taken up by members of the London Skating club in England in the 1890s and was introduced to North America in the early 1900s. The Skate Sailing Association of America, governing body over the sport in the United States, was organized in 1922.

The modern skate sail, generally rectangular or triangular in shape, has approximately 50 to 60 sq.ft. of area. The Skate Sailing Association of America recommends that the sail be perfectly flat and stretched to drumhead tightness. The spars and rigging should be moderately light, yet strong and as simple as possible so that they can be handled easily in cold, windy weather. In sailing, the skate sail is always carried on the windward shoulder, that is, between the sailor and the wind. The sail material can be a good grade of sheeting or unbleached muslin but for best results should be a nonporous, lightweight sailcloth, balloon silk or nylon. Long, tubular racing skates 16 to 18 in. in length are used.

Learning how to skate sail on the ice before and against the

wind requires only a basic proficiency in skating, for the sail gives added stability and bears much of the sailor's weight. Speeds up to 55 m.p.h. have been reported.

See also WINTER SPORTS.

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I-CH'ANG, a port of China on the north bank of the Yangtze river in western Hupeh province. Although a relatively small town, with about (1953) 73,300 inhabitants, it plays an important economic role in the trade of Szechwan province and the Yangtze valley. In 1958 it was one of five municipalities in Hupeh under direct provincial administration, as well as being the seat of eight districts forming a special *ch'ü* (region). Ten miles above the port begins the rugged country through which the Yangtze breaks in a series of four great limestone gorges and about 60 rapids and whirlpools, the grandeur of which has been a favourite theme of many Chinese poets, especially Li Po (*q.v.*; 701–762). A short distance above I-ch'ang is the prospective site of a hydroelectric dam that has vast promise for the industrialization of central China. During flood stages 1,000-ton steamboats can navigate up to I-ch'ang where transshipment takes place between upriver and downriver traffic. Formerly, carriage upriver was entirely hauled by junks pulled over the rapids by gangs of men. After 1909 small, high-powered river steamers carried a large proportion of the commodities passing upstream, though much of the traffic remains junk-borne. A motor highway reaches westward from Wu-han to I-ch'ang.

The city, captured in 1940, marked the farthest Japanese advance up the Yangtze valley in World War II. I-ch'ang was a treaty port from 1876 to 1943. A small foreign settlement formerly stood between the city wall and the sheltered anchorage.

(H. J. Ws.)

ICHINOMIYA, a commercial town in Aichi prefecture in Japan, about 11 mi. N.N.W. of Nagoya. Pop. (1960) 182,984. There are approximately 1,000 factories which manufacture about 60% of the nation's woolen fabrics. The cotton-textile industry is also important. The town developed in the 7th century from the Masumida shrine. During the Edō period (1603–1867), Ichinomiya was an important stage on the Gifukaido highway.

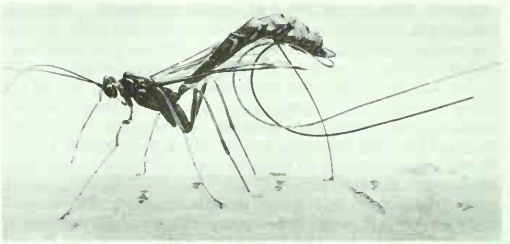
(R. B. H.)

ICHNEUMON, the largest of the common mongooses (*Herpestes* species), found from southern Spain throughout the whole of Africa to the Cape.

See MONGOOSE.

ICHNEUMON FLY, in its broadest sense, the common name for parasitic insects comprising the superfamily Ichneumonoidea, order Hymenoptera; in its restricted sense, the name refers to the largest family of this group, Ichneumonidae, typified by the genus *Ichneumon*. "Fly" in the common name is unfortunate since these insects are not flies at all (true flies, order Diptera, have only two wings whereas ichneumon flies have four) but are really parasitic wasps.

The Ichneumonoidea contains four families: Megalyridae, with less than 50 known species, mostly Australian; Stephanidae, with a few hundred known species, most of them native to tropical regions; and two very extensive families, Braconidae and Ichneumonidae, both widely distributed, and each with thousands of described species and even more thousands of undescribed ones. This superfamily includes most of the larger species of parasitic Hymenoptera, and also many that are very small; body lengths range from less than one-eighth inch to nearly two inches. The body, often brilliantly coloured, is usually comparatively narrow; the head is free and has long, slender antennae that very rarely



AUTHENTICATED NEWS

ICHNEUMON FLY (MEGARHYSSA LUNATOR); FEMALE PLUNGING HER OVIPOSITOR INTO A BRANCH TO LAY EGGS ON CERTAIN WOOD-BORING LARVAE

have as few as 11 segments and often have more than 50. The compound eyes are large, and the forewings usually have rather complete venation. Some species, however, are wingless, at least in the female sex. The abdomen, sometimes petiolate (attached by a narrow "waist") and sometimes sessile, is, in the female, provided with an egg-depositing organ (ovipositor) which ranges in length from so short as to be unnoticed to several times as long as the body. The largest ichneumons in the U.S. (*Megarhyssa* species) attain 1½–2 in. in body length, with an ovipositor of up to 4 in. *M. lunator* often bores several inches into a tree trunk to lay its eggs on the larvae of the pigeon tremex, a horntail or wood wasp (*see* SAWFLY).

All species are parasitic, many on the caterpillars of moths and butterflies and larvae of sawflies and of wood-infesting beetles. Some of the smallest species are parasites on plant lice; a few on adult beetles, true bugs or spiders; and some are even parasites of other ichneumon flies, these being called hyperparasites or secondary parasites.

The females deposit their eggs in or on the larvae or pupae (rarely eggs or adults) of the host species; the legless, maggot-like larvae that hatch from these eggs feed on the body fats and fluids of the host until fully grown. At this time the plump larvae usually spin silken cocoons, within which they pupate and from which the adult parasites eventually emerge. Those species parasitizing exposed hosts usually develop as internal parasites, whereas those attacking hosts concealed in wood burrows, plant stems, cocoons or leaf mines feed externally. In the case of the internal parasites the hosts feed and behave normally until shortly before the parasitic larvae have completed their development, but the hosts of the external feeders are paralyzed by the female parasites and do not regain activity. In most cases a single parasitic larva completes its development within or upon its host, but in some species many larvae develop in a single host. Twenty or more larvae of the braconid wasp *Apanteles glomeratus*, a common and widely distributed ichneumonoid parasite of cabbage butterfly caterpillars, complete development within a single caterpillar and then emerge to spin their cocoons beside the destroyed host.

Adults of ichneumon flies feed principally on honeydew secreted by aphids and certain related insects, or on host juices that exude from punctures made by the ovipositor. All species can, and under certain conditions do, reproduce without fertilization (parthenogenesis; *q.v.*). In most instances the progeny of such parthenogenetic reproduction are exclusively males, but certain species produce females regularly in parthenogenesis, the male sex being very rare or unknown.

Except for those that live as hyperparasites—and thus lower the numbers of other ichneumonids—ichneumon flies are generally beneficial and under certain conditions may play an important role in the control of plant pests. Some species have been transported from their original homes and colonized in new areas where their normal hosts became established and could not be controlled by sprays or other artificial treatment. *See* also INSECT.

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Townes, *A Catalogue and Reclassification of the Nearctic Ichneumonidae*, part i (1944), part ii (1945). (C. F. W. M.; X.)

ICHTHYOLOGY, that branch of zoology dealing with the study of fish (*q.v.*). As a foundation for an understanding of the anatomy and physiology of fish, one may start with the simple, diagrammatic lower chordate amphioxus (*q.v.*), then consider the characteristics of the subphylum Vertebrata (*see* VERTEBRATE) in general before approaching fish as a special group.

Paleontology (*q.v.*) includes the study of fossil fishes (*see* OSTRACODERM; PLACODERM). The lowest living fishes, the lampreys, and hagfishes, are jawless (*see* CYCLOSTOME). Next higher in development of structures are the jawed cartilaginous fishes (*see* CHONDRICHTHYES), including sharks, skates and rays. The bony fishes first developed a combination cartilage-and-bone skeleton (*see* STURGEON; GAR; BOWFIN). Then the true bony fishes, or Teleostei, appeared (*see* FISH: *Survey of the Bony Fishes*). The student may be interested in a particular fish or group of fishes, such as the herring, anchovy, char, salmon and trout, smelt, pike, electric eel, goldfish, catfish, eel, flying fish, sea horse, cod, barracuda, mullet, mackerel, swordfish, tuna, bass, drum, perch, sunfish, parrot fish, angelfish, goby, flatfish or flounder, sole, filefish, globefish, angler, etc., many of which are dealt with in separate articles.

Although not properly the province of ichthyology, the following related topics may be of interest to the reader: economic and ecological aspects, dealt with in FISH CULTURE, FISHERIES, and MARINE BIOLOGY; recreational aspects, touched on in AQUARIUM and FISHING.

ICHTHYORNIS, a group of extinct birds known from the Upper Cretaceous deposits (from about 70,000,000 to 130,000,000 years ago) of the Great Plains area of the United States (especially Kansas and Texas), now classified in the order Ichthyornithiformes. These flying birds, with strongly developed wings, were one of O. C. Marsh's notable discoveries, the two best-known species being about the size of the domestic pigeon. Marsh identified parts of a maxilla and a lower jaw bearing teeth set in sockets as belonging to this group of birds, an allocation that has led to considerable discussion. It is generally accepted now that these jaw fragments are those of a reptile, probably a small species of mosasaur (an extinct marine lizard). Indications are that *Ichthyornis*, like its modern relatives, lacked teeth.

The brain showed greater development than that of another extinct bird, *Hesperornis*, but still was smaller than that of modern birds. The vertebrae differ from those of other birds in being biconcave. The breastbone (sternum) is large, with a strong keel, and the wing bones are long and well developed, with the shoulder girdle similar in general type to that of living birds of strong flight. The legs were moderately strong with short shank (tarsus), fairly long anterior toes and a small, slightly elevated hind toe. The tail had a well-developed terminal plate of bone (pygostyle).

The indication is that these were birds of active flight, probably with webbed feet, in general form like modern gulls and terns. This resemblance, however, is superficial as the species are primitive, and are to be placed in the superorder Ichthyornithes, apart from the Neognathae, the modern birds.

Seven species are recognized in the genus *Ichthyornis*, of which *Ichthyornis dispar* and *I. victor* are known from partial skeletons and the others from fragments. These form the family Ichthyornithidae. *Apatornis celer* from western Kansas, placed in the family Apatornithidae, completes the list, the two families forming the order Ichthyornithiformes.

Though only two groups of birds are known from the Cretaceous —the divers, like *Hesperornis*, and the strong flyers, also probably of aquatic habit, like *Ichthyornis*—it is probable that the bird life of that period was more diversified. The two known are both highly specialized so that they stand alone and cannot be considered as directly ancestral to any of the known groups of birds which have been found in fossil deposits of later age or which are living. *See* also BIRD.

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ICHTHYOSAUR, an extinct sharklike reptile of the Mesozoic era (about 70,000,000 to 200,000,000 years ago) that showed far-reaching adaptations toward life in the seas and held much

BY COURTESY OF CHICAGO NATURAL HISTORY MUSEUM

SKELETON WITH OUTLINE OF BODY OF THE EXTINCT MARINE REPTILE STENOPTERYGIUS QUADRICISSUS, ICHTHYOSAUR FROM THE LOWER JURASSIC OF HOLZMADEN, GER.

the same position in the marine community as do the toothed whales of today. As is true of the whales, the ichthyosaurs descended from animals that lived on land; however, in the course of their adaptation to life in the water, their bodies became so modified that it is almost impossible to recognize their ancestry.

Intact skeletons of ichthyosaurs are known from a number of famous localities in Europe and North America, but the most interesting specimens come from Boll-Holzmaden in southern Germany, where skeletons of *Stenopterygius* often occur with remains of the skin preserved (*see* fig.) and with embryos or eaten young in the abdominal cavity. Their mode of reproduction (bearing live young from eggs hatched in the body) and their food (belemnites—relatives of the cuttlefish—and fish), as well as their at least occasional cannibalistic behaviour, have been inferred from the contents of the abdominal cavity.

The ichthyosaur body was thoroughly streamlined, pointed in front and ending in a vertical, membranous tail fin which was the principal organ of propulsion; the lower lobe of the tail fin was supported by the backbone. Along the mid-line of the back was a large membranous fin acting as a keel during propulsion. The fore and hind limbs were modified as lobelike steering paddles supported by greatly shortened and flattened limb bones and additional finger and toe bones. All these features suggest that the ichthyosaurs swam in a way similar to the sharks, by beating the tail fin from side to side and by steering with the fore and hind paddles or fins.

The relatively large skull tapered into a slender, elongated snout; the large eyes were within a ring of bony plates. The jaws were armed with a large number of sharp, conical teeth that were set in individual tooth sockets in the early ichthyosaurs (*e.g., Mixosaurus*) and in continuous tooth grooves in the later ones; some forms became practically toothless. The backbone consisted of short vertebrae with biconcave vertebral bodies. In *Mixosaurus* the end of the tail region of the backbone was almost straight; in the later forms it was bent sharply downward, a matter closely tied to the size and efficiency of the tail fin. This evolutionary change from straight to bent tail end seems to have occurred to some extent during the growth process of individuals as demonstrated in specimens of young and old *Stenopterygius*.

Although most ichthyosaurs were of moderate size, even some of the earliest ones attained a length of 25 ft. Toward the end of the Mesozoic era just prior to their extinction, ichthyosaurs reached nearly world-wide distribution.

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ICHTHYOSIS: *see* SKIN, DISEASES OF.

ICKES, HAROLD LE CLAIR (1874–1952), U.S. secretary of the interior under Pres. Franklin D. Roosevelt, was notable as a political reformer, conservationist and peppery controversialist and diarist. Born March 15, 1874, in Frankstown township,

Pa., he was active in Chicago politics even before his graduation from The University of Chicago in 1897. After receiving his law degree in 1907, he entered the legal profession, frequently handling civil liberties cases without pay; he also fought for municipal reform and the curbing of public utilities. Nominally he was a Republican but he frequently bolted the party, most notably when he supported Theodore Roosevelt's Bull Moose candidacy in 1912 and Franklin D. Roosevelt's New Deal in 1932. Roosevelt, seeking a Republican progressive for his cabinet, turned almost by accident to Ickes after two prominent senators had declined the position. Ickes was 58 at the time, and has been described as "a rather thickset bespectacled vigorous man." He made the most of his position, becoming one of the most energetic members of the Roosevelt cabinet. As secretary of the interior he fought for the preservation of natural resources against what he considered to be unfair exploitation by private interests.

He was also in charge of the Public Works administration, which during the New Deal spent over $5,000,000,000 on federal and nonfederal public works, ranging from municipal buildings to the enormous federal dam projects in western states. Ickes, who was dubbed "Honest Harold," in 1933 went about the spending of the money so carefully that the projects were very slow getting under way. Consequently the program did not have the desired effect of putting large sums immediately into circulation to prime the economic pump and help pull the nation out of the depression. Late in the New Deal heavy expenditures for construction did significantly stimulate the economy and left the nation enriched with numerous useful permanent structures. During World War II Ickes added to his other duties the administration of petroleum, coal mines and fisheries. In presidential campaigns he became known as "Roosevelt's hatchet man" because of his colourful attacks upon the Republican candidates; between campaigns he feuded with almost equal vigour with several of his Democratic colleagues, and in his lively diary, published after his death (*The Secret Diary of Harold L. Ickes*, 3 vol., 1953–54), recorded trenchant opinions of many others. He resigned Feb. 13, 1946, after a dispute with Pres. Harry S. Truman, and died in Washington, D.C., on Feb. 3, 1952. (FK. F.)

ICKNIELD WAY, a prehistoric route across southeastern England from East Anglia (the Wash) along the East Anglian ridge, the Chiltern hills and the Berkshire downs. The name, British in origin, was used originally for the Berkshire section; modern usage applies it more generally to the Chiltern-East Anglia parts of the track, much of which is still in use. It begins on the Wash and follows the chalk outcrop south and southwest by Thetford, Royston and Dunstable to the Thames at Goring. Southwest from Dunstable it has several versions: the Upper Icknield Way, above the spring line of the Chiltern escarpment; the Lower Icknield Way, below the spring line, presumably a summer road of later origin; and a ridgeway following the top of the Chiltern escarpment to the Thames at Pangbourne. The Icknield Way proper continued along the Berkshire downs by Blewbury and Wantage, linking up with the Berkshire ridgeway, a continuation of the Chiltern ridgeway, at West Kennet. The united road, though now lost in places, continued southward to the Stonehenge area and to Salisbury and no doubt to the south coast. Antiquities of all periods occur along the course of the Way, which was an important line of communication not only in prehistoric but also in later times. (WI. F. G.)

ICON, generally, is any image or portrait figure. The word is especially applied to the representation in the Orthodox Eastern Church of sacred personages or events (icon of a saint, icon of the nativity) in mural painting, mosaic or wood. (*See* BYZANTINE ART.) After the great controversy on their meaning, which took place in Byzantium in the 8th–9th centuries, the Eastern Church formulated a doctrine of veneration of the icons and also a canon, or set of technical rules, on their artistic form (*see* ICONOCLASTIC CONTROVERSY; COUNCIL: *Councils to the 9th Century: Second Council of Nicaea* [*787*]). Icons are considered as an essential part of the church, where they are given a special liturgical veneration. In the classical Byzantine and Orthodox tradition, iconography is not a realistic but a symbolical art; its function is to express in lines and colours the theological teaching of the church. (*See* also ORTHODOX EASTERN CHURCH: *Worship.*)

The term "iconography," once confined to the study of engravings, has come to be applied to the history of portrait images in Christian art, though it is also used with a qualifying adjective for Greek, Roman and other art. (AL. S.)

See V. Lossky and L. Ouspensky, *The Meaning of Icons* (1956).

ICONIUM: *see* KONYA.

ICONOCLASTIC CONTROVERSY, concerning the use of religious images (icons), reached its peak in the Byzantine empire in the 8th and 9th centuries. The early church, fearful of idolatry, was consistently opposed to the making and veneration of portraits of Christ and the saints. In spite of this disapproval, the use of icons steadily gained in popularity, especially in the eastern provinces of the Roman empire. Toward the end of the 6th century and in the 7th, icons became the object of an officially encouraged cult, often implying a superstitious belief in their animation. Opposition to such practices became particularly strong in Asia Minor, possibly under the influence of Judaism and Islam. In 726 the Byzantine emperor Leo III took a public stand against icons, and in 730 their use was officially prohibited. This opened a persecution of icon worshipers which reached great severity in the reign of Leo's successor, Constantine V (741–775). Iconoclast doctrine was defined in 754 by the Council of Hieria, the acts of which have not been preserved. After the death of Constantine V iconoclasm entered on a milder course. In 787 the empress Irene convoked the seventh ecumenical council at Nicaea, at which iconoclasm was condemned and the use of images re-established. The iconoclasts returned to power in 814 after the accession of Leo V and ratified their doctrine at a council held in 815. The second period of iconoclasm came to an end with the death of the emperor Theophilus in 842. In 843 the veneration of icons was finally restored by the empress Theodora; this event is still celebrated in the Orthodox Eastern Church as the Feast of Orthodoxy.

All the writings of the iconoclasts have perished. Their doctrine can be reconstructed, however, from the works of their adversaries. The principal objections to icon worship were the Old Testament prohibition (the second commandment), the charge of idolatry, the fact that images were made of "vile" matter, and, with reference to icons of Christ, that a representation of the Second Person of the Trinity either "circumscribed" his divine nature along with the human or separated the two natures, both alternatives being heretical (Monophysite and Nestorian respectively). The defenders of icon worship insisted on the symbolic nature of images (*i.e.*, that they served as reminders of their prototypes to whom the veneration was addressed) and on the dignity of created matter which could be charged with supernatural grace, and reversed the charge of heresy by arguing that the representation of Christ was a necessary consequence of his incarnation, and to deny the one was to deny the other. The principal authors who formulated the orthodox position against the iconoclasts were, in the 8th century, the patriarch Germanus and John of Damascus and, in the 9th, Theodore Studites and the patriarch Nicephorus. *See* also BYZANTINE EMPIRE.

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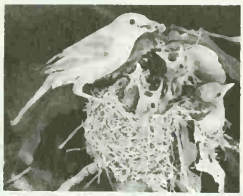
ICONOSTASIS, the screen in a Greek, Russian or Armenian church, which encloses the sanctuary. It is generally of masonry, high enough to reach the spring of the vault, and extends into the body of the church as far as the easternmost nave pier. In its nave front there are usually three doors. The face of the screen is often decorated with many tiers of small arcades; each arch encloses the representation of a saint. In Russian churches only the hands, feet and faces of the painted representation or icon are exposed; the rest of the panel is covered with elaborate, engraved, embossed metalwork. In earlier times in Greece, however, the entire image was painted.

ICTERUS, a genus of birds belonging to the family Icteridae, intermediate between the finches and starlings; many of them are

called blackbirds and troupials; others are known as the American grackles (*q.v.*). One of the best known is the orchard oriole (*I. spurius*), an inhabitant of northern South and Central America and the United States. Very many species exist in the neotropical region, though a few migrate northward in summer. They are nearly all gregarious, many of them with loud and melodious notes, rendering them favourites in captivity. Some have a plumage wholly black, others are richly clad; the well-known Baltimore oriole, golden robin or hangnest (*I. galbula*), of the United States has, in the male, plumage of brightly contrasted black and orange (colours of the armorial bearing of Lord Baltimore, original grantee of Maryland). The most divergent forms of Icteridae seem to be the meadow lark and the bobolink (*qq.v.*) or ricebird with its buntinglike bill. There are more than 90 species in the family Icteridae, mostly in South America. *See* COWBIRD; ORIOLE; RED-WINGED BLACKBIRD.



JOHN H. GERARD
ORCHARD ORIOLE (ICTERUS SPURIUS)

ICTINUS, Greek architect of the 5th century B.C., was the architect of the Parthenon at Athens, of the Hall of the Mysteries at Eleusis and of the temple of Apollo Epicurius at Bassae, near Phigalia.

IDA (d. 559) first king of the Anglo-Saxon kingdom of Bernicia (*q.v.*), succeeded, according to Bede, in 547, and reigned 12 years. Tradition regarded him as the founder of Bamburgh, though this derives its name from Bebbe, "a certain queen," whom Nennius in the *Historia Brittonum* says was the wife of Ida's grandson Aethelfrith. Between Ida and Aethelfrith (d. 616), with whom the consecutive history of Northumbria begins, the names of six kings are recorded, three of whom were sons of Ida. (D. WK.)

IDA, classical name of a mountain range in northwest Asia Minor, at the head of the Gulf of Adramyttium (Edremit) and a short distance to the southeast of the site of ancient Troy. The modern Turkish name is Kaz Dagi. Its highest peak, about 5,000 ft., provides a view of the Marmara and Aegean seas, and from its heights, it is said, the gods witnessed the battle between the Greeks and Trojans. It was known as a classic shrine and is famous in mythology as the site where Paris passed judgment on the rival goddesses and as the scene of the rape of Ganymede.

Ida (Ide, Idhi or Psiloriti) is also the classical name of a mountain traversing the island of Crete and site of a cave where Zeus was said to have been reared. The mountain is associated with the worship of Zeus, and relics of the classical Greek period, found there in cave excavations, substantiate the view that it was a shrine of the period. It is the highest peak (8,058 ft.) of Crete.

IDAHO, popularly known as the "Gem state," in the Pacific northwest of the United States, occupies most of the southern and northwestern part of the area enclosed by 42° and 49° N. and 113° 03′ and 117° 16′ W. To the north lies British Columbia, which Idaho borders for 45 mi. To the east are Montana and Wyoming; to the south, Utah and Nevada; and to the west, Oregon and Washington. Idaho extends nearly 315 mi. on its southern boundary and over 483 mi. from north to south, but an irregular northeastern mountain boundary limits Idaho's area to 83,557 sq.mi., of which 849 sq.mi. is inland water. Thirteenth in size among the states of the United States, Idaho is about as large as England and Scotland combined or nearly twice as large as the New England states. The capital is Boise. Idaho became the 43rd state in 1890. The state flower is the syringa. The state bird is the mountain bluebird.

The word Idaho as a name for the territory apparently originated in Washington, D.C., early in 1860 as a suggested name for Colorado; a dozen Indian language derivations for the name have been offered, but none of them has been substantiated.

PHYSICAL GEOGRAPHY

Physical Features.—Idaho's terrain is marked by startling diversity. Almost all physical features typical of the United States, except seacoast, may be found somewhere in Idaho: broad valleys and rugged mountains, arid plains and green prairies, sagebrush deserts and humid forests, spectacular canyons, great waterfalls, volcanic deposits and old limestone coast lines, major rivers and wandering streams that sink into the lava, gentle hills and glaciated peaks, sand dunes and hot springs, natural lakes and artificial reservoirs, range land and all types of farms: dry, irrigated and naturally watered.

All of Idaho is in the Columbia river basin, except the southeastern corner, which is drained by the Bear river flowing into the Great Salt lake basin. Most of the state is tributary to the Snake river and consists of a series of steep mountain masses and ranges running north and south. The highest peak is Borah Peak (12,662 ft.), in the Lost river range. But across southern Idaho from east to west the broad valley of the Snake curves in a great geologic down warp that cuts across the bordering mountain ridges, which are buried in the valley. The valley surface—a series of geologically complex lake beds and lava flows—is furrowed by a number of almost unbelievably deep and narrow canyons. Within the canyons are spectacular waterfalls, the most notable being Shoshone falls (212 ft.) and Twin falls. Turning north, the Snake flows along Idaho's western boundary through Hell's canyon (*q.v.*)—the deepest gorge in North America—and then turns west to the Columbia. The Salmon river and Clearwater mountains, together with their attendant river canyons, form a barrier to transportation that has divided the state into sections. Most of northern Idaho is mountainous also, but elevations are lower. Three of the state's four large lakes, Coeur d'Alene, Pend Oreille and Priest, are in northern Idaho; the other, Bear lake, is in the southeast corner. Other natural attractions include Soda springs near Bear lake, and the magnificent Sawtooth range, with its multitude of alpine lakes, in the Sun valley area.

Climate.—Idaho's climate is as diverse as its physical features. Altitude, more than latitude, determines the climate: Lewiston, in north Idaho, is the warmest place in the state. Western prevailing winds from the Pacific are mild but are robbed of most of their moisture by the Cascade mountains before reaching Idaho. Mountain barriers on the east protect the state from cold waves that sweep down the Great Plains. Most of the mountain wilderness has cool summers and severe winters; the populated valleys, however, generally are mild in climate. Temperatures range from 108° to −45° F. (about 42° to −43° C.); the mean annual temperature varies from about 36° F., with the coldest region centring in Custer county around the Sawtooth range, to 55° F. along the middle reaches of the Snake river. Annual rainfall varies even more than temperature, averaging 25 in. in the north and 8 in. on the dry plains of the south. Tornadoes are virtually unknown.

Soil.—Most Idaho soils are volcanic in origin, high in lime and potash but low in nitrogen and organic material. The deficiencies are easily overcome by plowing in alfalfa and clover. The windblown soils of the Palouse region, which straddles the Idaho-Washington boundary, are of special note, being fine and light and easy to till.

Vegetation.—Idaho's diversified climate produces a corresponding diversification in vegetation. Arid southern plains support only such plants as sagebrush, greasewood and salt grass. Greater precipitation in the north makes possible heavy evergreen forests of pine, cedar, fir and spruce, which extend southward into the higher altitudes where late-melting snow provides moisture. Deciduous forests are almost unknown, but a startling variety and profusion of colourful flowers—camas, columbine, mountain daisy, to name a few—may be found almost everywhere in the spring.

Animal Life.—Buffalo roamed the upper Snake river plains until 1840, but since then the deserts have been given over mainly to coyotes and hosts of jack rabbits. Beaver are historically important in Idaho because they attracted the trappers. Although relatively few in number, they are holding their own under careful state supervision. Weasels (ermine), mink and martens are fairly common. Badgers are plentiful, otters quite rare and wolverines on the brink of extinction. All of the following large mammals are found: elk, moose, white-tailed deer, mule deer, pronghorn, bighorn, black bears, grizzly bears and coyotes.

Ignoring common birds, there are ducks, geese, sage grouse, sharptails, pheasant, quail and doves. Hawks, owls, eagles, vultures, crows, ravens and magpies are common. The principal snakes include the Rocky mountain rubber boa, wandering garter, bull snake and prairie rattlesnake.

Parks and Recreation Areas.—There were 26 state parks and recreational areas, many historic as well as scenic, which constituted the state park system when a major development program was undertaken in 1958. Craters of the Moon National monument, established in 1924, is the product of Snake river lava flows as late as 200 to 1,000 years ago and is an awesome example of the result of volcanic activity.

Sun Valley.—This is a delightful valley located on Big Wood river, which drains a portion of the rugged Sawtooth mountains. The area was developed by Union Pacific railway officials because of the beautiful scenery, ample fine snow pack and calm weather. In about 20 years Sun Valley became world famous as a winter resort.

Primitive Areas.—In 1931 the state legislature passed the Primitive Area act, which reserved 1,250,000 ac. across the southern watershed of the Salmon river as a primitive area. Primitive conditions are expected to prevail because roads and buildings are prohibited.

Another area as large and nearly as primitive may be found on the Selway-Bitterroot drainage; there are several additional areas of this type. Idaho is one of the last frontiers in this respect.

HISTORY

What is now the state of Idaho was originally in Oregon country, claimed in turn by Spain, Russia, Great Britain and the United States, the last two settling, by treaty in 1846, on the 49th parallel as the northern U.S. border. Oregon territory (1848) included the present state of Idaho, as well as what is now Oregon, Washington and part of Montana. A half century of exploration and fur trade preceded white settlement which began in 1860. By the time Idaho reached the political maturity of statehood in 1890, there had begun a gradual shift from a primarily mining and stock-raising economy to a farming and lumbering one. Industrial development, confined almost entirely to mining in the 19th century, began to diversify after 1900 and to expand rapidly after 1940.

Explorers who came to Idaho at the beginning of the 19th century found practically the entire area occupied by Indian peoples of diverse language and seminomadic culture, notably the Shoshone and the Bannock in the south, and the Nez Percé, Pend d'Oreille and Kutenai in the north. Horses acquired from the Spaniards had given them mobility soon after 1700. Lewis and Clark from the United States, whose explorations through the Oregon country (1805–06) were the main basis for the U.S. claim, and the fur trader David Thompson from the British North West company (1808–12) established friendly relations with the Indians, and Thompson erected the first post, Kullyspell (Kalispell) House, on Lake Pend Oreille in 1809. Other fur trappers soon entered Idaho. Andrew Henry of the Missouri Fur company crossed the continental divide into the valley of the upper Snake in order to escape from hostile Blackfeet warriors near the three forks of the Missouri and put up Ft. Henry, a temporary winter shelter, in 1810. John Jacob Astor's overland party from St. Louis to the Pacific crossed southern Idaho in 1811. The Astor enterprise failed, however, and was sold out to the North West company, for whom Donald Mackenzie organized the annual Snake river brigade that trapped in southern Idaho from 1818 to 1832. The U.S. gave up the region during the War of 1812, and Great Britain controlled it until the treaty of 1846.

A new era in the fur trade commenced in 1821, with reorganization of operations of the Hudson's Bay company (successor to the North West company) and with penetration of St. Louis mountain men under Jedediah Smith into the Snake country. Competition was sharp, and the British sent Peter Skene Ogden to trap the Snake country bare so that the mountain men would be kept away from rich beaver lands in British Columbia. Overexploitation, together with a style shift from fur to silk hats, reduced the fur industry to a small operation. At the end of the fur trade, the British company had two important Idaho posts—Ft. Hall (built in 1834 by Nathaniel J. Wyeth of Boston, but soon sold to the Hudson's Bay company) and Ft. Boise. The missions of Henry Harmon Spalding among the Nez Percé after 1836 and of Father Nicholas Point among the Coeur d'Alenes after 1842 grew out of the fur trade, which declined after 1840 with the coming of a large immigration through Idaho over the Oregon trail. A Mormon Salmon river mission at Ft. Lemhi (1855–58), followed in 1860 by Mormon settlement of Franklin and by a gold rush to northern Idaho, marked the transition from the wanderers of the fur trade to permanent white settlement.

Thousands of miners rushed to the Clearwater and Salmon river country after Elias Davidson Pierce's party discovered gold at Pierce on Sept. 30, 1860. Fabulous reports from Florence a year later brought in more than 10,000 prospectors. Important new discoveries in the summer of 1862 expanded the mining regions by hundreds of miles and thousands of men, and on March 4, 1863, Idaho territory was created to include all the new mines in what until then had been eastern Washington and western Dakota. (Until May 26, 1864, Idaho territory included all of Montana and practically all of Wyoming; final boundaries were not established until 1868.)

More than 32,000 miners, merchants, packers and farmers lived in the newly organized territory. Over one-half of them were in the Boise region, and another one-third in what soon was to be Montana. Continuation of the gold fever kept the mining population high in southwestern Idaho through the early years of the territorial period, and in 1864 Boise became the permanent territorial capital, as it later was of the state.

Quartz mining—both of gold and silver—became prominent in the Boise basin, Rocky Bar and Silver City in 1864 and at Atlanta and Warren shortly thereafter. A complex mining economy developed, with problems of capital and labour and with an advanced industrial technology. Quartz mining was relatively permanent in nature; farm and service communities grew up in irrigated valleys, and range cattle were driven in from California and Texas to form the basis for large Idaho herds.

Expansion of white occupation of Indian lands—particularly for cattle ranging—led to friction and hostility with the Indians. Three wars (Nez Percé, 1877; Bannock, 1878; and Sheepeater, 1879) resulted. Certain Nez Percé bands, forced to move onto the reservation in June 1877, became embroiled with white ranchers; the Indians crushed a U.S. army force at White Bird and then fought the battle of the Clearwater on nearly even terms with a force commanded by Gen. O. O. Howard. Deciding to join their friends the Crows of Montana, the Nez Percé made a hard journey over the mountains, only to have to beat off forces under Col. John Gibbon at the battle of Big Hole. Chief White Bird and many of the warriors eventually took refuge in Canada, but Chief Joseph finally made a deal with General Howard to return to the Idaho reservation—a bargain which the U.S. failed to keep.

In 1878 the Bannock Indians, a Shoshonean tribe, disturbed by white intrusion into their lands on Camas prairie in southern Idaho, went on the warpath; after military defeat at South mountain, they wandered over much of eastern Oregon before returning across southern Idaho into Wyoming where they were captured. Finally the Sheepeaters, who inhabited the Salmon river mountain wilderness, were rounded up in 1879 after they had been accused (perhaps unjustly) of massacring a settlement of Chinese miners on remote Loon creek.

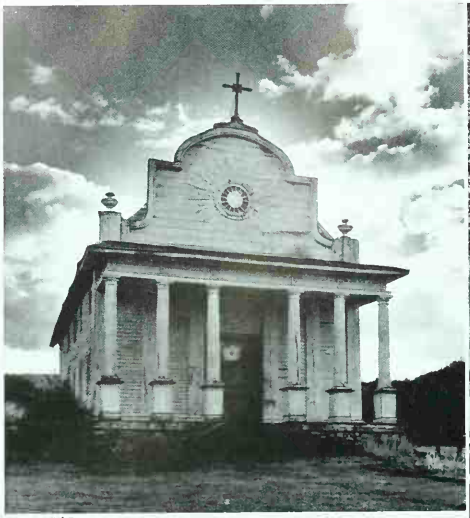
Improved transportation, so necessary for large-scale quartz and base-metal mining, came with the construction of railways. By 1880 the Utah and Northern had been completed across southeastern Idaho; the Oregon Short Line was completed through the Snake river valley in 1884; and the Northern Pacific crossed north Idaho at the same time. Thus it was possible to develop important lead-silver mines on Wood river and in the Coeur d'Alene mountains. Idaho grew rapidly with the new mining and railways, and the consequent expansion of irrigation, after 1880. Admission as a state came on July 3, 1890, after a plan to divide the territory between Washington and Nevada had been rejected at the end of a long and bitter north-south sectional controversy.

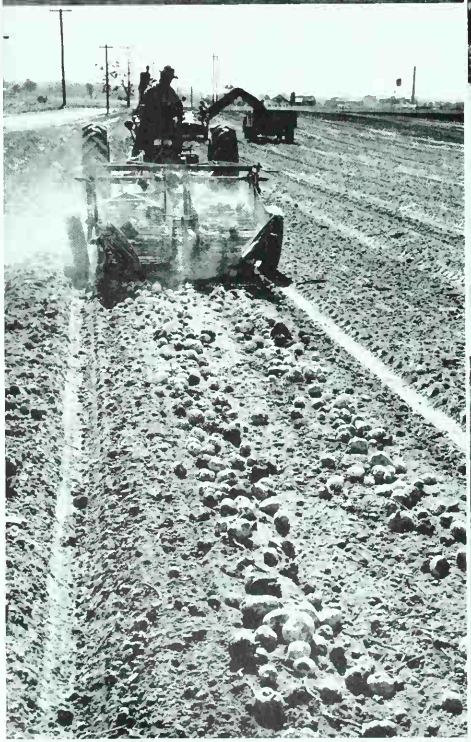
PHOTOGRAPHS, (TOP) DAVID W. CORSON FROM A. DEVANEY, (BOTTOM LEFT) RAY ATKESON, (BOTTOM RIGHT) PHILIP GENDREAU

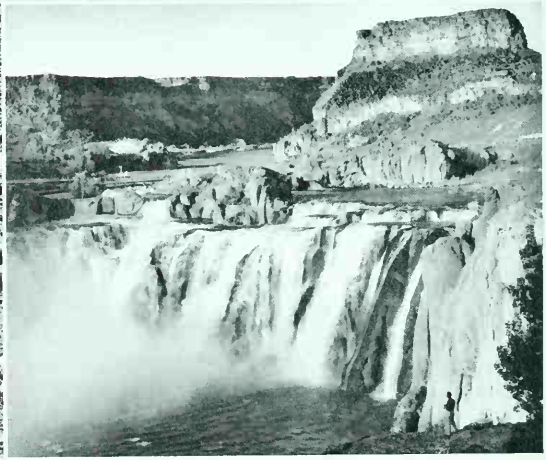
OUTDOOR WORK AND PLAY IN IDAHO

Top: A sheepherder with his flock in Sun Valley
Bottom left: A skier on a slope of Baldy mountain above the resort in Sun Valley
Bottom right: A log drive on the Priest river. Lumbering and forest products are important in the state's economy

IDAHO







PHOTOGRAPHS, (TOP LEFT, CENTRE RIGHT AND BOTTOM RIGHT) RAY ATKESON, (TOP RIGHT) ANSGAR JOHNSON, (BOTTOM LEFT) H. ARMSTRONG ROBERTS

SCENES IN IDAHO

Top left: The Cataldo mission built in 1848 by Father Antonio Ravalli and a group of Indians. The church, restored in 1928, is the site of an annual Indian pilgrimage

Top right: Little Redfish lake, near the Sawtooth mountains

Centre right: Deer, driven down from the higher mountains by winter snow, seeking forage in Sun Valley

Bottom left: Harvesting potatoes. The state is a leading producer of potatoes

Bottom right: Shoshone falls on the Snake river

Idaho was one of the most prominent of western silver states and voted Populist in its first national presidential election in 1892. The more radical Populist element of the Coeur d'Alene mining district, however, became involved in a long series of labour wars (1892–99) that culminated in the dynamiting of the Bunker Hill and Sullivan concentrator at Wardner, April 29, 1899. Local suppression of the union, the Western Federation of Miners, followed during a two-year period of martial law. A shocking aftermath of the Coeur d'Alene labour war came six years later with the assassination of former governor Frank Steunenberg by Harry Orchard, one of the disaffected miners. National leaders of the federation were arrested for conspiracy in the case. Newly elected Senator William E. Borah gained a national reputation as prosecutor during the resulting trial and acquittal of William D. Haywood, secretary of the federation and organizer of the Industrial Workers of the World (I.W.W.). Borah continued to be Idaho's most prominent political figure until his death in 1940.

At the beginning of the 20th century an important commercial lumber industry began to develop, especially in the valuable white-pine forests of northern Idaho. Ponderosa pine also was utilized commercially, and lumbering gained a position second only to agriculture in economic importance. Irrigation in Idaho expanded dramatically at the same time. Co-operative and private canal systems proved successful in the upper Snake river valley, settled primarily by Mormons moving northward from Utah. Canal companies in the Boise area, though, were unable to develop the major projects with success, and farmers' irrigation districts took over. In the Twin Falls region important projects carried on under the provision of the Carey act (1894) turned large tracts of sagebrush desert into fertile irrigated farms between 1902 and 1908; establishment of the Boise and the Minidoka projects under the United States reclamation service led to the construction of important dams with large reservoirs (Arrowrock, American Falls, Anderson Ranch, Palisades), so that by the second half of the 20th century roughly half of Idaho's potentially irrigable land had been reclaimed, and miles of farms existed where a desert had been before.

GOVERNMENT

Idaho's constitution, adopted Aug. 6, 1889, was detailed and codelike in nature; it therefore has required frequent amendment. A legislature meets every two years for 60 days, with special sessions at the call of the governor. There are 44 senators and 79 representatives, including 16 members added from the 11 most populous counties by reapportionment in 1963. A supreme court, district courts, county probate courts and precinct justice's courts comprise the judiciary. A governor, lieutenant governor and six other elective officers, together with a large number of administrators, make up the executive branch. A reorganization in 1919 consolidated most state agencies into departments under the governor, but subsequent alterations again gave the state administration a more complex pattern.

The state operates on a biennial budget: departmental requests are screened by the state budget officer, who is advised by an interim prelegislative budget committee of the outgoing session; a report is released six weeks before the new legislative session convenes. The governor presents his final recommendations on the fifth legislative day. All funds are subject to legislative appropriation and to strict budgetary control; actual expenditures from the general fund are authorized by the state board of examiners, made up of the governor, secretary of state, auditor and attorney general, in accord with the pattern of actual anticipated state income.

Local government in Idaho is decentralized. More than half of the nearly 850 units which existed in the second half of the 20th century were special districts: cemetery, highway, irrigation, drainage, soil conservation, etc. More important were the 44 counties and 199 municipalities.

POPULATION

At the time Idaho was admitted as a state the population was 88,548; in 1910, 325,594; in 1940, 524,873; and in 1960, 667,191. In the second half of the 20th century the population was distributed primarily along the Snake river and near the western boundary of north Idaho. The state was still predominantly rural (48.0% urban in 1960), but the farm population gradually was decreasing and the cities growing. Less than 3.3% were foreign born in 1950, and only about .5% were Indians. There was an interesting Basque concentration in the Boise area.

*Idaho: Places of 5,000 or More Population (1960 Census)**

Place	Population				
	1960	1950	1940	1920	1900
Total state	667,191	588,637	524,873	431,866	161,772
Alameda	10,660	4,694	2,691	772	—
Blackfoot	7,378	5,180	3,681	3,937	—
Boise	34,481	34,393	26,130	21,393	5,957
Burley	7,508	5,924	5,329	5,408	—
Caldwell	12,230	10,487	7,272	5,106	997
Coeur d'Alene	14,291	12,198	10,049	6,447	508
Collister	5,436	—	—	—	—
Franklin	7,222	3,489	1,559	—	—
Idaho Falls	33,161	19,218	15,024	8,064	1,262
Kellogg	5,061	4,913	4,235	—	—
Lewiston	12,691	12,985	10,548	6,574	2,425
Lewiston Orchards	9,680	—	—	—	—
Moscow	11,183	10,593	6,014	3,956	2,484
Mountain Home	9,344	1,887	1,193	1,644	529
Nampa	18,013	16,185	12,149	7,621	799
Pocatello	28,534	26,131	18,133	15,001	4,046
Twin Falls	20,126	17,600	11,851	8,324	—
Whitney	13,603	—	—	—	—

*Populations are reported as constituted at date of each census.
Note: Dash indicates place did not exist during reported census, or data not available.

EDUCATION

In Idaho, education started in the several Indian missions. In the fall of 1860 Hannah Comish taught the children of Franklin in her log cabin. Several years later, similar efforts were made in the mining towns. The office of territorial superintendent of instruction was created in 1864. Thereafter, the usual formal integrated organization of school districts was effected. Administration of the various state educational programs, higher education, elementary and secondary schools, and vocational education was assigned to the state board of education, established in 1913; local school management, however, remained under local school boards. Reorganization of school districts, provided for by statute in 1947, resulted in a 40% decrease in the number of schools, and in the consolidation of 1,088 districts into 168 within a decade.

Schools of higher learning include the University of Idaho in Moscow (1889), the College of Idaho at Caldwell (1891), and Idaho State college in Pocatello (1901), Northwest Nazarene college at Nampa (1913). There are also two-year institutions: Boise junior college (1932), Ricks college at Rexburg (1888), and Lewis-Clark Normal school, a branch of the University of Idaho, at Lewiston (1955).

Idaho State college consists of a liberal arts college, a teachers college and a professional and graduate school. It was incorporated as the Academy of Idaho in 1901, and the name was changed to Idaho Technical institute in 1915, to the Southern Branch of the University of Idaho in 1927 and to Idaho State college in 1947. The school of trade and industrial education is a nonacademic division of the college. The University of Idaho, the state university and land-grant college, includes the colleges of agriculture, letters and science, engineering, law, mines, forestry, education, and business administration, and a graduate school. The Lewis-Clark Normal school is a division of the state university, offering a two-year program for elementary-school teachers.

HEALTH AND WELFARE

The state department of health administers a mental health service, two state mental hospitals, a tuberculosis hospital, a maternal and child health program, a crippled children's service, a dental health program and a public health nursing service. Water pollution control, milk and food sanitation and health education are additional activities of the department. The state department of public assistance has social service and child welfare divisions, and the department of labour and the state mine inspector are charged with industrial safety programs. The state board of corrections administers the state penitentiary at Boise and undertakes rehabilitation of prisoners.

ECONOMY

The shift to an agricultural economy is shown by the fact that in the second half of the 20th century one-third of the men employed in Idaho were in agricultural occupations; one-quarter were in transportation and trade; of the remainder, one-tenth were in manufacturing, and almost that many in construction. Seasonal variation in employment was pronounced. Industrial wages reflected the relatively small size of most of the state's industries. Per capita income for the state rose from $1,436 in 1951 to more than $1,500 by 1960.

The total labour force in 1950 was 218,309, with 18,989 and 15,501 engaged in manufacturing and construction, respectively. Idaho ranked lowest among the mountain states in per capita income because of an unbalance between the primary occupations of agriculture, forestry and stock raising vis-à-vis manufacturing, mining and construction. Greater industrial development was warranted by the resources.

Agriculture.—Agricultural production produced more income in Idaho in the second half of the 20th century than any other source, field crops making up more than 95% of the total, truck crops and fruits comprising the remainder. The major grain crops are wheat, barley and oats. Other important crops include hay, potatoes, beet sugar, dry beans, dry peas, clover seed and field corn. Crops of lesser importance include hops, alfalfa seed, onions and sweet corn; and green peas, apples, prunes, peaches, pears and cherries are the economically important fruits in Idaho.

Industry.—The growing shift to industry is shown by the fact that after livestock (primarily cattle and sheep) and dairy products in the second half of the 20th century, industry followed agriculture in value, being followed in turn by lumbering and mining. Industry in Idaho grew rapidly in the decade before 1950 and continued to rise. Phosphate plants in the southeast and the national reactor testing station at Arco—where atomic electric power was pioneered from 1951 to 1955—were the main industrial development after World War II. The phosphorus industry developed markedly after 1950, with four large companies producing a variety of products.

Transportation.—Four transcontinental railways serve Idaho: the Union Pacific, the Northern Pacific, the Great Northern, and the Chicago, Milwaukee, St. Paul and Pacific. Mountain barriers separating northern Idaho from the rest of the state delayed completion of a paved north-south highway until 1938. Construction on Idaho's more than 600 mi. of the interstate system of completely unimpeded, controlled access highways began in 1956. Air transportation is especially important in linking Idaho's widely separated centres of population and in penetrating the extensive wilderness areas of the state.

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(M. D. B.; M. W. W.)

IDAHO FALLS, a city of southeastern Idaho, U.S., and the seat of Bonneville county, originated as Eagle Rock, a community that grew up at Taylor's Ferry (1863), later Taylor's Bridge, over the Snake river. Serving heavy traffic on the Salt Lake-Montana road, the town prospered as a division point on the Utah and Northern railway (1879) but declined with removal of the railway shops to Pocatello in 1887. Reorganized as Idaho Falls in 1890, the community flourished again: irrigated farming grew rapidly, and an early sugar factory came in 1903. Other agricultural industrial plants were installed, and Idaho Falls became the marketing centre for upper Snake river valley potatoes. Municipal generators utilize the hydroelectric potential of the falls, and headquarters for the national atomic reactor testing station are there. Idaho Falls also has a Mormon temple, completed in 1944. For comparative population figures *see* table in IDAHO: *Population.* (M. D. B.)

IDAS, in Greek legend, son of Aphareus of the royal house of Messene. In Homer he is called the strongest of all men: he fought with Apollo for the maiden Marpessa, whom he wished to make his wife. When the final choice, at Zeus's behest, was left to Marpessa herself, she chose Idas, who was mortal, fearing that the divine Apollo might desert her when she grew old.

Idas had a brother, Lynceus; and as a pair they are best known for their fight with Castor and Polydeuces (Lat. Pollux), the Dioscuri or Sons of Zeus, over the division of a herd of cattle which the four had stolen. Idas claimed the whole herd and drove the cattle off toward Messene; but the Dioscuri overtook him and lay in wait in a hollow oak. Lynceus, however, thanks to his proverbial keenness of sight, espied Castor through the trunk of the tree and warned his brother, who thereupon slew Castor. Then Polydeuces slew Lynceus, and finally Idas was struck by lightning. According to another tale, the Dioscuri carried off the brides of Idas and Lynceus. In the ensuing fight, Castor slew Lynceus and was himself in turn slain by Idas, who was slain in his turn by Polydeuces.

The annihilation of the legendary Messenian brothers by the Dioscuri, whose cult was Spartan, may perhaps indicate the subordination of historical Messenia to Sparta, its eastern neighbour (8th–7th centuries B.C.). There was some difference of opinion as to whether Idas and Lynceus were buried at Sparta or in Messenia.

IDDESLEIGH, STAFFORD HENRY NORTHCOTE, 1ST EARL OF (1818–1887), English statesman who was an able minister but an undistinguished parliamentarian in successive Conservative governments after 1866. He was born in London on Oct. 27, 1818, and educated at Eton and at Balliol college, Oxford. From 1842 to 1845 he was Gladstone's private secretary at the board of trade, where he remained until his appointment in 1850 as one of the secretaries to the 1851 exhibition. Succeeding to the family estates in Devon as 8th baronet in 1851, Northcote on Gladstone's invitation joined Sir Charles Trevelyan during 1852–54 in departmental inquiries which led to the important report of 1854 recommending recruitment to the civil service by examination. In 1855 he entered parliament for the Peelite constituency of Dudley. Breaking with the Peelites in 1857, he was defeated at North Devon in that year. He represented Stamford from 1858 to 1866 and North Devon from 1866 to 1885.

Rapidly establishing his reputation as an orthodox Conservative of front-bench calibre, Northcote joined Lord Derby's last cabinet as president of the board of trade in 1866–67; under Disraeli in 1867–68 he was secretary of state for India. Returning to office in 1874, he spent the next six years as chancellor of the exchequer, and succeeded Disraeli as leader of the house of commons in 1876. Northcote was a competent financier who attempted to follow Gladstonian tradition in his budgets despite mounting expenditure; but he was less successful as a parliamentary leader. His "greybeard" management of the opposition to Gladstone's second administration after 1880 was much criticized and often impeded by the "Fourth party" under Lord Randolph Churchill. On the latter's insistence, Lord Salisbury, when he became prime minister in 1885, sent Northcote to the house of lords (as earl of Iddesleigh) with the nominal post of first lord of the treasury. In 1886 Iddesleigh acted as foreign secretary in Salisbury's second ministry, but his retirement had been decided upon before he died suddenly at 10 Downing street on Jan. 12, 1887.

Originally a protégé of Gladstone, toward whom he was later accused of remaining too deferential, Northcote was an efficient, hard-working public servant and a Conservative whose views were usually more flexible than his critics alleged. But he failed to gain respect as a party leader, and suffered greatly from the ridicule of Churchill and his friends, who nicknamed him "the Goat." Under these circumstances, only loyalty to his old friend the marquess of Salisbury kept Northcote in politics so long that his health gave way.

His second son, Stafford (1846–1911), Baron Northcote, was governor of Bombay (1899–1903) and governor general of Australia (1903–08).

See A. Lang, *Life of Sir Stafford Northcote* (1890). (A. F. T.)

IDDINGS, JOSEPH PAXSON (1857–1920), U.S. petrographer, who demonstrated the genetic relationships of igneous rocks formed during any one period of igneous activity within a region, was born in Baltimore, Md., on Jan. 21, 1857, and received his education at Yale, Columbia and Heidelberg universities. He was assistant geologist (1880–88) and geologist (1888–92) with the United States geological survey; in 1892 he became associate professor and, from 1895 to 1908, professor of petrology at The University of Chicago.

In his technical papers he emphasized the textural and chemical graduation of rocks and recognized the role of water in magmas. He concluded that physical conditions affect the essential mineral composition of rocks as well as their crystalline texture and that variations in crystallinity depend upon temperature and rate of cooling, and so contested the widely held opinion that granular rocks necessarily hardened at great depths and in very large masses.

Iddings worked with other petrographers on "Quantitative Classification of Igneous Rocks," published in the *Journal of Geology* (1902) and later as a book, and his important *Igneous Rocks*, in two volumes, appeared in 1909–13. His other publications include *Rock Minerals* (1906) and *The Problem of Volcanism* (1914). Iddings died at Brinklow, Md., on Sept. 8, 1920.

(M. A. F.; C. L. Fe.; X.)

IDE, HENRY CLAY (1844–1921), U.S. representative in the Samoan and Philippine Islands and U.S. minister to Spain, was born at Barnet, Vt., on Sept. 18, 1844. Ide graduated from Dartmouth college, Hanover, N.H., in 1866 and was admitted to the Vermont bar in 1871. He was state's attorney in Caledonia county and served in the Vermont senate from 1882 to 1885.

In March 1891 Ide was appointed U.S. land commissioner in Samoa, where he won the praise of Robert Louis Stevenson for his "capacity, moderation, tact, and temper" before leaving Samoa in November of that year. Under the joint appointment of the United States, Great Britain and Germany, he was chief justice of Samoa from 1893 to 1897.

From 1900 to 1906 Ide served in various official capacities in the Philippine Islands, including the offices of acting governor and governor general in 1905–06. He played an important role in framing new laws on civil procedure and internal revenue and in reforming of the currency of the Philippines.

In 1909 he was appointed U.S. envoy extraordinary and minister plenipotentiary to Spain. He held that position until 1913, when he returned to St. Johnsbury, Vt. At the time of his death on June 13, 1921, Ide was a director of a number of banks and railway and manufacturing companies.

A *Life of Henry Clay Ide* (1935) was printed privately by the author, A. F. Stone.

IDEA. This word, brought into English from the Greek, was for some time most commonly used roughly in the technical sense (or senses) given to it by Plato in his theory of forms (*see* Universal). But by the 17th century it had come to be used more or less in its modern sense of "thought," "conception," "concept"; sometimes of "belief"; sometimes of "intention" or "plan."

In the 17th and 18th centuries the word "idea" was in very general use as a technical term of philosophy, not with its Platonic meaning, but in a variety of senses mostly traceable to Locke, some of which were derived by him from Descartes. Locke introduces it first as "that term which, I think, serves best to stand for whatsoever is the object of the understanding when a man thinks" and later as signifying "the immediate object of perception, thought, or understanding." But this vague usage leads him into serious difficulties. In the first place, he holds that ideas are "in the mind"; so that, if ideas are said to be the objects of perception, he is faced with the problem of explaining how perception of things in our minds could lead us to knowledge of the "external" world. Secondly, he is led to overlook the important respects in which thinking and understanding must be distinguished from perception: he speaks indeed as if thinking and understanding really are essentially forms of perception, or as if all three consisted alike in "having ideas." George Berkeley retained the word "idea," for which he sometimes used "sensation" as a synonym, to stand for the objects of perception; he retained the view that ideas are "in the mind"; and he sought to evade the problem which Locke had failed to solve—the problem of founding our knowledge of the material world on perception of mind-dependent ideas—by refusing to draw any distinction between ideas and material objects. Material objects, he held, are "collections" of ideas, and hence they too can exist "only in the mind."

Hume introduced a distinction between ideas and impressions —the latter term being designed to cover "all our sensations, passions, and emotions," the former "the faint images of these in thinking and reasoning." In so doing, however, he did not much improve upon Locke: he still held that the objects of perception are "in the mind" and for the most part he retained in his account of thinking the fatally misleading analogy with perception. It was urged by an early critic, Thomas Reid, that most of the perplexities in which Locke, Berkeley and Hume had been entangled arose from initial confusions in the use of the word "idea," for which he thought Descartes ultimately responsible; and even though it can hardly be adequate to trace all difficulties to this one source, it can certainly be said that their uses of the term "idea" require very close and critical scrutiny, if their problems are to be resolved or even rightly understood.

See Idealism; Knowledge, Theory of; and Psychology; *see* also references under "Idea" in the Index. (G. J. Wk.)

IDEAL means primarily that which is of the nature of an idea. It is, however, more commonly used to denote that which is perfect or supreme of its kind. *See* Idea; Idealism.

IDEALISM is the name of a group of distinct but allied philosophical theories all of which agree (1) in denying that mind has originated from or may be reduced to matter and (2) in affirming that mind is a more fundamental feature of the universe than matter is. Some writers (*e.g.*, Marxists) define philosophical idealism as the view that mind is primary and matter secondary, but this would not clearly distinguish it from theism, the view that matter and finite minds were created and are sustained by an eternal, infinite and immaterial deity. It is thus convenient to adhere to the more common practice of regarding idealism as the philosophy which not only denies the truth of materialism and asserts the reality and importance of mind but also maintains either that matter does not exist at all or else that, if it does exist, it is more closely dependent on the existence of mind than it need be by the sole fact of having been created by God. Like theism, idealism is a religious philosophy, as any philosophy must be which regards the material world as somehow less real than the world of mind or spirit. But although idealists all seek to establish a view of the world that lays the foundations for a rational religion, they are not all committed to belief in a personal God or, indeed, to belief in God at all.

In what follows, the word "idealism" and its different meanings will be considered first. Then, since idealism is a group of modern philosophical views associated in its beginnings particularly with the arguments of George Berkeley, the survey is begun with a brief account of his system. The third section is a short account of phenomenalism, a theory about the material world that is briefly indicated in Berkeley's writings, but which was subsequently developed in ways that bring it into conflict with the religious aspects of idealism properly so called. Next, Immanuel Kant's transcendental idealism is discussed; and finally, after a fifth section on the absolute idealism of the 19th century, the article closes with a discussion of the main criticisms that have been brought against idealism.

Origin and Use of the Term.—The word "idealism" is derived from the Greek word *idea*, which means, in untechnical language, a visible form or the look or appearance of something. This word became a technical term in the philosophy of Plato, who used it to mean a universal by contrast with particulars, or a standard, limit or ideal by comparison with the particular things which merely approached or approximated to it.

1. The word "idea," then, was first used in philosophy to mean Platonic ideas; *i.e.*, suprasensible universals or forms held to be truly apprehended by the intellect and contrasted with particular things deceptively presented to the senses. In this sense

Beauty Itself or Absolute Straightness are ideas in contrast with the particular things that may appear beautiful in one context and ugly in another, or with the more or less but never perfectly straight lines that we see or feel by our senses.

2. "Idea" was used in the 16th and 17th centuries for a form or shape impressed by a hard object upon some soft material, as when Descartes (in his *Rules for the Direction of the Understanding*, xii) wrote of "shapes or ideas" formed in the brain by things outside the body as if by the action of a seal on wax.

3. "Idea" was also used for a supposed representative *in the mind* (not in the brain, which is, of course, material) of an external object perceived by means of this representative. Descartes, in *Meditation III* contrasts such ideas, which, he says, "are, as it were, pictures of things," with activities of the mind such as acts of will and assertions. To perceive a man or the sky was, according to Descartes, directly to perceive such a representative idea in the mind, so that material things were never perceived except indirectly.

4. Not all of these picture ideas, however, are copies of something external to the mind, and according to Descartes we also have ideas such as that of a chimaera formed by combining at will ideas of colour and shape originally received from the senses. Such ideas were called ideas of the imagination.

John Locke, by frequent use in his *Essay Concerning Human Understanding* (1690) of the word "idea" in sense 3, gave wide currency to the theory that external objects cannot be directly known but must be known indirectly by means of representative ideas that are themselves directly perceived and exist only in the mind. Locke and his followers were called "ideists" by contemporary critics, and the theory of representative ideas "the new way of ideas." In this philosophical usage, ideas are contrasted with material objects, are likened to pictures or images and are said to exist "in the mind." Usage 2, however, encourages the belief that they are somehow impressed *on* the mind as if by physical pressure, and usage 1, lingering alongside usage 3, made it possible to think of them also as objective existences just as independent of perception as Plato's ideas were. But the fact that ideas in sense 3 exist "in the mind" makes it easy to assimilate them to ideas of the imagination which no one supposes to exist except while they are actually being experienced.

Now the word "idealism," as most commonly used by philosophers, is based upon the word "idea" in sense 3. It is true that Leibniz, when he wrote in 1702 that "what is good in the hypotheses of Epicurus and Plato, of the greatest Materialists and the greatest Idealists, is combined in my view" (*Werke*, ed. by C. J. Gerhardt, iv, p. 560), appears to have had sense 1 in mind; but when the word came into general philosophical use about the middle of the 18th century, idealism was taken as the view that there was no material world but only ideas existing in immaterial minds. Thus Denis Diderot wrote in 1749 (*Oeuvres*, ed. by J. Assézat, vol. i, p. 304): "We call *idealists* those philosophers who, knowing only their own existence and that of the sensations that follow one another within them, do not grant anything else . . . a system which, to the shame of the human mind and of philosophy, is the most difficult to oppose although the most absurd of all. . . . Whether we raise ourselves to the skies, whether we go down to the bottom of the abyss, we never get outside ourselves: now that is the result of the first of Berkeley's dialogues and the foundation of his whole system." It will be noticed that Diderot attributed to Berkeley not only the view that we have direct knowledge of ideas only, but also the view that it is impossible to have knowledge of anything beyond one's own existence and one's own ideas. This latter view is today called solipsism, but in the 18th century it was called idealism or egoism (*see* the *Encyclopédie, s.v.* "Égoistes"). It will be seen, then, that we must begin with Berkeley, to whose philosophy, which was little understood in his lifetime, the name "idealism" was given.

Immaterialism.—Berkeley called his philosophical system immaterialism. In denying the existence of material substance he held that the universe consists of God, the infinite spirit; of finite active spirits, including, of course, human beings; of passive, inert ideas, which exist only "in the mind" of spirits; of the relations between all these; and of nothing else. He believed that his denial of the existence of material substance enabled materialism, skepticism and atheism to be refuted and the cause of religion to be more firmly established than hitherto. That this system, if true, refuted materialism is obvious. That it refuted skepticism, Berkeley held, followed from the fact that we are each certain of our own existence and of the ideas in our minds. Skepticism arises from the inevitable disappointment at being unable to get knowledge of something beyond these ideas. Atheism is refuted "by this simple reflection on the repugnancy included in supposing the whole, or any part, even the most rude and shapeless of the visible world, to exist without a mind." In Berkeley's view, what exists independently of finite minds must exist in God's mind.

The first step in the arguments leading to these conclusions had been taken by Descartes and Locke when they said that ideas which cannot exist apart from a mind's awareness of them are the immediate objects of perception. These philosophers had held that, whereas ideas of colours, sounds, tastes and smells (the so-called ideas of secondary qualities) were not, ideas of shape, size and movement (the so-called ideas of primary qualities) were copies of physical features of independently existing material things. Put in its briefest terms, Berkeley's argument was that, once it is granted that what we immediately experience are ideas or sensations (he used both words) and that our knowledge of the world is based on what we immediately experience, then we can form no conception of anything besides or beyond ideas or sensations and the minds in which they exist. If our knowledge of things in nature is derived from experience, he argued, then it is derived from ideas and cannot reach to anything fundamentally different from them, apart from the minds in which they exist. The very being of ideas is their being experienced, for just as it would be absurd to say that a pain could exist unfelt, so it is absurd to say that an odour could exist unsmelled, that a sound could exist unheard, that a feel could exist unfelt, or that a colour could exist unseen. Berkeley added the further argument that the very notion of something existing unexperienced is contradictory since it implies that something not experienced is experienced. He was, however, as anxious to avoid skepticism as he was to refute materialism, and he therefore argued that his denial of material substance was not a denial of the familiar world in which men know one another and come across all sorts of physical bodies. Although material substance does not exist, trees and rocks and cherries do, and these are nothing but "collections" of ideas. Since they are collections of ideas we know them directly, without any dubious intermediaries, and hence we have no cause for doubt concerning them. And as they exist independently of human will and appear to us in a regular order, they must be results of the Divine will and exist in the Divine mind when not perceived by humans.

Berkeley was anxious to accommodate his immaterialism to the beliefs of ordinary men, and he therefore stressed the differences between ideas of sense and ideas of imagination, pointing out that the latter are more under the control of the will than are the former and are less vivid and regular. Arthur Collier, however, in his *Clavis universalis* (1713), which seems to have been written in complete independence of Berkeley, stressed the likeness between ideas of sense and of imagination. He asserted that in denying the independent existence of a material world he was saying that bodies exist in mind in the way in which "objects seen in a looking glass, by men light-headed, ecstatic, etc." exist only in mind. In order to prove that the objects perceived by sense are in the mind in the same way as are the objects of the imagination, Collier appeals to the fact that an imagined object may appear just as external to the mind as a perceived object. He sharpens the paradox which Berkeley had blunted.

The arguments for immaterialism which have so far been considered are, with one exception, based on an examination of sense experience and assume that sense knowledge is immediate and, as such, indubitable. The exception is the argument that the very notion of unexperienced material substance is self-contradictory. Now Collier put forward further arguments to show that matter

was a self-contradictory conception. He held, for example, that it can be proved both that the external world is finite and that it is infinite in extent, both that it is finitely and that it is infinitely divisible. From this he concluded that there is no more ground for believing that there is an external world than for believing that there is a triangular square. Leibniz, too, upheld a version of the immaterialist thesis. Starting from the assumption that, if something complex or containing parts exists (as it does), then there must be ultimate elements which are simple and without parts, he asked whether these ultimate simples could possibly be material. Now anything material, he argued, is necessarily divisible into parts which are themselves divisible into further parts, and so on *in infinitum*. Hence, he concluded, nothing material could possibly be an ultimate element of the world, but since there must be ultimate elements, they are necessarily immaterial. These ultimate immaterial elements of the world he called monads. Not all monads were held by him to be minds, but they were all mindlike rather than material, and hence Leibniz' monadism (as it is called) is a sort of immaterialism. Now arguments such as these do not start from Berkeley's assumption that sense experience is reliable and fundamental. On the contrary, they show, if successful, that the view of the world suggested by sense experience needs to be corrected by philosophical thinking. Immaterialism, then, may be supported by the appeal to experience in the manner generally adopted by Berkeley, or by arguments which purport to show that experience is misleading, in the manner of Leibniz.

Those who, like Berkeley, accept the fundamental reliability of sense experience are called empiricists. Those who, like Leibniz, hold that sense experience is misleading by comparison with properly conducted philosophical argumentation, are called rationalists. Thus immaterialism has been supported both by empiricist and by rationalist arguments.

Phenomenalism.—Berkeley's idealism was intended not only as a defense of religion, but also, as he put it in the title of his *Treatise Concerning the Principles of Human Knowledge* (1710), as a step toward removing "the chief causes of error and difficulty in the sciences." The denial of material substance, he thought, put out of the way a notion that could only cause confusion. On Berkeley's view, to say that a physical object, a tree, for example, exists is to say that if someone looks he will see certain colours and shapes, that if someone touches he will feel certain hardnesses and temperatures, and so on. Thus Berkeley defined material objects in terms of actual and possible sensations, that is, in terms of what is or may be directly observed. He held that this principle of defining entirely in terms of observed or observable entities should be extended to the natural sciences and even to mathematics.

In following out this plan he endeavoured to show that the only genuine causation is that exercised by minds with wills and that what goes by that name in the physical world is nothing but a regular sequence of ideas or sensations. He argued, too, that there is no absolute or empty space, but that space is definable in terms of touch and felt movement. Thus within Berkeley's philosophy there may be seen the beginnings of a radical philosophy of empiricism. Hume later in the 18th century and J. S. Mill and Ernst Mach in the 19th detached this element from the religious part of Berkeley's philosophy in order to develop what they regarded as a consistent form of empiricism. Berkeley's view that material things are collections of ideas was thus transformed by Mill into the definition of matter as a permanent possibility of sensation; and Mach made ingenious attempts to show that atoms and other unobservables of the natural sciences were "economical ways of symbolizing experience" (*The Analysis of Sensations*, 1886). The view that statements about physical objects and statements about the unobservables of natural science are reducible to statements about actual and possible sense experiences is called phenomenalism. It occupies a somewhat uneasy position between idealism and materialism, although it is, in its general bearing, more akin to the latter than to the former. But insofar as the ultimates to which phenomenalism refers are ideas, sensations, impressions or (to use a 20th-century expression) sense data, and insofar as these, as items of immediate experience, seem to be unthinkable apart from some percipient, there is an immaterialist look about phenomenalism which it inherits from its idealist ancestry. (*See* also PHENOMENALISM.)

Transcendental Idealism.—It has been shown that there are two forms of immaterialism and that there are two different types of argument purporting to establish it: there is the empiricist form, which starts from the premiss that there is immediate acquaintance with mind-dependent ideas and concludes that the notion of material substances beyond these ideas and causing them is redundant; and there is also the rationalist form, according to which material substances could not possibly exist, or at any rate could not be ultimate features of the world. The empiricist form is held to be a consequence of the policy of limiting one's view of the world to what sense experience reveals. The rationalist form is an attempt to prove by rational deduction that there is some logical absurdity in the very notion of material substance, so that it is impossible that material substances should exist or should be more than appearances of ultimate immaterial substances. In this second line of argument the court of appeal is not sense experience but rational conceivability. Now it was argued by Kant, in his *Critique of Pure Reason* (1781), that a consistent empiricism leads to skepticism, for in mere sense experience the percipient would be passively immersed first in one and then in another sight or feel or smell or sound or taste without there being any memory of past or recognition of new ones. To this disconnected sensible phantasmagoria he gave the name "manifold of sense"; and the phrase "perceptions without concepts are blind" (*Critique of Pure Reason*, 1st ed., p. 51) expresses his view that acquaintance with particular items of this manifold would not constitute knowledge. On the other hand, Kant argued, philosophical rationalism in its extreme form (he sometimes called it dogmatism) is nothing but an uncontrolled play of concepts or mere thoughts. From a mere concept or thought it is possible only to deduce another concept or thought, not to draw conclusions about what exists in the world. The rationalists erroneously thought that they could prove things about the nature of the substances in the world, or could prove that the world is or is not caused, or is infinitely or only finitely divisible, by arguments based only on the concept of substance, the concept of cause or the concept of infinity. This view is expressed in the phrase with which he balanced that already quoted: "thoughts without content are empty." Kant therefore argued that if there is to be genuine knowledge, the data of sense must fall within forms of space and time contributed by the mind itself and must be brought into some form of conceptual order by the activity of the understanding. It is only because the mind contributes the forms of space and time that we can be absolutely certain, as we are, that anything perceived must fall within one or both of them; and it is only because we impose conceptual forms such as those of substance and cause upon our sensations that we are quite sure that anything experienced must be in an ordered world of interacting things. If experience of a natural world is to be possible, the data of sense must be actively arranged (Kant's word is "synthesized") by the understanding in terms of concepts, principles or categories such as substance and cause. A sensation or idea on its own, for example, gives no knowledge at all and can only co-operate in doing so when it is regarded as belonging to some substance, whether it be a material thing or an embodied mind.

Kant believed, of course, that the ideas which are the raw material of our knowledge must somehow be due to realities existing independent of human minds; but he held that human knowledge cannot reach to them because it can only arise in the course of synthesizing the ideas of sense themselves. Things-in-themselves must remain forever unknown to us. He therefore called himself a formal or transcendental idealist, because the mind determines the form in which reality appears to us. "The mind does not derive its laws (*a priori*) from nature, but prescribes them to her" (*Prolegomena to Every Future Metaphysic* [1783], section 36). Nevertheless Kant thought that he could refute both the idealism of Descartes and that of Berkeley. The former he called "prob-

lematic idealism," because Descartes merely held that the existence of matter could be doubted; and the latter "dogmatic idealism," because Berkeley maintained outright that matter does not exist. As Kant falsely believed that Berkeley's theory was that things in space are mere imaginations, his "refutation" of Berkeley need not detain us. His argument against problematic idealism was that the man who doubts the existence of objects in space outside him must be sure of his own existence but could not know of it unless he was aware of continuing physical things with which his own continually changing ideas could be contrasted. It will be seen, therefore, that Kant held both that the understanding is responsible for so ordering our sense experiences that they constitute the natural world (this is his transcendental idealism) and also that the embodied selves existing in the natural world are correlative with material objects of which they have as direct a knowledge as they have of themselves (this is his "empirical realism"; *cf. Critique of Pure Reason*, 1st ed., p. 375). But how can the understanding both be a condition without which there could not be a natural world at all and also be a part of it belonging to embodied selves in space and time? Kant's answer was that experience is made possible by the synthesizing activity of a transcendental self of which we can know nothing except that it is a condition of our knowledge of the natural world and of ourselves as empirical selves within it. If Kant was right, the immaterialists made the mistake of supposing the sensible world depended upon empirical selves, whereas in fact there could be no experience of empirical selves any more than of the sensible world without the activity of a transcendental self.

According to this argument, therefore, there must be things-in-themselves and transcendental synthesizing activities, but any attempt to discover what sort of thing they are is doomed to inevitable failure. Kant recognized, nevertheless, that we do not remain content with this limitation but endeavour to extend our knowledge beyond the bounds of possible experience. He gave the name "reason" to the intellectual faculty with which we undertake this fruitless task. Prompted by reason, we speculate about the ultimate nature of the world, its source and its destiny, but in doing so we run into antinomies (*i.e.*, equally cogent arguments leading to incompatible conclusions). It was Kant's view that the traditional arguments for the existence of God inevitably call forth equally plausible counterarguments and hence cannot be relied upon as defenses of the religious viewpoint. Theoretical reason, indeed, cannot even establish the freedom of the will, in spite of the importance of this notion for our moral life. On the other hand, however, Kant argued that reason has a practical use in which the moral law is revealed and with it the fact of freedom. Thus man's practical reason reveals him as a member of two worlds: the sensible world in which he is a natural being with desires that are subject to the law of causation; and an intelligible world in which he is spontaneous and free. (*See* also TRANSCENDENTALISM.)

Absolute Idealism.—Absolute idealism, which, along with positivism and materialism, was one of the most influential philosophies of the 19th century, is, in its essentials, the work of Hegel. It was largely due to his writings that the positivism and materialism that were so congenial to the new scientific outlook and to the developing industrial society had to face objections not only from the traditional religious teachers but also from philosophers who were free to speak their minds untrammeled by specific religious dogmas. In spite, therefore, of the difficulties to which his highly individual style and the scope of his writings give rise, the most characteristic traits of his idealist view must here be sketched in. The most convenient way of doing this will be to consider some ways in which he criticized and transformed Kant's transcendental idealism. He discussed Kant's views very fully in paragraphs 40–60 of his *Encyclopaedia of the Philosophical Sciences* (1817) and at the end of his *Lectures on the History of Philosophy*.

"Every philosophy" wrote Hegel in his *Science of Logic* (1812) "is essentially idealism"; but he did not mean by this that every philosophy was immaterialist. He said, indeed, that all that Berkeley's immaterialism amounted to was that the word "ideas" was applied to what previously had been called "things," everything else being left just as it had been. Nor was he impressed by Kant's "refutation of idealism," for this merely rectified Berkeley's paradox by a return to the common sense that Berkeley had disturbed. By "idealism" Hegel meant "the proposition that the finite is ideal"—"ideal" being used to mean "not truly existing." In the passage in the *Science of Logic* from which these definitions are taken Hegel goes on to say that, in denying that the finite is real, idealism is at one with religion. Hegel argues that finite or limited being presupposes infinite unlimited being, within which the finite is a dependent element. The infinite contains the finite within it, for if the infinite were distinct from and external to the finite it would be limited by it and therefore not be infinite. Now Kant had said that the reason was the faculty by which we fruitlessly seek to transcend the limitations imposed by sense experience and the categories of the understanding. According to Hegel, however, this urge toward completeness shows that the reason is a superior, less limited faculty than the understanding, tending toward genuine philosophical knowledge of the infinite. He believed that Kant should not have remained satisfied with the notion of distinct faculties of sensibility, understanding and reason but should have seen that the sensibility is that part of experience that is most refractory to rational explanation and that the reason is the understanding freed from the restrictions of fixed and limited forms. According to Hegel there is a progress in knowledge from the vague blind stare of the senses, through the neatly distinguished categories of common sense and natural science, to the unified knowledge that is philosophy. The movement toward philosophical completeness necessarily leads away from mere sense experience. In this connection reference may be made to Kant's refutation of the ontological argument for the existence of God (*see* THEISM). According to this argument God, defined as the All-Perfect Being, must exist since existence is a perfection and a being without it would not be perfect. To this Kant objected that existence is not a predicate and therefore not a perfection and that it is impossible to deduce the existence of anything from a mere definition. This, of course, is a particular application of Kant's principle that thoughts without content are empty. Hegel, however, accepted the ontological argument, arguing that, although it does not follow from the thought of some finite thing, such as a hundred dollars, that that thing exists, the thought of an All-Perfect or Infinite Being is different and does imply existence. The principle behind this defense of the ontological argument is that the simple sort of verification that is appropriate when we are concerned with the existence of sensible objects is quite inappropriate for highly complex beings. It is absurd to think of verifying the existence of the Infinite Being in the way in which we verify the existence of a hundred dollars, and hence Kant's refutation rests on a confusion of categories. Hegel's defense of the ontological argument is thus a defense of the view that some thoughts are so coherent, comprehensive and compelling that the nonexistence of their object is unthinkable. He considered that if perceptions without concepts are blind, then the choice is between more or less adequate thoughts rather than between those that are supported by sense experience and those that are not.

Another way of approaching Hegel's absolute idealism is by reference to his criticisms of Kant's theory of the categories. In the section on transcendental idealism three categories only have been indicated, those of substance, cause and interaction; but Kant in fact held that there are 12 in all, which he arrived at by consideration of the forms of judgment distinguished in the traditional Aristotelian formal logic. Kant's general idea was that formal logic showed the forms of thought which the understanding uses in bringing order to the manifold of sense. On the one hand there is the manifold of sense, on the other 12 distinct categories. Hegel argued that the categories and that to which they apply should not be divorced from one another, and that the categories themselves should be considered in their relations to one another. If the categories and that to which they apply are inseparable, then an examination of the forms of thought is at the same time an exploration of the forms of being, and logic and metaphysics are one. And if the categories are not to be regarded as ultimate

items on a short list, then it may be possible for us to discover why it is that antinomies arise. They arise, Hegel held, from the limitation or abstract character of each form of thought considered on its own.

The aim, therefore, should be to show how our thinking becomes more and more adequate as, from the contradictions involved in the less satisfactory categories, we proceed toward those that are complex and comprehensive. This is the aim which Hegel claimed to fulfil in his *Science of Logic*, where, commencing with the most abstract category, "being," he passed through mathematical, physical, chemical and biological categories to the absolute idea. Just as the absolute idea contains within itself the truth of all the more abstract categories, so the later and more comprehensive systems of philosophy contain within themselves the truth of all the earlier and partial ones. "The latest philosophy contains therefore those which went before; it embraces in itself all the different stages of them; it is the product and result of those that preceded it. We can now, for example, be Platonists no longer" (*Lectures on the History of Philosophy*).

Absolute idealism, then, comprised the following main themes. It was held that the common-sense world of distinct things and embodied minds in space and time is not the world as it really is but merely the world as it appears in terms of uncriticized categories. It was held in the second place that the mathematical and physical categories are the least adequate for grasping the truth of things and that the world as a whole is best conceived in terms of self-conscious mind. It was held in the third place that thought does not consist in the imposition of ready-made forms upon merely given material, but is, in its most characteristic features, the relating of each particular experience with the infinite whole of which it is an expression. This was the general view which, in the latter part of the 19th century and in the beginning of the 20th, spread from Germany to Great Britain and the British empire, to the United States and, in rather different forms, to France and Italy too. The British writer who most consistently reproduced the central features of Hegel's absolute idealism was Bernard Bosanquet, especially in his *Logic* (1888) and *The Principle of Individuality and Value* (1912). In the former he traced the types of judgment and inference appropriate to the various stages of thought, from the rudimentary forms that are closest to mere sense experience to its highest systematic development. In the latter he showed the consequences of the view that no particular thing is real in isolation from the whole and that rational understanding and inference would be impossible unless the world were a system no part of which could be what it is apart from its relations to the other members. A somewhat more idiosyncratic version of absolute idealism is presented in the writings of F. H. Bradley. His *Ethical Studies* (1876) turned the Hegelian weapons against the utilitarian ethics and underlying empiricist assumptions of the time, while his influential *Appearance and Reality* (1893) was an attempt to show that, in spite of the appearances, the world is really "one comprehensive sentience." Josiah Royce's *The World and the Individual* (1901) was the most impressive American work in the tradition of absolute idealism. Mention should also be made of J. M. E. McTaggart's *The Nature of Existence* (2 vol., 1921–27), in which a subtly argued chain of reasoning is employed to establish the conclusion that the ultimate constituents of the world are a system of timeless selves who need no God to maintain the order that they observe. About the year 1900 absolute idealism had come to be by far the most active philosophical influence in the universities of the British empire and the United States, permeating the teaching of ethics, aesthetics and politics as well as the more fundamental disciplines of logic and metaphysics. Philosophy was thought to justify at any rate some of the religious hopes and to point the way to moral and political improvement.

Criticisms of Idealism.—By the middle of the 20th century philosophical idealism had lost its position of predominance and had few upholders in academic circles. The following paragraphs contain a summary of the types of argument that have led to this.

1. Immaterialism has never had wide support from philosophers, and both transcendental idealists and absolute idealists were chary of it. Now the first step in the empiricist form of immaterialism is the assertion that the objects immediately perceived are ideas or sensations which exist only "in the mind." This step has been challenged in two ways. In the first place it has been urged that immaterialists fail to distinguish between the object perceived (*e.g.*, a coloured patch) and the act of perceiving it and that it is the latter, not the former, that is really "in the mind." Those who use this argument, however, admit that the idea or sensation (for which the 20th-century name is "sense datum" or "sensum") only exists while it is being perceived and can only have those characteristics which it is perceived to have. They still have the problem, therefore, of determining the relationship of this entity to the material objects which, in any view, continue to exist when not perceived by any finite observer. The result is either a revised version of Locke's representationalism or else some form of phenomenalism. A second line of argument, therefore, takes the course of denying that there are such entities as sense data at all. Powerful support for this view is given by the reflection that if sense data have only those characteristics which they are perceived to have, then they must literally be vague or indefinite objects. For if someone sees a coloured patch with many speckles on it and yet does not see how many speckles there are, then according to the sense-datum theory he must be seeing a sense datum that has many speckles but has no definite number of them. Unless this paradox can be removed, upholders of sense data are in danger of maintaining the existence of entities with properties that seem to be logically impossible. If the analysis of perception in terms of ideas or sense data is untenable, then the arguments for immaterialism, as well as those for phenomenalism, cannot even get started.

2. The rationalist arguments for immaterialism and the arguments for the other types of idealism meet with criticisms of a type first clearly formulated by G. E. Moore. Idealists assert conclusions that conflict with common sense. Not only do they talk about transcendental selves and absolute ideas, but they deny that tables and embodied selves and other finite beings are real at all. But we do *say* that tables and people exist, and anyone who denied this would be *commonly* held to be saying what is false. Again, idealists have denied that time is real, and yet it certainly took time for this sentence to be written. Thus we have to choose between accepting the truth of statements that are universally understood and are universally held to be true, and accepting the truth of statements that are understood by very few and need a lot of philosophical argumentation in their support. The opponents of idealism argue that it is the first alternative that ought to be accepted, for, they say, it is ultimately only by means of the ordinary language which we are brought up to speak that anything at all can be explained to anybody. Someone who says that tables and people are not real is misusing the word "real," for it is commonly used just to indicate that it is tables and people that exist and such things as chimaeras and unicorns that do not. According to this argument, then, rationalist immaterialism and absolute idealism must be false because they deny the truth of common-sense statements that are certainly true if anything is true, and assert the truth of other statements whose meaning cannot be clearly explained in terms of the ordinary language in which everything explainable must ultimately be explained.

3. The absolute idealist holds that truth is a relationship of coherence between thoughts rather than a correspondence between thoughts and external realities. Against this empiricists argue that, important as coherence may be, it is secondary to the prime condition that statements are true by virtue of their stating what is the case. The idealist's objection to this, however, is that ascertaining what is the case (*i.e.*, verifying) is not a mere irrational seeing or touching, but is the testing of a theory and, since verification has its meaning and point only in the context of the theory that is being tested, it cannot take us beyond judgment, thought or inference (Brand Blanshard, *The Nature of Thought*, vol. ii, pp. 227–259. George Allen & Unwin Ltd., London, 1939; new impression, 1948).

4. The absolute idealist also maintains the view expressed by Hegel as "The truth is the whole." Understanding the world is discovering the place of subordinate things in subordinate wholes,

of subordinate wholes in less subordinate ones and, ultimately, of everything subordinate in the infinite whole. All our reasoning, it is held, rests on the assumption that everything is necessarily connected with everything else. The properties that things have they necessarily have, although we may not always see that this is so. It has been objected to this part of the idealist view that it is meaningless to say of any fact that it is necessarily as it is, since necessity is a property of elements of a symbolic system or of linguistic expressions: facts are the case, propositions may be necessarily true in the light of certain definitions and rules of inference. To this the idealist's reply is that necessity is a relationship between the elements of systems, so that the necessity of linguistic systems is one instance of a much wider notion. To understand anything, on his view, is to see it in its place in the various systems to which it belongs and is hence to grasp its necessity. "In what we take as the real world we can see the outlines of a necessary structure that is the counterpart of thought's ideal" (B. Blanshard, *ibid.* p. 516). *See* MATERIALISM; *see* also references under "Idealism" in the Index; and biographies of the philosophers mentioned in this article.

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IDENTIFICATION: *see* FINGERPRINT; EVIDENCE; INVESTIGATION, CRIMINAL.

IDENTITY, LAW OF: *see* THOUGHT, LAWS OF.

IDEOGRAM, a pictorial symbol that conveys an idea or a meaning directly, as distinguished from a logogram (a word sign), syllabogram (a syllabic sign) or letter (an alphabetic sign), which represent sounds or linguistic elements. *See* PICTOGRAPHY; WRITING; LOGOGRAM AND SYLLABARY; *see* also references under "Ideogram" in the Index.

IDES, the name given in the Roman calendar to the 13th day of the month with the exception of March, May, July and October, the Ides in these months falling on the 15th day. *See* CALENDAR.

IDIOT, a person with insufficient mental development. The mental age does not exceed, according to the usual definitions, that of a normal two-year-old child. The condition is sometimes defined legally as well as medically. *See* MENTAL DEFICIENCY: *Classification: Idiocy.*

IDLIB, a town and capital of the *muhafaza* (governorate) of the same name, is situated 35 mi. S.W. of Aleppo in the northwest of the Syrian Arab Republic. The area of the *muhafaza* is 2,727 sq.mi.; pop. (1960) 331,745. This district was formerly part of the *muhafaza* of Aleppo, but for administrative purposes it was separately constituted in 1959.

The town of Idlib (pop. [1961 est.] 36,361) lies on the main road between Aleppo and Latakia, Syria's chief port. Its buildings are of mud brick and stone, set in the midst of gardens and vineyards against a background of limestone hills. The climate is continental, with hot dry summers and cold wet winters, the rainfall being as a rule sufficient to make irrigation for the most part unnecessary. It is the centre of a rich agricultural area and part of the produce of Ar Ruj (the northern portion of the Rift valley) is marketed there. The chief products of the district are barley, wheat, vetches, grapes, beans, olives, sesame, cotton and nuts. Idlib is also an important textile centre, spinning sufficient cotton and yarn to supply the surrounding region. (M. V. S.-W.)

IDO: *see* ESPERANTO.

IDOCRASE, a rock-forming mineral of variable composition also known as vesuvianite. Idocrase, a hydrous calcium aluminum silicate with some magnesium and iron, is transparent or translucent, has a vitreous lustre and is commonly brown or green. Transparent crystals of a good green or brown colour may be cut as gem stones. A compact green variety resembling jade is found at several localities in California and is known as californite. A sky-blue variety, cyprine, has traces of copper. Some varieties contain fluorine or boron. The crystals of idocrase have tetragonal symmetry, and the structural formula is $Ca_{10}(Mg.Fe)_2Al_4(Si_2O_7)_2(SiO_4)_5(OH)_4$. The crystal structure resembles in some ways that of garnet (*q.v.*). The crystals are four- or eight-sided prisms terminated by basal planes and pyramids. Idocrase occurs commonly as well-developed crystals, also as striated columnar aggregates. The specific gravity is about 3.4 and the hardness 6.5. Most varieties are optically uniaxial and negative. Viluite, a variety containing boron, is optically positive and may be biaxial.

Idocrase is found principally in crystalline limestones near their contacts with igneous rocks (*see* METAMORPHISM) and in beds of marble and calc-silicate granulite associated with gneiss and mica schist. It is also found in association with serpentinite and in chlorite schist and amphibolite. Minerals commonly occurring with it are calcite, garnet, diopside, wollastonite, phlogopite and amphibole.

Localities where fine crystals have been found are the Ala valley in the Piedmont; Monte Somma (Vesuvius); the Vilyui river, Sib.; Christiansand, Nor.; and, in North America, at Auburn, Me.; Amity, N.Y.; Franklin, N.J.; and Litchfield, Que. (J. B. T.)

IDOL, literally an image (Gr. *eidolon*), particularly an image used as an object of worship. In philosophy, the word can mean a prejudice of some kind that hinders clear thought. It was used in this sense by Giordano Bruno and adopted from him by Francis Bacon (*q.v.*), who in a celebrated passage of his *Novum Organum* distinguished four kinds of idol, namely: (1) "idols of the tribe," prejudices more or less common to the whole human race; (2) "idols of the cave," prejudices peculiar to individuals; (3) "idols of the market place," prejudices encouraged by one's social group and mother tongue; and (4) "idols of the theatre," prejudices or false notions taught and encouraged by various schools of thought.

IDOLATRY, in Christian thought, the worship of someone or something other than God as though it were God, "the elevation of a preliminary concern to ultimacy" (Paul Tillich). The first of the Ten Commandments prohibits idolatry: "You shall have no other gods before [or besides] me."

Christian thought has distinguished several forms of idolatry. Gross or overt idolatry consists of explicit acts of reverence addressed to a person or an object—the sun, the king, an animal, a statue. This may exist alongside the acknowledgment of a Supreme Being; for example, Israel worshiped the golden calf at the foot of Mt. Sinai, where it had encamped to receive the Law and the covenant of the one true God. A man becomes guilty of a more subtle and "fine" idolatry, however, when, though he refrains from any overt act of adoration, he attaches to a creature the confidence, loyalty and devotion that properly belong only to the Creator. Christian moral theology interprets as idolatry any inordinate desire by which one looks to the object of his desire as the ultimate source of good and the ground of his being. Therefore the New Testament warns believers to "Put to death . . . what is earthly in you: immorality, impurity, passion, evil desire, and covetousness, which is idolatry" (Col. iii, 5). For example, the nation is a good creature of God, but it is to be loved and served with an affection appropriate to it, not with the ultimate devotion that must be reserved for the Lord of all nations. Even true doctrine—for example, true doctrine about idolatry—may become an idol if it fails to point beyond itself to God alone.

At the same time Christian thought has insisted upon the principle of mediation and has rejected the charge that attachment to a mediating agency is automatically idolatrous. The Christian Scriptures are called "the Holy Bible," not because they have an intrinsic holiness or are themselves the source of such holiness, but because the God who alone is holy is mediated and disclosed to men through the words of the Bible. Christians are not in agreement about the agents of mediation—for example, about the role of the Virgin Mary and of the other saints. But where such mediation is acknowledged to be present, it is also acknowledged that reverence shown toward it applies not to the agent of mediation in and of himself but to the one for whom the agent stands. A

special instance is the human nature of Jesus Christ (which is worthy of divine worship because of its inseparable union with the Second Person of the Holy Trinity) and the consecrated Host in the Eucharist (which may properly be adored because it has been changed into the very body of Christ). Although the accusation of idolatry is thus a part of the polemic of Christian against Christian, so that Protestants are accused of bibliolatry and Roman Catholics of Mariolatry, the fundamental meaning of the term is the direct moral corollary of the Jewish-Christian avowal of the oneness of God: "Hear, O Israel: The Lord our God is one Lord."

See Thomas Aquinas, *Summa theologica*, II–II, Q. 94; John Calvin, *Institutes of the Christian Religion*, I, ch. 11–12. (J. J. Ps.)

IDOMA, a people and an indigenous language of west Africa. The Idoma-speaking peoples of Nigeria, numbering about 250,000 in the 1960s, inhabit a wide arc from the Arago districts of Lafia Emirate, south through Idoma division to the outlying Iyala and Nkum peoples in Ogoja province. The population of Idoma division, Benue province, was estimated at about 319,000 in 1953. Of these, perhaps two-thirds were Idoma and one-third were Egede, Akweya (Akpa), Ufia (Utonkon) and Ibo. The western Idoma have in the past been called Akpoto. Idoma is a highly tonal language of the Kwa group. Nine rather distinct Idoma dialects have been identified, including Arago and Iyala; and the cluster is closely related to the Egede, Akweya, Afo and Etulo (Utur), and more remotely to the Igala, Bini and Yoruba languages.

The Idoma are agricultural, growing a mixture of savanna and rain forest crops, yams being the staple. Because of the tsetse fly, cattle and horses cannot be kept, although earlier they were traded in from the north. Most Idoma, including the Iyala, live in savanna country, but the southern fringe of Idoma division lies in the "palm belt." Food is exported to both northern and southern Nigeria, and the western districts yield coal of fair quality.

The patrilineal, nonexogamous social structure is based on segmented, corporate lineages, which are the land-holding units. From two to four lineages unite under a chief to form a "land"; lands were usually at war with their neighbours before the peaceful conditions of British rule. Where constituent lineages of a land are related, they may be said to form a clan, but many of the lands include lineages not regarded as related. There are numerous men's societies, which seem to have formed originally to police the markets. Cowrie-shell and iron currencies of Hausa and Egede origin were used, as well as brass rods from the coast.

The Idoma were once a part of the Jukun (Apá) empire, but suffered severely in the Fulani wars (early 19th century) that drove many Idoma south of the Benue river to their modern locations. Their country was opened to British influence by H. M. T. Trenchard in 1909; really serious administration began with railroad construction there after World War I. Modern Idoma occupy a key position between northern and eastern Nigeria, and have begun to play an important role in national politics.

See Robert G. Armstrong, "The Idoma-speaking Peoples," *Peoples of the Niger-Benue Confluence, Ethnographic Survey of Africa, Western Africa*, pt. x, for a fuller bibliography (1955). (R. G. Ar.)

IDOMENEUS, in Greek legend, son of Deucalion, grandson of Minos and Pasiphaë, and king of Crete. He courted Helen and took a distinguished part in the Trojan War. According to the *Odyssey*, he returned home safely with all his countrymen who had survived the war. In later tradition, having been overtaken by a violent storm, he vowed to sacrifice to Poseidon the first living thing that met him when he reached home. This proved to be his son, whom he slew in accordance with his vow; whereupon a plague broke out and Idomeneus was driven out. He fled to the district of Sallentum in Calabria and subsequently to Colophon in Asia Minor, where he settled near the temple of the Clarian Apollo and was buried on Mt. Cercaphus. But the Cretans showed his grave at Knossos, where he was worshiped as a hero with Meriones.

IDRIS I (Mohammed Idris el-Mahdi es-Senusi) (1890–), first king of the united kingdom of Libya, was the son of Senusi el-Mahdi (1845–1902) and the grandson of Mohammed ben Ali ben es-Senusi (*c.* 1791–1859), an Algerian from Mostaganem who from 1843 lived in Cyrenaica and founded a powerful Muslim fraternity known as Senusiya (*see* Senussi and Senussites). Since Idris was a minor at the time of his father's death, the chieftainship passed to his cousin Ahmed esh-Sherif, who fought against Italy in the Italo-Turkish War of 1911–12 and in World War I. In 1917 Idris secured an agreement with the British and Italian governments, was recognized by the Senusi chiefs as Grand Senusi and in Nov. 1920 acknowledged Italian suzerainty over Cyrenaica. He was given the hereditary title of amir with jurisdiction over the oases of Kufra, Jaghbub, Jalu, Aujila and Jedabia. On the rise of fascism in Italy, he withdrew in Jan. 1923 to Egypt with his family, while his lieutenants continued to rule in the oases. In 1940, under an agreement with the British government, he organized an auxiliary military force which fought with the British 8th army.

In Nov. 1947 Idris returned to Cyrenaica and the following year was installed in the palace of the former Italian governor at Bengasi. On June 1, 1949, he was recognized by Great Britain as ruler of Cyrenaica. In Dec. 1950 he was chosen by the national assembly representing Cyrenaica, Tripolitania and the Fezzan to be king of Libya when that state came into being. On Dec. 24, 1951, Great Britain and France relinquished their administrative authority, and Idris proclaimed the independence of the new state. Being childless, Idris married in 1955 Aliya Abd-el-Kader Moneim Lamlun; but she did not bear him the heir he hoped for, and he divorced her in 1958. (K. Sm.)

IDRISI (Abu 'Abdullah Mohammed ibn Mohammed ash-Sharif al-Idrisi) (1100–*c.* 1166), Arab geographer, scientist and poet, was a descendant of the Prophet Mohammed through Idris I of Morocco and the Banu Hammud, princes of Málaga. According to a very late authority Idrisi was born at Ceuta in A.H. 493 (A.D. 1099–1100). He studied at Córdoba and traveled widely in Spain, north Africa and Asia Minor. Roger II of Sicily (1101–05) treated him with great honour and entrusted him with the compilation of a treatise on the whole of the known world in which information from existing geographical works was collated with reports of travelers. After 15 years Idrisi completed early in 1154 the *Nuzhat al-mushtāq fi'khtirāq al-āfāq* ("Delight of him who wishes to traverse the regions of the world"), generally known as *Kitāb Rujār* ("The Book of Roger"). He constructed a silver globe and planisphere, both of which have perished. The treatise was illustrated with maps and it can be shown that these were based upon the text, not the text upon the maps. He compiled another recension for William the Bad (1154–66) but it has been lost. A manuscript of a third version was found in the Hakimoglu Ali Pasha mosque in Istanbul in 1906; this is dedicated to an anonymous but not royal patron and omits the descriptive part of *The Book of Roger* but retains the itineraries and includes some new material. A manuscript of Idrisi's work on botany and materia medica also survives in Istanbul and a few of his verses have been preserved. It is unlikely that he remained in Sicily after the anti-Muslim riots of 1161 but it is not known when or where he died. No life of him has been traced in Arabic biographical literature and the account by Leo Africanus in *De viris illustribus apud Arabes* (Zurich, 1664) is of no value.

The Book of Roger is divided according to the seven climates of Greek geographers, beginning at the equator and extending northward as far as the latitude at which cold made the earth uninhabitable. Each climate is then subdivided by vertical lines into ten equal sections numbered from west to east. All divisions that do not coincide with these are ignored in the arrangement of the book. There is evidence of hasty compilation and of misunderstanding of the written sources. Some legendary matter is included such as descriptions of the land of Gog and Magog, the wonders of Rome and the islands of St. Brendan; mathematical and descriptive errors are common. The maps seem to have been reduced by eye and areas well known to the author are shown as disproportionately large. The preface mentions written sources consulted by Roger which include Ptolemy and Orosius but no other European writers. Al-Masudi and Ibn Hawqal are among the chief Arabic authorities Idrisi used but he appears not to have known al-Biruni or al-Maqdisi. Much of the information given was not derived from these sources and must have been taken from

travelers' accounts and in Roger's own dominions from official records. The description of Sicily is the most detailed and is of great historical interest, for it includes much more than purely topographical information. Idrisi's place names are often difficult to identify because of corrupt manuscripts and the ambiguities of the script. In Italy, Greece, parts of France and even in Sicily some of them seem to have been taken from classical rather than Arabic maps or contemporary vernacular usage. In other parts of France and in northern Europe generally he gives versions of contemporary spoken forms. Ireland occupies the first and Britain the second section of the seventh climate. Some of his English place names are French in form. He knew something of the coast between Dartmouth and Grimsby, mentions Dover, London, probably Oxford and perhaps the Scilly Isles but he knows no British river by name except the Thames and nothing of the interior or the west coast.

A garbled abridgment of his work was printed in Arabic (Rome, 1592), and in a Latin translation as *Geographia Nubiensis* (Paris, 1619), the title being due to a misunderstanding. His influence on European cartography and exploration was not important but it has been suggested that his delineation of Africa influenced the maps of Marino Sanuto and Pietro Vesconte. Like Ptolemy, Idrisi believed that Africa extended to the east and enclosed the Indian ocean on the south. It has also been suggested, without evidence, that his account of a voyage, apparently to Madeira and one of the Canaries, may have influenced the exploration of the Atlantic.

The most important manuscripts of *The Book of Roger* are in the Bibliothèque Nationale, Paris, and the Bodleian library, Oxford. The maps they contain were reproduced by Konrad Miller, *Mappae arabicae* (1926–31). The maps of the greater part of the British Isles were reproduced by D. M. Dunlop, "Scotland According to al-Idrisi," *Scottish Historical Review*, vol. xxvi (1947). There is no edition of the complete Arabic text. The French translation of A. Jaubert, 2 vol. (1836–40), is complete but very unsatisfactory. Sections of the text, especially those relating to Europe and north Africa, have been studied and sometimes edited and translated in monographs and papers, many of which are in the academic journals of the countries concerned. For details of these *see* G. Sarton, *Introduction to the History of Science* (1927–48), vol. ii, pp. 410–412; C. Brockelmann, *Geschichte der arabischen Litteratur* (1898–1902) and the article "Idrisi" by C. F. Seybold in the *Encyclopaedia of Islam*, vol. ii (1930). The account of the British Isles was edited, translated and discussed by A. F. L. Beeston, "Idrisi's Account of the British Isles," *Bull. Schl. Orient. Stud. Lond. Univ.*, vol. xiii (1949–50).

On Idrisi's life and work generally, *see* especially M. Amari, *Storia dei musulmani di Sicilia*, 2nd ed. by C. A. Nallino, vol. i, pp. 49–51; vol. iii, pp. 460–468, 677–701 (1933–37). (C. F. Bm.)

IDUMAEA: *see* EDOM.

IDUN (IÐUNN), in Norse mythology, is the wife of Bragi (*q.v.*), god of poetry. She guarded those apples which the gods must eat to preserve their youth. When she and her apples were seized by a giant, the gods quickly began to grow old. This story is mentioned in a Norwegian poem as early as the late 9th century. *See* also GERMANIC MYTHOLOGY AND HEROIC LEGENDS. (G. T.-P.)

IDYL or IDYLL (Gr. *eidyllion*, a descriptive piece, from *eidos*, a shape or style), a short poem of a pastoral or rural character, in which something of the element of landscape is preserved or felt. The earliest commentators of antiquity used the term to designate a great variety of brief and homely poems, in which the description of natural objects was introduced, but the pastoral idea came into existence in connection with the Alexandrian school and particularly with Theocritus, Bion and Moschus, in the 3rd century B.C. Ten of the so-called idyls of Theocritus (*q.v.*) are extant, and these are the type from which the popular idea of this kind of poem is taken. The word was revived at the Renaissance. In 1658 the English critic, Edward Phillips, defined an idyl as "a kind of eclogue," but it was seldom used to describe a modern poem. The general use, or abuse, of the word in the second half of the 19th century, both in English and French, arose from the popularity of two works, by two eminent poets. The *Idylles héroïques* (1858) of Victor de Laprade and the *Idylls of the King* (1859) of Tennyson enjoyed a success in both countries which led to a wide imitation of the title among those who had, perhaps, a very inexact idea of its meaning. On the whole, it is impossible to define the idyl as a definite literary form and understanding of its exact meaning is further obscured because although the noun carries no bucolic idea with it in English, the adjective "idyllic" has come to be synonymous with pastoral and rustic.

IESI, a town and episcopal see in Ancona province of the Marches (Marche) region of central Italy, is situated on the Esino river, 30 km. (18½ mi.) W.S.W. of Ancona by road. Pop. (1957 est.) 35,095 (commune). The old quarter is completely surrounded by 14th-century walls. Of note are the 13th-century Gothic church of S. Marco, the Signoria palace (architect Francesco di Giorgio Martini, 1486) and the palace of Frederick II (13th century). The Pinacoteca contains 15th- and 16th-century Tuscan and Lombard carvings and paintings by Lorenzo Lotto. The town is on the Rome-Ancona railway. Agricultural and other machinery, soap, matches, food, silk, hemp, wool and paper are made; agricultural products include cereals, flax, hemp, mulberries and silkworms. Iesi was a Roman colony (Aesis) from 247 B.C. Destroyed by the Goths and Lombards, it formed part of Pepin's gift to the church (756). It supported the Ghibellines until the battle of Benevento (1266) and then passed to the Church under which it remained (except for the period 1406–47) until 1861. It is one of the oldest sees of Italy, its first bishop, the 4th-century St. Septimius, being the town's patron saint. Iesi was the birthplace of the emperor Frederick II and of the composer G. B. Pergolesi. (M. T. A. N.)

IF, a small offshore island, made of limestone, in the Mediterranean sea 2 mi. outside the port of Marseilles, France. Its castle, built by Francis I in 1524, was later used as a state prison, and has been made famous by Alexandre Dumas' novel, *The Count of Monte Cristo.* (AR. E. S.)

IFE, a town of Western Nigeria, Africa, lies about 750 ft. above sea level and 54 mi. E. of Ibadan by road, in the rain forest area and within the main cocoa-growing regions. Pop. (1963 est.) *c.* 90,000 (Africans only). Formerly called Ile-Ife, it is one of the larger, and possibly the oldest, of the Yoruba towns. It has been described as the "holy city" of the Yoruba (*q.v.*) and at its centre is the palace (*afin*) of the *oni* of Ife, the spiritual head of the Yoruba people. In the palace compound (about two acres) is the Ife museum containing examples of Ife bronze and terra-cotta heads and figures. Cire-perdue bronze castings of uncertain date were first discovered by the archaeologist Leo Frobenius in 1910; further bronze heads were found in 1938 and terra-cotta figures in 1957. Another notable relic in the custody of the *oni* is the staff of Oranyan, an 18-ft. granite monolith in the shape of an elephant's tusk. A local legend relates that Ile-Ife was the place where mankind was created. The Yoruba at least appear to have been established there at an early date. Ife seems to have largely escaped the contacts made by Benin with the first European explorers and was later less affected by the Fulani attacks and the civil wars of the 19th century than were the neighbouring Yoruba kingdoms of Oyo, Ibadan and Abeokuta.

Apart from some modern two-story buildings, the houses are mostly of red mud with pan (metal) roofing. At the north of the town stands Oduduwa college (the nucleus of the University of Ife), named in honour of the reputed ancestor of the Yoruba. Ife is linked by main road westward with Ibadan and Lagos, northward with Oshogbo, Ilorin and Northern Nigeria, and eastward with Benin and Eastern Nigeria. The people are by tradition town-dwelling farmers and live mainly by farming the surrounding country. A substantial cocoa crop is also exported. (W. H. I.)

IFFLAND, AUGUST WILHELM (1759–1814), German actor, dramatist and manager, was born in Hanover on April 19, 1759. At the age of 18 he broke with parental authority and joined the Gotha court theatre to study acting under Konrad Ekhof's direction. In 1779 he went to Mannheim where he created the part of Franz Moor in Schiller's *Die Räuber*. In 1796, upon Goethe's invitation, he appeared as guest star on the Weimar court stage, charming his audiences with truthful and yet stylized por-

traits of pathetic and comic middle-class characters. His flights into tragedy (Lear, Wallenstein, Egmont) were less successful. As an author Iffland achieved like fame in the fields of domestic drama and sentimental comedy (*Verbrechen aus Ehrsucht, Die Jäger, Der Spieler, Die Hagestolzen*). In 1798 he was appointed manager of the Berlin National theatre, and in 1811 director-general of all the royal theatres in Prussia. He died in Berlin on Sept. 22, 1814.

See his autobiography *Meine Theatralische Laufbahn* (republished 1885). (A. M. N.)

IFNI, an African province of Spain, forms an enclave on the Atlantic coast of southern Morocco. Pop. (1960) 47,582. Area 579 sq.mi. With a coast line of about 50 mi. and extending about 15 mi. inland, Ifni is a semidesert area of mountains and coastal plain, with grass-steppe vegetation and rare dry farming. Camels, sheep, goats and fish are almost the only resources. The inhabitants are mostly Berbers (*q.v.*) of the Bamrane (Ait Ba Amran) tribe.

In 1476 the Spanish fort of Santa Cruz de Mar Pequeña was established nearby to assist with colonizing the Canary Islands and to protect a fishery. This post was destroyed by the Moors in 1524 but its memory lingered and in 1860 the sultan of Morocco recognized Spain's right to refound a post with some surrounding territory. The new post was not occupied until 1934, following French pacification of the Anti-Atlas hinterland. It became part of Spanish West Africa in 1952 but, following an attack in Nov. 1957 by bands of Moroccan nationalist irregulars, was in 1958 reorganized as a province under a governor general.

The capital, Sidi Ifni, has grown up since 1934 around ravines leading to the Wadi Ifni. Pop. (1954) 9,332. Set in a bay affording indifferent shelter, Sidi Ifni handles trade with Morocco, the Canary Islands and Spanish Sahara and has a good airport. Tracks lead north and southeast to Morocco, surplus labour emigrates to northern Morocco and Moroccan nationalism is active.

See T. G. Figueraz, *Santa Cruz de Mar Pequeña-Ifni-Sahara* (1941); *Atlas Histórico y Geográfico de África Española* (1955). (R. J. H. C.)

IFUGAO, a pagan group of wet-rice agriculturalists occupying the subprovince of the same name in the mountainous area of northern Luzon, Phil. They are of Malay stock and their language is Malayo-Polynesian, as is that of their neighbours (*see* IGOROT), but they have developed a number of cultural characteristics which set them apart. They numbered nearly 70,000 in 1939 but World War II reduced their population to a figure (1948) of 50,000.

Their great system of irrigated rice terraces, which scale the mountain walls, is world-famous, and was developed with a simple technology. The Ifugao live in small hamlets of five to ten houses scattered among the terraces. In addition to rice, the prestige crop, large amounts of sweet potatoes are grown on hillside plots and form the staple diet of the poorer class. Pigs and chickens are also raised, primarily for the numerous rituals and sacrifices.

Ifugao social organization is based almost exclusively on kinship. Each individual is the centre of a "kinship circle" which extends to the third cousin, and these units are all-important in the feuds and head-hunting activities which formerly prevailed.

The Ifugao lack political organization and have relied on marriage alliances and trading pacts; they recognize temporary go-betweens who settle disputes in terms of customary law. The aristocrats, who form an upper class, maintain their prestige by periodic feasts.

Ifugao religion has an elaborate cosmology and over a thousand deities of various classes. Ancestral and other deities are invoked in the case of illness or other difficulties with the aid of rice wine and feasting.

In the 1960s there were numerous schools and missions in the subprovince and Ifugao was playing an important role in the development of the Mountain province as a tourist attraction. *See* also PHILIPPINES, REPUBLIC OF THE.

See R. F. Barton, *The Half-way Sun* (1930), *The Religion of the Ifugaos*, memoir 65, American Anthropological Association (1946). (F. R. E.)

IGALA (IGARA), a people of the Northern Region of Nigeria, living on the left bank of the Niger below its junction with the Benue river; their territory runs southward from the confluence for 90 mi., and extends inland about 70 mi. Their ruler, the *Ata*, also governs two other groups, the Bassa Nge and Bassa Nkomo, who live between the Igala and the Benue river. The king's office is sacred, forming the apex of an elaborate hierarchy of titles. The Igala kingdom is the largest of the four administrative divisions of Kabba province; its total population in 1952 was approximately 361,000, of whom about 290,000 were Igala.

Igala culture reflects contact with other peoples notably in southern Nigeria and in the Niger-Benue region. The strong link between their language and that of the Yoruba (they form a unit in the Kwa group of west African tongues) suggests a common origin. They share certain religious beliefs with the Ibo, and the institution of kingship with the Benin kingdom and the former Jukun empire. They also have close ties with the Nupe and Igbira kingdoms.

Although primarily an agricultural people, the Igala have always been active traders on the Niger between the delta and the confluence; Idah, the capital, is one of the major trading towns on the river. Palm oil and kernels have become the chief exports, displacing traditional goods like foodstuffs, cotton and cloth. Official economic development plans in the 1960s were designed to encourage the palm oil industry, improve agriculture, and exploit the rich timber resources. Iron ore occurs in several places, but is of too low a grade to repay extraction at present.

Christian missionaries have worked among the Igala since 1865, converting many in the towns and larger villages; primary schools have been established by the various missions and the native authority. Many of the Igala are Muslims, and Idah and Ankpa are centres of Muslim influence, which is growing rapidly in strength. *See* also AFRICA: *Ethnography (Anthropology)*: *West Africa.*

See Robert G. Armstrong, "The Igala (Peoples of the Niger-Benue Confluence)," in *Ethnographic Survey of Africa, Western Africa*, part x (1956). (J. S. Bo.)

IGARKA, a town and river port of Krasnoyarsk *krai* of the Russian Soviet Federated Socialist Republic, U.S.S.R., stands on the right bank of the Yenisei, 368 km. (230 mi.) above the estuary and 672 km. (418 mi.) from the sea. Pop. (1959) 14,300. The town was founded in the years 1929–30 as a base for the timber industry of the Siberian north and became one of the largest sawmilling centres of the U.S.S.R. It may be reached by ocean-going vessels, accompanied, if necessary, by icebreakers. Joinery is carried on and furniture and boats are made. Two state vegetable farms nearby supply the town. There is a Pedagogic School of Peoples of the North and a permafrost research station of the Soviet Academy of Sciences. (R. A. F.)

IGBIRA, a Nigerian people, numbering about 160,000, in and around the town of Okene, in Igbirra division of Kabba province, except for about 10,000 in Koton Karifi division and about 10,000 in the Toto and Umaisha districts of Nassarawa emirate, Benue province, where they are a one-third minority. The Fulani (*q.v.*) conquest in 1853 and slave raids of the mid-19th century decimated the Igbira of Panda and Koton Karifi. The Okene group was never conquered until the British occupation, shortly before 1900.

The Igbira language, whose various dialects are mutually intelligible, is most closely related to Nupe, and thus belongs to the Kwa family of Niger-Congo languages.

The Igbira are agricultural and were active traders when they were first visited by MacGregor Laird (*q.v.*) in 1833. They are patrilineal, both as to inheritance and as to clan membership. For a century or more before the Fulani conquered them, Panda and Koton Karifi were independent states headed by divine kings, who were also rain makers; the date of the establishment of the Okene group is uncertain. Both states claimed connections with the Igala kingdom and the Jukun empire; but judging by the language differences any such connections probably were political or ritual rather than ethnic. Judging by Laird's description of the old city of Panda, and by the size and importance of modern

Okene, the Igbira may be regarded as having an urban orientation. Christian missions of several denominations were active in the 1960s and operated many schools. Islam was likewise increasing in importance. *See* also AFRICA: *Ethnography (Anthropology)*: *West Africa*.

See Paula Brown, "The Igbira (Peoples of the Niger-Benue Confluence)," in *Ethnographic Survey of Africa, Western Africa*, part x (1956); J. R. Wilson-Haffenden, *The Red Men of Nigeria* (1930).
(R. G. AR.)

IGLESIAS, PABLO (1850–1925), Spanish political leader, played a major part in the development of democratic socialism and trade unionism in Spain. He was born at El Ferrol on Oct. 17 or 18, 1850, was brought up in a foundling home and became a printer. He helped found the Spanish Socialist party in May 1879 and was one of the first Socialists to be elected to the Madrid municipal council (1905) and to the *Cortes* (1910). From 1886 he was editor of *El Socialista*, the official organ of the Spanish labour movement. He ended a life-long devotion to the workers' cause (for which he served eight terms of imprisonment) as president of the Unión General de Trabajadores (U.G.T.) and leader of the parliamentary Socialist party. He died in Madrid on Dec. 8 or 9, 1925.

See J. J. Morato, *Pablo Iglesias* (1931); J. Zugazagoitia, *Pablo Iglesias* (1935). (H. F. GR.)

IGNATIEV, NIKOLAI PAVLOVICH, COUNT (1832–1908), Russian diplomat, the negotiator of the 1860 treaty which defined the Russo-Chinese frontier, was born at St. Petersburg on Jan. 29 (new style; 17, old style), 1832. At 17 he became an officer of the Guards. His diplomatic career began in 1856 at the congress of Paris, after the Crimean War, where he took an active part as military attaché in the negotiations regarding the rectification of the Russian frontier on the lower Danube. Two years later (1858) he was sent with a small escort on a dangerous mission to Khiva and Bukhara. The khan of Khiva laid a plan for detaining him as a hostage, but he returned safely, after concluding a treaty of friendship with the khan of Bukhara. In 1859 he was Russian envoy at Peking when the Chinese government was terrified by the advance of the Anglo-French expedition of 1860 and the burning of the summer palace. He used the occasion to secure for Russia, by the treaty of Peking of Nov. 14 (N.S.; 2, O.S.), 1860, not only the left bank of the Amur, the original object of the mission, but also a large extent of territory and seacoast south of that river. Ignatiev was ambassador in Constantinople from 1864 till 1877. His chief aim was to liberate from Turkish domination and bring under the influence of Russia the Christian Slavonic nationalities in general and the Bulgars in particular. His diplomacy led up to the Russo-Turkish War of 1877–78, at the close of which he negotiated with the Turkish plenipotentiaries the treaty of San Stefano. Ignatiev then retired in semidisgrace. After the accession of Alexander III in 1881, he was appointed minister of the interior to carry out a nationalist, reactionary policy, but resigned in 1882. He died in St. Petersburg on July 3 (N.S.; June 20, O.S.), 1908.

IGNATIUS, SAINT (d. *c.* A.D. 110), bishop of Antioch and a most powerful theologian and church leader who suffered martyrdom in Rome under Trajan (A.D. 98–117). He assuredly was a gentile Christian, as his Roman name indicates (Lat. Egnatius). He surnamed himself Theophoros (*i.e.*, "God-bearer"), the first known instance in which this pagan cult word is used as a name.

Ignatius' seven authentic letters, which belong to the Apostolic Fathers, contain the only reliable information about him. They were written when Ignatius had been taken prisoner during a persecution of the Antioch church and, under sentence of death, was being taken to Rome by a guard of soldiers. During a lengthy stop at Smyrna (mod. Izmir) in Asia Minor, he wrote to the churches of Ephesus, Magnesia and Tralles, from which delegations had visited him, and also to Rome, requesting the Roman Christians not to do anything that would prevent his death as a martyr. Three other letters were written from Troas, to the churches in Smyrna and Philadelphia, which he had just visited, and to Smyrna's bishop, Polycarp, personally.

That Ignatius actually suffered martyrdom in Rome is certain from Polycarp's epistle (ix, 2); Eusebius (*Ecclesiastical History*, iii, 36, 3) and Origen (*Homiliae in Lucam*, vi) also say that he was thrown before the wild animals. The date is uncertain but probably was between A.D. 107 and 110. The oldest story of his martyrdom, the so-called *Martyrium Colbertinum*, is a legendary report from the 4th or 5th century A.D. There is a longer recension of the Ignatian epistles and five additional letters, all of which are spurious and do not contain additional trustworthy information.

In his vigorous fight against heresy, Ignatius, in contradistinction to his contemporaries (*e.g.*, Clement of Rome), does not rely upon the Old Testament and Jewish traditions. He rather develops his theology from the same sources from which many Gnostic theologians draw their arguments, namely from the Pauline Epistles and the milieu of the Gospel of John. With his Gnostic opponents he has in common as his basic theological problem the radical contrast between the two cosmic spheres of flesh and spirit. But in contrast to docetic Christology (*see* DOCETISM), for Ignatius salvation is the unifying of the two spheres in the person and work of Christ. This metaphysical union is continued in the church, but here the representations of Christ, the "gospel" and the Eucharist, are guaranteed in their effectiveness and legitimacy by the bishop.

In his theological elaboration of these constitutive elements of church doctrine, Ignatius stands halfway between the apostolic age and the early Catholic Fathers. What he calls "gospel" are not yet written documents from a canon of New Testament writings but traditional credal formulas (*see* GOSPELS) which are rather primitive and are not yet thought of as being authorized by the apostles. In their content they are concise enumerations of Christ's birth through Mary, his baptism by John, his suffering and death under Pontius Pilate and his resurrection.

In antidocetic additions to these formulas, Ignatius stresses the real union of flesh and spirit, divinity and humanity in Christ, both before and after the resurrection. In the sacrament of the Lord's Supper the union of flesh and spirit in Christ is mysteriously present. It is therefore the "medicine of immortality" and can also be called "the bread of God." It is not yet, however, understood as a repetition of Christ's sacrifice. In his emphasis upon the pre-eminence of the bishop, Ignatius is an early promoter of the concept of the monarchical episcopacy, but he does not yet know a doctrine of apostolic succession.

As the culmination of his life Ignatius longs to experience the actualization of the union with Christ in suffering and death. In his passion for martyrdom a central motive of the most primitive Christian faith, the idea of discipleship, is revived.

St. Ignatius' feast day is Feb. 1 in the Roman calendar; Dec. 17 in the Book of Common Prayer; Dec. 20 in the Greek Church; and Oct. 17 at Antioch. *See* also APOSTOLIC FATHERS.

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(H. H. KO.)

IGNIS FATUUS (Lat. *ignis*, "fire"; *fatuus*, "foolish"), the name applied to the pale flame, also called will-o'-the-wisp and jack-o'-lantern, sometimes seen flickering over marshy ground and, it is said, over churchyards. No entirely satisfactory explanation has been put forward but it is generally believed that the effect is due to the spontaneous ignition of gases (especially methane, CH_4, or phosphine, PH_3) produced by the disintegration of dead plant and, possibly, animal matter.

IGNORANCE, in English and U.S. law (as in Roman law) falls into two categories: ignorance of law (*ignorantia juris*) and ignorance of fact (*ignorantia facti*). In general, it is no defense to a criminal charge that the accused was unaware that his conduct was criminal. This principle has been thought to be essential to

the effective administration of law and is justified by the practical consideration that, in cases of serious criminality, the accused is ordinarily aware of the wrongfulness of his conduct if not its criminality. A more doubtful question arises, however, in statutory offenses involving conduct not obviously dangerous or immoral. A developing body of U.S. law permits exculpation for mistake of law in some such situations, particularly when the accused in good faith has made reasonable efforts to discover what the law is. Ignorance or mistake of fact provides a defense to a criminal charge when the mistaken view of the facts is inconsistent with the required criminal purpose. Thus, one who takes and carries away goods of another believing them to be his own is not guilty of larceny since he lacks the intent to steal. (*See* CRIMINAL LAW.)

In civil matters ignorance of the law is usually irrelevant. A man may not repudiate a promise because he was ignorant that it was given under circumstances that would create a binding contract. On the other hand, ignorance of fact may relieve a party of liability or provide the basis for recovery, as where an insurance company pays the sum assured in ignorance of the fact that the policy had lapsed. Ignorance of foreign law, where relevant, is treated as ignorance of fact.

In logic, ignorance is contrasted with doubt. Each makes it impossible to affirm or deny one proposition or another, but ignorance is based on the absence of evidence, and doubt on the presence of equally strong evidence for each proposition. For *ignorantio elenchi* (refuting an argument not advanced by the adversary) *see* FALLACY. (F. A. A.)

IGOR (*c.* 877–945), grand prince of Kiev, presumably the son of the Novgorodian prince Rurik (*q.v.*), succeeded the great warrior and diplomat Oleg on the Kievan throne in 912. Igor is depicted in the *Primary Russian Chronicle* as a greedy, rapacious and unsuccessful prince. A Russian expedition in Transcaucasia in 913–914 ended in complete disaster. Igor's expeditions against Byzantium in 941 and 944 were also failures, and a great number of Russian ships were destroyed by the so-called Greek fire. The new treaty which Igor concluded with the Byzantine government in 945 was less favourable for Kievan Russia than Oleg's treaties of 907 and 911 had been.

Having returned from his Byzantine expedition, Igor went with a small retinue to the land of the Drevlyane (the region of the Pripet river) to collect tribute. He extorted more tribute than was customary and indulged in many acts of violence; finally the Drevlyane rose in rebellion and killed their rapacious "sovereign." (S. G. PU.)

IGOR (IGOR SVYATOSLAVICH) (1151–1202) was from 1178 prince of Novgorod-Seversk and in 1198–1202 prince of Chernigov. The 12th century was a most difficult time for the southern and western Russian principalities because of the frequent and devastating invasions of their nomadic neighbours, the Polovtsy or Kumans, and the ceaseless strife among the Russian princes themselves. One of the attempts to deal a counterblow to the Polovtsy was undertaken in 1185 by Prince Igor Svyatoslavich together with his brother Prince Vsevolod of Trubchevsk, his son Vladimir of Putivl and his nephew Svyatoslav Olgovich of Rylsk. The expedition ended in disaster; the Russian host, which had penetrated deep into the Don steppes, was surrounded by an overwhelming Polovtsian force and, after three days' battle, was almost annihilated, the princes having been taken prisoner. This event, described in the *Russian Chronicle*, became the subject of the famous *Tale of the Host of Igor*, a beautiful epic poem allegedly composed by an eyewitness (*see* RUSSIAN LITERATURE). (S. G. PU.)

IGOROT, a general name (meaning "mountaineer") for "non-Christian" peoples of the central Cordillera of north Luzon, Philippines; also used for specific ethnic groups within the region; *e.g.*, the Bontok. Some live in the tropical forests of the foothills, but most live in rugged grassland and pine forest zones from about the 3,500 to 8,000-ft. levels. Still imperfect censuses showed a total of about 250,000 in the earlier 1960s, with slowly rising numbers in most communities. Usually medium in height with brown skin and straight hair, the Igorot peoples are genetically composite, with varying frequencies of later Malayan and earlier Indonesian type characters, and an understratum of Negritoid.

Notorious in earlier days for their warmaking and head-hunting, they were partially pacified by the Spanish and the process was completed during the U.S. period; but local killings may still occur in remote areas.

Ethnologists distinguish about ten main ethnic groups, each with its own dialect and special types of houses, clothing, art design, social structure and other distinctions. These units in turn have subgroup variations, and indeed such differences show even between local communities, since formerly each settlement was likely to be politically separate and often feuding with its neighbours.

There are also two broad groupings of the Igorot as a whole: one, by far the larger, comprises the peoples of the higher country in the south, central and west zones, having intensive wet rice cultivation mostly in steplike terraces up the mountainsides; the other, peoples of the lower rain forest areas in the east and north, growing dry rice in seasonally shifting gardens. The first group nearly all live in populous villages (the Nabaloi or Ibaloi, Kankanai, Lepanto or Northern Kankanai, Bontok, Southern Kalinga, Tinguian), but one ethnic unit (Ifugao) has small farmsteads of kinsmen dotted through the rice terraces. The second group are sparsely settled in hamlets or farmsteads around which new gardens are cleared as the soil is worked out (the Gaddang, Northern Kalinga, Isneg or Apayao); some Gaddang live in tree houses.

Cultural elements common to the Igorot area as a whole include use of iron and brass worked by local smiths from metal traded from the lowlands, weaving, beliefs relating to sacred trees and mountains, and animal sacrifice (pigs, chickens, dogs) for omen reading. Modern trade, peaceful travel on roads, Christian mission work, schools and other government activities, and urban influences especially from two mountain centres (Baguio, summer capital of the Philippines, with its gold mines, and the Mountain Province capital, Bontoc) are slowly bringing about assimilation of the Igorot to the general life of the Philippines.

See also BONTOK; TINGUIAN; IFUGAO; ISNEG.

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IGUAÇU (IGUASSÚ; Spanish IGUAZÚ), a river which rises near the crest of the great coastal escarpment Serra do Mar in Paraná state, Braz., just east of Curitiba, and flows west for 745 mi. to join the Paraná river. It is thus part of the Plata river system (*see* PLATA, RÍO DE LA), and for the last 75 mi. of its course it forms the boundary between Brazil and Argentina. About 14 mi. above its mouth the river cascades over the famous Iguaçu falls. The Iguaçu river follows a meandering course westward across the Paraná plateau, but is frequently interrupted by rapids. It is only navigable for river boats for a short distance from Pôrto Amazonas to União da Vitória. Between prairie-covered uplands, the valley of the Iguacu is filled with dense semideciduous forest, cleared in part by pioneer farmers.

At Iguaçu falls the river drops about 269 ft. into a narrow gorge before emptying into the Paraná. The falls are about 2½ mi. wide, but the water is divided into hundreds of individual falls separated by rocky and heavily forested islands. National parks have been established on either side of the boundary by Argentina (1928) and Brazil (1939). Modern tourist hotels have been built at Foz do Iguaçu and Puerto Iguazú. The falls can be reached most easily by air, but many tourists prefer the river boat trip up the Paraná. The Brazilians have built a highway across Paraná state to Foz do Iguaçu. About 30 to 40 ft. higher than Niagara falls, Iguaçu is often described as a potential hydroelectric power site but there are difficulties in the way of such development. First, the volume of water in the Iguaçu river varies greatly during the year, being highest in the southern hemisphere winter; it has been estimated that the rate of flow over the falls is about 62,000 cu.ft. per second for mean annual volume, which under extreme flood conditions may reach more than 450,000 cu.ft. per second. Second, such power development would require co-operation be-

tween Argentina and Brazil—traditionally un-co-operative with each other. Third, there is no potential market for power within range of transmission lines.

The name of the river and the falls is a Guarani word meaning "great water." The first Spanish explorers named the cataracts Salto de Santa María (Santa María falls), but the Indian name persisted. (P. E. J.)

IGUANA, the common name for lizards of the family Iguanidae, particularly the larger forms of the family. The same name, or its corruption "goanna," is misapplied to the monitors (family Varanidae). With three exceptions all the genera (numbering about 65 and containing about 700 species) belong to the new world; the exceptional genera are *Brachylophus* (nearing extinction) in the Fiji Islands and *Hoplurus* and *Chalarodon* in Madagascar. The Iguanidae can be regarded as the new world analogue of the old world Agamidae, which family it closely resembles in its structure and in the modifications which its members have undergone.

The only absolute distinction between the two families is in the position of the teeth; in the Agamidae they are fused to the crest of the jaw bones and in the Iguanidae attached to the inner slope below this crest. In many, however, the teeth are peculiar in being blade- or spear-shaped, with the upper cutting edges strongly serrated. Most iguanas are clothed with small scales and have a large dewlap, a pouch situated beneath the head and neck. Often a crest on the back and tail is composed of narrow, elongate scales which gradually diminish in size posteriorly. The tongue is short and cannot be thrust out.

Perhaps the best-known species is the common iguana (*Iguana iguana*), which occurs throughout tropical Central and South America. Reaching a length of as much as six feet (including the tail), this animal is much sought for as an article of diet; the flesh, white and tender, tastes somewhat like that of frogs' legs and is greatly esteemed by the Indians. The iguana is arboreal, its favourite haunts being trees overhanging water, into which it will unhesitatingly plunge if disturbed. Like most of the arboreal species, the ground colour is greenish, relieved in this particular case by brown bands, which form regular rings on the tail. The food consists largely of tender leaves and fruits but the lizards will also readily eat small birds and mammals. Another semi-arboreal genus of tropical America is *Basiliscus,* whose members exhibit some curious modifications. The body is compressed from side to side, the tail very long and whiplike, the hinder part of the head produced into a flat lobe like a cock's comb and the outer edges of the toes provided with a wide fringe of elongate scales; the males of all species have a crest along the back but in two species (*B. basiliscus* and *B. plumifrons*) this is enormously developed, being as deep as the body, supported by rays like the fins of a fish, and covered with very thin scales. In addition to these structural peculiarities they have the power, shared only by a few other forms of this family, of being able to run across the surface of water; if disturbed near the water they scutter across it on their hindlimbs, the body being held almost upright with the tail raised as a counterpoise and the forelimbs folded against their sides.

Basiliscus often dives to the bottom as does *Deiroptyx* of Cuba, which rushes across the surface in the same way and in some quiet corner dives to the bottom, where it remains until the alarm has passed. *Amblyrhynchus* has achieved fame as the only marine lizard. Its aquatic nature has usually been exaggerated, however, and actually it seldom takes to the water. Large herds of these lizards used to frequent the rocky shores of the Galápagos Islands, feeding on the seaweeds between tidemarks. The ground iguana, *Cyclura,* one of the most primitive members of the family, was formerly found in the Galápagos but now is found on only a few islands of the West Indies. *Ctenosaura* species are the rather large black iguanas of Central America.

About ten genera of small iguanids are found in the U.S.; they are by far the most conspicuous lizards of the southwest, and include the desert iguana (crested lizard), the earless, zebra-tailed (gridiron-tailed), fringe-toed, collared, leopard and spiny lizards; the anoles, chuckwallas, utas and horned toads.

BY COURTESY OF NEW YORK ZOOLOGICAL SOCIETY

BANDED IGUANA (BRACHYLOPHUS FASCIATUS) FROM THE FIJI ISLANDS

The terrestrial species of the family are usually duller in colour than the arboreal ones and the body is, as a rule, depressed rather than compressed; this flattening has been carried to an extreme in the so-called horned toads (*Phrynosoma*) of the deserts of the United States and Mexico. As well as being flattened, they have, like many desert dwelling animals, developed an armour of spines, the largest of which occur on the back of the head and neck. This lizard greatly resembles the Australian moloch lizard, an agamid that under the influence of similar conditions has developed a very similar appearance. A unique characteristic of the horned toads is their ability to squirt a fine jet of blood from the eye; this extraordinary phenomenon, which has never been satisfactorily explained, only occurs under stress of great emotion, fright or anger. The lizard puffs itself up until the eyes bulge and then a very fine stream of blood is shot out of the eye, sometimes to a distance of 5 ft. The special mechanism for this discharge is an agglomeration of blood vessels at the corner of the eye.

Another peculiarly modified genus is *Anolis,* which occurs throughout the warmer districts of both North and South America and which is particularly abundant among the West Indian islands. All of the lizards of this genus have the basal joints of their fingers and toes dilated and covered with transverse lamellae like those of the gecko (*q.v.*) and these adhesive pads, together with the powerful claws, render the animals excellent climbers. They have wonderful powers of changing colour, rivaling in this respect the true chameleons; in fact they are frequently called American chameleons. Anoles or anole would be a better term. The males often have enormously developed dewlaps which may be brilliantly coloured and can be expanded and contracted at will, like a fan.

Iguanids, except for a few species, reproduce by means of eggs laid in the ground. The few exceptions, iguanids living in cool, mountain climates, hatch their eggs within their bodies and bear live young.

See also LIZARD; REPTILES.

See K. P. Schmidt and R. F. Inger, *Living Reptiles of the World* (1957); A. d'A. Bellairs, *Reptiles* (1960). (H. W. P.; X.)

IGUANODON, a large extinct amphibious dinosaur, one of the bipedal plant-eating ornithopods, skeletons of which have been found near Mons, Belg., and on the Isle of Wight. *See* DINOSAUR.

IGUVINE TABLES, a set of inscribed bronze tablets found in 1444 at La Schieggia on the line of the ancient Via Flaminia, 8 mi. E. of Iguvium (modern Gubbio, Italy), an Umbrian town. It is probable that these tables, bought by the town of Gubbio in 1456, were found at the site of the temple of Jupiter Appenninus, from which some votive bronze figures have come. Seven tables are still extant, in the museum at Gubbio; a further two were taken to Venice in 1540 and there lost. They are written in the Umbrian dialect, four and part of a fifth using the Umbrian, the rest the Latin alphabet. The earliest was inscribed before

400 B.C., the latest just before 90 B.C. The tables give the liturgy of the *Fratres Atiedii*, a brotherhood of priests not unlike the Arval Brothers (*q.v.*) at Rome, and are of great value for the study of Italic dialects.

The first, sixth and seventh tables contain regulations for the lustration (purification) of the sacred *templum* ("precinct") at Iguvium, for a definition of its boundaries, and for a number of sacrifices to be undertaken before the purificatory rites. These include sacrifice of three oxen to Jupiter Grabovius, pregnant sows to Trebus Iovius and sucking pigs to Fisus Sancius, lambs to Tefer Iovius and bullocks to the infernal deity Hontus, with ritual prayers to be recited at the libation trenches. The same tables also contain instructions for the lustration of the people, for a procession along the augural way to the suburb of Acedonia, and for the ritual hunting and slaughter of three heifers to the goddess Torra Iovia. The significance of many of these Umbrian divine names is doubtful.

The second table is concerned with the private cleansing ritual of the brotherhood, and the third and fourth contain obscure brotherhood ceremonies, including sacrifices to Jupiter, Pomonus, Vesuna and other deities. The fifth table deals with administrative details of the brotherhood, the election of chief brother or *quaestor*, the proper arrangement of banquets, clan fees owed to the brotherhood and portions of the flesh to be assigned to the brotherhood at the sacrifices performed at annual festivals of ten federated clans.

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IHARA (or IBARA) **SAIKAKU** (original name probably HIRAYAMA TŌGO) (1642–1693), Japanese poet and novelist, one of the most brilliant figures of the 17th-century literary revival, was born at Osaka in 1642. His early fame was occasioned chiefly by his amazing facility in composing *haiku* (*see* JAPANESE LITERATURE) and linked verse. In 1677 he turned out in the space of "a day and a night" 1,600 verses. Not surprisingly, these were not all of first quality, but to compose at the rate of one verse a minute for 24 hours was an achievement that few poets could match. He steadily increased the number of verses produced in a day, reaching 4,000 in 1680 and the incredible figure of 23,500 verses in 1684. This was somewhat over 16 a minute, and the performance earned him the nickname of the "20,000 poet." Saikaku continued to write verses at more normal speeds, but his style (essentially that of the Danrin school, headed by Nishiyama Soin, his master) was considered so bizarre that rival poets called it "Dutch" to indicate its extreme outlandishness.

Besides poetry Saikaku wrote some unsuccessful puppet plays and works of poetic criticism, but he is best known as a novelist. The style of Saikaku's novels is swift, allusive and elliptic, all qualities stemming from his training as a *haiku* poet. Their content reflects from many angles the Japanese society of the time. After many years of bitter warfare Japan was enjoying peace and prosperity. The merchant class had so risen in importance that its tastes now prevailed in the arts, and the licensed quarters catered to its whims. Many of Saikaku's novels are concerned with the voluptuary pleasures of these quarters. The first and most famous, *Koshoku Ichidai Otoko* ("The Man Who Spent His Life at Love-making," 1682), relates the amorous adventures of its hero, Yonosuke, from his precocious experiences at the age of 6 to his departure at 60 for an island of women. The popularity of this novel led Saikaku to write others in a similar vein, of which the best is *Koshoku Gonin Onna* ("Five Women Who Loved Love," 1686), a work based on actual events.

Saikaku also wrote novels about the samurai. These are generally considered inferior to his amorous tales or to such accounts of tradesmen's life as *Nippon Eitagura* ("The Japanese Family Storehouse," 1688), a collection of stories on how to make (or lose) a fortune. Whatever the subject, Saikaku's satirical humour and his knack (derived from the *haiku*) of being able to seize the one detail that best evokes a person's character or his milieu are always conspicuous. Although Saikaku's works reveal a particular affinity for the lively spirit of Osaka, he wrote with facility about all Japan. His *Saikaku Shokokubanashi* ("Saikaku's Tales of the Provinces," 1685), for example, records many stories picked up during his travels. His popularity was enormous everywhere and his influence on fiction continued for many years after his death.

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IJAW, an African people of the Niger river delta. Consisting of a large number of formerly autonomous groups, speaking dialects of the Nigritic language, they numbered about 500,000 in the 1960s. West of the main Niger outlets, each group is a cluster of villages with loose ties of co-operation mainly against outsiders. Its members claim descent from a common ancestor: children of high bridewealth marriages through the father, those of low bridewealth unions through the mother. Government is by assemblies of elders at group and village levels, often presided over by priests of tutelary gods. The economy is based on fishing, palm oil collecting and flood-land agriculture. East of the main outlets, groups consist of migrants from the western delta, amalgamated with non-Ijaw units. Formerly, each group claimed a distinctive culture and political autonomy. The economy was once based on fishing; but from about 1500, following contact with European merchants, the communities of Bonny, Calabar and Nemke began trading first in slaves and later in palm oil. Wealthy traders became very powerful and governed in council with a hereditary king. Each trader purchased many slaves for incorporation into his own section of the community; if the trader had no suitable heir, an able slave succeeded him. Competition with other groups over hinterland markets, and stress on cultural separation rather than on common descent meant that ability was valued more than pedigree, enabling the emergence of slaveborn leaders like George of Calabar and Jaja of Opobo.

See also AFRICAN LANGUAGES: *The Niger-Congo Family.*

See R. G. Horton, *The Gods as Guests* (1960); K. O. Dike, *Trade and Politics in the Niger Delta, 1830–1885* (1956). (RO. G. H.)

IJMA' (literally "agreeing upon"; *i.e.*, consensus), one of the four bases (*usul*) of the faith of Islam, the other three being the Koran, the Tradition and reason. *Ijma'* defined broadly means the general agreement, on any principle, of those leaders and scholars who are recognized as having the right to hold an opinion. It rests on the theory that the Muslim people are protected by God against error; prophetic tradition says "My community shall never agree upon an error." Because it makes possible changes in doctrine and practice, *ijma'* is generally regarded as an instrument of reform.

See ISLAM: *Development of the Shari'a.*

IJOLITE, in petrology an igneous rock composed essentially of nephelite and an alkali pyroxene, usually aegirinaugite. The rock was originally described from Iivaara in the parish of Kuusamo, northern Finland. Typically the pyroxene is well crystallized, the nephelite allotriomorphic. Accessory minerals include melanite, titanite, perofskite, apatite, cancrinite and calcite. The rock is the plutonic equivalent of the volcanic nephelinites and nephelite dolerites. Ijolites form characteristic members of carbonatite-alkali igneous complexes like those of Alno, Swed.; Fen, Nor.; Kola peninsula, U.S.S.R.—there carrying abundant wollastonite—and Iron hill, Colo. The ijolites of Magnet cove, Ark.; Ice river, B.C.; and Sekukuniland, Transvaal, are among the better-known representatives found in rock collections. The rocks known as urtite (type locality in the Kola peninsula) and melteigite (Melteig, Fen district, Nor.) are essentially similar assemblages. In the former nephelite largely preponderates while melteigite is a melanocratic variant with excess pyroxene.

(C. E. T.)

IJSSELMEER, a shallow fresh-water lake, the southern part of the former Zuider Zee (*q.v.*), Neth., was cut off from the northern part, the Wadden Zee (*q.v.*), and the North sea by the building of a dam, which was completed in 1932.

The dam shutting out the North sea, 18½ mi. long between North Holland and Friesland, was constructed of boulder clay backed with

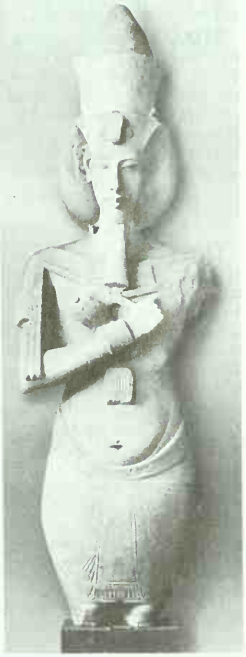
sand and faced with stone to just below water level, about 20 ft. lower than its crest. Protection at lower levels was afforded by boulders resting on mats of willow saplings. A two-track concrete-paved motor road with a parallel cycle path follows the inner berm. Locks provide passage for barges and small sea-going craft between the lake and the open sea. The water in the lake, brackish in 1932, has been replaced by fresh water, partly by inflow from the IJssel, one of the branches of the Rhine.

The water content is regulated by sluices. The lake is a source of fresh water, valuable in occasional summer droughts to the provinces of North and South Holland and Friesland. The original fishing for herring, anchovy, flounder, etc., has been replaced by fresh-water fisheries, chiefly for eel. In spring the eel larvae, born in the Sargasso sea, are admitted into the lake by manipulation of the sluices.

Large parts of the total area of 1,425 sq.mi. are being reclaimed by constructing encircling dikes and pumping the water out. By 1980 the land area of the Netherlands will have been extended by nearly 900 sq.mi. of rich polders, also providing an outlet for the overpopulated centre of Holland. The greater part (480 sq. mi.) of the remaining area would constitute the (smaller) IJsselmeer. (J. T. T.)

IKEBANA, the general term for any style of Japanese floral art. *See* FLOWER ARRANGING: *Japanese Flower Arranging.*

IKHNATON (AKHENATEN), the name assumed, early in his reign, by the Egyptian Pharaoh Amenhotep (Amenophis) IV, who reigned from 1379 to 1362 B.C. The adoption of this appellation, perhaps to be translated "Pleasing to the Aton," heralded a profound change in the official religion of Egypt. Henceforward, by the king's decree, the worship of the great god of Thebes, Amon-Re, and of the other deities of the large pantheon was to be replaced by that of the sun-disk, the Aton, a universal god whose rays fell upon noble and commoner, Egyptian and Asian alike. The cult of this deity probably originated in the north, at Heliopolis, where the hawk-headed sun-god, Re-Horakhte, had long held sway; it seems to have achieved some popularity at Thebes in the reign of Amenhotep III. Soon after his accession, Ikhnaton set about building chapels at Karnak for this new form of the sun-god. In the sandstone quarries where stone for these chapels was cut, the king already describes himself as "first prophet of Re-Horakhte, rejoicing in the Horizon, in his name 'Sunlight which is in Aton.'" The high priest of the Aton was called "greatest of seers," the title borne since early times by the Heliopolitan pontiffs. But the new cult emphasized the personal nature of the relationship between the god and the king; no longer anthropomorphic, the sun was depicted as a golden orb shedding rays of light on the king and his queen Nefertiti, each ray ending in a little hand proffering the sign of life, the *ankh*, to the royal pair.



FROM K. LANGE AND M. HIRMER, "EGYPT"

PILLAR STATUE OF IKHNATON, FROM THE TEMPLE OF ATON AT KARNAK

These innovations must have aroused the opposition of the powerful priesthood of Theban Amon and of most of the nobility. In the sixth year of his reign Ikhnaton took another revolutionary step. With a band of his own supporters, whom he elevated to high office, he moved to a virgin site, nearly 300 mi. N. of Thebes, which he named Akhetaton, "The Horizon of Aton." At this place, known to modern archaeologists as Tell el Amarna (*q.v.*), he built a fine new city, with palaces, temples, administrative buildings and residential quarters in which his entourage could live in spacious villas. There, untrammeled by tradition, he could put into practice the new ideas that fired his imagination. In the centre of the city rose the great temple where the Aton was worshiped, not in dim-lit shrines but in the full sunlight of a roofless sanctuary. Nearby, in a brilliantly decorated palace, the king and his family lived, surrounded by a sycophantic court of nobles whose tombs, cut in the rock cliff to the east of the city, display their anxiety to follow the king's "teaching" in every respect.

At the boundaries of his new domain, both east and west of the river, Ikhnaton set up stelae on which he declared his intention never to extend the city's limits. Not content with leaving Thebes, the king embarked on a fanatical persecution of the priesthood of Amon and their god, and ordered the name of Amon to be erased from every monument where it could be found. Since "Amenhotep" meant "Amon is satisfied" he changed his name to Ikhnaton. The other gods of the pantheon were likewise repudiated, though in a less thorough fashion; their cults were neglected and shrines to the Aton were put up in the old religious centres. Finally, since the cult of the Aton was an exclusive, indeed a monotheistic cult, the very word "gods" was deleted here and there from inscriptions.

This religious revolution was accompanied by a new aesthetic. The art of the Amarna age is characterized by a love of natural forms, many of the age-old artistic conventions which had hitherto bound the hand of the sculptor and painter being discarded in favour of a greater realism. Some of the manifestations of this new trend in artistic expression lack felicity; the physical peculiarities of the king are monstrously exaggerated in the early colossi, and reliefs show the king and queen in profile, adoring the Aton or dandling their children with unprecedented informality, and depict them with grotesquely elongated features, thin limbs and thickened bodies. As in every age of experiment, mistakes were made, but the finest products of the sculptors' workshops at Amarna, such as the exquisite heads of Nefertiti now in the Berlin museum, have their place among the world's masterpieces and many of the smaller objects, the brightly coloured necklaces imitating flower petals, the wall and floor paintings with their naturalistic designs of plants and animals, have a freshness which has put many critics in mind of the art of Minoan Crete. That the king himself was the inspiration for this new spirit in art, as well as in thought, is suggested by the inscription of his chief sculptor, Bek, on the rocks at Aswan, where he was sent to obtain granite; he describes himself as "the chief of works in the Red mountain, the assistant whom His Majesty himself taught, the chief of sculptors on the great and mighty monuments of the king in the house of Aton in Akhetaton."

Religious reformer and artist, Ikhnaton was also perhaps a poet. The beautiful hymn to the Aton inscribed in the tomb of one of his courtiers, which has been likened to Psalm civ, is plausibly attributed to the pen of the king himself, though it owes much to earlier hymns to the sun. The following short extract (taken from J. B. Pritchard [ed.], *Ancient Near Eastern Texts Relating to the Old Testament*, 2nd ed., pp. 370–371, Princeton University Press, 1955) will indicate its quality:

> How manifold it is, what thou hast made! . . .
> O sole god, like whom there is no other!
> Thou didst create the world according to thy desire,
> While thou wert alone:
> All men, cattle, and wild beasts,
> Whatever is on earth, going upon [its] feet,
> And whatever is on high, flying with its wings.
>
> The countries of Syria and Nubia, the *land* of Egypt,
> Thou settest every man in his place,
> Thou suppliest their necessities:
> Everyone has his food, and his time of life is reckoned.
> Their tongues are separate in speech,
> And their natures as well;
> Their skins are distinguished,

As thou distinguishest the foreign peoples . . . .
. . . there is none other that knows thee
Save thy son Nefer-kheperu-Re Wa-en-Re,
For thou hast made him well-versed in thy plans and in thy strength.

Ikhnaton had little time or interest to devote to foreign affairs. Though Asiatic tribute continued to flow into the royal coffers, the Amarna letters show clearly how, little by little, the prestige won by his forebears in Syria and Palestine crumbled, while appeals for help from his loyal vassals went unheeded, the misdeeds of the disloyal unpunished.

Much uncertainty persists concerning Ikhnaton's family. He himself was undoubtedly the son of Amenhotep III and the great royal wife, Tiy. The parentage of Nefertiti, his queen, is uncertain; it is not improbable that she was a foreigner, perhaps, as some have thought, a Mitannian, whose alien creed inspired her husband. Yet sculptors depict her so like him that many have thought them brother and sister. In reliefs dating from the Amarna period six daughters are shown on terms of happy domestic intimacy with their parents. The oldest, Meritaton, married Smenkhkare, perhaps the younger brother of Ikhnaton; the second died young and the third, Ankhesenpaaton, married Tutankhaton, whose relationship to Ikhnaton may have been that of half-brother.

Portraits of Ikhnaton show him to have had certain physical abnormalities—a cranial deformity, effeminate figure and adipose thighs—suggesting that he may have suffered from some illness, perhaps an endocrine abnormality. Some have thought him mad. Of his courage, his vision and his originality of mind there can be no doubt. Had he succeeded in his reform, the course of Egyptian civilization might have taken a different turn. Yet the religion of the Aton had little ethical content, and Ikhnaton's ideas did not survive him. Nothing is known of the manner of his death. He was not buried in the tomb prepared for him at Akhetaton. His body may be that of a young man found in tomb no. 55 of the Valley of the Tombs of the Kings at Thebes, enclosed in a coffin made for a princess who was possibly his daughter Meritaton. His co-regent Smenkhkare may not have survived him; suspicion of foul play cannot be absent. Tutankhaton, who as his son-in-law succeeded to the throne, was a mere child and under the stern regency of Horemheb the return was soon made to Thebes and Akhetaton gradually deserted. Tutankhaton's name was changed to Tutankhamen (*q.v.*). The fetters of convention settled once more upon religion and art, and Ikhnaton, omitted from the official king lists, became "that criminal of Akhetaton."

See also references under "Ikhnaton" in the Index.

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IKI, an island of Japan, lying about 10 mi. off the northwest coast of Nagasaki prefecture of which it is part. Area, 53 sq.mi.; pop. (1960) 50,497. Most of the island is tableland and about 70% is under cultivation; cereals and tobacco are the important crops. Some of Kublai Khan's invading Mongols landed at Iki in the 13th century, for the island lies in the Tsushima strait (eastern channel) on the direct route from Korea to Kyushu. Anchorages are at Gōnoura, Katsumoto and Ashibe. The chief town is Gōnoura. (R. B. H.)

ILA-TONGA, related Bantu-speaking peoples, numbering more than 200,000 in the 1960s, who inhabit the Southern province of Northern Rhodesia and extend into the adjacent Sebungwe district of Southern Rhodesia. Their closest ties are with such Northern Rhodesian peoples as the Sala, Soli and Lenje of Central province, the Leya of Southern province and the Subia and Totela of Barotse province. In pre-European days, they were organized into many small, independent neighbourhoods, dominated by petty chiefs among the Ila, while the Tonga (who had no chiefs) recognized the ritual authority of hereditary guardians of local shrines. More recently they were organized into a number of tribes, each with its own government. The Ila live in large villages, the Tonga in small hamlets or scattered homesteads. They have nonlocalized clans with matrilineal succession and inheritance, but the Ila show patrilineal tendencies. They are agricultural, with the Ila giving emphasis to pastoralism and the Tonga to horticulture. Tonga near the Cape to Congo railway have turned to maize as a cash crop. Valley Tonga of the Zambezi valley depend on labour migration for cash income.

Ila-Tonga allow polygyny; husbands pay a bride price, usually in cattle, and marriage is patrilocal. Divorce is common and involves return of the bride price; children usually accompany the divorced mother. There is a belief in one deity, but rituals chiefly involve ancestral and natural spirits. Community rituals at local shrines appeal for rain and safety from threatened disasters; harvest festivals celebrate new crops. Illness or misfortune is usually attributed through divination to anger of ancestral spirits or to sorcery. Illness attributed to demonic possession is treated by dance ritual. An increasing number of Ila and Tonga were being educated at active mission and government schools. In 1957–58 about 57,000 Tonga were moved from homesites near the Zambezi river that would be flooded by the formation of Lake Kariba upon the completion of Kariba hydroelectric dam. (The Tonga Bantu should not be confused with Tonga [*q.v.*], a Pacific island group.)

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ILCHESTER, a small agricultural village in the Yeovil rural district of Somerset, England, on the Ivel or Yeo river, 5 mi. N.W. of Yeovil. Pop. (1951) 731. Ilchester (Gifelcestre, Ivelcestre, Yevelchester, Ivelchester) was the Lindinae of the Romans and the northern tribal capital of the Durotriges. A royal mint was established by the time of Edgar (959–975), and money was coined there until the reign of Henry III. In 1086 Ilchester was a royal borough with 107 burgesses and was granted a charter by Henry II which was confirmed by John in 1203 who gave it the same liberties as Winchester. It had a king's jail from before 1166 until 1843. From the 14th to the 19th centuries it was the centre of the county administration and the assizes and quarter sessions were held there. The town was governed by a bailiff and 12 capital burgesses; the corporation, established in 1556, was abolished in 1886. From 1298 until 1832 Ilchester returned two members to parliament (among them Richard Brinsley Sheridan). It had two annual fairs, and its Wednesday market dated from Saxon times until the mid-19th century. In the middle ages there were seven parish churches in the town, St. Mary Major being the only one left; there were also a Dominican friary, an Augustinian nunnery, a lepers' hospital and an almshouse. Roger Bacon was born there *c.* 1214.

See J. Stevens Cox, *The Ilchester Mint* (1948) and other *Ilchester Historical Monographs* (Ilchester, 1947–); *Proc. of Somerset Arch. Soc.*, vol. 96 (Taunton, 1951). (J. S. C.)

ÎLE-DE-FRANCE, an ancient region of France. The name "Francia," given under the Merovingians to the region between the Rhine and the Seine, was restricted under the Carolingians to the country bounded by the Aisne, Oise and Seine rivers. In the 10th and 11th centuries it signified only the territory limited by the Seine, the Marne, the Beuvronne, the Oise and the Nonette. In the middle ages the word "isle" often designated countries more or less bounded by rivers, but it is not given specifically to "France" before 1387. In the 16th century the *gouvernement* of Île-de-France was constituted under a governor or a lieutenant of the king. In the 18th century Île-de-France was divided between the two *généralités* or *intendances* of Paris and Soissons. Under the Revolution the *département* of Seine was formed from the territory of Île-de-France, other sectors going to the *départements* of Seine-et-Oise, Seine-et-Marne, Oise and Aisne and smaller sectors to Loiret and Nièvre. The name Île-de-France was also used for Mauritius while that island was in French possession during the 18th century.

See P. Bernus, *Histoire de l'Ile de France* (1936); A. Leynitz, *L'Ile de France, sa géographie, son histoire* (1948). (MI. M.)

ILEITIS, the medical term for inflammation of the ileum, the lower three-fifths of the small intestine. It is a form of regional enteritis. *See* GASTROINTESTINAL TRACT, DISEASES OF: *The Intestines; Regional Enteritis.*

ILERDA, CAMPAIGN OF (49 B.C.), the victory of Julius Caesar over Pompey's forces in Spain (*see* CAESAR, GAIUS JULIUS). When Caesar had forced Pompey to evacuate Italy, he decided not to follow him to Greece, but first to deal with Pompey's seven legions in Spain. In the spring of 49 B.C. he sent forward six legions from Gaul under Gaius Fabius, and joined them as soon as possible at Ilerda (Lérida) on the Sicoris (Segre) river, a tributary of the Ebro. Five Pompeian legions, together with many Spanish auxiliaries, commanded by L. Afranius and M. Petreius, concentrated against Caesar. They held Ilerda, which stood on a hill, and occupied a steep ridge (Gardeny) to the southwest, while below the city was a stone bridge over the river which was vital to their supplies. The river was subject to violent spring flooding. Caesar, who failed to provoke Afranius to battle, formed a camp near the enemy in order to hamper their foragers, but his attempt to seize a strong point between Ilerda and Gardeny was beaten back. When floods swept away his bridges, he was in a precarious position and short of supplies, although he managed to get one convoy safely across the river about 20 mi. to the north. Then he diverted part of the river just below Ilerda to make a ford near his camp; this forced the Pompeians to move two legions over the Sicoris to cover their communications against Caesar's superior cavalry. The tables thus being turned, Afranius retired toward the Ebro. Caesar, however, pursued him and headed him off; after a week of maneuvering the Pompeians, short of food and water, had to surrender. Caesar, having won a great victory with little loss, then showed his clemency: the enemy troops were disbanded, Afranius and Petreius were spared, and within two months all Spain was Caesar's.

See T. Rice Holmes, *The Roman Republic and the Founder of the Empire*, vol. ii (1923). (H. H. Sp.)

ILESHA, a town of Western Region, Nigeria, lies on hills in the heart of the region and is the centre of an administrative division, bounded by the divisions of Ondo, Ife and Oshun. Pop. (1960 est.) 82,427 (Africans only). The divisional council offices and the council hall (1934) are situated on Market square. Near this square are the Afin (king's palace), the central mosque and the principal park. The Wesley guild hospital was established in 1913.

Among the educational institutions are the women's training college; Ilesha grammar school, oldest secondary school of the town; and St. Margaret's secondary school. The main occupations are farming and trade; chief exports are cocoa and kola nuts; imports are consumer goods, such as cottons and hardware. Ilesha is linked by trunk roads with Ibadan and Lagos to the west, Oshogbo to the northwest and Benin to the southeast. The town has relics of its past as a warlike centre of the Yoruba people, such as the memorial to the warrior Ogedengbe, a native of Ilesha, who died in 1910. The inhabitants are of the Ijesha subgroup of the Yoruba; they are much interrelated and hold some land in common. They consider it a great advantage "to be an Ijesha who lives in Ilesha." (F. O. E.)

ILFORD, a municipal borough of Essex, Eng., which under the London Government act, 1963, was to be amalgamated on April 1, 1965, with Wanstead and Woodford, parts of Dagenham and of Chigwell to form a new London borough (*see* LONDON). Ilford municipal borough (1926), 7 mi. E.N.E. of London bridge, has been a residential area since the late 19th century. Pop. (1901) 41,279; (1961) 178,210. Area 13.2 sq.mi. Ilford returns two members to parliament. Industries include light and electrical engineering, photographic materials and chemicals. The name (Hile-ford in 1231) denotes the crossing of the Hyle river, now the Roding. The fertile marsh land was formerly used as a market garden for London.

ILFRACOMBE, an urban district and bathing resort of Devonshire, Eng., on the southern shore of the Bristol channel, 52 mi. N.W. of Exeter by road, in the North Devon parliamentary division. Pop. (1961) 8,701. The oldest part lines the winding valley breaking the steep coastal cliffs and forming the harbour between Capstone (181 ft.) and Hillsborough (447 ft.) hills. The town has spread over these hills, on the edge of Exmoor, and tunnels lead to beaches at the foot of the cliffs. The church of Holy Trinity, dating originally from the 12th century, is of various periods and has a magnificent wagon roof.

ILI, river of central Asia, in the Sinkiang-Uigur Autonomous Region of the People's Republic of China and the Kazakh Soviet Socialist Republic of the U.S.S.R. The length, from the confluence of its two headstreams, the Tekes and the Kunges, is 590 mi.; including the Tekes, it is 870 mi. The Tekes rises east of Lake Issyk-Kul on the north slopes of the Khan-Tengri mountain knot of the Tien Shan in the southeastern corner of Alma-Ata *oblast* of the Kazakh S.S.R. At first the Tekes flows eastward into Sinkiang until it meets the Kunges, which rises farther east in the Tien Shan. The combined stream, assuming the name Ili, then turns westward past Kulja (I-ning) and re-enters the Kazakh S.S.R., where it flows past the town of Ili to Lake Balkhash (*q.v.*). In its upper reaches, the Ili is a mountain torrent with a steep gradient. Below the confluence with the Kash, a right-hand tributary, the Ili emerges from the Tien Shan on the broad Ili valley, characterized by low swampy banks overgrown with reeds. The valley, enclosed by outlying spurs of the Tien Shan, ends at the Kapchagay gorge, 7 mi. below the town of Ili, where the Turkestan-Siberian (Turksib) railroad crosses the Ili. Beyond the Kapchagay gorge, which is the site of a proposed dam and hydroelectric station, the Ili flows through desert sands past the small settlement of Bakanas, forming a narrow delta on Lake Balkhash. Muskrats introduced among the reeds of the Ili delta before World War II have acclimatized and are being trapped for their pelts. The Ili is fed mainly by the melting snows and glaciers of the Tien Shan and reaches its high-water stage in July and August, when the rate of flow rises to 100,000 cu.ft. per second (average annual rate of flow is 15,000 cu.ft. per second). The short tributaries that join the Ili along its middle course are used for irrigation. The main stream is navigable during the ice-free season from April to October.

The proposed Kapchagay project will create an 800-sq.mi. reservoir that will require the relocation of the town of Ili and of the Turksib railroad crossing. The reservoir project also was a factor in the realignment of the Urumchi-Alma Ata railroad from the Ili valley to the Dzungarian gate.

The Russians moved into the Ili valley in the conquest of central Asia in the mid-19th century and clashed repeatedly with the Chinese, who had reached the area earlier. From 1871 to 1881, the Russians occupied the entire valley, including China's Kulja district, before the valley was divided between China and Russia along the present border.

In addition to being the designation of the river and of the Soviet town on the lower course, Ili is also the name of a former Chinese headquarters of the upper valley. This town was sacked in a Muslim rebellion in 1868 and was superseded by Kulja. The remains of old Chinese Ili are called Hui-yüan. (T. Sp.)

ILION, a village of Herkimer county, N.Y., U.S., 12 mi. S.E. of Utica (*q.v.*) on the Mohawk river (the New York State Barge canal); a part of the Utica-Rome standard metropolitan statistical area. Originally part of a Palatinate German settlement, Ilion was unimportant until 1825 when the Erie canal was built. In that decade Eliphalet Remington, Jr., perfected a rifle of such excellence that it was adopted by the U.S. army and several foreign governments. Remington factories thereafter became the principal support of Ilion and the villages around it. Searching for diversification, the company in 1873 introduced the first practical typewriter. Further diversification into office machinery and equipment led to the Univac electronic computer, developed in the 1950s.

The community was known successively as German Flats, Morgan's Landing and Remington Corners before it was incorporated as Ilion in 1852. For comparative population figures *see* table in NEW YORK: *Population.* (V. C. C.)

ILIPA, BATTLE OF (206 B.C., or, less probably, 207), the final victory of the Roman general P. Cornelius Scipio (later sur-

named Africanus) over the Carthaginian forces in Spain during the Second Punic War (*see* PUNIC WARS). Scipio, who had been campaigning against the Carthaginian armies in Spain since 210, met their combined forces under Hasdrubal Gisco and Mago near Ilipa (Alcalá del Río, about 8 mi. N. of Seville). With 45,000 infantry and 3,000 cavalry, he had about 10,000 men less than the enemy. For several days the two armies faced each other in battle array, with their best troops in the centre, and their allies on the wings. Early one morning a Roman cavalry attack forced Hasdrubal Gisco to lead out his men in their normal formation, only to find too late that Scipio had put his Roman troops on the wings and his Spanish allies in the centre. A complicated maneuver followed. Scipio's centre advanced slowly, declining battle but "fixing" the enemy's centre; meanwhile his wings were extended, then they advanced in column and wheeled again into line, thus outflanking the enemy, whose resistance soon crumpled. By a rapid pursuit Scipio cut off the enemy's retreat. Few Carthaginians escaped. This victory was won by brilliant tactics, such as no Roman army could have performed a few years earlier; they were made possible only by Scipio's recent reforms and training. The battle smashed Carthaginian power in Spain once and for all, and this affected the whole course of the war against Hannibal.

See H. H. Scullard, *Scipio Africanus in the Second Punic War* (1930), with bibliography; for the site, *Journal of Roman Studies*, vol. 26 (1936). (H. H. Sc.)

ILKESTON, a market town and municipal borough in the Ilkeston parliamentary division of Derbyshire, Eng., 10½ mi. N.E. of Derby and 7 mi. W. of Nottingham by road. Pop. (1961) 34,672. It is a mining and manufacturing town standing on a hill overlooking the Erewash valley to the east. In the market place, used for a market on Saturdays and illuminated by fluorescent lighting, stands the church of St. Mary the Virgin, a Norman and Early English building with a fine 13th-century chancel screen. The town obtained a grant for a market and fair in 1252 and was incorporated in 1887. Coal mining and the making of iron and concrete pipes, hosiery, needles, plastics, clothing, various fabrics and coffee are its chief industries.

IL-KHANS, a Mongol dynasty, founded by Hulagu (*q.v.*), which reigned in Iran from A.D. 1256 to 1335. The Il-khans (subordinate khans) ruled nominally as vassals of the great khan (of Mongolia, later of China). The extent of their empire was approximately from the Oxus (Amu-Darya) river to the Indian ocean and from the Indus to the Euphrates. Hulagu was succeeded by his son Abaqa in 1265. The greatest Il-khan was the seventh in succession, Ghazan (1295–1304). He made Islam the dynasty's official religion and, aided by his minister Rashid al-Din Fadlullah, initiated legal, fiscal and administrative reforms and reorganized the land tenure system, measures rendered necessary by a long period of administrative decay. Under Ghazan toleration of other faiths diminished. Buddhist temples in particular being destroyed. His aim, no doubt, was to establish religious conformity which, in regions where religion and law were synonymous, was necessary to establish a uniform administration and judicature. His successor, Ulja'itu (1304–16), moved the capital from Tabriz to Soltaniyeh nearer Iran's centre. Only Ulja'itu's mausoleum at Soltaniyeh is left to indicate the architectural skill and splendour of this period. The reign of his successor, Abu Said (1316–35), was followed by a period of decline in which power was divided among adventurers and provincial princes; Khurasan in the northeast became a prey to inroads of the Jagatai Turks. Central power was not re-established until Timur achieved paramountcy in Iran after 1380.

Under the patronage of the Il-khans history writing, medicine, astronomy and mathematics flourished. *See* also PERSIAN HISTORY. (P. W. A.)

ILKLEY, a small town and urban district in the Ripon parliamentary division of the West Riding of Yorkshire, Eng., 17 mi. N.W. of Leeds by road, lying in mid-Wharfedale, bounded by the Wharfe river (north) and the crest of Ilkley moor (south), rich in legend. Pop. (1961) 18,519. "Cup and ring" and "swastika" markings on the rocks of the moor, as well as stone circles in the vicinity, give ample evidence of prehistoric occupation. In 1919 Roman remains were excavated in the town and the 1st-century fort was possibly the Olicana of Ptolemy. Ilkley was originally a spa but is now residential. There is a large open-air swimming pool which attracts many visitors to this place which has become famous through the popular song beginning:

Wheer wer' ta bahn w'en Aw saw thee,
On Ilkla Moor baht 'at?

The ruins of Bolton abbey (*q.v.*) stand by the Wharfe, about 6 mi. above Ilkley.

ILLAWARRA, a coastal district south of Sydney, New South Wales, Austr., is a lowland area cut off from the inland plateau by a section of the Eastern highlands which varies in height from 1,200 to 2,000 ft. Area 2,234 sq.mi.; pop. (1961) 298,466. The name is a corruption of the aboriginal Alowrie ("from the high place to the sea"). The climate is mild with an average annual rainfall of 48 in. Illawarra lake is a salt lagoon connected with the sea, and there are many fine beaches and mountain viewpoints. The district embraces the steel-producing city of Greater Wollongong and, in the north, the Bulli coal deposits. In the south are the fertile grazing lands about Shellharbour, Kiama and the Shoalhaven river. The district is notable for the Illawarra breed of Shorthorn dairy cattle, and 25,000,000 gal. of milk are produced annually. Fishing is also an important industry. (W. H. ML.)

ILLE-ET-VILAINE, a *département* of northwest France, formed in 1790 out of the eastern, gallicized part of the ancient province of Brittany (*q.v.*). Area, 2,700 sq.mi.; pop. (1962) 614,268. It fronts the English channel coast at the root of the Breton peninsula in the Bay of St. Michel, and is bounded west by Côtes du Nord, southwest by Morbihan, south by Loire Atlantique, east by Mayenne and northeast by Manche. The heights that run close to the north coast of Brittany form the main watershed, and most of the *département* is drained south by the river Vilaine and its tributaries, including the Ille, Seiche and Meu. The Vilaine has been canalized as far as Rennes, where it is connected by canal via the Ille with Évran on the north-flowing Rance. Farther east the Couesnon is the principal stream draining north toward the Bay of St. Michel. Recent drowning of the lower river valleys has been responsible for the deep re-entrants of the sea, known as *rivières*, the largest being that of the Rance in the extreme northwest, where the tidal energy has been harnessed. Silting at the head of the Bay of St. Michel has produced the Marais de Dol from which rise occasional protrusions of rock that were once islands. The flat coastal strip there has been reclaimed and is intensively used for market gardening. Small holdings on which early vegetables are grown also fringe the peninsulas of the "Emerald coast" about St. Malo. Farther inland the ribs of hard rocks that form the higher ground have poor soils and still carry extensive heaths, but there are better soils in the basin of Rennes, developed on shales and partly infilled with more recent Tertiary sediments. In the small, hedge-bounded fields of this *bocage* (*q.v.*) country a variety of crops are grown, but pastoral farming has become increasingly important and cattle products provide the chief farm income. Cider-apple orchards are a ubiquitous feature of the landscape. Apart from stone quarrying there is little mineral exploitation in the *département*, and manufacturing is little represented except at Fougères, which specializes in making ladies' footwear, and Rennes, where the industrial basis was extended by the establishment, in 1951, of Citroen automobile works.

Rennes, the ancient capital of Brittany, is by far the largest town and is the *préfecture*. A cathedral and university city and important market centre, it is the seat of an archbishop, and the headquarters of judicial and educational administration. The law courts, built in the 17th century for the Breton parliament, are of special interest. The *département* is divided into four *arrondissements*, Rennes, Fougères, Redon and St. Malo. Fougères, an old fortress town of the eastern border of Brittany, has been resuscitated by modern industry. Redon, in the extreme south, is situated on the canalized Vilaine where it is intersected by the Brest-Nantes canal, but its port traffic is no longer important. St. Malo, on a granite islet attached to the north coast, is a considerable port and tourist centre. Adjoining it on the Rance estuary St. Servan has a trawler fleet for distant cod fishing. Dinard and Paramé are

other nearby resorts. Cancale, another fishing port, is the chief centre of oyster culture in the Bay of St. Michel. (AR. E. S.)

ILLEGITIMACY, the state of being of illegitimate birth or born out of wedlock. Illegitimacy poses problems for all societies, which, to perpetuate themselves, generally sanction procreation only within some form of marriage, a socially recognized and regulated relationship between the sexes which legitimatizes births and denotes some responsibility for the rearing of children. Marriage laws and customs almost universally condemn births out of wedlock. The form and degree of this condemnation, however, vary from society to society as well as from time to time and among different strata within the same society. For the legal aspects of illegitimacy *see* BASTARD. (*See* also LEGITIMACY.)

Social Policy.—Historically, illegitimacy has been dealt with very harshly in many societies. Various punitive measures have been imposed on unmarried mothers, and their offspring have suffered social as well as legal disabilities. In Great Britain an act of 1576 made it an offense to beget an illegitimate child which was likely to become a public charge. Many illegitimate infants were abandoned; institutions established for their care, such as the Foundling hospital of London, established in 1739, were unequal to the need and had to restrict admissions and otherwise limit their services. In the United States St. Vincent's Infant asylum was established in Baltimore, Md., in 1856 by the Sisters of Charity (St. Vincent de Paul). Similar institutions were founded in major cities and by 1900 county orphan asylums, many of whose charges were illegitimate children, were common throughout the country. In the 20th century more and more infants formerly referred to as "foundlings" or "deserted" have been cared for by legal adoption, by foster home care, especially for older children, and by assistance to unwed mothers, enabling them to raise their children. For discussion of various programs *see* ADOPTION; CHILD WELFARE; FOUNDLING HOSPITAL. *See* also POOR LAW; SOCIAL WELFARE.

Statutes and attitudes affecting illegitimacy generally have reflected a liberal trend during the 20th century, with a number of variations and exceptions that are best understood within their respective historic and cultural settings. In the U.S.S.R., for example, the elimination of illegitimacy by fiat in the family code of 1918, which recognized no legal or social distinction between a child born in and out of wedlock, was consistent with other familial and social changes following the 1917 Revolution. The family code of 1926 as amended each decade thereafter to provide financial gratuities and honorific titles for unwed as well as married mothers, and to give the state responsibility for rearing all children of unwed and married mothers unable to do so, was consistent with the Soviet Union's population goals and efforts to replace an estimated 15,000,000 to 20,000,000 persons killed in World War II.

In Japan, Germany and England the temporary and selective reversal of liberal trends in attitudes concerning illegitimacy in the post-World War II period reflected far greater aversion to illegitimacy resulting from United States troops than to indigenous illegitimacy, and was probably more indicative of feelings of resentment among the respective countries than of attitudes toward illegitimacy.

In the United States the liberal trend was indicated by efforts to accord illegitimate children equal legal and social rights with other children, an increasing number of states not recording illegitimacy status on birth records; the development of maternity homes under private auspices to care for unwed mothers; the emergence of adoption agencies specifically to serve minority groups; and the availability of federal social security benefits entitled Aid to Dependent Children (ADC) for illegitimate children. There were a few exceptions to this trend in the United States in the early 1960s, including considerable criticism of low-income Negro females who had repeated illegitimate births. Several states attempted to legalize compulsory sterilization by tubal ligations for females having more than one illicit pregnancy. There was criticism also in that the ADC program provided an indirect subsidy of illegitimacy and some states considered excluding illegitimate children of recidivist unwed mothers from ADC benefits, although evidence indicated less than 10% of all illegitimate children received such benefits.

The apparent world-wide liberal trend in social policy concerning illegitimacy during the first six decades of the 20th century faced two counterbalancing factors. The increasing demand for adoptable infants tended to lessen the censure of those unwed mothers who served the social function of providing childless couples with adoptable infants, and tended to increase the number of laws and committees concerned with adoption and the rights of illegitimate children at the international level, but the concomitant concern about the "population explosion" had the potential to reverse the liberal trend of social policy affecting illegitimacy.

Measures of Illegitimacy.—There are three measures of illegitimacy—number, ratio and rate. The number of illegitimate births indicates the total volume of illegitimacy and is used to compute the ratio and rate. The illegitimacy ratio is the number of illegitimate births per 1,000 live births. It indicates the proportion of all reproduction occurring outside of marriage. (The ratio usually is termed "rate" when stated as a percentage of 100; thus, a "4% rate of illegitimacy" indicates a ratio of 40 illegitimate births per 1,000 live births.) Technically, the illegitimacy rate is the number of illegitimate births per 1,000 unmarried females of childbearing ages.

Extent and Variations Among Countries.—There are wide differences among countries in the illegitimacy ratio. Ratios in 1958, for example, ranged from a low of 4 in Israel to a high of 739 in Panama. Such variations are the result of many factors including differences in statutes and cultural traditions regulating marriage, coition and reproduction. A few examples will illustrate the difficulties involved in making comparisons among countries. In a number of Central American countries and Caribbean political units where illegitimacy ratios have exceeded 500 (50%) there were large indigenous populations among whom legal marriage (as distinct from tribal and religious marital rites) was an unfamiliar concept, overpopulation was not thought to be a problem and births out of wedlock received only mild censure. After World War II, Panama's illegitimacy ratio was almost 50 times Japan's, but in Japan legalized abortions annually exceeded 1,000,000 and approximated the number of live births (*see* also BIRTH CONTROL). Jamaica's ratio was about 15 times that of the United States, but in the United States the average age at marriage was ten years younger than in Jamaica and the estimated number of illegal abortions exceeded the estimated number of illegitimate births! Denmark's ratio was considerably lower than that of most Latin-American countries, but in Denmark one-third of all marital first births occurred within the first six months of marriage.

Variations among countries in illegitimacy result also from differences in the completeness of birth registration, the extent of misrepresentation on birth records to conceal illegitimate births and the methods used to compute the ratio and rate. In a number of Scandinavian countries and the United States, for example, the illegitimacy rate usually is based on the childbearing ages 15–44 and unmarried includes "never married," "widowed" and "divorced," but in many countries the rate is based on the childbearing ages 10–49 and includes adulterine births.

General Trends.—In industrialized countries illegitimacy generally decreases or is relatively low during periods of economic depression and the early years of war, increases or is relatively high during periods of economic prosperity and immediate postwar years, and is highest when a prosperity and immediate postwar period coincide. In many countries, for example, illegitimacy ratios by the 1960s had declined from the high ratios in the post-World War II period of the late 1940s, but were still considerably higher than in the depression years of the 1930s. In countries only beginning to industrialize, the illegitimacy ratio generally increases rapidly at first and then fluctuates very unpredictably as the result of many social changes including the breakdown of traditional family forms, the inclusion of native populations in vital statistics and changes in definitions of illegitimacy. In Mauritius, for example, the ratio dropped from 498 to 11 in one year (1954–55) when infants born of marriages performed by religious authority but not civilly registered were no longer con-

sidered illegitimate. Such general trends are subject to many exceptions and limitations of data, some of which can be illustrated with specific reference to the United States.

Trends and Data Limitations in the United States.—A survey of data in the United States covering the period 1940–60 showed that the estimated number of illegitimate births increased from 89,500 to 224,300, the ratio from 38 to 53 and the rate from 7 to 23. (The proportion attributed to nonwhites increased from 55% to 63% and that attributed to teen-agers decreased from 46% to 41%.) Such data had several limitations, however, making it difficult to establish that there had been an actual proportionate increase in illegitimacy. The number of illegitimate births, on which ratios and rates were based, reflected a considerable numerical increase in total live births and included estimates for an increased number of states not recording illegitimacy status on birth records (5 in 1940 and 15 in 1960—Arizona, Arkansas, California, Colorado, Connecticut, Georgia, Idaho, Maryland, Massachusetts, Nebraska, New Hampshire, New Mexico, New York, Oklahoma and Vermont). The nonrecording states complicated national estimates and undoubtedly affected figures in the recording states. For example, Utah recorded illegitimacy on birth records and had one of the lowest ratios and rates. Utah, however, was almost encircled by nonrecording states and, considering that an estimated 20% of white unwed mothers in the United States migrated temporarily from their home states during pregnancy, it was probable that at least some unmarried mothers from Utah had their babies in neighbouring states. It was possible also that in the United States the illegitimacy ratio increase (23% among nonwhites and 1% among whites) represented only a more inclusive reporting of illegitimate births effected by the increase (more than two-thirds among nonwhites and about 3% among whites) in the proportion of all births attended in a hospital or by a physician. A greater awareness of such data limitations resulted in increased questioning of the significance of racial, socioeconomic, rural-urban and age differences in illegitimacy that had been emphasized in the two preceding decades. Also, there was increased recognition that the foci of public concern about the problem of illegitimacy were not always adequate guides for research. Considerable public attention had been focused upon the increasing number of teen-age unwed mothers, for example, in the late 1950s, with little attention given to either the marked increase in the total number of teen-age females or to the fact that from 1940 to 1959 the illegitimacy rate had increased least among females aged 15–19 (112%) and most among females aged 30–34 (478%). (Rates in the late 1950s were about 16 for 15–19 year olds and ranged between 39 and 46 for each five year grouping of 20–39 year olds.)

Causes of Illegitimacy.—Knowledge about the causes of illegitimacy consists primarily of descriptions of social, familial and psychological factors associated with only certain groups of unwed mothers. Historically such descriptions frequently have been interpreted as explanations of why illegitimacy occurs, without sufficient scrutiny of their circular reinforcement by the causal theories and selective samples upon which they were based. In the 1920s the emphasis upon immorality and mental deficiency as causes of illegitimacy was supported with descriptions of unwed mothers found in "rescue homes" and other charity-type institutions. In the 1930s the interest in broken homes, poverty and disorganized neighbourhoods as causes of illegitimacy was consistent with descriptions of unwed mothers reported in domestic court files, police records and "homes for wayward girls." In the 1940s and early 1950s the focus upon emotional disturbance as a cause of illegitimacy went hand-in-hand with descriptions of unwed mothers who came to the attention of psychiatric social workers and psychotherapists. In the mid-1950s renewed interest in white-collar crime and delinquent youth among the middle classes was accompanied by descriptions of unwed mothers attended by physicians in private practice and cared for in private maternity homes. In the late 1950s it was recognized that such descriptions, however accurate of the groups described, did not explain why illegitimacy occurred, because the great majority of all females who fitted the descriptions being emphasized at any one historic time did not become unwed mothers. Such recognition was accompanied by studies of unwed mothers from multiple sample sources, providing tentative evidence that within given age and racial groups unwed mothers were fairly representative of unmarried females in general with respect to education, intelligence, occupation and socioeconomic status.

See also references under "Illegitimacy" in the Index.

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ILLINOIS, the "Prairie state," is one of the north central group of the conterminous United States. It is bounded on the north by Wisconsin, east by Lake Michigan and Indiana, southeast and south by the Ohio river, which separates it from Kentucky, and southwest and west by the Mississippi river, which separates it from Missouri and Iowa. The enabling act of congress providing for the organization of Illinois territory into a state extended its jurisdiction to the middle of Lake Michigan and the Mississippi river. The greatest length of Illinois is 382.1 mi. and the extreme width is 212.6 mi.; the total area of the state, exclusive of its Lake Michigan jurisdiction (1,526 sq.mi.), is 56,400 sq.mi., and the total land area is 55,930 sq.mi., giving it the rank of 24th in size among the states. It was admitted to the union on Dec. 3, 1818, the 21st state; the capital, since 1839, is Springfield. The official tree is the oak, of which 19 species grow in the state; the official flower is the violet; and the official bird is the cardinal (*Cardinalis cardinalis*). The state flag consists of a symbol based on the perched eagle, prairie boulder, shield, olive branch and scroll (bearing the state motto, "State Sovereignty, National Union") of the state seal on a white field edged with gold. The official state slogan is "Land of Lincoln."

PHYSICAL GEOGRAPHY

Physical Features.—Illinois is located with its southernmost point at 36° 58′; northernmost point, 42° 30′; easternmost point, 87° 30′; and its westernmost point, 91° 31′; except for its extreme southern point, it lies entirely in the prairie region. The southern end of the state is within the coastal plain belt at its northward extension along the Mississippi river. The surface is an inclined plane, sloping generally toward the south and southwest. The average elevation above mean sea level is 600 ft.; the highest elevation is Charles Mound (1,241 ft.), located on the Wisconsin-Illinois boundary in the northwestern corner of the state, in Jo Daviess county.

An elevation from 15 to 40 mi. wide, called the Illinois Ozarks, crosses the southern part of the state, from Grand Tower in Jackson county, on the Mississippi river, in the west to Shawneetown in Gallatin county, on the Ohio, in the east. The highest point in this southern range of hills is 1,065 ft. at Williams hill in Pope county.

The drainage of Illinois is far better than its low elevations and comparatively level surface would indicate. There are nearly 500 streams in the state, grouped into two river systems; three-fourths of the waters flow into the Mississippi river, and the remaining one-fourth flows into the Wabash or Ohio rivers. The most important river is the Illinois, formed by the junction of the Des Plaines and Kankakee rivers in Grundy county; the Illinois river in its course of 273 mi. drains approximately 25,000 sq.mi. and in a few places broadens into wide, lakelike expanses, notably at Lake Peoria. The Kaskaskia, in the south, notorious for its variation of volume, and the Rock, in the north, are other important rivers emptying into the Mississippi; the Embarrass, Little Wabash, Saline and Cache in the east are important tributaries of the Wabash and Ohio rivers. Generally the Ohio river bottoms are so low and level that they are poorly drained. The Chicago river originally emptied into Lake Michigan, but by the construction in 1900 of a drainage canal, the direction of the river was reversed so that it now flows into the Mississippi.

Climate.—Illinois has a typical continental climate with a wide range in temperature and frequent short-period fluctuations in temperature, humidity, cloudiness and wind direction. Particu-

larly in the winter, therefore, Illinois' geographical location results in temperatures that reflect both the northern and southern temperature belts of the United States. The north-south range in average temperature is 14° in January but only 5° in July. The mean annual temperature at Freeport, in the far northwest, is 48.4° F.; at Springfield, in central Illinois, 52.4°; at Cairo, the southernmost city, 59.8°. The mean annual temperature increases approximately 2° for every degree of latitude. The lowest temperature ever recorded was −35° F. on Jan. 22, 1930, at Mount Carroll, and the highest was 117° F., July 14, 1954, at East St. Louis, a maximum range of 152°.

Precipitation ranges from 33 in. in the far north to 48 in. in the far south, 20–22 in. falling May–Sept. in most sections; but in the period Oct.–March there are only 11 in. in the extreme northwest and as high as 22 in. in the extreme south. Seasonal snowfall at Chicago has ranged from 10 to 66 in.; Cairo has had 48 in. in one winter, yet one-third of Cairo winters have had less than 5 in. The average seasonal number of days with a snow cover of one inch or more is 80 in the extreme north but less than 20 in the extreme south; frost penetration in the soil ranges from about 36 in. in the extreme north to 6 in. in the extreme south. At Cairo, precipitation during winter is 25% of the annual total, while at Moline it is only 13%. Illinois is generally affected by most of the storm systems that move east or northeast through the central U.S.; precipitation is associated with air masses which have moved north from the Gulf of Mexico. Summer thunderstorms are occasionally severe with damaging winds or hail in local areas. Tornadoes are most likely during spring and early summer and are more numerous in the southwest, but may occur anywhere in the state. The heavily populated southern Illinois area probably has more severe tornadoes per unit of population than any other part of the U.S. The most disastrous tornado on record struck southern Illinois, March 18, 1925, causing property loss estimated at $16,500,000, with 742 persons killed and 2,756 injured.

Soil.—The soil of Illinois is well known for its fertility. The surface soils are largely composed of drift deposits, varying from 2 to 100 ft. in depth; they are often overlaid with a dark-coloured loam 10 in. or more deep, and in a large portion of the state there is a subsoil of mottled clay; the clay pan in the central area of southern Illinois is not particularly productive. The soil of the prairies is darker and more granular than that of the forests, although most differences disappear with cultivation. The alluvial soil of the river bottoms is exceptionally fertile, and the American bottoms, extending along the Mississippi from Alton to Chester, have been cultivated for more than 200 years. Along the river bluffs there is a deposit of loess, well suited for orchards and vegetable production. The excellent drainage has always been advantageous to agricultural development. For the control of soil erosion, to preserve land resources and to perform similar conservation functions, 98.4% of all Illinois farms are in soil conservation districts, and all but one of the 102 counties (Du Page) are included in the state's 99 soil conservation districts.

Vegetation.—Illinois stretches about 380 mi. north and south in the centre of the North American continent and its vegetation is accordingly varied, ranging from the white pine and tamarack of the north to the bald cypress and tupelo gum of the south. Before the coming of the white man the area was an interspersion of tall prairie and eastern deciduous forest; the popular nickname "Prairie state" derives more from the fact that pioneers first encountered prairie there than from the actual amount of prairie, which is less extensive in Illinois than in many more westward states. Forest originally covered about 40% of the area; by the 1960s, through commercial use of timber and clearing of the land for agriculture, this had been reduced to about 10%, as compared with the 15% which agricultural experts consider desirable for best use of the land. With the establishment of the Shawnee National forest in southern Illinois and an increasing interest in timber production, there was evident, in the second part of the 20th century, both an increase in acreage and a more intelligent use of forests and their products.

Animal Life.—Illinois once supported a great variety of animal life, now greatly depleted. Fur trading was an important commercial enterprise in the period of exploration and settlement, mink, muskrat, beaver and fox being significant; although some trapping is still carried on, it is of minor importance and the sporting value of fur animals has become relatively more important, especially since World War II. Three kinds of rabbits are native to the state: the white-tailed jack rabbit in the northwest, the swamp rabbit in the south and the cottontail throughout the state; they make up over one-third of the gamebag annually. Perhaps no mammals are enjoyed by more people than the gray and fox squirrels which inhabit town and city parks as well as woodlands. Deer have an interesting history: when white settlers first came they were common but not generally numerous, and as settlement increased their numbers increased, probably reaching a peak in the mid-19th century. Further clearing of land and more intensive agriculture eliminated their habitats and by 1910 native wild deer were virtually extinct. In 1933 the department of conservation placed four deer on a state game refuge. These and groups subsequently released gradually built up their number and in 1957 the first deer-hunting season since 1900 was inaugurated. The deer are concentrated in the southern and northwestern parts of the state. Quail increase from the northern to the southern part of the state, the majority being south of a line drawn from Rock Island southeastward through Peoria to the Indiana line. Pheasants are less numerous and are concentrated in northern Illinois. The state is in the heart of the Mississippi flyway and is frequented by hundreds of thousands of waterfowl during the fall and spring migrations and in the winter. About 20 species of waterfowl are common in the state but only the wood duck nests there in appreciable numbers. Illinois has produced sizable catches of commercial fish for many years; the most important game fish is the largemouth bass, common in all types of lakes and ponds.

State Parks and Memorials.—A consciousness of the value of the state's many historic sites and the need for recreational facilities, particularly for the great urban population, have led to the establishment of many state parks and memorials in Illinois. Places of interest in connection with Abraham Lincoln include Lincoln's New Salem State park, 20 mi. N.W. of Springfield, a reproduction of the village as it was in his time; the Lincoln Log Cabin State park, south of Charleston; and the Lincoln tomb, home and other memorials in Springfield. Stephen A. Douglas is commemorated by a monument on the site of his tomb in Chicago, and the sites of the seven Lincoln-Douglas debates (at Ottawa, Freeport, Jonesboro, Charleston, Galesburg, Quincy and Alton) are marked. Other places of historic interest include Cahokia Mounds State park near East St. Louis and Dickson Mound State memorial on the Illinois river near Havana; Pere Marquette State park, at the junction of the Illinois and Mississippi rivers and Starved Rock State park, on the upper Illinois river, associated with the French period in Illinois history; Ft. Kaskaskia and Ft. Chartres State parks along the Mississippi below East St. Louis and Ft. Massac State park on the Ohio, all of which were French military strongholds of the 18th century; Nauvoo State park, on the Mississippi river north of Quincy, the site of the Mormon settlement; and the Ulysses S. Grant home in Galena, now a museum.

Among the state parks primarily of scenic and naturalistic interest are the Mississippi Palisades and Apple River Canyon parks in northwestern Illinois, the White Pines Forest, Buffalo Rock, Matthiessen, Illini and Gebhard Woods parks in north central Illinois, the Spitler Woods park near Decatur and the Giant City, Ferne Clyffe and Dixon Springs parks in southern Illinois. Among those with water areas (in some cases with facilities for camping and swimming) are Illinois Beach State park on Lake Michigan near Waukegan; Illinois and Michigan Canal State parkway along the old canal in Will, Grundy and La Salle counties; Kickapoo State park near Danville; Grand Marais State park near East St. Louis; and Fox Ridge State park near Charleston. Lake areas which are now state parks include Argyle lake in McDonough county, Beaver dam in Macoupin county, Lake Le-Aqua-Na in Stephenson county, Lake Murphysboro in Jackson county, Ramsey lake in Fayette county, Spring lake in Tazewell county and Weldon springs in De Witt county.

Chicago Portage, which preserves a portion of the famous por-

tage discovered by Marquette and Jolliet, was designated as a national historic site in 1952; not owned by the federal government, it is under the jurisdiction of the Cook County Forest preserve.

HISTORY

French Exploration and Settlement.—The first Europeans to visit the region now known as Illinois were the French. In 1673, the Jesuit father Jacques Marquette, under orders to begin a mission to the Indians, and the explorer Louis Jolliet, who acted under orders of Jean Talon, intendant of Canada, ascended the Fox river, crossed the portage between it and the Wisconsin river and followed that stream to the Mississippi, which they descended to a point below the mouth of the Arkansas. On their return journey they ascended the Illinois river and crossed the portage to Lake Michigan; in 1675 Marquette founded a mission at the Indian town of Kaskaskia, near the present Utica, Ill. In 1679 the explorer René Robert Cavalier, sieur de la Salle, attempting to find the mouth of the Mississippi, ascended the St. Joseph river, crossed the portage separating it from the Kankakee, which he descended to the Illinois and built in the neighbourhood of Lake Peoria a fort which he called Ft. Crèvecoeur. La Salle reached the mouth of the Illinois Feb. 6, 1682. After such preliminary explorations, the French made permanent settlements, which had their origin in Jesuit missions and French trading posts. Chief of these were Kaskaskia, established near the mouth of the Kaskaskia river, about 1703; Cahokia, a few miles below present East St. Louis, Illinois, founded about 1699; and Ft. Chartres, on the Mississippi between Cahokia and Kaskaskia, founded in 1719 to be a link in a chain of fortifications intended to extend from the St. Lawrence to the Gulf of Mexico.

By the treaty of Paris, 1763, France ceded to Great Britain its claims to the country between the Ohio and Mississippi rivers, but because of the resistance of Pontiac, a chief of the Ottawas, who drew into conspiracy most of the tribes between the Ottawa river and the lower Mississippi, the English were not able to take possession until Capt. Thomas Stirling arrived at Ft. Chartres, Oct. 10, 1765—the last place in North America to lower the French flag.

British Rule.—British policy was not favourable to the economic development of the newly acquired country, since it was feared that its prosperity might react against the trade and industry of Great Britain. But in 1769 this policy was relaxed, and immigration began from the seaboard colonies, especially from Virginia. In 1771 the people of the Illinois country demanded a form of self-government similar to that of Connecticut. The petition was rejected by Gen. Thomas Gage; and William Legge, 2nd earl of Dartmouth (1731–1801), secretary of state for the colonies and president of the board of trade and foreign plantations, drew up a plan of government for Illinois in which all officials were appointed by the crown. This, however, was never operative, for in 1774 the Quebec act (*q.v.*) extended the boundaries of Quebec to the Ohio on the south and the Mississippi on the east, recognized French civil law and brought the Illinois country under an appointive governor and council. Most of the Illinois French were loyalists in the Revolutionary War; when the English instigated Indian attacks on the frontier, George Rogers Clark (*q.v.*), who acted under orders of Patrick Henry, governor of Virginia, captured the British posts of Cahokia and Kaskaskia in 1778 and Vincennes in 1779. These conquests had much to do with the United States' securing the country west of the Alleghenies and north of the Ohio in the treaty of Paris, 1783.

Territorial Status and Statehood.—The Virginia house of delegates in 1778 extended the civil jurisdiction of Virginia to the northwest, and appointed Capt. John Todd (1750–82) of Kentucky governor of the entire territory north of the Ohio, organized as "the county of Illinois." This government, confined to the old French settlements, was short lived and inefficient. In 1787 after Virginia and the other states relinquished their claims to the country west of the Alleghenies, the Northwest territory was organized by the congress under the Articles of Confederation by the famous ordinance of 1787. Two years later St. Clair county was formed out of the southwest part of the Illinois country, while the eastern portion and the settlements around Vincennes, Ind., were united into the county of Knox. In 1795 the southern part of St. Clair county was organized into Randolph county, with Kaskaskia as the seat of administration. In 1800 the Illinois country was included in the territory of Indiana, and in 1809 the western part of that territory, from Vincennes north to Canada, was organized as the territory of Illinois; it included, besides the present state, all of Wisconsin except the northern part of the Green Bay peninsula, a large part of Michigan and all of Minnesota east of the Mississippi. In 1812, by permission of congress, a representative assembly was chosen, a territorial constitution was adopted and the territorial delegate in congress was elected directly by the people.

In 1818 Illinois became a state of the American union (see *Government*, below), the enabling act fixing the line 42° 30′ as the northern boundary, instead of that provided by the ordinance of 1787, which passed through the south bend of Lake Michigan. The reason given for this change was that if the Mississippi and Ohio rivers were the only outlets of Illinois trade, the interests of the state would become identified with those of the southern states; but if a Lake Michigan outlet were provided, closer relations would be established with the northern and middle states, so that "additional security for the perpetuity of the Union" would be afforded.

Because there was conflict between French and English land claims, congress in 1804 established land offices at Kaskaskia and Vincennes to examine existing claims and to eliminate conflict with future grants; in 1812 new offices were established at Shawneetown and Edwardsville for the sale of public lands; and in 1816 more than 500,000 ac. were sold. In 1818, however, many citizens were in debt for their lands, and squatters invaded the rights of settlers. Congress therefore reduced the price of land from $2 to $1.25 per acre and adopted the policy of pre-emption, preference being given to the claims of existing settlers. The Indians, however, resisted measures looking toward the extinguishment of their claims to the country. Their dissatisfaction with treaties signed in 1795 and 1804 caused them to espouse the British cause in the War of 1812, and in 1812 they overpowered a body of soldiers and settlers who had abandoned Ft. Dearborn (*see* CHICAGO). For a number of years after the end of the conflict, the Indians were comparatively peaceful; but in 1831 the delay of one band of Sauks and Foxes in withdrawing from lands in northern Illinois caused Gov. John Reynolds (1788–1865) to call out the militia. The following year the return of the Sauk leader Black Hawk resulted in war in northern Illinois and Wisconsin (the Black Hawk War); and by 1833 the United States had acquired title to all the Indian land in Illinois.

The financial and industrial policy of the state was unfortunate. Money being scarce, the legislature in 1819 chartered a state bank which was authorized to do business on the credit of the state. This bank never operated and a second was chartered in 1820. In a few years the bank failed, and the state in 1831 borrowed money to redeem the depreciated notes issued by the bank. A third state bank was chartered in 1835; two years later it suspended payment, and in 1843 the legislature provided for its liquidation. The state also undertook to establish a system of internal improvements, granting a loan for the construction of the Illinois and Michigan canal in 1836, and in 1837 appropriating $10,000,000 for the building of railroads and other improvements. The experiment proved unsuccessful; the state's credit declined and a heavy debt was incurred, and in 1840 the policy of aiding public improvements was abandoned. Through the efforts of Gov. Thomas Ford (1800–50) a movement to repudiate the debt was defeated, and a plan was adopted by which the entire debt could be reduced without excessive taxation; by 1880 practically the entire debt was extinguished.

A notable incident in the history of the state was the immigration of the Mormons from Missouri about 1839. They succeeded in securing favours from the legislature, and their city of Nauvoo had courts and a military organization that were independent of state control. Political intrigue and claims of independence from the state, as well as charges of polygamy and lawless conduct,

aroused such intense opposition that in 1844 a civil war broke out in Hancock county resulting in the murder of the leader of the Mormons, Joseph Smith, and the removal of the Mormons from Illinois in 1846.

Slavery Question and the Civil War.—The slavery question was a problem of lasting political importance. Slaves had been brought into the Illinois country by the French, and Gov. Arthur St. Clair (1736–1818) interpreted the article of the ordinance of 1787 forbidding slavery in the Northwest territory as a prohibition of the introduction of slaves into the territory, not an interference with existing conditions. Negroes were held as indentured servants, and such servitude was recognized in the Indiana code of 1803, the Illinois constitution of 1818 and statutes of 1819; indeed, slavery would have been recognized in the constitution of 1818 had it not been feared that recognition would have prevented the admission of the state to the union. In 1824 the voters rejected a legislative proposal calling for a constitutional convention; the aim, not expressed, was the legalization of slavery. But the resolution of the legislature was rejected, the leader of the opposition being Gov. Edward Coles (1786–1868), a Virginia slaveholder who had freed his slaves on coming to Illinois. The opposition to slavery, however, was at first economic, not philanthropic. In 1837 there was only one abolition society in the state, but chiefly through the agitation of Elijah P. Lovejoy (*q.v.*), abolition sentiment grew.

By 1840 the moral issue had become political and the Liberty party was organized. In 1848 it united with the Free-Soil party; but as the Whig party also favoured the policy of nonextension of slavery, these parties did not succeed. In 1854, however, the Liberty and Free-Soil parties united with some Whigs and those Democrats opposed to the Kansas-Nebraska bill; they secured a majority in the legislature and elected Lyman Trumbull to the U.S. senate. Two years later these elements were absorbed by the Republican party and elected candidates to state offices—the first time that the Democratic party had been defeated, its organization having been in control since the admission of Illinois to the union. Important in this political revolution was a change in the character of the population. Until 1848 southerners predominated in the population, but after that year immigration from the northern states was greater than that from the south, and the number of foreigners also increased. The influence of immigration and sectionalism upon Illinois politics is well illustrated by the fact that the first six governors (1818–38) were born in the southern states, six of the eight U.S. senators of that period were also southern born and all of the representatives, with one exception, also came to Illinois from the southern states. After 1838 the eastern states began to be represented among the governors but until 1901 no governor was elected who was a native of Illinois.

The opposition to slavery continued to be political and economic rather than philanthropic. The constitution of 1848, which abolished slavery, also forbade the immigration of slaves into the state. The famous contest for the office of U.S. senator between Stephen A. Douglas (Democrat) and Abraham Lincoln (Republican) took place in 1858. Douglas was elected but the vote showed increasing northern sympathy, and two years later Lincoln, then candidate for the presidency, carried the state. The policy of Illinois in the early period of secession was one of marked loyalty to the union; even in the southern part of the state the majority of the people had no sympathy with proslavery men in their efforts to dissolve the union. The state contributed more than 250,000 men to the federal armies. From 1862 to 1864, however, there was some opposition to a continuance of the war. The legislature of 1862 was Democratic, and for political purposes that body adopted resolutions against further conflict and recommended an armistice and a national convention to conclude peace. A constitutional convention that same year attempted to assume legislative powers; it wrote into the proposed constitution clauses preventing Negroes and mulattoes from immigrating into the state and from voting and holding office; and although the constitution as a whole was rejected by the people, these clauses were ratified. A Democratic mass meeting, which met at Springfield in July 1863, adopted resolutions that condemned the suspension of the writ of habeas corpus, endorsed the doctrine of state sovereignty, demanded a national assembly to determine terms of peace and asked President Lincoln to withdraw the Emancipation Proclamation in order to permit the people of Illinois to fight only for "Union, the Constitution and the enforcement of the laws." Anti-war and pro-southern secret societies, including the Knights of the Golden Circle (*q.v.*), began to flourish, and so did exaggerated stories about their activities and strength. Capt. T. Henry Hines of the Confederate army led an elaborate attempt to liberate Confederate prisoners in Chicago (known as the Camp Douglas conspiracy) which was thwarted by a discovery of the plans. In the elections of 1864 the Republicans and Union Democrats united, and after an exciting campaign they were successful. The new legislature was the first state legislature to ratify (Feb. 1, 1865) the 13th amendment.

Political Record.—From the close of the Civil War until the end of the 19th century the Republican party was generally dominant, but the trend of political development was not without interest.

In 1872 many prominent men joined the Liberal Republican party, among them Gov. John M. Palmer, Sen. Lyman Trumbull and Gustav Körner (1809–96), one of the most prominent representatives of Illinois' German population. Economic depression gave the Granger movement considerable popularity, and an outgrowth of the Granger organization was the Independent Reform party of 1874 which advocated retrenchment of expenses, the state regulation of railways and a tariff for revenue only. A Democratic Liberal party was organized in the same year, one of its leaders being Governor Palmer; consequently, no party had a majority in the legislature elected in 1874. In 1876 the Greenback party, the successor in Illinois of the Independent Reform party, secured a strong following; although its candidate for governor was endorsed by the Democrats, the Republicans regained control of the state administration.

In 1912, as a result of the Progressive secession, the Republican party lost control of the state for the first time in 16 years, the Democratic presidential electors winning by a vote of 405,038, as compared with 386,478 for the Progressives and 253,593 for the Republicans. By 1914 the normal Republican majority in Illinois reasserted itself, and two years later Pres. Woodrow Wilson lost the electoral vote of the state. At the same time the Republicans recaptured the governorship, which it held without interruption for the next 16 years. But in 1932 the people of the commonwealth cast their vote heavily for Franklin Delano Roosevelt and also elected a Democratic governor, Henry Horner. This political shift was confirmed in 1934 when 22 of the state's 27 seats in the house of representatives were filled by Democrats and again in 1936 and 1940 when President Roosevelt carried the state.

After 1944, when Roosevelt again carried the state but a Republican governor was elected, no pronounced trend developed. Harry S. Truman carried Illinois in 1948, and Paul Douglas and Adlai E. Stevenson, both Democrats, were elected U.S. senator and governor, respectively. In 1950 Illinois elected a Republican U.S. senator, Everett McKinley Dirksen, and returned him to office in 1956 and 1962. Douglas, the Democratic senator, was re-elected in 1954 and 1960. In 1952 and 1956 the state's electoral votes went to Republican Dwight D. Eisenhower and in 1960 to Democrat John F. Kennedy. In the latter year a Democratic governor, Otto Kerner, was also elected, replacing Republican William G. Stratton who had served two terms (1953–61).

GOVERNMENT

Constitution and Apportionment.—On July 4, 1800, the Northwest territory was divided and the Illinois country was made a part of Indiana territory; Illinois territory was formed March 1, 1809, by dividing Indiana territory. The first legislative body of Illinois territory—the governor and three judges, all appointed by the president—met June 16, 1809, and passed a code of laws, keeping most of the laws previously in force; the first representative assembly passed a similar bill confirming the laws in force. On April 18, 1818, congress made provision for a state convention

to form an Illinois state constitution and government; on Aug. 26 the delegates adopted a constitution which went into effect when Illinois was admitted as the 21st state on Dec. 3, 1818.

In 1848 a second constitution was adopted, and in July 1870 the electorate adopted a third. Agitation for a new constitution resulted in a constitutional convention which in 1922 submitted a new constitution to the voters who rejected it by 921,398 to 185,298. A proposal for a constitutional convention was passed by the legislature in 1933 but was defeated by the electorate in 1934, 23.5% for, 20% against and 56.5% not voting.

At that time, amendments to the constitution could be made either by a constitutional convention or by the affirmative vote of two-thirds of the members of each house of the legislature; the amendment then had to be ratified by a majority of the electors voting in the next general election. Prior to 1950, 19 amendments were submitted to the voters; of these, 7 were adopted. Many amendments were defeated because citizens who voted for candidates but neither for nor against a proposed amendment were in effect voting against the amendment, since a majority of those voting in the election had to approve the amendment. In the period 1908–50 no amendment carried in a general election.

Constitutional amendment was made much simpler by the adoption of the Gateway amendment in 1950. The Gateway amendment provided that as many as three amendment propositions may be submitted to the voters at an election, instead of only one as formerly. Adoption requires a two-thirds majority of those voting on the amendment, or a simple majority of those voting in the election, whichever is less. Since the Gateway amendment was adopted, a number of amendments have been voted on by the electorate, about half of which were adopted. The most important of these concerned legislative apportionment and the organization of the state judiciary (see *Judicial*, below). As a result of the former, the districts from which state senators and representatives were chosen were revised for the first time in half a century. Members of the legislature had been chosen by districts, 3 representatives and 1 senator from each of 51 districts; total membership in the legislature had been 204. The amendment adopted designated 58 senatorial and 59 representative districts, increasing the number of senators by 7 and the number of representatives by 24, for a total legislative membership of 235. Under the amendment the 101 downstate (other than Cook) counties elect 34 rather than 32 senators, and Cook county (in which Chicago is located) elects 24 rather than 19; 30 representative districts were placed in Cook county (previously 19) and 29 (previously 32) were located downstate. The new senate district boundaries and apportionment were meant to be permanent; the representative districts were to be reapportioned on a population basis every ten years, beginning in 1963. After a redistricting bill was vetoed and a governor's committee failed to act, the state supreme court held that all representatives must be elected at large in 1964.

Legislature.—Regular sessions of the legislature meet on the first Wednesday after the first Monday in January in odd-numbered years. The term of senators is four years, that of representatives two years. The constitution of 1870 provided for minority representation in the election of representatives; by cumulative voting each voter may cast as many votes for one candidate as there are representatives to be chosen, or he may distribute his votes (giving three votes to one, or one-and-one-half votes to each of two, or one vote each to three candidates), the three candidates receiving the highest number of votes being elected. Special legislation is prohibited when general laws are applicable, and special and local legislation is forbidden in any of 23 specified cases. The general assembly may pass an act over the governor's veto by a two-thirds vote of all members elected to each house. In practice, the governor's veto is not often overridden; if the governor's political party controls either of the two houses, it is all but impossible to secure legislation not desired by the governor.

Executive.—The constitution provides for an executive department consisting of a governor, lieutenant governor, secretary of state, auditor of public accounts, treasurer, attorney general and superintendent of public instruction; all except the treasurer may be re-elected to succeeding terms. (Illinois has never elected a governor to three successive terms.) The most far-reaching administrative change in state government occurred in 1917 with the enactment of the Consolidation act combining more than 100 state boards, divisions and commissions into nine departments. By the early 1960s the number of major departments, each directed by a departmental administrative officer appointed by the governor, had more than doubled. In addition, a number of boards and commissions were charged with varying responsibilities; among the most significant were the budgetary, commerce, legislative audit and youth commissions.

Illinois enacted a civil service law in 1905 under which approximately two-thirds of the state's employees were covered by 1960. The civil service commission is a division of the department of personnel; certain employees, including the scientific and academic staffs of the state universities and clerks in offices headed by elected officers, are exempted.

Judicial.—Under the judicial article of the 1870 constitution (which was essentially similar to that in the constitution of 1848), judicial powers were vested in a supreme court, appellate courts, circuit courts, county courts, justices of the peace and police magistrates, and such courts as might be created by law in and for cities and incorporated towns. Special arrangements for additional courts were made for Cook county. As the state's population increased, these courts, independent and in many cases with overlapping jurisdictions, proved unable to cope with the growing amount of litigation, and by the late 1950s some courts in Cook county were several years behind in hearing cases. After an unsuccessful attempt in 1958, an amendment revising the judicial article was passed at the general election of Nov. 1962 and came into force on Jan. 1, 1964. As a result, the state's many courts were consolidated into a single trial court, known as the circuit court, under the administrative supervision of the supreme court. The amendment provided that three of the seven supreme court justices be elected from Cook county (formerly Cook and four other counties had elected one). Provision was also made for the election of judges to the appellate bench, which had previously been staffed by circuit judges. As under the old article, election of judges standing for office for the first time was by partisan ballot. However, the amendment permitted judges to run for re-election on their records, without opposition. It also abolished the offices of justice of the peace and police magistrate, replacing them with magistrates appointed by the circuit judges. All courts, including the magistrates' courts, were made courts of record. Each county elects a state's attorney, who serves for four years.

Local Government.—The local government of Illinois includes both county and township systems. The earliest American settlers came from the southern states and introduced the county system; but the increase of population from New England and the middle states led to a recognition of township organization in the constitution of 1848, and this form of government, at first prevalent only in the northern counties, is found in most of the middle and southern counties. Cook county, although it has a township system, is governed by a board of commissioners elected by the townships and the city of Chicago. Incorporated cities must have a population of at least 2,500. Requirements for suffrage are: age of 21 years or more, citizenship in the United States and residence in the state for 1 year, in the county 90 days and in the election precinct 30 days preceding the exercise of suffrage.

Relation to Corporations.—The relation of the state to corporations and industrial problems has been a subject of important legislation. The constitution declares that the state's rights of eminent domain shall never be so abridged as to prevent the legislature from taking the property and franchises of incorporated companies and subjecting them to the public necessity in a way similar to the treatment of individuals. In 1903 the legislature authorized the municipal ownership of public-service corporations. Railways organized or doing business in the state are required by the constitution to have a public office where books for public inspection are kept, showing the amount of stock, the owners

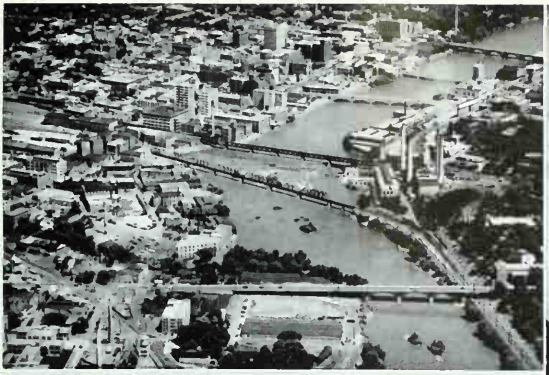
*Illinois: Places of 5,000 or More Population (1960 Census)**

Place	Population				
	1960	1950	1940	1920	1900
Total state	10,081,158	8,712,176	7,897,241	6,485,280	4,821,550
Addison	6,741	813	819	510	591
Alton	43,047	32,550	31,255	24,682	14,210
Arlington Heights	27,878	8,768	5,668	2,250	1,380
Aurora	63,715	50,576	47,170	36,397	24,147
Barrington	5,434	4,209	3,560	1,743	1,162
Bartonville	7,253	2,437	1,879	1,588	—
Batavia	7,496	5,838	5,101	4,395	3,871
Beardstown	6,294	6,080	6,505	7,111	4,827
Belleville	37,264	32,721	28,405	24,823	17,484
Bellwood	20,729	8,768	5,220	1,881	—
Belvidere	11,223	9,422	8,049	7,804	6,937
Bensenville	9,141	3,754	1,869	650	374
Benton	7,023	7,848	7,372	7,201	1,341
Berkeley	5,792	1,882	724	—	—
Berwyn	54,224	51,280	48,451	14,150	—
Bloomington	36,271	34,163	32,868	28,725	23,286
Blue Island	19,618	17,622	16,638	11,424	6,114
Bradley	8,082	5,699	3,689	2,128	1,518
Bridge View	7,334	1,393	—	—	—
Broadview	8,588	5,196	1,457	430	—
Brookfield	20,429	15,472	10,817	3,589	—
Cahokia	15,829	794	465	—	—
Cairo	9,348	12,123	14,407	15,203	12,566
Calumet City	25,000	15,709	13,241	—	—
Calumet Park	8,448	2,500	1,593	—	—
Canton	13,588	11,927	11,577	10,928	6,564
Carbondale	14,670	10,921	8,550	6,267	3,318
Carlinville	5,440	5,116	4,965	5,212	3,502
Carmi	6,152	5,574	4,098	2,667	2,939
Carpentersville	17,424	1,523	1,289	1,036	1,002
Centralia	13,904	13,863	16,343	12,491	6,721
Centreville	12,769	—	—	—	—
Champaign	49,583	39,563	23,302	15,873†	9,098
Charleston	10,505	9,164	8,197	6,615	5,488
Chicago	3,550,404	3,620,962	3,396,808	2,701,705	1,698,575
Chicago Heights	34,331	24,551	22,461	19,653	5,100
Chicago Ridge	5,748	888	376	176	—
Cicero	69,130	67,544	64,712	44,995	16,310
Clarendon Hills	5,885	2,437	1,281	—	—
Clinton	7,355	5,945	6,331	5,898	4,452
Collinsville	14,217	11,862	9,767	9,753	4,021
Crest Hill	5,887	—	—	—	—
Creve Coeur	6,684	5,499	3,535	—	—
Crystal Lake	8,314	4,832	3,917	2,249	950
Danville	41,856	37,864	36,919	33,776	16,354
Decatur	78,004	66,269	59,305	43,818	20,754
Deerfield	11,786	3,288	2,283	610	—
De Kalb	18,486	11,708	9,146	7,871	5,904
Des Plaines	34,886	14,994	9,518	3,451	1,666
Dixon	19,565	11,523	10,671	8,191	7,917
Dolton	18,746	5,558	3,068	2,076	1,229
Downers Grove	21,154	11,882	9,526	3,543	2,103
Du Quoin	6,558	7,147	7,515	7,285	4,353
East Alton	7,630	7,290	4,680	1,669	454
East Moline	16,732	13,913	12,359	8,657	—
East Peoria	12,310	8,698	6,806	2,214	899
East St. Louis	81,712	82,295	75,609	66,767	29,655
Edwardsville	9,996	8,776	8,008	5,336	4,157
Effingham	8,172	6,892	6,180	4,024	3,274
Elgin	49,447	44,223	38,333	27,454	22,433
Elk Grove Village	6,608	—	—	—	—
Elmhurst	36,991	21,273	15,458	4,594	1,728
Elmwood Park	23,866	18,801	13,689	1,380	—
Evanston	79,283	73,641	65,389	37,234	19,259
Evergreen Park	24,178	10,531	3,313	705	445
Fairfield	6,362	5,576	4,008	2,754	2,338
Flora	5,331	5,255	5,474	3,558	2,311
Forest Park	14,452	14,969	14,840	10,768	4,085
Franklin Park	18,322	8,899	3,007	914	483
Freeport	26,628	22,467	22,366	19,669	13,258
Galesburg	37,243	31,425	28,876	23,834	18,607
Geneseo	5,169	4,325	3,824	3,375	3,356
Geneva	7,646	5,139	4,101	2,803	2,446
Glencoe	10,472	6,980	6,825	3,381	1,020
Glen Ellyn	15,972	9,524	8,055	2,851	793
Glenview	18,132	6,142	2,500	760	—
Granite City	40,073	29,465	22,974	14,757	3,122
Harrisburg	9,171	10,999	11,453	7,125	2,202
Harvey	29,071	20,683	17,878	9,216	5,395
Harwood Heights	5,688	655	—	—	—
Hazel Crest	6,205	2,129	1,299	438	—
Herrin	9,474	9,331	9,352	10,986	1,559
Highland Park	25,532	16,808	14,476	6,167	2,806
Hillside	7,794	2,131	1,080	555	—
Hinsdale	12,859	8,676	7,336	4,042	2,578
Hometown	7,479	—	—	—	—
Homewood	13,371	5,887	4,078	1,389	352
Hoopeston	6,606	5,992	5,381	5,451	3,823
Jacksonville	21,690	20,387	19,844	15,713	15,078
Jerseyville	7,420	5,792	4,809	3,839	3,517
Joliet	66,780	51,601	42,365	38,442	29,353
Kankakee	27,666	25,856	22,241	16,753	13,595
Kewanee	16,324	16,821	16,901	16,026	8,382
La Grange	15,285	12,002	10,479	6,525	3,969
La Grange Park	13,793	6,176	3,406	1,684	730
Lake Forest	10,687	7,819	6,885	3,657	2,215
Lansing	18,098	8,682	4,462	1,409	830
La Salle	11,897	12,083	12,812	11,537	10,446
Lawrenceville	5,492	6,328	6,213	5,080	1,300

Place	Population				
	1960	1950	1940	1920	1900
Libertyville	8,560	5,425	3,930	2,125	864
Lincoln	16,890	14,362	12,752	11,882	8,962
Lincolnwood	11,744	3,072	752‡	355	—
Litchfield	7,330	7,208	7,048	6,215	5,918
Lockport	7,560	4,955	3,475	2,684	2,659
Lombard	22,561	9,817	7,075	1,331	590
Loves Park	9,086	5,366	—	—	—
Lyons	9,936	6,120	4,960	2,564	951
Macomb	12,135	10,592	8,764	6,714	5,375
Madison	6,861	7,963	7,782	4,996	1,979
Marion	11,274	10,459	9,251	9,582	2,510
Markham	11,704	2,753	1,388	—	—
Mattoon	19,088	17,547	15,827	13,552	9,622
Maywood	27,330	27,473	26,648	12,072	4,532
Melrose Park	22,291	13,366	10,933	7,147	2,592
Mendota	6,154	5,129	4,215	3,934	3,736
Metropolis	7,339	6,093	6,287	8,055	4,069
Midlothian	6,605	3,216	2,430	—	—
Moline	42,705	37,397	34,608	30,734	17,248
Monmouth	10,372	10,193	9,096	8,116	7,460
Morris	7,935	6,926	6,145	4,505	4,273
Morton	5,325	3,693	2,241	1,179	894
Morton Grove	20,533	3,926	2,010	1,079	564
Mount Carmel	8,594	8,772	6,987	7,456	4,311
Mount Prospect	18,906	4,009	1,720	349	—
Mount Vernon	15,566	15,600	14,724	9,815	5,216
Mundelein	10,526	3,189	1,328	—	—
Murphysboro	8,673	9,241	8,976	10,703	6,463
Naperville	12,933	7,013	5,272	3,830	2,629
Niles	20,393	3,587	2,168	1,258	514
Normal	13,457	8,772	6,983	5,143	3,795
Norridge	14,087	3,428	—	—	—
Northbrook	11,635	3,348	1,265	—	—
North Chicago	20,517	8,628	8,465	5,839	1,150
North Lake	12,318	4,361	—	—	—
North Riverside	7,089	3,230	1,036	—	—
Oak Lawn	27,471	8,751	3,483	489	—
Oak Park	61,043	63,529	66,015	39,858	—
Olney	8,780	8,612	7,831	4,491	4,260
Ottawa	19,408	16,957	16,005	10,816	10,588
Palatine	11,504	4,079	2,222	1,210	1,020
Pana	6,432	6,178	5,966	6,122	5,530
Paris	9,823	9,460	9,281	7,985	6,105
Park Forest	29,993	8,138	—	—	—
Park Ridge	32,659	16,602	12,063	3,383	1,340
Pekin	28,146	21,858	19,407	12,086	8,420
Peoria	103,162	111,856	105,087	76,121	56,100
Peoria Heights	7,064	5,425	4,376	1,111	309
Peru	10,460	8,653	8,983	8,869	6,863
Pontiac	8,435	8,990	9,585	6,664	4,266
Princeton	6,250	5,765	5,224	4,126	4,023
Quincy	43,793	41,450	40,469	35,978	36,252
Rantoul	22,116	6,387	2,367	1,551	1,207
Riverdale	12,008	5,840	2,865	1,166	558
River Forest	12,695	10,823	9,487	4,358	1,539
River Grove	8,464	4,839	3,301	484	333
Riverside	9,750	9,153	7,935	2,532	1,551
Robbins	7,511	4,766	1,349	431	—
Robinson	7,226	6,407	4,311	3,375	1,683
Rochelle	7,008	5,449	4,200	3,310	2,073
Rock Falls	10,261	7,983	4,987	2,927	2,176
Rockford	126,706	92,927	84,637	65,651	31,051
Rock Island	51,863	48,710	42,775	35,177	19,493
Rolling Meadows	10,879	—	—	—	—
Round Lake Beach	5,011	1,892	410	—	—
St. Charles	9,269	6,709	5,870	4,099	2,675
Salem	6,165	6,159	7,319	3,457	1,642
Schiller Park	5,687	1,384	804	390	—
Skokie	59,364	14,832‖	7,172	763	529
South Holland	10,412	3,247	2,272	1,247	766
Springfield	83,271	81,628	75,503	59,183	34,159
Spring Valley	5,371	4,916	5,010	6,993	6,214
Steger	6,432	4,358	3,369	2,304	712
Sterling	15,688	12,817	11,363	8,182	6,309
Stickney	6,239	3,317	2,446	550	—
Streator	16,868	16,469	14,930	14,779	14,079
Summit	10,374	8,957	7,043	4,019	547
Sycamore	6,961	5,912	4,702	3,602	3,653
Taylorville	8,801	9,188	8,313	5,806	4,248
Tinley Park	6,392	2,326	1,136	493	300
Urbana	27,294	22,834	14,064	10,244	5,728
Vandalia	5,537	5,471	5,288	3,316	2,665
Venice	5,380	6,226	5,454	3,895	2,450
Villa Park	20,391	8,821	7,236	854	—
Washington	5,919	4,285	2,456	1,643	1,459
Washington Park	6,601	5,840	4,523	1,516	—
Watseka	5,219	4,235	3,744	2,817	2,505
Waukegan	55,719	38,946	34,241	19,226	9,426
Westchester	18,092	4,308	621	—	—
West Chicago	6,854	3,973	3,355	2,594	1,877
Western Springs	10,838	6,364	4,856	1,258	662
West Frankfort	9,027	11,384	12,383	8,478	—
Westmont	5,997	3,402	3,044	—	—
Wheaton	24,312	11,638	7,389	4,137	2,345
Wheeling	7,169	916	550	313	331
Wilmette	28,268	18,162	17,226	7,814	2,300
Winnetka	13,368	12,105	12,430	6,694	1,833
Wood River	11,694	10,190	8,197	3,476	—
Woodstock	8,897	7,192	6,123	5,523	2,502
Worth	8,196	1,472	702	240	—
Zion	11,941	8,950	6,555	5,580	—

*Populations are reported as constituted at date of each census. †Part of Champaign township annexed to Champaign city Jan. 22, 1920. Population of Champaign city, including this annexation, 16,256. ‡Lincolnwood. Name changed from Tessville in 1935. ‖Skokie. Returned in 1940 as Niles Center.

Note: Dash indicates place did not exist during reported census, or data not available.

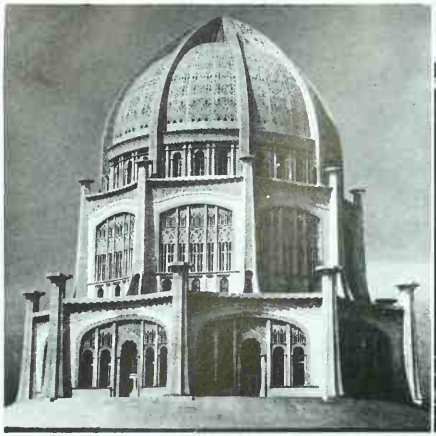


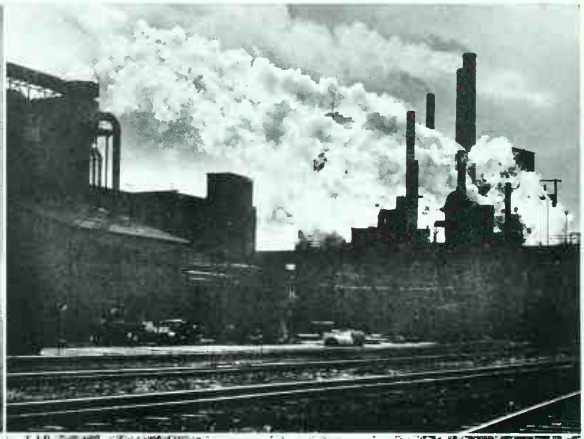
BY COURTESY OF (TOP LEFT) ROCKFORD CHAMBER OF COMMERCE, (CENTRE LEFT) INTERNATIONAL HARVESTER CO. FROM "HARVESTER WORLD," (BOTTOM LEFT, BOTTOM RIGHT) ILLINOIS DIVISION OF PARKS AND MEMORIALS, PHOTOGRAPH, (TOP RIGHT) A. DEVANCY, INC.

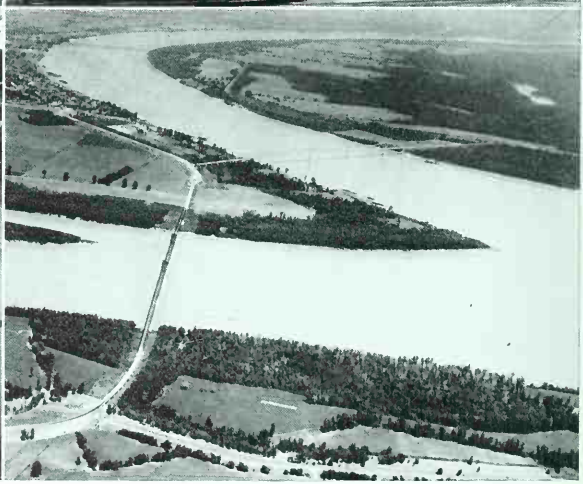
VIEWS OF NORTHERN AND CENTRAL ILLINOIS

Top left: Rockford, showing downtown area and the Rock river
Top right: State capitol at Springfield and statue of Abraham Lincoln
Centre left: Rolling farmland in Jo Daviess county near the Mississippi river. More than three-fourths of the land area in Illinois is in farms
Bottom left: New Salem State park, north of Springfield. Cabins are reproductions of homes built in New Salem village during the 1830s when Abraham Lincoln lived there
Bottom right: Nature trails at Matthiessen State park, LaSalle county

ILLINOIS







BY COURTESY OF (TOP RIGHT) A. E. STALEY MANUFACTURING CO., (CENTRE LEFT) ILLINOIS DEPARTMENTAL INFORMATION SERVICE, (CENTRE RIGHT) UNIVERSITY OF ILLINOIS; PHOTOGRAPHS, (TOP LEFT) LIL AND AL BLOOM FROM BLACK STAR, (BOTTOM LEFT) BENEDICT GELMAN FROM "SOUTHERN ILLINOISAN," (BOTTOM RIGHT) FAIRCHILD AERIAL SURVEYS, INC.

SCENES IN ILLINOIS

Top left: Baha'i temple in Wilmette, north of Chicago.
Top right: Corn processing plant at Decatur, central Illinois
Centre left: Fort Massac State park, near Metropolis in the southernmost part of the state. Statue is of George Rogers Clark (1752–1818) who crossed the Ohio river there in 1778 to capture Kaskaskia from the British
Centre right: Illini Union building, social and recreational centre of the University of Illinois at Urbana
Bottom left: Coal miners leaving the shafts at Elkville. Soft coal is mined in the southwestern section of the state
Bottom right: Confluence of the Ohio (top) and Mississippi rivers at Cairo

and the amount of liabilities and assets. An antitrust law of 1893 exempted from the definition of trust combinations those which were formed by producers of agricultural products and livestock, but the United States supreme court in 1902 declared the statute unconstitutional as class legislation. The employment of children under 14 years of age in factories or mines, as well as working employees under 16 years of age for more than 48 hours a week, is forbidden by statute.

Finance.—The cost of state government, by the late 1950s, exclusive of revolving funds and tax refunds, exceeded $900,000,000 annually. The state debt in the early 1960s totaled more than $300,000,000.

The revenue system employed by local units of government is based on the general property tax. There is local assessment of all real and personal property (except railroad property, which is state assessed). The basic revenue source of the state is the retailers' occupation or sales tax. Other state revenue sources include an indirect tax on corporations, motor vehicle licence and fuel fees, inheritance tax, beverage-liquor revenue tax, cigarette tax, pari-mutuel taxes, insurance fees and taxes, public utility gross receipts taxes as well as a number of miscellaneous fees and taxes. Faced with rising state expenditures in the second half of the 20th century and handicapped by an apparent constitutional prohibition of the graduated income tax and a reluctance to levy a general property tax, Illinois more frequently considered financing capital improvements through long-term bond issues.

The constitution also prohibits the state from lending its credit or making appropriations in aid of any corporation, association or individual, and from constructing internal improvements; counties, townships and other political units cannot incur indebtedness in excess of 5% of their assessed property evaluation. The legislature may not contract a debt of more than $250,000 except to suppress treason, war or invasion, unless approved by a vote of the people.

POPULATION

In the decade 1950–60, the over-all population of Illinois increased from 8,712,176 to 10,081,158 even though every county south of Springfield, except for counties surrounding the St. Louis, Mo., metropolitan area, and Effingham, Jackson and Massac counties, lost population. These losses were heavily concentrated in the extreme southern end of Illinois; Franklin, Gallatin, Saline, Pope, Hardin, Johnson, Pulaski and Alexander counties all had losses from 20% to 30%. The heaviest growth was in the Chicago suburbs, with Du Page county growing 102.8%, Lake up 64.0%, McHenry up 66.2%, Kendall up 44.8% and Will up 42.6%. A substantial portion of this suburban growth came from the city of Chicago, which lost 3.3% of its population, although as some moved out of Chicago, others moved in; particularly has the influx of southern Negroes been heavy. In that same decade a number of villages, some quite old, incorporated as cities, including Cahokia, Carpentersville, Morton Grove, Mount Prospect, Niles, Oak Lawn, Rockdale and Westchester, as did the village of Park Forest (dating from 1940) and the newly established Rolling Meadows (see *Table*); all but Cahokia were in the Chicago metropolitan area.

The population of Illinois in 1810 was 12,282; in 1850 it was 851,470; in 1900, 4,821,550; in 1950, 8,712,176 and in 1960, 10,081,158. This last figure represents an increase of 16% over the population in 1950.

The population per square mile in 1960 was 180.2, as compared with 154.5 in 1950, and with 49.6 for the U.S. in 1960. The urban population in 1960 which included, among other places, the thickly settled suburban area, or "urban fringe" adjacent to the 15 cities which had 50,000 inhabitants or more in 1960 amounted to 8,133,282 or 80.7% of the total.

The number of occupied dwelling units (or households) in 1960 was 3,084,738, as compared with 2,585,691 in 1950. The average population per household had declined from 3.4 in 1950 to 3.2 in 1960.

The population of the state was distributed by colour and nativity in 1960 as follows: 82.7% native white; 6.7% foreign-born white; and 10.6% nonwhite, practically all Negro. (Of the foreign-born white population in 1960, 13.7% was born in Poland, 12.8% in Germany and 10.5% in Italy.) There were 96.4 males per 100 females in the 1960 population, as compared with 98.3 in 1950. Of the population 9.7% was 65 years old or over; and 57.1% of the population 14 years old and over was in the labour force.

Of the total number of employed males, 4.4% were engaged in agriculture, 4.9% in construction, 31.8% in manufacturing, 5.4% in transportation, 18.0% in wholesale and retail trade and 27.0% in service industries, including professional, business and personal services.

EDUCATION

Public education in Illinois had its genesis in the land of the Northwest territory reserved for educational purposes by the ordinance of 1787. The first school law, which provided for state taxation for public schools, was enacted in 1825. Only a few schools were established under this act since the section providing for taxation was soon repealed. Free schools supported by the sale of land reserved for education and by local taxation were established as early as 1834.

A second state school law enacted in 1855 and providing for a state school tax is the foundation of the present Illinois public school system. The superintendent of public instruction was first elected in 1856. The Illinois constitution of 1870 required the legislature to provide a thorough and efficient system of public schools.

Elementary and High Schools.—The public schools are free to all between the ages of 6 and 21 and school attendance is compulsory for all children from 7 to 16 years of age. Between 1949 and 1959 enrollment increased by more than 500,000, to about 1,700,000; this additional school population resulted in nearly a 50% increase in the number of teachers employed.

Of the total public school funds about three-fourths comes from local sources and about one-fourth from state funds, exclusive of nonrevenue receipts and items of duplication. Average school expenditure per pupil (including local, state and federal as well as operations and equipment) has been rising steadily; it rose from approximately $375 in 1950 to about $600 in 1960. In the middle part of the 20th century there was an extensive consolidation of public school districts in Illinois, the number being reduced from almost 12,000 in 1945 to about 5,000 in 1950 and to about 1,700 by 1960. This consolidation was encouraged by state legislation authorizing county school surveys and limiting state financial aid to schools which could meet specific standards.

Public Universities.—In addition to the University of Illinois, the state provides for higher education at Southern Illinois university, Carbondale, and at four other state universities situated at Normal, Charleston, De Kalb and Macomb. The University of Illinois was founded in 1867 as the Illinois Industrial university, and received its present name in 1885; since 1870 it has been coeducational. The expansion of the university through the acquisition or organization of new colleges or schools began in 1896 when the Chicago College of Pharmacy became the University of Illinois school of pharmacy. Since that date important changes have been made. The university consists of colleges of agriculture, commerce, education, engineering, fine and applied arts, journalism, law, liberal arts and sciences, physical education, veterinary medicine and a graduate school; the school of social work; the institutes of aviation, government and public affairs, labour and public relations, all at Urbana; the colleges of dentistry, medicine, nursing, pharmacy and a graduate division, all at the Chicago professional campus; and an undergraduate division in Chicago which offers work in commerce, engineering, liberal arts and sciences and physical education.

In the middle part of the 20th century the growth of Southern Illinois university, established in 1869, was rapid; in the fall quarter of 1960 the enrollment was well over 10,000, more than triple the resident student enrollment of 1953. The main campus is at Carbondale; the university also has a campus at Edwards-

ville and residence centres in Alton and East St. Louis. The professional schools and their dates of establishment are agriculture (1955), applied science (1959), business (1956), communications (1955), fine arts (1955) and home economics (1957).

The four universities under the jurisdiction of the teachers college board are Northern Illinois university at De Kalb, established 1895; Western Illinois university at Macomb, established 1899; Eastern Illinois university at Charleston, established 1895; and Illinois State Normal university, at Normal, established 1857. Chicago Teachers college in Chicago (1869) is state supported and municipally controlled.

Private Colleges and Universities.—Illinois also has a number of distinguished private and church-related institutions of higher learning. Among the privately endowed institutions are The University of Chicago (*q.v.*); Bradley university at Peoria (1896); George Williams college in Chicago (1884); Illinois Institute of Technology, Chicago, established in 1940 by merger of the Armour Institute of Technology, founded 1892, and Lewis institute, founded 1896; Knox college at Galesburg (1836); National College of Education, Evanston (1886); Rockford college, Rockford (1847); Roosevelt university, Chicago (1945); School of the Art Institute of Chicago, Chicago (1866); and Wheaton college, Wheaton (1853). Roman Catholic colleges for women include Barat College of the Sacred Heart, Lake Forest (1904); College of St. Francis, Joliet (1874); Mundelein, Chicago (1930); Rosary, River Forest (1848); and Saint Xavier, Chicago (1846). Maryknoll seminary at Glen Ellyn (1949) and St. Procopius at Lisle (1887) are Roman Catholic men's colleges; De Paul university (1898) and Loyola university (1870), both in Chicago, and Quincy college at Quincy (1860) are Roman Catholic coeducational institutions.

Institutions affiliated with the Presbyterian Church are Blackburn college at Carlinville (1857), Illinois college at Jacksonville (1829) (also affiliated with the Congregational Church), Lake Forest college at Lake Forest (1857), Millikin university at Decatur (1901), Monmouth college at Monmouth (1853) and McCormick Theological seminary in Chicago. Illinois Wesleyan at Bloomington (1850), MacMurray college at Jacksonville (1846) and Northwestern university at Evanston (1851) are Methodist, as is Garrett Biblical institute, a seminary, at Evanston.

Other church-related institutions include Augustana college at Rock Island (1860), Carthage college at Carthage (1847) and Concordia Teachers college at River Forest (1864), all Lutheran; Aurora college at Aurora (1893), Advent Christian Church; Elmhurst, at Elmhurst (1865), Evangelical and Reformed Church; Greenville, at Greenville (1855), Free Methodist Church; North Central at Naperville (1861), Evangelical United Brethren; Northern Baptist Theological seminary at Chicago (1913), American Baptist convention; Olivet Nazarene at Kankakee (1907), Church of the Nazarene; The Principia college at Elsah (1898), for Christian Scientists; and Shimer college at Mount Carroll (1852), Episcopal. *See* also the various city articles.

Junior Colleges.—In addition to these four-year colleges Illinois in the early 1960s had 25 recognized junior colleges, 17 publicly controlled (of which 6 were branches of the Chicago Junior college) and 8 private. Among the latter is Lincoln college, at Lincoln, founded by the Cumberland Presbyterian Church and chartered in 1865, the only college named for Abraham Lincoln in his lifetime.

HEALTH AND WELFARE

The Illinois department of mental health supervises all state institutions concerned with the care and treatment of the mentally ill and mentally retarded. These include 13 state hospitals for the mentally ill, located at Elgin, Kankakee, Jacksonville, Anna, East Moline, Peoria, Chicago, Alton, Manteno, Galesburg, Tinley Park, the Illinois Security hospital at Menard and the Illinois State Psychiatric institute at Chicago. Schools for the mentally retarded are at Lincoln, Dixon, Centralia and Harrisburg. The department of mental health also operates 29 community mental health clinics and the Illinois State Pediatric institute at Chicago, a research institution for children under age six. In the early 1960s a program was begun to establish district hospital clinics, designed to serve as intensive treatment centres for those in need of psychiatric care, throughout the state. The Institute for Juvenile Research operates 17 child guidance clinics.

The department of children and family services operates nine residential educational institutions, among them the Illinois School for the Deaf and the Illinois Braille and Sight Saving school at Jacksonville, the Illinois Soldiers' and Sailors' home at Quincy, the Illinois Soldiers' and Sailors' Children's school at Normal and the Illinois Eye and Ear infirmary (in conjunction with the University of Illinois) at Chicago.

The department of public safety administers the penal institutions: branches of the state penitentiary at Joliet-Stateville, Pontiac and Menard, the state farm for misdemeanants at Vandalia and the State Reformatory for Women near Dwight. In addition to these institutions for adult offenders the legislature in 1953 authorized the creation of the Illinois Youth commission to administer the handling of juvenile offenders. The Youth commission administers four institutions: the Illinois State Training School for Boys near St. Charles, the Illinois State Training School for Girls at Geneva, the Illinois Industrial School for Boys at Sheridan and the Reception and Diagnostic Center for Boys at Joliet; the commission also administers nine boys' forestry camps.

THE ECONOMY

Agriculture.—Among the more important changes which took place in Illinois agriculture during the 20 years preceding 1960 were the pronounced increase in size of farms and the accompanying decrease in number of farms. The average farm size reached 185 ac. compared to 147 ac. in 1939. This change required almost complete mechanization and constant increases in capacity of equipment. The number of Illinois farms declined 22% during this period, largely the product of consolidating farms, but due in small degree to moderate reductions in total farm land. Land in farms increased slightly in the late 1930s and early 1940s, but then started a gradual decline amounting to about 4% after 1945. Urban development and new highways took the greater part of this land. Areas adjacent to large metropolitan communities were most affected, as in Cook county where land in farms declined 35% following World War II. The number of tenants on farms increased from about 92,000 in 1930 to more than 100,000 in 1935, but since then has fallen steadily, to fewer than 92,000 in 1940, fewer than 70,000 in 1950 and fewer than 60,000 in 1960.

Cereals are the main crop and corn (maize) is the leading product. The largest corn crop on record up to 1960 was that of 1959, when 673,350,000 bu. were produced from 10,050,000 ac. Illinois is also an important soybean-producing state and produces important quantities of wheat, oats, rye, barley and sweet corn for canning. Apples, peaches, strawberries, cherries, plums and other fruits are grown. The state also ranks high in the production of milk, chickens (including commercial broilers), eggs, cows and heifers two years old and over (milk cows) and ranks very high in the number of hogs. Sheep, horses and mules are of minor importance as compared with other states. Thirteen Illinois counties consistently rank among the 100 leading U.S. counties in the value of all farm products sold: McLean, De Kalb, La Salle, Iroquois, Livingston, Champaign, Henry, Bureau, Ogle, Kane, Vermilion, Whiteside and Lee.

Industry.—The growth of manufacturing in Illinois, largely because of the development of the state's exceptional transportation facilities, was the most rapid and remarkable in the industrial history of the United States. In 1850 the state ranked 15th; in 1870, 6th; in 1880, 4th; and by 1900 had become 3rd, but by 1960 had dropped back to 4th behind New York, Ohio and Pennsylvania. In 1904 the value added by process of manufacture was $570,285,000. In 1919, just after World War I, it was $1,929,125,000; in 1937 it reached $2,319,036,000; in 1947, $6,683,083,000; and in 1957, $12,363,458,000.

Illinois ranks high in the meat-packing industry, producing about 10% of the U.S. total in the 1950s. Manufacture of iron and steel products and of products depending on iron and steel as raw material is first in importance among Illinois industries, repre-

senting more than 50% of all Illinois manufacturing. The iron for these industries is secured from the Lake Superior region, the limestone and much of the coal from mines within the state. The position of Illinois in the heart of the agricultural section and its easy access to a bountiful supply of iron caused the state to become the chief producer of agricultural implements. The most important industries in terms of value added by manufacturing are machinery, food and kindred products, electrical machinery, fabricated metal products, primary metal industries, printing and publishing, chemical and allied products, transportation equipment, instruments and related products and stone, clay and glass products.

Chicago, with its tributary manufacturing suburbs of Maywood, Harvey, Cicero, Blue Island, Chicago Heights and others in Illinois, and Hammond and Gary in Indiana, is the great manufacturing centre of the state. A lesser manufacturing area has grown in the railway network that centres at East St. Louis, Collinsville, Granite City and Edwardsville; a third centre is formed by Moline, East Moline, Rock Island and Davenport, Ia. Rockford is best known for its furniture manufactures, Kewanee for boilers, Elgin for watches, Decatur for its corn products industry, Moline, Peoria and Springfield for agricultural and road equipment and Peoria for its distilleries.

Mining.—In mining and allied interests Illinois occupies an important place. The state ranks among the top ten both in the number of persons engaged in the mining industries and in the value of products mined. In addition, large quantities of minerals are imported into the state for processing. Coal constitutes the chief mineral product. The Illinois coal field, as a part of the eastern interior field, extends into Indiana and western Kentucky. At least 70% of this field lies in Illinois from the latitude of Rock Island south to the Illinois Ozarks. It covers more than 55 counties and approximately 35,000 sq.mi. of the land surface of the state. The number of mines and miners has been declining for nearly 40 years, the quality of the coal and the expansion in the use of other fuels being the basic cause for the decline. The peak year was 1918 with 89,979,500 short tons being mined. Petroleum, the mineral second in importance, was long known to exist in the state but was not seriously exploited until 1906, when the annual production reached 4,397,050 bbl. (42 gal.). The peak production year was 1940, a total of 147,647,000 bbl. being produced that year. In the second half of the 20th century annual production was about 80,000,000 bbl. from 32,000 producing wells. The producing area covers about 16,000 sq.mi. in the southern portion of the state. Clay products also are important. Limestone, dolomite, lime, cement, sand, gravel, tripoli, lead and zinc are other leading products. The quarrying industries are well distributed throughout the state and furnish not only stone for construction work but also limestone for agricultural purposes; the state is also a major producer of silica sand. Illinois has ranked as the leading state since 1842 in the production of fluorspar (fluorite).

Finance.—All general banking laws must be submitted to the people for ratification. Northern Illinois is in the 7th federal reserve district, with headquarters in Chicago, and the southern part in the 8th, with headquarters in St. Louis. Although Chicago is the banking and financial centre of the state the rest of Illinois is well served by a full range of national and state banks and other financial institutions. The system of state banks created by the act of 1887 operated under the supervision of the auditor of public accounts until 1957. In that year state banks, credit unions and similar organizations were placed under the supervision of the newly created department of financial institutions.

Transportation.—Transportation facilities have been an important factor in the economic development of Illinois. The first settlers used the waterways, some coming by way of the Great Lakes while others used the Ohio river. The first improved transportation facilities were the turnpikes and canals, undertaken in whole or in part by the state. The task of connecting Lake Michigan and the Mississippi river was accomplished by the state's building the Illinois and Michigan canal to La Salle, at the head of the navigation on the Illinois river, a work begun in 1836 and completed in 1848. In 1890 the sanitary district of Chicago undertook the construction of a canal between Chicago and Lockport, where the new canal joined the Illinois and Michigan canal. This work was opened in 1900, providing a waterway with a depth of 20 ft. for navigation between the above places; but from Lockport to Utica, on the Illinois river, a distance of 62 mi., there was no adequate means of water transportation. A legislative act of 1919 provided for the issue of bonds to the amount of $20,000,000 for the construction of an 8-ft. channel, the Illinois waterway, connecting the points mentioned. The bond issue was insufficient to complete the waterway, and the federal government in 1930 completed the original Lockport-to-Utica portion and extended the improvement from Utica to the mouth of the Illinois river. This improved waterway was opened to navigation in 1933. The federal government also had completed in 1907 the Illinois and Mississippi canal from Hennepin to the Mississippi river near Rock Island. Of these waterways, the Illinois and Michigan and the Illinois and Mississippi canals were little used by 1950. The Illinois waterway, however, experienced a substantial increase in tonnage. Fully opened to navigation in 1935, it carried a tonnage of 1,695,120 that year; annual tonnage reached 12,000,000 by 1950 and more than 24,000,000 by 1960. The completion of the St. Lawrence seaway greatly stimulated the expansion of the deep-water port of Chicago (*q.v.*).

Railways are a major means of transportation, although motor bus, truck and airlines have made heavy inroads into this field since 1930. With 11,349 mi. of railroads, Illinois in 1960 was second only to Texas. Between 1920 and 1960 little new mainline road was built and about 1,500 mi. of branch lines, including more than 150 mi. of electric railroad, were abandoned.

Civil aviation continued to develop in Illinois; in 1940 there were about 50 airports, 1,300 pilots, less than 1,000 private aircraft; in 1950 there were more than 150 certified airports, almost 10,000 registered pilots, more than 3,500 private aircraft; by 1960, there were about 125 public airports and more than 500 private landing strips, almost 14,000 registered pilots and almost 4,000 private aircraft. Through the department of aeronautics the state assists in developing public airports and conducts extensive air safety programs. Numerous airlines serve Illinois with scheduled service and a dozen Illinois cities are served by one or more airlines. In 1949 helicopter airmail service was inaugurated to suburbs in the Chicago area; by the 1960s inter-airport passenger helicopters were serving Midway and O'Hare airports and Meigs field in Chicago and the Gary (Ind.) airport.

The improvement of roads in the state of Illinois has been given marked attention. A state highway commission was created in 1905, and in 1914 state appropriations for hard roads were made from the proceeds of automobile licence fees. Actual construction was begun in 1914. Road building in Illinois is carried on under four distinct systems—the township, the county, the state and the city.

Acts of congress in 1916 and 1919, apportioning federal aid in behalf of roads, allotted Illinois $3,300,000 and $8,700,000, respectively. The question of issuing $60,000,000 in bonds based on automobile licence fees for the construction of 4,800 mi. of hard roads was submitted to the voters of the state in Nov. 1918 and was approved by them. A bond issue of $100,000,000 providing for the continuance of a state-wide system of hard-surface roads was approved by the people at the general election of 1924. In 1960 the state maintained about 14,500 mi. of highways of which about 13,000 were primary highways.

See also references under "Illinois" in the Index.

BIBLIOGRAPHY.—There is no comprehensive bibliography of the literature which relates to Illinois. Perhaps most useful is *A Handbook of Illinois History* by Paul M. Angle and Richard L. Beyer (1943).

The best general history of the state is the 5-volume work edited by C. W. Alvord, *The Centennial History of Illinois* (1918–20). This work consists of: vol. i, C. W. Alvord, *The Illinois Country, 1673–1818;* vol. ii, T. C. Pease, *The Frontier State, 1818–1848;* vol. iii, A. C. Cole, *The Era of the Civil War, 1848–1870;* vol. iv, E. L. Bogart and C. M. Thompson, *The Industrial State, 1870–1893;* vol. v, E. L. Bogart and J. M. Mathews, *The Modern Commonwealth, 1893–1918.* An introductory volume to this work is Solon J. Buck, *Illinois in 1818* (1917). Older standard histories which are still valuable are John Moses, *Illinois, Historical and Statistical,* 2 vol., 2nd ed. (1895);

A. Davidson and B. Stuvé, *Complete History of Illinois from 1673 to 1873* (1874); N. Bateman and P. Selby, *Historical Encyclopedia of Illinois* (1901). The best one-volume history is T. C. Pease, *The Story of Illinois,* rev. ed. (1949) and the Writers' Program, Illinois, *Illinois,* rev. ed. (1947) is also excellent. A picture history is James Monaghan, *This Is Illinois* (1949).

Much basic material about the state may be found in the *Journal of the Illinois State Historical Society* as well as its *Transactions* and *Occasional Publications;* the *Illinois Historical Collections;* and the University of Illinois, *Studies in the Social Sciences.* The *Blue Book of the State of Illinois,* edited and published by the secretary of state every two years, is the best source of current information about state government and officials.

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Current statistics on production, employment, industry, etc., may be obtained from the pertinent state departments; the principal figures, together with the current history, are summarized annually in the *Britannica Book of the Year,* American edition. (C. C. W.)

ILLINOIS, UNIVERSITY OF, an institution of higher learning in Urbana, Ill., was chartered as a land-grant college in Feb. 1867. *See* ILLINOIS: *Education.*

ILLITERACY. Illiteracy has usually been loosely defined in the past as inability to read and write. Since the discovery of methods of manufacturing paper and the invention of the printing press in the 15th century, illiteracy has declined at a more or less constantly increasing rate. By the end of the first decade of the 20th century, it had been largely eliminated in most countries of western Europe, in the major part of North America and in a few other areas of the world, but it was still widespread in Asia and Africa.

Extent of Illiteracy.—In *World Illiteracy at Mid-Century,* a report covering all areas of the world published in 1957 by the United Nations Educational, Scientific and Cultural organization (UNESCO), an effort was made to determine the extent of illiteracy among individuals 15 years of age and older; a summary of the findings appears in the table. When the data submitted did not cover the age specified, estimates were made through the use of general population data. Unfortunately the percentages reported are not comparable in all cases, due to the use of diverse sources of data and varying standards of literacy, but the report provides the most comprehensive information available and the findings are highly significant.

Estimated Population and Extent of Illiteracy in the World at Mid-20th Century, by Continents and Regions

Continent and region	Estimated population (in 000,000)		Estimated extent of illiteracy	
	Total (all ages)	Adult (15 years old and over)	Per cent of adult illiteracy	Number of adult illiterates (in 000,000)
World total*	2,496	1,587	43–45	690–720
Africa	198	120	80–85	98–104
Northern Africa	65	40	85–90	34–36
Tropical and southern Africa	134	80	80–85	64–68
America	330	223	20–21	45–47
Northern America	168	126	3–4	4–5
Middle America	51	30	40–42	12–13
South America	111	67	42–44	28–29
Asia	1,376	830	60–65	510–540
Southwest Asia	62	37	75–80	28–30
South central Asia	466	287	80–85	230–240
Southeast Asia	171	102	65–70	68–72
East Asia	677	404	45–50	180–200
Europe	393	293	7–9	22–25
Northern and western Europe	133	102	1–2	1–2
Central Europe	128	96	2–3	2–3
Southern Europe	131	95	20–21	19–20
Oceania	13	9	10–11	1
U.S.S.R.	186	112	5–10	6–11

From *World Illiteracy at Mid-Century,* published by UNESCO, Paris (1957); used by permission.

The striking fact revealed, even when minimal standards were generally used, is that from 43% to 45% of the adult population of the world, or approximately 700,000,000 persons, are wholly illiterate. About 75% of the world's illiterate population lives in Asia, about 14% or 15% in Africa, about 6.5% in the Americas and the remaining 4% or 5% in Europe, Oceania and the U.S.S.R. The largest number of illiterates are found in south central and east Asia and the highest percentages occur in Africa and in south central and southwest Asia.

According to the UNESCO report, the countries and other areas of the world having the least illiteracy were: 1% to 2%, St. Helena (Africa), Greenland, Austria, Channel Islands, Denmark, Faeroe Islands, Finland, Germany, Iceland, Ireland, Isle of Man, Liechtenstein, Netherlands, Norway, Saar, Sweden, Switzerland, United Kingdom, Australia and New Zealand; 2% to 3%, Japan, Czechoslovakia and Canada; 3% to 4%, United States, Bermuda, Belgium and France. The countries having the greatest extent of illiteracy (95% to 99%) were Angola, the former British Somaliland, Eritrea, Ethiopia, French Equatorial Africa (now the Central African Republic and the republics of Chad, Congo and Gabon), French Somaliland, French West Africa (now the republics of Guinea, Mauretania, Mali, Senegal, Ivory Coast, Upper Volta, Dahomey and Niger), Mozambique, Réunion, South-West Africa, Spanish West Africa (Ifni and Spanish Sahara), Aden, Afghanistan, Bhutan, Muscat and Oman, Nepal, Portuguese Timor, Saudi Arabia, Trucial Oman (Trucial States) and Yemen.

Functional Literacy.—The use of "minimal" standards of literacy—at the lowest end of the scale, mere ability to read and write one's name—served a valuable purpose for many generations. In the course of time, however, it became apparent that limited ability to read and write does not qualify adults to use reading and writing effectively in meeting many of the practical needs of daily life. To designate the higher level of competence required, the term "functional literacy" was proposed and has been used widely since. During its early use a functionally literate person was defined as one who is able to read and write as well as children who have had four full years of schooling.

With the adoption of this concept countries began to discontinue the use of traditional literacy tests when taking censuses and secured instead statements concerning the extent of schooling, a practice begun by the United States in 1940. This plan is supported by research which shows that there is a reasonably close correspondence, on the average, between last school grade attended and reading competence. Estimates of illiteracy are considerably increased when a higher level of reading ability is adopted as a standard. Using the 1950 census as a basis, Ambrose Caliver of the U.S. office of education calculated the percentage of adults in the United States 25 years of age and above who had received less than five years of schooling. His findings for the country as a whole showed that 11% of the adults in the United States were not functionally literate by that standard. The range of states was from 3.9% in Iowa to 28.7% in Louisiana. By the same standard about 55% of the population of the world 15 years of age and older is functionally illiterate.

Further adjustments in literacy standards may be desirable, for two reasons. First, such groups as army officials, directors of industrial and commercial organizations and members of national literacy conferences have criticized fourth-grade standards as wholly inadequate to meet contemporary needs; for example, the U.S. census for 1940 showed only 4% of the population to be illiterate, yet during World War II the U.S. Armed Forces institute found it necessary to establish a literacy training program. These groups recommended as a minimum sixth- or eighth-grade, or even higher, standards. On the other hand a uniform level of literacy is not equally appropriate for all areas of the world. Thus a person may be defined as functionally literate "when he has acquired the knowledge and skills in reading and writing which enable him to engage effectively in all those activities in which literacy is normally assumed in his culture or group." (*The Teaching of Read-*

ing and Writing: An International Study, by William S. Gray, page 24, UNESCO, Paris, 1956.)

Reduction of Illiteracy.—In the 20th century, and particularly after World War II, efforts to eliminate illiteracy were greatly accelerated. The movement was stimulated by the urgent need for broader understanding among citizens of newly established nations, particularly those where suffrage was being widely extended, and by the problems posed by technological and economic developments. National literacy campaigns were carried on with great vigour; those in Turkey, the U.S.S.R. and China were particularly notable. In some countries orthographic and other reforms were introduced (*see*, for example, TURKISH LANGUAGE) and in almost all countries the system of elementary education was enlarged. Paralleling these developments new approaches to literacy training were developed among groups which had previously been deprived of such opportunities. Among the leaders in this effort were James Y. C. Yen of China, Lorenco Filho in Brazil, Jaime Torres Bodet in Mexico and Frank Laubach, an American-born missionary. In addition to its promotional activities, UNESCO has conducted certain practical programs in collaboration with its member states. Two important ones are the International training centres: the Arab States Fundamental Education centre (ASFEC) in Egypt, serving the Arab states of the middle east, and the Regional Training Centre for Teachers of Fundamental Education (CREFAL) in Mexico, serving all of Latin America.

The influence of the foregoing developments on methods of teaching adults to read has been very significant. Prior to 1950 highly specialized methods of two general types were used widely in achieving the limited goals sought. One type was synthetic in character and began by teaching the sounds of letters which were then used in the recognition of new words. The other type was analytic in character and began by teaching whole words which were later used in identifying the sounds of letters. As the concept of functional literacy emerged, the view spread that good teaching should cultivate a thoughtful reading attitude, a clear grasp of meaning and interest in independent reading as well as the skills of word recognition.

When a world-wide study of methods of teaching adults to read was made for UNESCO between 1952 and 1955 it was found that they still differed widely in character. They varied from the formal use of synthetic or analytic methods to broadly conceived programs of teaching which emphasized all the interests, attitudes and skills essential on the part of a good reader. A detailed study of the relative merits of the different methods used revealed the following facts: (1) that no single, highly specialized method secures superior results; (2) that the use of a given method promotes growth in whatever aspect of reading it emphasizes, such as skill in word recognition or a clear grasp of meaning; and (3) that best results are assured when the methods used emphasize all essential aspects of reading.

Stimulated by the results of the UNESCO study, and other reports, wide experimentation was undertaken in various parts of the world to develop improved programs of teaching. Resulting trends were well illustrated by the findings of a study of primers printed in 30 languages and used in six countries of the Americas. The outstanding finding was not the diversity but the uniformity of methods. Almost without exception the primers were eclectic in nature, even though based on different approaches. The essential principles of primer construction, as demonstrated by field testing, are the gradual introduction of new elements and provision for growth in ability to read independently, to understand what is read and to read fluently. Although methods of developing word recognition must of necessity vary with the nature of the language involved, the foregoing report indicated progress toward the establishment of sound patterns of literacy teaching.

Reference should be made also to experimental use of television as an aid in reducing illiteracy. Beginning about 1958 the Foundation for World Literacy, sponsored by the Memphis (Tenn.) Chamber of Commerce, began the use of telecasts based on materials prepared by Laubach. Measures of the progress made during a year showed that those who learned with reasonable ease or had previously made some progress in learning to read profited from the instruction thus provided. Those who learned less rapidly were unable to keep up with the work and discontinued their efforts. The experiment showed that the use of television might be of great value in the fight against illiteracy, but much experimentation was needed in order to learn how it might be used most effectively either alone or in co-ordination with other modes of instruction.

As the requirements for literacy have expanded, short-term courses which were formerly given to meet "minimal" standards have been greatly modified and enriched. Of great importance also is the fact that they are being extended to enable motivated and capable illiterate adults to gain admission to the regularly established educational institutions of a country, thus facilitating upward intellectual and cultural mobility.

See also ADULT EDUCATION; READING.

BIBLIOGRAPHY.—UNESCO publications include: *World Survey of Education* (1950), *World Illiteracy at Mid-Century* (1957) and *The Teaching of Reading and Writing: An International Survey* (1956). *See*, in *Yearbooks* of the National Society for the Study of Education, "How Well Do Adults Read," *Adult Reading* (1956), "World Literacy: Its Status and Problems," *Community Education: Principles and Practices from World-Wide Experiences* (1959), and *Fundamental and Adult Education*, xi, no. 2 and no. 3 (1959). *See* also *Report on the Situation in America as to Illiteracy*, published by the Committee for Cultural Action of the Inter-American Council, Pan American Union (1957). (W. S. GY.)

ILLUMINATED MANUSCRIPTS. Illumination, in art, is a term applied to the embellishment of written or printed text or design with colours or gold and, rarely, with silver. The old form of the verb "to illuminate" was "to enlumine," and 13th-century laymen who practised the art were called "enlumineurs." While the term should strictly be applied to the brilliant book ornamentation which was developed in the middle ages, it has been extended, by usage, to the illustration and decoration of early manuscripts in general, and can be extended to include monochrome drawings in manuscripts.

Illumination is found in three main portions of the page: the initial, which may be "historiated," *i.e.*, contain within it narrative scenes, or "decorated"; the border, whose decoration may be confined in a band or may spill freely over the margin; and thirdly, in actual pictures with or without a frame, interrupting the text and sometimes occupying a whole page. All these forms of decoration are called miniatures, a word derived from *minium*, the red lead (alternative name *rubrica*) used by the rubricator (often a separate person from the scribe) who illuminated titles and the first lines of columns or chapters in red (or sometimes blue). Miniatures on papyrus were painted in water colour but on parchment a form of egg tempera was used; gilding was applied, either gold leaf or powdered gold, the former giving a shiny effect when burnished, the latter having a dull surface.

The production of precious illuminated manuscripts survived the introduction of printing by nearly a century (*see* BOOK). Generally speaking, the art of decorating manuscripts did not create new forms through a development based on writing, but rather it took over pictures and ornament from other forms of art, in particular from monumental painting. (The word "monumental" is used throughout this article to distinguish paintings in the ordinary sense from miniature paintings.) On the whole painting in manuscripts develops parallel with monumental painting of the same period; at certain crucial periods in the history of art manuscript miniatures constitute the main evidence for the transmission of styles. This is true of late antique art, some of whose phases of transition into Byzantine and Romanesque art can best be studied in illuminated manuscripts. It is true also of 15th-century Flemish art, whose sudden efflorescence in the monumental painting of Jan Van Eyck would be inexplicable without reference to the continuous development of Flemish painting that had preceded it in manuscripts.

LATE ANTIQUE AND EARLY BYZANTINE ILLUMINATION

Illumination in Antiquity.—The earliest surviving examples of manuscripts accompanied by painted illustrations are Egyptian papyrus rolls of the 2nd millennium B.C., and they may

have existed in Egypt long before this date. The *Book of the Dead* (*see* EGYPT: *History: Ancient Religion* and BOOK), of which innumerable versions on papyrus rolls were found in tombs, was illustrated, sometimes with drawings of a rather schematic kind in monochrome, at other times with water colours of great delicacy and brilliance such as those of the Hunefer papyrus in the British museum (Pap. 9901). No illuminated manuscript in Greek has been found dating from before the 4th century A.D. although they may have existed before then. The earliest example is a fragmentary 4th-century Roman copy of the *Iliad* of Homer in the Ambrosiana library, Milan (Cod. F.205, inf.), with 58 miniatures in a naturalistic style deriving probably from Hellenistic originals. By this time the codex, introduced in the 2nd century, had supplanted the roll as the book form, and during the 4th century also parchment (*q.v.*) came into use, permanently replacing papyrus. Another important manuscript from the 4th century is the Roman Virgil in the Vatican (Cod. Vat. Lat. 3225) which contains vivid little scenes in which the perspective is that of a "bird's-eye" view. In both these manuscripts the illuminated portion is contained within a frame and fitted into spaces predetermined by the scribe, across the column of writing.

Illuminated secular manuscripts included other than literary subjects; there is an important herbal of Dioscorides written and illuminated in Constantinople in the early 6th century in which the plants are drawn with great exactitude and finesse (Vienna, Cod. Med. Graec. 1).

Manuscripts of Christian subjects were produced at the same time as those of classical literature (and emerged from the same scriptoria) in a style which in the 4th century at any rate was not distinct, being equally determined by paintings of the late antiquity, based on Hellenistic models. The close resemblance between the Vatican Virgil and the Quedlinberg Itala fragment (a Christian text) in the Berlin State library suggest that they may have come from the same scriptorium in the Western Empire. An early custom, derived from late antique art, was the insertion at the beginning of each book of the Gospels of a picture of the evangelist writing it. This practice was carried on through Byzantine channels into the Italian manuscript tradition. It occurs in the 6th- or 7th-century Gospel now in Rossano, southern Italy, written and illuminated in or near Constantinople in silver and gold on purple parchment. A further development of the style of the Vatican Virgil is seen in the 6th-century Byzantine *Genesis* in Vienna (Vindob. Theol. Gr. 31) in which the strongly modeled figures are set in a vaguely adumbrated landscape.

The pen drawings which illustrate the 5th-century Coptic manuscript of the Old Testament in the National Library of Naples (MS I.B.18) derive unmistakably from Hellenistic originals. An evangelary written in the 6th century by a scribe called Rabula in northern Mesopotamia (Florence, Laurentian library MS Plut. 1, 56) shows forms of Hellenistic art under Syrian influence and prefigures later Byzantine art. Several manuscripts from this period of transition from the forms of late antiquity to the Byzantine style (6th–7th century) are hard to assign definitely to Constantinople rather than to Byzantine dependencies in Asia Minor or Syria: this applies to the Vienna Genesis and to another manuscript of the same period, also in gold and silver on purple, the Sinope Gospels (Paris, Bibliothèque Nationale, suppl. gr. 1286).

The important 6th-century manuscript of St. Augustine's Gospels at Corpus Christi, Cambridge (Cod. 286), which was probably executed in lower Italy, bears witness to a survival of late antique and early Christian art in the west. The Ashburnham Pentateuch at the Bibliothèque Nationale is of a different type: its 19 miniatures are stylistically and iconographically unique and indicate a connection with oriental models. (*See* BYZANTINE ART: *First Period: Manuscript Illumination.*)

LATER BYZANTINE ILLUMINATION

Post-Iconoclastic Byzantine Illumination.—The development of Byzantine illumination can be traced more clearly after the iconoclastic controversy of the 8th and 9th centuries. As art flourished again, the works of the "Byzantine renaissance," as it is called, began to be produced. To this renaissance belong those splendid codices in which works of late antique or early Christian times were transmitted, partly in accurate copies, partly in free imitations. Two examples are the Joshua Roll (Palat. Gr. 431 in the Vatican library), and the 10th-century Psalter at Paris, the inspiration of whose miniatures is clearly pagan, although the subjects are Christian (Paris, Bibliothèque Nationale, Cod. Gr. 139). On the other hand, typical middle Byzantine illumination modeled its style on monumental art (*see* BYZANTINE ART: *Golden Age: Manuscript Illumination*).

Although Constantinople determined the trend of artistic production, illumination was also cultivated outside the capital. As practised in the monasteries of Athos, its importance was far-reaching. From the 11th century a school of miniaturists developed in Russia, the works of which are, at first, scarcely to be distinguished from those of Byzantium. The menology of Basil II at the Vatican (Cod. Vat. Gr. 1613) is the only Byzantine manuscript in which the miniatures are actually signed by the eight artists. The style in the later works, and especially in the productions of the monasteries, became dry, but it persisted through the Latin conquest (1204–61) and was capable of a rebirth after the restoration of the empire under the Palaeologues (1261).

WESTERN ILLUMINATED MANUSCRIPTS FROM THE 7TH–14TH CENTURY

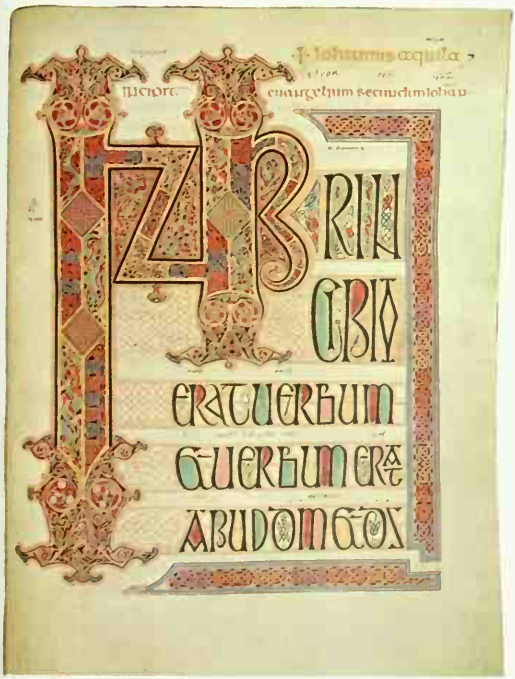
Frankish and Lombardic Illumination.—The mass of the manuscripts produced in the monasteries of the Frank and Lombard kingdoms in the 7th and 8th centuries have quite a different character from late antique manuscripts in the western empire. Among the large number preserved only a few have figurative representations. Illuminated Bibles or Gospels are scarce. Ornament, in general, is restricted to initials and decorated pages, a method of embellishment based on the art of the scribe, not of the painter. Compared with the simplicity of the text in late antique manuscripts, it is a complete revolution. Part of the material originated in upper Italy and south France, apparently in the early 7th century. Later, the art was transplanted to central and northern France. The majority of the manuscripts, and especially those richest in decoration, came from north France in the latter half of the 8th century; *i.e.*, not until the Irish and Anglo-Saxon arts of illumination were already highly developed.

England.—Two fundamentally different English schools must be distinguished, the Northumbrian and the southern English. By the time Irish missionaries reached Northumbria, missionaries from Europe had already established monasteries there, and the interaction of these two influences produced a school of miniature painting supreme in Europe throughout the 7th century. The splendid Lindisfarne Gospels, written about the beginning of the 8th century (British museum, Cotton Nero D VI) are attributed to Northumbria. They show an extraordinary fusion of Irish, classical and Byzantine elements.

The development in the south was determined by the Roman mission and by the close relations kept up between the Italo-Saxon churches and monasteries and Rome itself. The most important works of the Canterbury school are St. Augustine's Psalter (British museum) and the Codex Aureus in Stockholm (Royal Library Manuscript A35).

Ireland.—In Ireland during this period illumination achieved a climax never again reached. The two chief Irish works are the Book of Durrow (Dublin, Trinity college, A. 4, 5) and the Book of Kells (Dublin, Trinity college, A. I, 6). The Book of Durrow (*c.* 700) is pure Irish in style. The Book of Kells (for which the date 700 has been disputed in favour of a later period) shows traces of foreign ornamental ideas. Irish artists did not attempt naturalistic representation but made the figures of a picture as free as if they were calligraphic designs, so that it is often difficult to see what these plaited figures really mean. This anti-naturalistic method of representation stands in sharp contrast to the whole range of classical antique art in all its derivations. Irish manuscripts show a richness of decoration unparalleled, so far as is known, up to that time. The various Gospels are preceded by whole pages with carpetlike designs and the initials at the beginning of the text grow and spread until they, too, cover the page.

The attack on Ai (Josh. 7: 3–5), from the Joshua Roll;
Byzantine, 10th century. The Vatican library



First page of St. John's Gospel from the Lindisfarne Gospels; English, written about the beginning of the 8th century and attributed to the Northumbrian school. British museum

The opening words of St. Mark's Gospel, "Initium evangelii Ihu Xpi," which fill the whole page, from the Book of Kells; Hiberno-Saxon, 8th century. Trinity college, Dublin, Ireland

BYZANTINE AND EARLY WESTERN ILLUMINATION

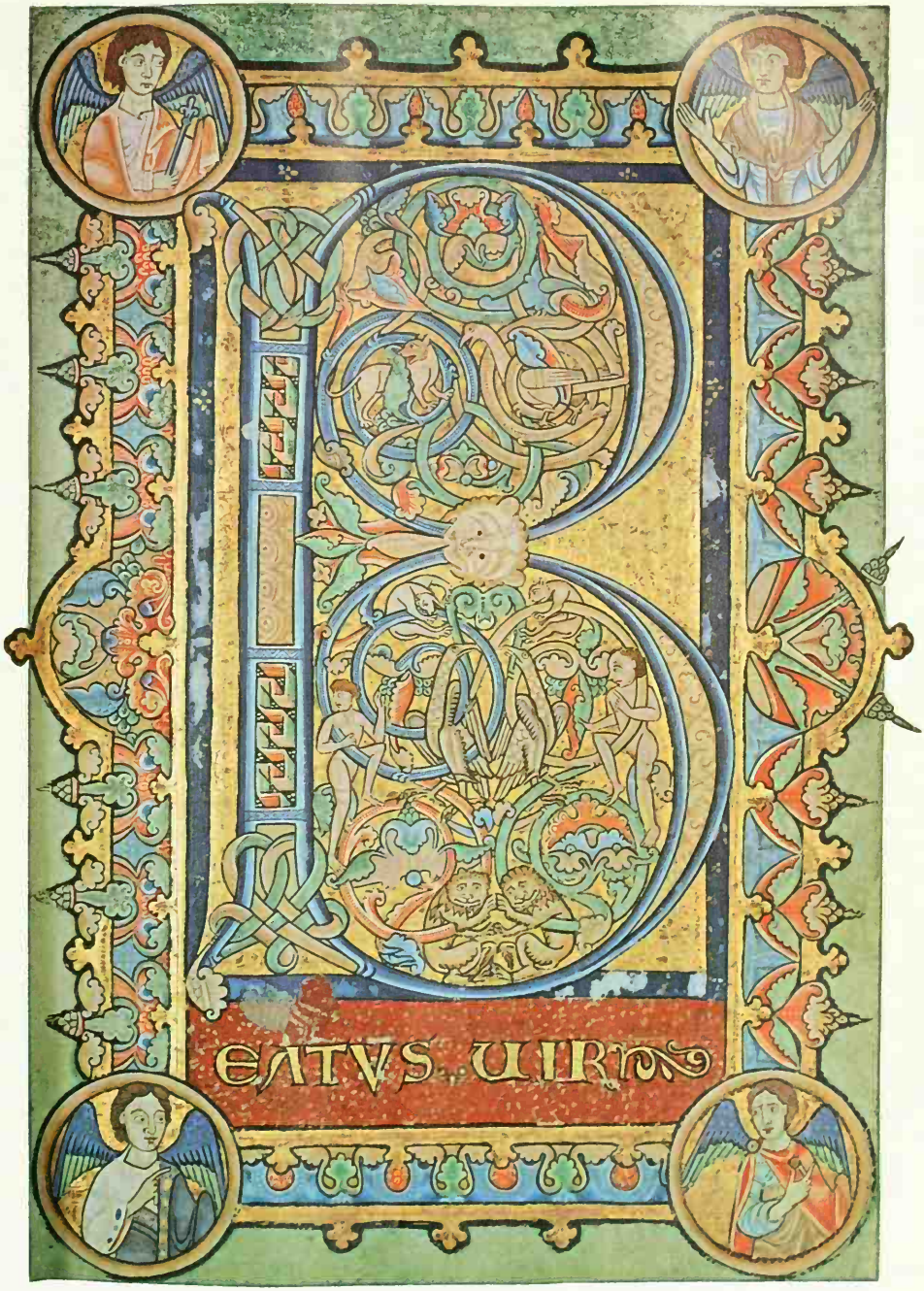
BY COURTESY OF (TOP) BIBLIOTECA APOSTOLICA VATICANA, (BOTTOM LEFT) THE TRUSTEES OF THE BRITISH MUSEUM, PHOTOGRAPH, (BOTTOM RIGHT) THE GREEN STUDIO, DUBLIN, BY PERMISSION OF THE BOARD OF TRINITY COLLEGE, DUBLIN

ILLUMINATED MANUSCRIPTS

Initial "B" at the beginning of the Psalms, showing David slaying a bear and a lion, from the Winchester Bible. English, 12th century

12TH-CENTURY HISTORIATED INITIAL

BY PERMISSION OF THE DEAN AND CHAPTER OF WINCHESTER, PHOTOGRAPH E. A. SOLLARS, WINCHESTER

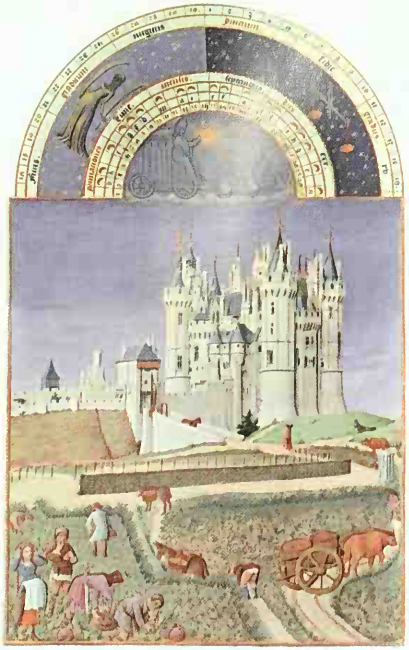


Initial "B" of the Beatus page, from the York Psalter. English, 12th century. University of Glasgow, Scotland

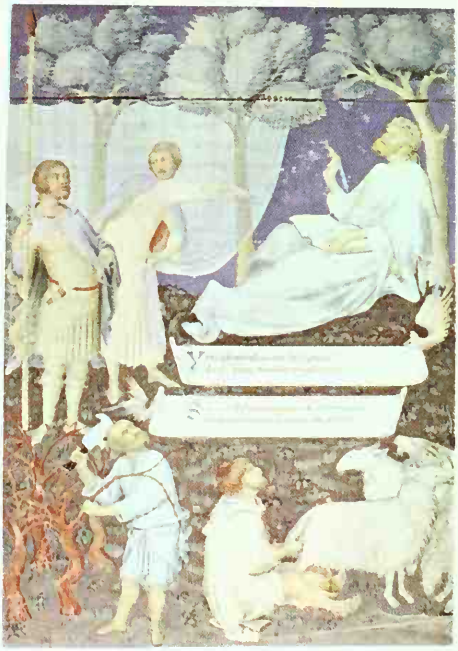
12TH-CENTURY DECORATED INITIAL

BY COURTESY OF HUNTERIAN MUSEUM, UNIVERSITY OF GLASGOW. PHOTOGRAPH: STUDIO SWAIN, GLASGOW

ILLUMINATED MANUSCRIPTS

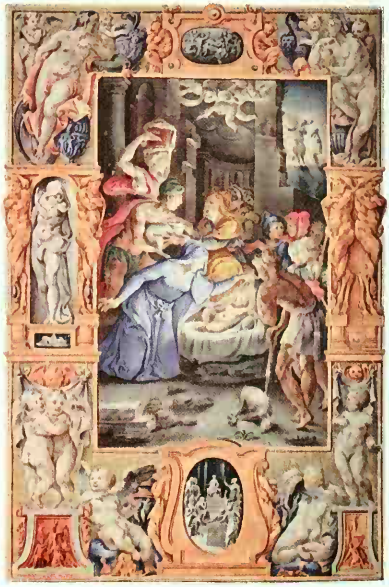


"Grape Harvest," illumination for the month of September from the Chantilly book of hours, *Très riches Heures du duc de Berry*, executed by the Limburg brothers. Flemish, 15th century. Musée Condé, Chantilly, France



"Virgil and His Characters," an illumination by Simone Martini (*c.* 1284–1344) from a manuscript once owned by Petrarch. Italian, 14th century. Ambrosian library, Milan, Italy

St. Luke from the Sforza book of hours written for Bona of Savoy, widow of Galeazzo Maria Sforza (1444–76), duke of Milan. Italian, 15th century. British museum



The "Adoration of the Shepherds" by Giulio Clovio (1498–1578) from the book of hours of Cardinal Alessandro Farnese. Italian, 1546. Pierpont Morgan library, New York city

14TH–16TH-CENTURY EUROPEAN ILLUMINATION

BY COURTESY OF (TOP LEFT) MUSÉE CONDÉ, CHANTILLY, (TOP RIGHT) BIBLIOTECA AMBROSIANA, (BOTTOM LEFT) THE TRUSTEES OF THE BRITISH MUSEUM, (BOTTOM RIGHT) PIERPONT MORGAN LIBRARY, NEW YORK. PHOTOGRAPH, (TOP LEFT) GIRAUDON, PARIS

Carolingian Manuscripts.—Simultaneously with the reform of writing, a project of Charlemagne, there arose a number of new schools of painting which aimed at restoring the connection with antique and early Christian art. The chief works probably were not created before the beginning of the 9th century. They include the Gospel book of Ada (Charlemagne's sister) at Trier (Municipal Library Manuscript 22), after which all these works are called the Ada group; the group was produced at the Palatine school of Aix-la-Chapelle. These manuscripts include rich canon tables, pictures of the evangelists and of their symbols under large arcades, symbolic representations of the church, the fountain of life, etc. Obviously there is an ancient pictorial tradition, which can be traced on one side to Syria and on the other to Italy and England. The colouring is varied and splendid, the figures dramatic in movement, the faces fine and full of expression and the outlines of the figures rich in style. On the whole, the treatment, with its sharp and clear outlining of form, shows more of the spirit of drawing than of painting. All this points to models of high artistic importance.

In decided stylistic contrast to the Ada group are other manuscripts issuing from the Palatine school of Aix-la-Chapelle. Its chief work, the Gospel book of Charlemagne, is preserved among the crown treasures at Vienna. The treatment is altogether pictorial; the colouring is fine, simple and not too varied. The plain style of embellishment, with the greatness of conception in the figures and the soft pictorial treatment, point to early Christian models. This tendency is continued chiefly in the so-called school of Reims, where a Gospel book at Epernay town library was made for Ebbo of Reims (816–35). There are significant changes of style, however; the broad pictorial technique has made room for a hatched treatment, which has led to the supposition that the artist was accustomed to using a drawing pen. The style is expressed in the Utrecht Psalter, which influenced later Anglo-Saxon work, and which subsequently exercised a strong influence on development in England. The Utrecht Psalter (Utrecht University library) is at once the most subtle and the strangest production of Carolingian art. The composition with landscape like stage scenery is reminiscent of early Christian models. There can be no doubt that the Utrecht Psalter has some direct connection with early Christian art. Nevertheless, it is essentially a creation of Carolingian times. The school of Tours was at its prime toward the middle of the 9th century under the lay abbot Count Vivian. The Gospel book destined for the emperor Lothair is the most important work (Bibliothèque Nationale Lat. 266). The Tours manuscripts took from early Christian models a large number of Bible illustrations and introduced them into medieval art. A quite distinctive style marks the works of the Franco-Saxon school. It shows, unmistakably, a continuation of the Irish and Hiberno-Saxon school enriched by Carolingian elements. Its strength is based entirely on ornament and it is notable for having spread the art of the initial as developed in England and Ireland.

Anglo-Saxon Illumination.—Anglo-Saxon illumination began to flourish once more under King Edgar (*c.* 960). The new style, based on Carolingian art, suddenly made its appearance completely developed in the works of the Winchester school. It is one of the most original and attractive in the whole range of medieval art. The artist was not satisfied with normal movements of the neck or head, so the line of the neck is unnaturally prolonged and curved; the draperies appear as if driven by a gale of wind, and end in fluttering points; the seams are broken into numberless small folds. From the standpoint of correctness, fault might be found with these figures, but as the expression of immense spiritual force they excite wonder. Anglo-Saxon art, too, reaches its climax when it dispenses with painting in thick colours and contents itself with sketchlike drawings, which may be tinted with various light colours. The chief work of the early period is the Benedictional which Bishop Aethelwold (963–984) caused to be written by the scribe Godeman (British museum Add. 49598).

One of the most important seats of Anglo-Saxon art was at Canterbury. A copy of the Utrecht Psalter (British museum Harley 603) was made there about 1000 (though added to in the 10th and 11th centuries). More than three hands worked at it, so it must have been made in a large scriptorium. The Anglo-Saxon style remained full of life until the middle of the 11th century and actually survived into the 12th. It was not confined to England; during the 10th century it crossed the channel to France, where the style appears in many works in such freshness and spontaneity that it seems likely that Anglo-Saxon artists had emigrated there. Of this type is the Evangelary (Boulogne library, No. 11) written at the Abbey of St. Bertin. In northern France, side by side with the illuminations influenced by the Anglo-Saxons, other manuscripts were created which are independent in style and full of intense expression.

Ottonian.—The Ottonian renaissance flourished in Germany during the late 10th and early 11th century. Its political background was the renewal of the Holy Roman empire by Otto I. Within a few decades an abundance of magnificent manuscripts was produced, which can be ascribed to a number of different schools, some using Carolingian, others early Christian models. Middle Byzantine art, too, begins to exercise influence at this period. Most pictures in the Ottonian manuscripts spring from these sources. All the schools, however, were very creative in ornament. They used whole page illuminations with purple ground and richly formed initials of golden foliated branch work, similar to those found occasionally in Carolingian times, especially in the Metz school. The works of the golden age of Ottonian art approach the illusionistic conception of the late antique. But at the beginning of the 11th century painting became less three-dimensional, the background of the pictures being divided up by ornamental and coloured stripes, for which the Byzantine gold background was occasionally substituted. The most prominent centres of artistic activity were the monasteries of Reichenau, situated on an island in Lake Constance, Trèves, Cologne, Hildesheim, Corvey, Fulda and Ratisbon.

Romanesque.—Illumination at the middle of the 11th century was at a turning point. Anglo-Saxon schools and the German Ottonian renaissance were dying out, and so the connection with antique painting disappeared. From then onward in the whole of the west the style was based on linear drawing, in which colour was used to tint the surfaces in the flat, with only slight modeling of forms. Artists abandoned the last reminiscences of the illusionistic manner of the late antique, in which the picture was based on objects either seen or visualized. The medieval style, which then established itself, dispensed with illusion, and gave the different components of the pictures, *i.e.*, the figures and whatever else was necessary to understand the action, but released them from contact with natural space. Even the background had a chiefly ornamental importance. The gold ground became more and more popular; borders and backgrounds consisting of a system of frames were also used. This manner of representation permitted the artist to pack the most complicated ideas into a picture and create the corresponding frame to hold the conceptions together. This tendency completely dominated the art of illustration. A counter movement was Byzantine art, which never altogether lost contact with the antique, preserving formulas from the illusionistic age. In the 12th and 13th centuries Byzantine influence penetrated farther and farther into Italy and obtained a strong hold in Germany.

In the west of Europe, especially in northern France, in Burgundy and in England, Byzantine influence may also be traced. Stained glass, with all its beauty of colour, is also based on outline drawing, rather than real modeling. It had an extremely strong influence on the method of painting, described above, in which numerous figurative representations were combined within a system of frames. In the 12th and, especially, the 13th centuries, many illuminated manuscripts show traces of having been imitated from stained glass.

Anglo-Norman.—Soon after 1100 Anglo-Norman scriptoria were at the height of their power. Their productions were chiefly enormous Bibles, separate books of the Bible with commentaries and especially the Psalter. The Anglo-Saxon lightness was not yet completely abandoned but heavier, more Romanesque figures with flat opaque colours became the fashion. Initials became astonishingly rich in invention and design, enlivened with numerous fan-

tastic forms of men and animals in strange colours.

St. Albans and Bury St. Edmunds were dominant centres in the first half of the 12th century and Winchester in the second half. The level of quality at Canterbury was more sustained if less momentous. The St. Albans Psalter and the Bury, Lambeth and Winchester Bibles are splendid examples of English art of the period. Toward the end of the century well-proportioned forms of measured placidity and solemnity of movement became more characteristic of these pictures. Of the greatest importance is the final copy of the Utrecht Psalter (Bibliothèque Nationale Lat. 8846).

France and Netherlands, *c.* 1100–1200.—An important scriptorium rose at Cîteaux in Burgundy, the founder of which was Stephen Harding (abbot 1109–33). Here, the inspiration was English. Numerous manuscripts with most peculiar decoration, especially initial letters of quite fantastic formation, emanate from Limoges and western France. The productions of monasteries in the southern Netherlands and northern France are extraordinarily numerous. Some of these are dated and indicate the names of the artists. In the eastern part of this territory, a style approaching the Rhenish predominated, while toward the west, where the narrowness of the straits provided a natural connection with England, the Anglo-Norman affinities already mentioned made their appearance.

In these districts, also, the presence of strong Byzantine influences, increasing in the second half of the 12th century, can be established.

Germany, 12th–13th Century.—In Germany the development of art, after the Ottonian renaissance, varied in the different territories. In the southeast, the Middle Byzantine influence, already perceptible in the early 11th century, became permanent.

In the western and northern districts of Germany, Byzantine influence was not so powerful in the 12th century. One work, however, the famous *Hortus Deliciarum* of the abbess Herrad of Landsberg in Alsace, was unique for the unusual illuminations it contained. (The original perished in 1870.) Pure pen drawing had become prevalent. On the lower Rhine, in north Germany and in Weingarten (Berthold Missal, Pierpont Morgan library, New York) some miniatures were executed in body colour. These are clear and calm in style, and at times they rise to monumental dignity, *e.g.*, in the Gospel book of Henry the Lion made at Helmarshausen, or the Hildesheim manuscripts of the 12th century (Hildesheim, Ratman Missal, etc.).

With the beginning of the 13th century Byzantine influence extended its power over almost all Germany, and its style displays great restlessness. In the latter part of the 13th century the desire to create original forms and to express passionate feeling was so strong that the style was often positively distorted. The Byzantine tendency attains its zenith in the Gospel book of the town hall at Goslar and the related miniatures in Halberstadt, executed in the first third of the 13th century. Immediately after the middle of the 13th century numerous fine works were produced especially in south Germany, where refined Byzantinesque style, mixed with the court style of Paris, predominated (Psalter, Munich Staatsbibliothek Lat. 3900 and the Gospels of Aschaffenburg, Staatsbibliothek Manuscript 3).

The Gothic Style.—In the first half of the 13th century, in conjunction with the rise of the international Gothic style in all spheres of art (*see* GOTHIC ART), there was a complete transformation of the fundamental ideas of book ornamentation. A refined and dainty style was cultivated which often contrasted with contemporary monumental painting of the period (although it sometimes approximated in its effects to stained glass of the period). Picture and text were more closely assimilated, and the historiated initial became predominant in Gothic manuscripts. When the miniature remained independent, it bore the character of a small medallion or of a quatrefoil. The initials, however, expanded more and more until they twined themselves all round the pages of text. Figures dispersed at random in the margin, called drolleries, introduced a new style of embellishment on which all development to 1500 was founded. Paris is regarded as the birthplace of this new style, which was to oust all the previous tendencies in France and England, and was created under the strong influence of monumental art in Paris about 1240. Its chief works are the Psalters written for St. Louis or other members of the royal family (Bibliothèque Nationale Lat. 10525) and the liturgical manuscripts executed for the Ste. Chapelle, Paris. These works combine two qualities: first, the greatest simplicity of style, in that they work out the pure Gothic line; second, a markedly figurative treatment of ornament and in architectonic details, in costume, etc. It is very difficult to distinguish between French and English work of this period. In spite of numerous English traits the Psalter of the municipal library at Nürnberg and the Psalter of Queen Isabella, Edward II's wife, at Munich (Staatsbibliothek) probably originated from Paris. Queen Mary's Psalter at the British museum (Royal 2 B VII) is, beyond dispute, an early 14th-century English masterpiece. In the work of the East Anglian school can be seen the gradual abandonment of Gothic outline drawing for the sake of a broader pictorial treatment. Its most singular characteristic is extravagant richness of ornamentation displayed in the large border frames of the decorated pages, interlaced with figures of every shape and kind. In Parisian illumination the characteristic style of the miniaturist Jean Pucelle (active *c.* 1340) shows the change unmistakably. From this time the development of modern painting can be followed in the miniatures of the manuscripts. The rapport between Italian and French art was based on political and dynastic relations and the transference of the papal court to Avignon. Pucelle's breviary of Queen Jeanne of Navarre (formerly Yates Thompson collection) and hours of Jeanne d'Evreur (Cloisters, Metropolitan museum, New York) contain certain miniatures that can only be understood as imitating Italian pictures of the 14th century.

From the middle of the 14th century onward, the naturalistic tendency became more and more powerful. It is seen most clearly in the dedication pictures which undoubtedly contain portraits of Charles V. In religious pictures, however, Gothic idealism continued until the beginning of the 15th century. The miniatures executed for Charles V are often set in quatrefoil frames, and grisaille is preferred to painting in colours. The name of André Beauneveu of Valenciennes is given for the Psalter at Paris (Bibliothèque Nationale Fr. 13091), that of Jacquemart de Hesdin for the prayer books at Paris (Bibliothèque Nationale Lat. 919) and Brussels (Bibliothèque Royale 11060–61). In these manuscripts there is a change in the borders, the delicate sprays of ivy, which had hitherto sprouted loosely over the margins, now completely fill them up, and new motives add to the wealth of ornament. In the miniatures the old Gothic tradition can be seen gradually being displaced by the new naturalism. The new art reached its climax in the second decade of the 15th century in two manuscripts begun for Jean de France, duc de Berry, which must be classed, beyond dispute, among the most magnificent illustrated books of all times. The unfinished prayer book at Chantilly (called, according to the inventory, *Très riches Heures du duc de Berry*) was illuminated by the Limburg brothers. Pictures which are reminiscent of famous Italian mural paintings stand side by side with faithful representations of reality, as, *e.g.*, the calendar pictures with the views of the duke's castles or the genrelike February snow landscape. Another step forward was the prayer book begun for the duc de Berry but after his death continued for Count William IV of Bavaria-Holland. To the early 15th century also belong the *Heures de Rohan* (Bibliothèque Nationale), the *Heures du Maréchal de Boucicaut* (Paris, Musée Jacquemart André), the Bedford Missal (British museum Add. 18850) and the Salisbury breviary in Paris (Bibliothèque Nationale).

Spain and Italy.—Spanish and Italian illumination had only a slight share in the movement on which Carolingian, Ottonian and Anglo-Saxon art was based. In Spain, as in Italy, tendencies prevailed, during this period, which can best be compared with the Franco-Saxon school. The Spanish manuscripts of the 9th to 11th centuries display a rich but fantastic decoration in which early Christian and Moorish elements are mixed. The figures are antinaturalistic, reminiscent of the Irish style. The most singular Spanish creation is the great series of illustrations to Beatus of

Liebana's Commentaries on the Apocalypse which have survived in many copies from the 9th (?) to the 12th centuries (the oldest in the Pierpont Morgan library).

The character of Italian illumination varies extremely in the different Italian territories, according to their relations with east and west. A curious blend of contrasting tendencies is to be seen in the book ornamentation of the Benedictines at Monte Cassino in the 11th and 12th centuries. Here Hiberno-Saxon, Ottonian and Byzantine stylistic elements are intimately combined. Southern Italy made a specialty of Exultet Rolls, as they are called, *i.e.*, long illuminated scrolls of parchment, which contained liturgical readings for use at Easter and which were unrolled by the officiant priest over the lectern of the pulpit. Various Italian monasteries produced from the 11th to the 13th centuries gigantic Bibles, some of which show a singular beauty of initial which was afterward imitated in the 15th century. The origin of these Bibles is partly to be sought in Tuscany, where, in the reign of the margravine Matilda, works of a pronounced original character were produced, *e.g.*, the Gospel book which Matilda presented in 1109 to the Abbey of Polirone (Pierpont Morgan library). During the 13th century, Italian illumination in the large university towns of northern Italy developed freely and in a manner quite its own. Legal textbooks, Bibles, etc., were executed and taken by the students all over Europe. Moreover, the 13th century produced a new type of book, the immense choir book, which was everywhere used at church services. In general, large miniatures are rare in Italian illuminated manuscripts of this period. Most have only historiated initials, but these are drawn out to great length and spread out over the margins in branch and leaf work; drolleries were added very early. As in monumental painting, Italy was foremost in diffusing the Byzantine style.

The immediate influence of the Crusades in causing an interpenetration of the western and Byzantine elements must not be overlooked. In the Latin kingdoms of the orient, there were executed for churches and princes magnificent manuscripts in which such a mixture of styles was inevitable, *e.g.*, the Psalter of Queen Melissenda of Jerusalem (British museum), the Missal of the Holy Sepulchre church at Jerusalem (Bibliothèque Nationale Lat. 12056) and many others. Similar works probably emanated from those districts of Italy which were particularly exposed to Byzantine influence. In this class may belong the missal at Madrid. A similar mixture of style is evident, in a much coarser form, in the epistolary, written in 1259 at Padua by Gaibana (Padua, Cathedral treasury). About 1300 a large number of Byzantinesque illuminations were produced at Bologna, which are distinguished by copious border decoration, with figures in the classicizing style. Splendid works of this kind are the Bibles at Paris (Bibliothèque Nationale Lat. 18) and at the British museum (Add. 18720).

During the 14th century, throughout Italy's busy scriptoria, as at Naples, where French influence is noticeable, numerous manuscripts rich in miniatures were produced (Bible in the Berlin Kupferstich-Kabinett, Manuscript 78E3, once belonging to Leo X).

EUROPE, 15th–16th CENTURY

Many illuminated manuscripts of the later 15th and the 16th century surpass in wealth of pictures and magnificent embellishment even the works from the time of the duc de Berry. In the 16th century they were eventually supplanted by engraving. The splendid miniatures of the 15th and 16th centuries, like those of the preceding period, were chiefly destined for princes and great courtiers. Three large centres of production were prominent: the Netherlands (Ghent, Bruges); France (Paris, Tours); Italy (Florence, Ferrara and others). Besides sacred texts such as books of hours, there were secular manuscripts of an incredible variety, among which the chronicles and the romances are prominent.

Netherlands.—It can only rarely be proved that individual Flemish painters on panel of the generation after Jan Van Eyck had a hand in illumination. A number of miniaturists are known from their works or from documents; *e.g.*, Jean le Tavernier, Willem Vrelant, Loyset Lyédet, Philippe de Mazerolles, the Bening family. About the middle of the 16th century the activity of the Flemish scriptoria seems to have died out. It is important to note Simon Marmion, unsurpassed in landscape (Book of Hours, British museum Add. 38126). A master belonging to the circle of Roger van der Weyden is called, after the Romance of Girart de Roussillon, Jean le Tavernier, who adorned the Conquêtes de Charlemagne executed for Philip the Good (Vienna Staatsbibliothek 2549). His second masterpiece, the Chronicle of Hennegau, is at Brussels (Bibliothèque Royale Manuscript 9066). A follower of Gerard David (*q.v.*) illuminated *c.* 1490–1510 the marvellously naturalistic Grimani Breviary (Venice, Library of St. Mark, Lat. 1, 99 [2138]).

France.—About the middle of the 15th century Jean Fouquet (*q.v.*), the most important personality among the French miniaturists, made his appearance. He died about 1480 at Tours, where he had lived before and after his journey to Rome, between 1443–47. Attested works of his are parts of the *Antiquités Judaïques* at Paris and the miniatures cut out from the *Heures d'Etienne Chevalier* at Chantilly. Fouquet's art, which otherwise shows affinities with Flemish naturalism, shows the emergence of Renaissance art.

Germany.—In Germany in the later 15th century, illustration passed a humble existence in monasteries and scriptoria which engaged in large-scale manufacture of manuscripts (Diebold Lauber in Hagenau). In contrast with this mass production, there are the splendid manuscripts of the emperor Maximilian. The finest work is the superb border, executed by Dürer and other great German artists, in a copy of the prayer book printed by Schönsperger (Munich Staatsbibliothek and Besançon).

Italy.—In Italy the renaissance in the manuscripts began with the introduction of the *scrittura umanistica*, which returned to the model of the fine Italian manuscripts of the 11th and 12th centuries, from which was also taken the scroll work design in the frames enclosing the pages of text (*see* CALLIGRAPHY). In the middle of the 15th century illumination attained a perfection never surpassed in its history. A number of new studios were associated with the luxurious courts, such as that of the Gonzaga at Mantua. The artists are sometimes those who are famous for their monumental paintings, for example, the Sienese Simone Martini (*q.v.*) illuminated a Virgil in the Ambrosiana Library, Milan; another Sienese, Giovanni di Paolo (*q.v.*) an antiphonal in Siena Communal Library (G. 1, 8); and Andrea Mantegna (*q.v.*) illuminated manuscripts; their style is reflected in many others. Northern Italy was prolific: Milan, Verona, Padua, Cremona, Ferrara and Mantua were among the centres. A masterpiece is the book of hours of Bona of Savoy, widow of Galeazzo Maria Sforza, duke of Milan (British museum Add. 34924). In the Ferrara school, a number of miniaturists worked for the ducal family of Este, including Taddeo Crivelli (Borso d'Este's Bible, 1455–62, Modena). An especially rich vein of illumination developed in the Veneto, inspired by the interests of epigraphers and antiquarians who included the painter Mantegna; collections of Greek and Latin inscriptions (of which the most famous is that of the Veronese epigrapher, Fra Giovanni Giocondo [*c.* 1433–1515]) were transcribed in many copies and illuminated with singular magnificence; representations of actual *stelae*, columns, etc. on which the inscriptions had been found were effectively incorporated in the paintings, along with other architectural and sculptural motives derived from classical art. The works of Petrarch, particularly his *Triumphs*, lent themselves especially to grandiose and imaginative illustration and there are many fine illuminated 15th-century manuscripts of this subject, some of them in the British museum (Harley 3567). It is impossible to divorce the miniatures of this period from the monumental painting of the time, to which it often approximated. The painter and illuminator Antonio Liberale da Verona (*q.v.*) illustrates this point: his huge and ornate historiated initials in the missals in the Piccolomini library in Siena contain what amount to full-scale paintings of extraordinary virtuosity. Martino da Modena, the most important miniaturist under Ercole d'Este I (active *c.* 1485), and Girolamo da Cremona (active *c.* 1470) were, like Liberale, influenced by the classicizing style of Mantegna. Girolamo illuminated a gradual also in the Piccolomini library. Miniature painting in

central Italy was chiefly concentrated at Florence and Siena.

In the 16th century, the high Renaissance with its shift of focus to Rome produced illuminators of note, such as Giulio Clovio (*q.v.*), who illuminated a magnificent book of hours in the Pierpont Morgan library, New York, for Cardinal Alessandro Farnese in 1546, in which some of the characteristics of mannerist painting are already evident.

For illuminated manuscripts outside Europe *see* INDIAN ART; PERSIAN ART. *See* also references under "Illuminated Manuscripts" in the Index.

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ILLUMINATI, a short-lived movement of republican free thought founded on May day 1776 by Adam Weishaupt, professor of canon law at Ingolstadt and a former Jesuit. The members of this secret society called themselves "Perfectibilists." Their founder's aim was to replace Christianity by a religion of reason, as later did the revolutionaries of France and the positivist philosopher A. Comte in the 19th century. The order was organized along Jesuit lines and kept internal discipline and a system of mutual surveillance based on that model. It ran the full gamut of fads which are usually linked with secret bodies of this kind, including the assumption of classical names. From 1778 onward they began to make contact with various Masonic lodges, where, under the impulse of A. Knigge (*q.v.*), one of their chief converts, they often managed to gain a commanding position. The total numbers never exceeded 2,000.

The scheme itself had its attractions for literary men like Goethe and Herder, and even for the reigning dukes of Gotha and Weimar. Such notables were claimed as members although not actually so. Secret societies of this kind fitted in with the idea of benevolent despotism as a vehicle for the Enlightenment, as Goethe shows in *Wilhelm Meister.*

The movement suffered from internal dissension and was ultimately banned by an edict of the Bavarian government in 1785. This undermined other genuine liberal forces that were now open to reprisals from the unprogressive authorities and the Roman Catholic Church alike.

See P. Tschackert in A. Hauck (ed.), *Realencyklopädie für protestantische Theologie und Kirche* (1901). (P. FO.)

ILLUSION is incorrect perception (*q.v.*) of external stimuli. Familiar examples occur in mirages (*see* MIRAGE); also when a tailor's dummy is mistaken for a living person, stationary lights seem to move in an advertising display (*see* VISION: *Space Perception: Visual Perception of Movement*), or a spoon appears bent in a glass of water. Such falsely perceived stimuli need not be visual: for example, to a stationary observer the pitch of a moving locomotive whistle may seem to change (*see* DOPPLER EFFECT); in a tactual illusion mentioned by Aristotle, the blunt end of a stylus or pencil inserted between the tips of crossed adjacent fingers can be felt as two. Illusion seems to arise either through distorted transmission of stimuli (*e.g.,* when light is bent in water or unevenly heated air), or through the perceiver's psychophysiology (*i.e.,* as the nervous system mediates immediate perception, the retention of past experience, expectation, emotional states, and so on). *See* GESTALT PSYCHOLOGY: *Founding and Early Development of Gestalt Theory;* SENSATION: *Physiology.*

Illusion is distinguished from hallucination (*q.v.*) in that hallucination involves sensory experience in the absence of appropriate external stimuli; both may lead to false belief (delusion). These three types of experience seem to occur in all people, and assume psychiatric importance only when they are disturbingly bizarre and persistent. Their common occurrence is a major problem in efforts to validate human knowledge (*see* KNOWLEDGE, THEORY OF).

ILLUSTRATION. To illustrate means to elucidate, and illustration is the placing of informative pictorial material in books, magazines and papers. Though the terms illustration and illumination are not always distinguished clearly and the two words are sometimes used interchangeably, illumination strictly speaking applies to the decorative accompaniment of a text while illustration refers to that pictorial matter which clarifies or demonstrates a point in a text or adds vividness and concreteness to the characters and incidents of a story. (*See* ILLUMINATED MANUSCRIPTS.)

In most cases the illustrations to a text never become completely identified with it, and over a period of time the same story or treatise may be illustrated by a number of different artists, each contributing a different kind of elucidation. However, sometimes one artist's work will seem to be the definitive illustration of a story, no matter how many others attempt it—an example that comes readily to mind is the work of John Tenniel for Lewis Carroll's *Alice's Adventures in Wonderland.* Tenniel's illustrations seem far more satisfactory even than those designed by the author of the book.

There are other instances where the author himself was also the designer of illustrations that have become inseparable from the text. Among others that could be mentioned are Edward Lear's drawings for some of his limericks and nonsense verse and William Blake's illustrations for his prophetic books.

Ancient and Medieval Illustrations.—The history of illustration is as old as that of books themselves. Man's desire to have his literature illustrated has expressed itself independently of books. Many paintings, for example, are illustrations in the sense that they take their meaning from a literary text (which, however,

is rarely provided for the viewer), and they can be fully understood only by those who are familiar with the literary sources. In the more usual sense of pictures intended to accompany a text not necessarily familiar, the earliest preserved illustrations date from the first known period of book production, the Middle Kingdom of Egypt (21st to 18th centuries B.C.), when large-scale workshops for the writing and illustrating of manuscripts were organized. Egyptian books were written on papyrus in roll form. The illustrations were similar in style to the wall paintings of the period, except that they were much more freely organized in space, usually with a single object or group of objects placed in an area left blank by the writer at the appropriate point in the text. Among the texts so illustrated were religious books, such as the *Book of the Dead*, scientific and literary works. The oldest surviving illustrated roll, the so-called Ramesseum papyrus (*c.* 1980 B.C.), is a ceremonial play.

The codex, the book of leaves bound together at one edge which is familiar to the modern world, was invented in the 1st century A.D., and for a time both roll and codex were used. The Greeks and Romans apparently made use of illustrated books. Their scientific texts seem to have been supplied most often with pictorial amplification. However, a number of illustrated epics (such as the *Iliad* and *Odyssey*) and plays have survived, and there is evidence that these were sufficiently available and popular to have become the models for wall paintings, vase decorations, metalwork and mosaic designs.

As the codex came into more widespread use, new forms were devised for illustrations. Instead of always being placed in the appropriate spot in the text, interrupting the writing, illustrations often were placed on separate pages left blank for the purpose and arranged so that the pictorial material faced the text to which it applied. Furthermore, many Byzantine, Celtic and western European manuscripts contained borders which surrounded pages of the text, and these borders frequently included illustrative pictures.

The Renaissance.—In the 14th century a new spirit entered book illustration. The monumental dignity of Byzantine manuscripts and the often fantastic storytelling of the middle ages gave way to an attempt to suggest reality. A notable early example is the *Très riches heures* of the duc de Berry, in which the occupations of the various seasons are depicted with a wealth of detail, a vivid sense of space and atmosphere and careful attention to the correct representation of man-made and natural objects.

Late medieval and early Renaissance scientific treatises were illustrated with great care and a real attempt was made to portray exactly the objects under consideration, but this was hindered by the impossibility of accurately multiplying pictures. No matter how carefully an artist might draw a plant or an animal, his work was likely to be distorted beyond recognition by the scores of copyists—each copying drawings rather than drawing from life—who would reproduce the manuscript. Only with the invention of printing in the first half of the 15th century did it become possible for illustrations to be exactly reproduced once they had been rendered to the artist's satisfaction.

The Introduction of Printing.—Early printed books (the first to be illustrated was Ulrich Boner's *Der Edelstein*, printed in 1461 by Albrecht Pfister in Bamberg, Ger.) used illustrations not so much for the sake of scientific accuracy as to produce books that would be attractive to the larger public that printing made possible. As with most manuscript illustrations, the idea of a picture was more important than the accuracy of its details—the same wood block illustration of a town might be labeled as the city of Ulm on one page of the *Nürnberg Chronicle* (1493) and as Damascus on another. Of course with biblical and literary texts the illustrations had to match the story more closely, and the efforts of such artists as Albrecht Dürer, Albrecht Altdorfer and Lucas Cranach to produce meaningful, coherent accompaniments to these texts are justly famous.

While the first printed books, both in northern Europe and in Italy, used woodcuts which could be printed at the same time as the text, it was not long before artists began to make intaglio illustrations which required a separate printing operation. In spite of this difficulty, engraved and etched illustrations had become more common than woodcuts by the end of the 16th century and they remained in vogue for almost 200 years. The various intaglio techniques permitted a fineness of line and a subtlety of tonal values impossible to achieve in woodcuts, and Rubens, Rembrandt, Tiepolo, Fragonard and scores of other artists used these mediums in their illustrations.

Illustrators of the 16th and 17th centuries were particularly fond of creating fables in pictorial form. The so-called "emblem books" were full of illustrations depicting odd combinations of people, animals and objects whose meaning was explained in didactic poems printed under the pictures. This love of learned allegory was also displayed in the elaborate title page illustrations of the time, in which the meaning of the book or the interests of the author were suggested by a collection of clearly symbolic objects.

The illustrator also came to serve the scholar in the 18th century. In the elaborately illustrated archaeological and topographical studies of the period the large, carefully prepared engravings assumed as much importance as the text. Books of this kind had been published in the 17th century as well, but the earlier treatises were crude indeed compared with the fine 18th-century works.

Woodcut and Lithography.—Toward the end of the 18th century Thomas Bewick, an English engraver, developed a technique of engraving on wood in a finely controlled manner. The blocks he produced were capable of as subtle a range of tonal variation as any intaglio process and they had a distinct technical advantage in that they could be printed at the same time as the text and on the same press. Bewick's discovery gave rise to a school of exceedingly skilful engravers on wood who could reproduce drawings and even paintings with astonishing fidelity. As a result, in the 19th century intaglio illustrations practically ceased to be made.

Another important discovery of the late 18th century was the lithograph, which became particularly popular among painters who wished to be illustrators. Many designers of illustrations were distressed at the transformation of their drawings at the hands of commercial engravers. A few artists, like Bewick or Blake, were fortunate enough to be able to engrave their own designs, but most were at the mercy of such skilled engravers as the Dalziel brothers and John Swaine in England and Timothy Cole in the United States. Through the use of lithography the artist was able to produce a print which closely approximated a drawing in crayon or wash without the intervention of a professional engraver.

At the same time there was a significant increase in the size of the reading public and a concomitant reduction in the cost of books. As publishers sought more purchasers for their books, illustrations became important commercial assets. The first traces of this interest of publishers in popular illustrated editions appeared in the 15th century. By the 17th century it was possible for a successful engraver to amass great wealth and enjoy a considerable reputation. Only after the 1830s, however, were illustrated books generally available to the public at comparatively low prices.

In 1832 the *Penny Magazine* appeared, the first periodical regularly to use large numbers of illustrations designed to appeal to the popular taste. Soon a host of illustrated magazines and pictorial newspapers were on the market—predecessors of the 20th century's *Life*, *Du*, *Paris-Match* and *The London Illustrated Weekly* and of the illustrated daily newspapers.

Photography and Photoengraving.—In 1844 Fox Talbot, the English pioneer photographer, used the newly developed technique to illustrate his book *The Pencil of Nature*, which showed the possibilities of photography for accurately and easily recording what an artist could transcribe only with considerable labour. Photography opened a whole new world, and it affected illustration in many ways. At first, individual photographs printed on paper were simply pasted into printed books. For larger editions, wood engravings or lithographs were made from photographs by commercial engravers and artists, and such copies of photographs were commonly used as illustrations in the 1850s and 1860s. Around 1851 a method was devised of transferring a drawing onto

a wood block photographically, thus allowing the engraver to enlarge or reduce the drawing at will and enabling him to keep the original drawing on hand as a guide to his engraving. By the time this technique was in general use, in the 1870s, the technique of reproducing line drawings directly by photochemical means, without the intervention of the engraver's hand, had been perfected. Direct reproduction of photographs on a printing press through the use of halftone blocks, which came into use in the 1880s, made it possible to do away with hand engraving entirely. By World War I the craft of wood engraving was no longer of commercial significance. These developments led directly to the richly illustrated books, newspapers and magazines that became characteristic of the 20th century.

At the same time a significant reaction to these new processes took place. In the 1880s and 1890s a number of artists, led by William Morris in England and Maurice Denis in France, began to feel that the use of reproductive engraving had given rise to books lacking the unity and harmony of true works of art. To them, the finely engraved illustration seemed out of keeping with the weight and colour of the type used to print the text. Furthermore, the illustrations themselves tended to be overly literal and failed to provide an imaginative accompaniment for the text. These men and their followers in England and on the continent of Europe produced books that had a tremendous influence. Through their efforts, side by side with the popular illustrated books and periodicals, a series of privately printed, fine-art editions came into being which convinced a number of artists and publishers that illustrated books could be works of art of a high order.

Many artists, among them Aubrey Beardsley, Howard Pyle and T. T. Heine, used photoengraving to reproduce their drawings and were able to design their illustrations in such a way that the results were highly satisfactory artistically. Other artists—Denis, Pablo Picasso, Pierre Bonnard, Henri Matisse, Aristide Maillol and Georges Rouault, for example—preferred the older techniques of wood engraving, metal engraving, etching and lithography as giving them more control over the finished product.

20th-Century Illustration.—Finely illustrated books of this kind are exceedingly costly, and the culture of the 20th century would certainly have developed differently without the prevalence of cheap, accurate and attractive illustrations in school texts, magazines, newspapers, advertising illustrations, catalogues and books of all kinds. The illustrations in publications such as these are almost all produced (or reproduced) photographically. The photograph itself, in the hands of 20th-century workers, yielded masterpieces equal in importance to all but the finest earlier illustrations. Furthermore, through photographic methods of full-colour reproduction, 20th-century publishers were able for the first time to illustrate books about the visual arts with facsimiles of paintings and drawings that were far less distorted than anything possible earlier.

This great diversity of illustration makes it almost impossible to consider any single style of illustration as the exclusive property of a single age. The artist illustrating a book on botany or geometry will work very differently than he would if he were dealing with a novel or a play. Furthermore, the intentions of illustrators have changed over the years. The earliest illustrators were concerned with the depiction of an object, action or personage, and rarely attempted to evoke a sense of space or setting in their pictures. The artists of the Renaissance tried to represent space and form in such a way that the illustration on the page seemed to be a replica of nature. This continued to be an important concern of the sophisticated illustrator of the 16th, 17th and 18th centuries, who used it as the basis for the expression of his own imagination and emotional feelings about his subject, or as a tool in the representation of objects of scientific interest. The invention of photography made it possible for the painter-illustrator to concentrate on other aspects of his work, though he did not immediately take advantage of the opportunity. By the 20th century the photograph was seen as a powerful illustrative medium for the depiction of current happenings, for the accurate reproduction of scenes, for vivid portraiture and for the elucidation of scientific investigations. The painter and draftsman were left free to explore the realm of the imagination and the possibilities of new communicative techniques in the graphic arts. From a rare, costly, handmade object, the illustrated text became an essential part of western culture.

See also ENGRAVING, LINE; LITHOGRAPH; WOODCUT AND WOOD ENGRAVING.

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(A. M. FR.)

ILLYRIA, the northwestern part of the Balkan peninsula, inhabited by the Illyrians since prehistoric times. The name is first used by ancient Greek historians, who write mostly about the people themselves and remain rather vague on the extent of their dominions. Greek accounts of the origin of the Illyrians are mixed with mythology; Appian writes that Illyria derives its name from Illyricus, son of the Cyclops Polyphemus and the sea nymph Galatea, who left Sicily to settle on the eastern shores of the Adriatic, while according to other Greek authors Illyricus was the son of Cadmus and Harmonia.

Modern archaeology and anthropology have thrown new light on the origin of the Illyrians. It is generally admitted that the Illyrians were an Indo-European people who settled in the western half of the Balkan peninsula sometime between the end of the Bronze Age and the beginning of the Iron Age; *i.e., c.* 1000 B.C. They were the bearers of the Hallstatt culture *(see* HALLSTATT). Many tumuli (burial places) containing Illyrian objects made of bronze and iron were discovered at Glasinac (Bosnia), Koman (Albania) and other parts of southeastern Europe.

At the height of their expansion the Illyrians extended their frontiers from the Danube to the Gulf of Ambracia and from the Adriatic to the Shar mountains. They were divided into many tribes of which the best known are, from north to south: Dalmatae, Ardaei, Dardani, Albani, Taulantii, Labeati, Orestes, Molossi, Chaones and Thesproti. At one stage of their incursions the Illyrians crossed into northern Italy by land and southern Italy by sea; the Iapygians of the "heel" of Italy were of Illyrian origin. Illyrian influences can also be traced in the ancient population of Macedonia. The Illyrian tribes of southern Albania came into contact with Greek culture, and their territory up to the Aoüs (mod. Vijose) river was known as Epirus (*q.v.*). They eventually formed their own kingdom, but they never lost their ethnic identity or their language under the influence of Greek civilization.

The Illyrian tribes were self-governing communities with a council of elders and a chosen leader. A strong tribal chieftain would unite several tribes into a kingdom which lasted for one or more generations. The last and best-known Illyrian kingdom had its capital at Scodra (mod. Shkoder). Under King Agron (second half of the 3rd century B.C.) it stretched from Dalmatia in the north to the Aoüs in the south. It stopped short of the Greek colonies of Buthrotum (Butrint), Apollonia, Epidamnus (Durres) and Lissus (Lezhe), self-governing cities which had reached a high degree of prosperity and cultural development and served as intermediaries for the trade between the Illyrian hinterland and Greece and Italy. The Illyrians exported mainly agricultural produce and livestock, particularly horses, and goods made of local bronze and iron. They also used their celebrated fast, long and narrow vessels *(lembi)* to practise piracy all along the Adriatic and even beyond.

King Agron had an army and a navy stronger than any of his Illyrian predecessors. In alliance with Demetrius II of Macedonia, he defeated the Aetolians who were besieging Medeon in Acarnania (231). Agron was so pleased with his victory that he drank too much and died suddenly. During the minority of his son his widow, Teuta, acted as regent. Emboldened by the success of her husband, Queen Teuta sent part of the Illyrian navy to Sicily and at the same time tried to conquer the Greek colonies of the coast. A group of Italian merchants was attacked and robbed during this

expedition. An embassy was sent from the Roman senate to demand reparations and guarantees for the future, but was dismissed by Teuta; one of the ambassadors was killed on his way back to Rome. At Rome Teuta was thought responsible for the assassination, but she made no excuses.

Teuta went on blatantly with her wars of conquest. Suddenly a Roman fleet of about 200 vessels appeared on the eastern shores of the Adriatic. The Greek colonies were occupied one after another and the Illyrians were forced to raise the siege of Issa (Vis). Teuta made her submission in 228 B.C. to the Roman consul Gnaeus Fulvius. By the peace treaty then concluded she renounced her claims to the districts, islands and coastal towns conquered by the Romans, bound herself to pay a war indemnity in annual installments and undertook not to allow more than two armed Illyrian vessels at a time to sail beyond Lissus, the port which henceforth marked the southern limit of maritime Illyria. But the Illyrian kingdom of the interior was not destroyed. A second naval expedition was sent against Illyria in 219. Philip V of Macedonia went to the aid of his Illyrian neighbours and thus started a protracted war which ended with the conquest of the whole Balkan peninsula by the Romans. The last Illyrian king, Genthius, surrendered in 168. The submission of the Dalmatians was secured by a powerful expedition led by Octavian (later the emperor Augustus) in 35–33 B.C., though they revolted again (A.D. 6–9) and were put down by Tiberius.

The Roman province of Illyricum stretched from the Drilo (Drin) river in the south to Istria in the north and the Savus (Sava) river in the east, and included Scodra, the ancient capital of the Illyrian kingdom, but its administrative centre was Salonae (Split) in Dalmatia. With the extension of the Roman empire along the Danube valley Illyricum was divided into the provinces of Dalmatia and Pannonia, both imperial. But the name Illyricum was used in a wider sense to include the provinces of Noricum (southern Austria and Tirol) and Moesia (parts of modern Serbia and Bulgaria). Territories inhabited by Illyrians were also included in the provinces of Macedonia, Achaea and (after the early 2nd century A.D.) Epirus. These provinces were later further subdivided, particularly in the 4th century.

Within the framework of the Roman administration the clansmen of the Illyrian highlands enjoyed their local autonomy while owing allegiance to the emperor and accepting the authority of his representatives. They held their general meeting or *conventus* on the occasion of the annual festivities in honour of the Caesars and, while expressing loyalty to the reigning emperor, they took the opportunity of consolidating their political rights. The concept of the *conventus* (*kuvend* in Albanian) has survived to this day in northern Albania. By contrast the cities of the coast and a few in the interior were thoroughly romanized; Roman colonies were founded at Dyrrachium (formerly Epidamnus), Scodra, Buthrotum and elsewhere.

Under the empire Illyria enjoyed a high degree of prosperity. It was traversed by the Via Egnatia running from Dyrrachium and Apollonia to Salonika and later Constantinople, and served as an important trade link between Rome and eastern Europe. Copper, asphalt and silver were mined in parts of modern Albania. Illyrian wine, oil, cheese and fish from the lakes of Scodra and Lichnidus (Ohrid), regarded as a great delicacy, were exported to Italy. Imports consisted mainly of manufactured and luxury goods. But the importance of Dyrrachium and Lissus derived from their functions as ports of transit for the trade between Italy and eastern Europe. Apollonia was a centre of culture renowned in Italy itself for its educational institutions; Julius Caesar sent his nephew Octavius (later the emperor Augustus) to Apollonia to complete his studies.

As the Illyrians were born warriors it was inevitable that the emperors should recruit them to serve with the Roman legions and even the praetorian guard. When in the 3rd century A.D. the Roman empire went through its first big crisis Illyricum became the last bulwark of Rome and of western culture in the ancient world. Several of the most outstanding emperors of that troubled period were of Illyrian origin, including Claudius II Gothicus, Aurelian, Diocletian, Constantine the Great, most of whom were chosen by their own troops on the battlefields and later acclaimed by the senate.

In A.D. 395 the empire was finally divided and Illyria east of the Drinus (Drina) river became part of the Eastern empire. Between the 3rd and 5th centuries it was devastated by the Visigoths and the Huns. Though these spread havoc wherever they went, they left no lasting mark on Illyria; the Slavs, on the other hand, who started their incursions into the Balkan peninsula in the 6th century, had by the end of the 7th century transformed the ethnic structure of Illyrian-speaking territories. Croatia, Dalmatia, Bosnia, Montenegro, Serbia and parts of Macedonia lost their Illyrian language and were thoroughly slavonized, so that only the Albanians remain as direct descendants of the ancient Illyrians. For their subsequent history *see* ALBANIA; *see* also ALBANIAN LANGUAGE; ILLYRIAN LANGUAGE. (T. Z.)

ILLYRIAN LANGUAGE was a language of the centum group of Indo-European (*q.v.*) languages, spoken in the Balkan peninsula through the early centuries of the Christian era. During the centuries before and after the beginning of the Christian era, by far the greater part of western Europe, as well as large sections of the eastern part of the continent, was inhabited by peoples who spoke languages belonging to the great Indo-European family. Knowledge of these languages is derived primarily from their use in inscriptions and in literary texts. However, such evidence is almost completely lacking for the extensive region including modern Yugoslavia, Albania and parts of southeastern Austria and of southwestern Hungary, among others. This area, subject to early and scattered Greek colonization and later to incorporation into the Roman empire accompanied by intensive romanization, as well as to sporadic migrations and raids by the Celts and Germanic tribes, was known in later antiquity as the Roman province of Illyricum. Slavonic-speaking peoples do not appear there before the 7th century A.D.

Practically all that is known of the indigenous tongue of ancient Illyricum has been derived from an intensive study of its place names, and of the names of persons contained in the thousands of Latin inscriptions found there, insofar as these names are clearly not derivable from other identifiable languages. There are very few glosses which are specifically designated by ancient authors as Illyrian, *e.g., sabaia, sabaium* ("a beerlike beverage"), *cf.* Germanic **sapa-*, Eng. *sap* (the asterisk denotes a hypothetical form); and only one inscription which can surely be assigned to that language. Found near Scutari in northern Albania, it reads in transcription: *ana oëθë iser*. It is interpreted as being a dedication to a goddess Oethe, whose name is preceded by an epithet *ana* and followed by a word meaning "sacred" (*cf.* Gr. *hierós*, "sacred," from Indo-European **isero-*).

However, ancient tradition and modern scholarship agree in regarding as an Illyrian offshoot the language of the more than 300 inscriptions found in southeastern Italy and called Messapic (*q.v.*). The linguistic evidence for this connection consists, first, in an impressive number of place names common to both areas; *e.g., Peuketioi* in both Illyricum and Apulia; and the *Galabrion* of the eastern Adriatic with the *Calabri* to the west; second, in some words occurring only in these two regions (*ana* as a divine epithet is common in Messapic); and, thirdly, in the fact that both areas exhibit a large measure of agreement in their reflexes of Proto-Indo-European phonemes.

From this evidence, meagre as it is, some statements can be made about the historical phonology and the morphology of what appears to have been a distinct Indo-European language. For example, names like *Acrabanis* make it probable that the Indo-European voiced aspirates became voiced stops in Illyrian, and that the Indo-European *ō* became *ā;* and *Vesclevesis* shows both that intervocalic *-s-* was preserved and that the language belonged to the centum group. These and other features contrast strongly with the contiguous Greek and Italic and afford links with the northerly Germanic and Balto-Slavic idioms. Another indication that the Illyrian homeland may have lain in eastern Germany or Poland is afforded by a large number of place names common to both regions, *e.g., Setwia* in both Dalmatia and Silesia.

The little that is known of Illyrian, combined with certain

archaeological facts and with the presence throughout western, central and southern Europe of names obviously Indo-European but not clearly attributable to any identifiable branch of the family, led earlier in the century to the hypothesis of a prehistoric diffusion of Illyrian-speaking Indo-Europeans over much of the continent. This theory, which for a time had many adherents, has been largely abandoned; and the term "Illyrian" is now usually restricted to the Balkan peninsula and immediately adjacent areas. *See* also ALBANIAN LANGUAGE; SERBO-CROATIAN LANGUAGE; VENETIC LANGUAGE.

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ILMENITE or TITANIC IRON ORE is a black metallic mineral named from the Ilmen mountains, U.S.S.R. Ilmenite is a source of titanium. Most titanium is used as the oxide in making pigments. The metal is used as a structural material in high-speed, long-range aircraft. Ilmenite is not used as an iron ore because of smelting difficulties. Ilmenite is usually in compact or granular masses or in grains as sand. It crystallizes in the hexagonal system and crystals are tabular or rhombohedral in habit. The hardness is 5.5 to 6.0 and the specific gravity 4.7; streak is black to brownish red. The composition is $FeTiO_3$ with iron 36.8%, titanium 31.6%, oxygen 31.6%. The ratio between titanium and iron may vary considerably and magnesium or manganese may replace some of the iron. Ilmenite is often intergrown with magnetite, and associated minerals are hematite, apatite, rutile, sphene, zircon and monazite.

Ilmenite occurs in veins, lenticular bodies, large masses, beds, beach sands and river placers, and as an accessory mineral of igneous and metamorphic rocks. The deposits at Allard lake, Quebec, Tahawus, N.Y., and in Norway are associated with anorthosite, norite or gabbro. Beach sands occur in Florida, India, Brazil, Australia and Japan. *See* also TITANIUM. (A. F. HR.)

ILOCANO, the third largest ethnolinguistic group in the Philippines, numbering over 2,500,000 in the 1960s. When discovered by the Spaniards in 1572 they occupied the narrow coastal plain of northwestern Luzon known as the Ilocos region. Their language is Malayo-Polynesian and closely related to that of the neighbouring Tinguian and other pagan peoples of the Mountain province, but their early Christianization and rapid acculturation led to population expansion and colonization of neighbouring provinces, and later to emigration to Mindanao and Hawaii.

The major Ilocano provinces, Ilocos Norte, Ilocos Sur and La Union, are among the most densely populated areas in the Philippines. Rice is the staple crop, grown on small fields and irrigated by rainfall during the rainy season. The great majority of rice fields are less than one hectare, and are mainly worked by their peasant proprietors. Vegetable plots supplement rice, and pigs, goats and chickens are also raised. Fish provide a limited amount of protein and flavour to the diet.

Tobacco is currently an important cash crop, but many Ilocanos must supplement their agricultural income by wage work or handicraft activities, particularly during the dry season. Ilocano cotton textiles have a reputation throughout the Philippines.

Social status is correlated with ownership of land, and the scarcity of riceland has given it a very high value. The wealthier families reside generally in the provincial capitals or in other centres of population, while the poorer classes live in the barrios and hamlets. Marriages are generally arranged to maintain class lines, the husband's family providing the *sabong* or dowry of land.

The population is Roman Catholic, except for a strong minority who belong to the Philippine Independent Church, a schismatic group founded by Gregorio Aglipay during the revolt against Spain at the end of the 19th century.

The Ilocanos have not only moved into new or frontier regions in the Cagayan valley and Mindanao but have also taken over large portions of Pangasinan, Nueva Ecija and Tarlac. In these regions they have been economically successful, so much so that they are sometimes called the "Yankees" of the Philippines. In each area they have also brought and maintained their own language and subculture, so that much of northern Luzon uses Ilocano as a lingua franca and imitates their way of life.

See also PHILIPPINES, REPUBLIC OF THE: *The People.* (F. R. E.)

ILOCOS NORTE, a Philippine province occupying the northwest corner of Luzon. Area 1,308 sq.mi.; pop. (1960) 287,333. The province comprises a narrow coastal plain and the Ilocos mountains paralleling the shore. Population densities average 1,800 per square mile of farmland. A wet season extends from June through October, followed by a seven-month dry season. Major town and provincial capital is Laoag (pop. [1960] 50,198) in the centre of the coastal zone. The second important trading centre is Batac (pop. [1960] 27,139), 17 km. (10.5 mi.) S. of Laoag. *See* also ILOCOS SUR. (R. E. HE.)

ILOCOS SUR, a Philippine province lying along the northwest coast of Luzon. Its physical geography is similar to that of the province of Ilocos Norte (*q.v.*). Area 1,037 sq.mi.; pop. (1960) 338,058, an increase of only 66,526 since 1939. The low rate of population growth was accounted for largely by migration to the southern islands. In both Ilocos Sur and Ilocos Norte, rice is the leading food crop and corn and beans are subsidiary. The major cash crop is tobacco and fishing is locally important. Vigan (pop. [1960] 25,990) is the provincial capital and main town; other trading centres are Candon and Narvacan, also on the coastal lowland. (R. E. HE.)

ILOILO, a province and a chartered city, on the southeastern side of Panay Island (*q.v.*), west central Philippines. The province is mountainous in the west, hilly in the northeast, level and fertile in the centre and along coastal areas. Rainfall averages 80 in. with a short spring dry season. Area 2,048 sq.mi. Pop. (1960) 966,266. Iloilo is a major rice-producing province with many areas harvesting two crops a year. Important secondary crops are sugar, tobacco, coconuts, bananas and pineapples. Important trading and rice-milling centres are Cabatuan and Janiuay on the main north-south highway; Pototan and Santa Barbara, which are also freight depots, on the Iloilo railroad; and Barotac Nuevo on the coast, northeast of Iloilo. The first Malay landing in Panay occurred in the 13th century near San Joaquin, 40 mi. S.W. of Iloilo city.

ILOILO city, the provincial capital, pop. (1960) 151,266, has a good port, protected by the offshore Guimaras Island and serving both interisland and international shipping. It grew rapidly as the major port for the great sugar exports of Negros but the construction of artificial ports on Negros caused a drop in Iloilo's freight. Passenger traffic remains high as thousands of labourers annually migrate through Iloilo to Negros' sugar plantations, returning with the new farming year. After the burning of the city in 1899, it was completely rebuilt and shows marked Spanish influence. The town is an educational centre with several private colleges in addition to a branch of the University of the Philippines. There are also several famous churches and two hospitals. (R. E. HE.)

ILORIN, a town and capital of the province of that name in Northern Nigeria, Africa, lies 1,200 ft. above sea level overlooking the valley of the Niger, 50 mi. to the north, and clear of the forest belt in a region of farms. Pop. (1960 est.) 47,089 (Africans only). The town is of open plan, with shade trees and single-story red mud houses with thatched roofs, many having the traditional openwork walls. The amir's palace is modern concrete in simplified Moorish style, and before it is the canopied well of Mallam Alimi. There is a hospital, a modern junior secondary school and a modern trade and vocational training centre.

Ilorin stands on the north-south railway and at the junction of the east-west and north-south trunk roads. It has an airstrip used by local services. The town has no electricity or other power and therefore no major industries. The principal local crafts are pottery, which is done by the women, the skill of throwing pots without a wheel being passed from mother to daughter, and hand weaving. The women use looms up to 22 in. while men work on 5-in. looms. Dyeing is done by women, and there are some goldsmiths and ironsmiths. Most of the men are engaged in farming

food crops, none of the Nigerian cash crops being grown in the district. The sale of farm produce is a monopoly of the women.

Ilorin has long been the subject of dispute between Northern and Western Nigeria although a former governor general, Sir John Macpherson, held that there was no case for alteration of the boundary. The bulk of the people are Yoruba, the principal race of Western Nigeria and before the 19th century Ilorin was part of the old Yoruba kingdom of Oyo. It rebelled in 1817 and with the aid of Mallam Alimi of Sokoto became independent. A son of Alimi became amir and Ilorin has since formed part of Northern Nigeria. Ilorin province has an area of 17,719 sq.mi. and a population (1960 est.) of 609,634. (W. H. I.)

ILYUSHIN, SERGEI VLADIMIROVICH (1894–), an outstanding Russian aircraft designer, was born at Didyalevo, Vologda province, Russia, in 1894. Mobilized in the Russian army in 1914, he was transferred to the army air arm and received his pilot's certificate in 1917. He joined the Red army in 1919 and two years later was sent to the Moscow Air Force Engineering academy (later renamed after N. E. Zhukovski), from which he graduated in 1926. He then began to design aircraft. In 1939 he designed the well-known IL-2 ("Shturmovik") armoured attack aircraft. Turning to the design of civil aircraft after World War II, he produced in 1946 the IL-12 twin-engined passenger aircraft and in 1957 the IL-18 ("Moscow") four-engined turboprop transport machine. Ilyushin reached the rank of lieutenant general in the Soviet army engineering technical service. He became a professor at the academy from which he had graduated. (D. Cr.)

IMAGE WORSHIP: *see* Idolatry; Iconoclastic Controversy; Symbol.

IMAGINARY NUMBER: *see* Complex Numbers.

IMAGISM, or *imagisme,* was a poetic program formulated about 1912 by Ezra Pound, in conjunction with the poets "H.D." (Hilda Doolittle), Richard Aldington and F. S. Flint, but on lines marked out beforehand by Ford Madox Ford and, to some extent, T. E. Hulme. The name occurs in a note to poems by Hulme printed in Pound's volume, *Ripostes* (1912), in "A Few Don'ts by an Imagist" (*Poetry,* 1913) and in the titles of several Imagist anthologies, of which however only the first (*Des Imagistes,* 1914) is faithful to the original conception.

Literary historians have presented imagism as an Anglo-American variant on French Symbolism (*see* Symbolists, The). Graham Hough calls it "Symbolism without the magic." But, reviewing W. B. Yeats's *Responsibilities* in *Poetry* (May 1914), Pound asked if Yeats were "an *Imagiste,*" and then replied, "No. Mr. Yeats is a symbolist, but he has written *des Images* as have good poets before him . . ."; and Pound distinguishes between "the sort of poetry which seems to be music just forcing itself into articulate speech" (*i.e.,* symbolism) and "that sort of poetry which seems as if sculpture or painting were just forced or forcing itself into words" (*i.e.,* imagism). In *Gaudier-Brzeska: a Memoir* (1916; new ed. 1961), Pound's attitude had hardened against the first in favour of the second. The name "Imagism" having been appropriated by Amy Lowell's break-away group, Pound now called the poetry he wanted to create "vorticism," a word made current by P. Wyndham Lewis and his magazine *Blast.* But this was still a poetry conceived of by analogy with sculpture rather than with music or any other art. The distinction is radical, since to Symbolist poetry-like-music, natural reality is as clay in the poet's arrogantly molding hand, whereas to Imagist poetry-like-sculpture it is resistant, a block for the carver.

See also Free Verse and biographies of the poets mentioned.

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IMAM (Arabic, "leader" in the sense of a "pattern whose example is followed"). In the Koran the word is used several times of leaders and (ii, 124) of Abraham, "Lo, I make thee a pattern [*imam*] for mankind." Imam thus became the name of the head of the Muslim community. His duty is to be the lieutenant, the caliph of the Prophet, to guard the faith and maintain the government of the state. Around the origin and basis of his office all controversies as to the Muslim state centre (*see* Islam: *Sects*). The Sunnites hold that it is for men to appoint; the Shi'ites, in general, that the appointment lies with God, through the Prophet or otherwise, and that he always has appointed. The Kharijites recognize no absolute need of an imam; he is convenient and allowable. Another distinction between the Sunnites and the Shi'ites is that the Sunnites regard the imam as liable to err, and to be obeyed even though he personally sins, provided he maintains the ordinances of Islam. But the Shi'ites believe that the divinely appointed imam is also divinely illumined and preserved (*ma'sum*) from sin.

The above is called the greater imamate. The lesser imamate is the leadership in the Friday prayers. This was originally performed by the imam in the first sense (*i.e.,* the caliph), who not only led in prayers but delivered a sermon (*khutba*), but with the growth of the Muslim empire and the retirement of the caliph from public life the function was necessarily given over to deputies. In Turkey these were servants of the state, each in charge of his own parish; they performed the rites of circumcision, marriage and burial. In Iran among Shi'ites their position is more purely spiritual, and they are independent of the state. A few of their leaders are called *mujtahids; i.e.,* capable of giving an independent opinion on questions of religion and canon law.

A third use of the term imam is as an honorary title. It is thus applied to leading theologians; *e.g.,* to Abu Hanifa, al-Shafi'i, Malik ibn Anas, Ibn Hanbal (these are called "the four imams") and al-Ghazzali.

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IMATRA, a borough of Kymen *lääni* (county), Finland, lies on the Vuoksi river near the U.S.S.R. border, 263 km. (163 mi.) N.E. of Helsinki by road. Pop. (1960) 33,449. It was formed in 1948 from parts of the municipalities of Ruokolahti, Joutseno and Jääski. At Imatra the river descends about 60 ft. in a series of long rapids (notably Tainionkoski and Linnankoski), and hydroelectric plants supply power to Helsinki and most of southern Finland. There are many pulp and cellulose mills and one, producing cardboard and sulfate cellulose, is among the largest in Europe. Other industrial establishments include big steel works and lumber mills. Imatra has a church designed by Alvar Aalto, and is a popular tourist centre. (E. S. Ku.)

IMBABURA, a province in north-central Ecuador, is 1,854 sq.mi. in area and in 1960 had an estimated population of 182,700. Its capital is Ibarra. The population of the province is concentrated in the basin of Ibarra, in which the chief form of land use is the growing of maize (corn) and the feeding of dairy cattle. At lower altitudes, however, there are irrigated fields of sugar cane. On the slopes of the bordering mountains the predominantly Indian farmers grow wheat, barley and potatoes. Higher on the mountain slopes sheep are pastured. In the towns of Imbabura there are small textile, leather and food-processing industries. The province is connected with Quito, the capital of Ecuador, by rail and by domestic airline. The Pan-American highway passes through the province from northeast to southwest. (P. E. J.)

IMBECILE, a person whose mental development is intermediate between an idiot and a moron. *See* Mental Deficiency: *Classification: Imbecility.*

IMBREX, in architecture, one of the raised, covering tiles placed over the joints between the flat tiles or pantiles in an ancient Greek or Roman roof. The pantiles were laid with the joints in each course, or row, exactly in line with the joints above and below, so that the imbrex tiles formed continuous ridges. There were two types: in one the tile was approximately semicircular, but in the more commonly used form and in the monumental marble examples the imbrex had vertical sides and an angular top. At the lower end of each row of imbrex tiles was an antefix (*q.v.*) or decorative terminal. The plural is imbrices.

IMHOTEP (Yemhatpe), physician, sage and architect, one of the great figures of the Egyptian Old Kingdom, afterward, under

the Ptolemies, was deified, becoming the god of medicine. Egyptian texts speak of Imhotep as a minister who lived in the reign of the Pharaoh Zoser, second king of the 3rd dynasty (*c.* 2680 B.C.). He was called Imouthes by the Greeks and identified with Asclepius, the god of healing. There is no doubt that Imhotep was a historical personage and that, like other Egyptian nobles, he held religious as well as civil offices. He was vizier, architect, chief ritualist, sage and scribe under Zoser, and it is believed that he was the designer of the great Step pyramid at Saqqarah and the inspirer of the great architectural development that marks the reign of Zoser (*see* EGYPT). There is no contemporary evidence that Imhotep was a physician, but his priestly duties were intimately concerned with magic, and in Egypt magic and medicine were inseparably related.

Imhotep was born in the neighbourhood of Memphis, his parents being Kanufer and Khreduonkh. The evidence afforded by Egyptian and Greek texts supports the view that his reputation for wisdom and learning was very great in his own time, and that he became at least a demigod not long after his death. In the Ptolemaic period he was invested with all the attributes of deity and was regarded as the son of the Memphite god Ptah, whose name is substituted for that of his earthly father, Kanufer. Imhotep had shrines as well as temples of his own in various parts of Egypt and of Nubia. It was believed that miraculous cures could be effected by his divine intervention, and his temples were thronged with sufferers, many of whom have left records of their gratitude. Statues and figurines of Imhotep as god of medicine have been found in considerable numbers, attesting to his widespread popularity. His prestige increased with the lapse of centuries, and his temples in Greek times were the centres of medical teaching.

Imhotep's posthumous deification is paralleled by that of another Egyptian sage and minister, Amenhotep, the son of Hapu, who lived in the 18th dynasty, held civil and religious offices in the reign of Amenhotep III and was deified under the Ptolemies and closely associated with Imhotep and with medicine. Imhotep and Amenhotep as deified mortals stand almost alone in Egyptian history, and both, during their lives, must have been men of outstanding merit to have earned such signal posthumous recognition.

See J. B. Hurry, *Imhotep, the Vizier and Physician of King Zoser and Afterwards the Egyptian God of Medicine,* 2nd ed., with bibliography (1928). (W. R. D.; X.)

IMITATION is the reproduction or performance of an act the stimulus for which is the perception of a similar act of another animal or person. Essentially it involves a model set by the imitatee to which the attention and response of the imitator are directed. As a descriptive term it covers a wide range of social adaptation. Observers of mammalians in their native habitat report the duplication of the activities of the older by the younger members of the species, or of the young of each other in play. Experiments on like animals in the laboratory, such as having one animal watch another pull a string to release an escape door of a cage, or the performance of some other seemingly simple act, have produced contradictory results. Where imitation was reported, it was described as of a low order—that is, it involved, at best, duplication of some element of the model, not the whole action. More carefully controlled studies, however, have given evidence for inferential imitation on the part of monkeys. In biology, the striking physical resemblances or imitations shown by unrelated organisms are examples of mimicry (*q.v.*).

Among human beings imitation has been used to describe behaviour ranging from ideomotor duplication of the leg reaction of a high jumper and such everyday experiences as yawning when others yawn, running when others run, laughing when others laugh (as well as a whole host of unconsciously and passively learned reproductions of social conduct) to the deliberate and self-conscious adoption of the ideas and habits of others.

Studies of infants show that in the second half of the first year they will imitate the expressive movements of those about them; for example, raising of the arms, smiling and babbling. In the second year they begin imitating other people's reactions to objects. As the child grows up all kinds of models are set before him, most of them determined by his culture: physical posture, language, basic skills, prejudices and pleasures and the moral ideals and taboos. His copying these is determined chiefly by the manner in which his drives are socially and culturally directed and controlled in terms of reward and punishment. The duplication of responses set up by those in positions of authority and prestige are well known. Here suggestion (*q.v.*) as well as imitation is involved.

The facts of imitation, then, are well established. Difficulty ensues, however, when the question of explanation is raised. Uniformity or similarity of thoughts and acts among people does not necessarily mean that these are caused by the same or similar psychological motives or mechanisms. Deviations in the situations, in drives and in the learned ways of adaptation are often too complicated to permit of easy explanation by such a descriptive term as imitation.

Many earlier psychologists took it for granted that imitation was caused by an instinct (*q.v.*) or, at least, by an inherited predisposition—the "pseudoinstinct" of W. McDougall (1908). Later writers have viewed the mechanisms of imitation as those of learning. It is usual, however, to distinguish between imitation caused by simple conditioned reflex, that caused by common trial-and-error learning and that involving the higher thought processes. Almost all agree with C. Bird, who said "We learn to imitate" rather than "learn by imitation." The conditioned-reflex theory of learning so modified as to include drive and final reward or punishment in the total process provides a lead to more careful analysis of the factors operating in various forms of imitation. (*See* also ANIMAL BEHAVIOUR; PSYCHOLOGY, COMPARATIVE.)

Certainly as it stands, imitation is a descriptive not an explanatory concept. Yet, as such, it has considerable use in social psychology. But any consideration of imitation among human beings must take the following factors into account: (1) there is a common constitutional or organic likeness in drives and learning capacity which make for similar adult motivations and like responses; (2) there are a great many similar situations in which the developing individual is conditioned through his nonculturalized but withal social relations as well as by means of culture itself; (3) social facilitation also plays a part, especially in the suggestion-imitation processes of prestige-bearing models and in the crowd-stimulus effect seen in mobs, panics, audiences, fashion and other forms of collective behaviour (*see* PSYCHOLOGY, SOCIAL); and (4) finally, there is so-called conscious or deliberate imitation, which rests upon the introjection of others' responses into one's own symbolic system and their reorganization, largely in self-other terms. This makes possible planned, self-conscious duplication of the ideas, attitudes and habits of others.

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IMITATION OF CHRIST (*Imitatio Christi*), a Christian devotional book written between 1390 and 1440. Its authorship is a matter of controversy, the book being ascribed to Thomas à Kempis (*q.v.*), to Gerard Zerbolt of Zutphen, to an unknown author or to a group of unknown writers. Whatever the identity of the author, he was a representative of the *devotio moderna* and its two offshoots, the Brethren of the Common Life and the Windesheim congregation. (*See* BRETHREN OF THE COMMON LIFE; GROOTE, GERHARD.)

The *Imitation of Christ* gives "exhortations useful for spiritual living" (part i), admonishes man to be concerned rather with the spiritual side of life than with the materialistic (part ii) and affirms the comfort that results from being centred in Christ (part iii). Finally it shows how the individual's faith has to be strengthened through the Lord's Supper (part iv).

The great dogmatic decisions of the early church on the

Trinity and on Christology and the rich religious heritage of the church are the undiscussed presuppositions of this work. The speculative thought of Scholasticism of the high and later middle ages is neglected, however, since—according to the *Imitation of Christ*—it contributes nothing to the religious life of the individual. It is affirmed that God's work of salvation is a mystery that cannot be discussed, explained or defined (iv, 18, 5); it can only be experienced through pious participation in the liturgy of the church, especially in the Lord's Supper. This mystery can become a reality in everyday living when man's existence is shaped by the essence of God's revelation. The *Imitation of Christ* finds this essence predominantly in the Sermon on the Mount (Matt. v–vii) and in John xiii–xvii; it is summarized in John xiii, 15: "I have given you an example, that you also should do as I have done to you." The life and thought of Christ are pictured as a pattern for the individual Christian.

The shaping of one's life according to the example that Christ gave is described in great detail. This can be seen especially when the *Imitation of Christ* admonishes man not to scrutinize the mystery of the Lord's Supper; this would cause only disturbance, perhaps even blasphemy, but the very least would be a wavering of faith. The salvatory usage of the Lord's Supper is guaranteed only if one subordinates intellect to faith and follows the example of Christ in self-denial, self-sacrifice and love for the brethren (iv, 8; 15–18, 5; iii, 13). Imitating Christ's love in simple faith constitutes salvation, which is described as spiritual unity with Christ (iv, 13; 17).

In its thought and language the *Imitation of Christ* is closely related to mysticism, but it is not a mystical work. It cannot be placed in the same category with Neoplatonism, St. Augustine or Meister Eckhart. It is typical of the unique thought of Gerhard Groote and the movement he founded, the *devotio moderna*, which adapted the high-flying thoughts and systems of mysticism to the religious needs of the rather sober minds in the rising city culture of the Netherlands at the end of the 14th century. In contrast to many mystical writings, the *Imitation of Christ* is clearly written; every sentence is easily understandable by all whose spiritual sense is in any degree awakened. The simplicity of its language, and the direct appeal to the religious sensitivity of the individual in an uncomplicated way, are perhaps the primary reasons why this little book has been received among Christians of all times and in almost all the major languages. It has been said that the *Imitation of Christ* has had a wider religious influence than any book except the Bible; if the statement is limited to Christendom, it is probably true.

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IMMACULATE CONCEPTION is a truth believed as an article of faith by Roman Catholics, meaning that Mary, God's Virgin Mother, by a special divine privilege and in view of Christ's future merits, was preserved free from all stain of original sin in the first instant of her conception. The dogma is only implicitly contained in the Bible. In Genesis (iii, 15) God foretells a struggle between "the woman" and the serpent, between the woman's "seed" and the serpent's "seed"; the latter will be defeated by the former. The traditional Catholic interpretation, identifying the serpent as the devil, the woman as Mary and her seed as Christ, argues as follows: (1) the woman's struggle against the enemy is the same as her Son's; (2) since the latter ends in complete victory over the devil, so must the former; (3) if Mary had been subject to sin even for an instant, her triumph over Satan would not have been complete.

The doctrine of the Immaculate Conception evolved slowly in the consciousness of Christian writers. During the first centuries they proclaimed Mary "all holy" and "purer than the angels." They even compared her innocence with Eve's before the latter's fall. From the 8th century on, their statements gradually increased in clarity, influenced particularly by the fact that a feast honouring Mary's conception had begun to be celebrated in England at that time. When the feast was introduced in France in the middle of the 12th century, Bernard of Clairvaux strongly objected, occasioning a controversy that divided Catholic scholars for about four centuries. The majority, including Thomas Aquinas, opposed the doctrine implied in the feast, arguing that since Christ was the Redeemer of all, and hence of Mary, all must have previously sinned (*cf.* Rom. v), including Mary. John Duns Scotus, leading the Franciscans, countered that, since Christ was a most perfect Redeemer, at least his mother must have been redeemed in a most perfect manner; *i.e.*, with a preservative redemption. This means that Christ's redemptive grace was applied to Mary to prevent sin from reaching her soul. Thus Mary was more indebted to the redemption than we, since she was redeemed not from a sin already contracted but from a sin she would have contracted if the Saviour's foreseen merits had not preserved her.

By the end of the 14th century most theologians were sympathetic to the Franciscan opinion, as it was called. They felt that she who had been chosen to be the worthy mother of God's Son could not have been affected by Adam's original prevarication. The councils of Basel (1439) and Trent (1546) openly favoured this view; so did Popes Sixtus IV (reigned 1471–84), Alexander VII (1655–67), Clement XIII (1758–69) and several others. Finally, on Dec. 8, 1854, Pius IX, urged by the vast majority of Catholic bishops throughout the world, issued the bull *Ineffabilis Deus* in which he solemnly declared that the doctrine was revealed by God and hence to be firmly believed as such by all the faithful. The feast of the Immaculate Conception is kept on Dec. 8.

The United States bishops, assembled at the sixth provincial council of Baltimore in 1846, chose the Immaculate Conception as patroness of the United States. The choice was ratified by Pius IX on July 2, 1847.

See also MARY: *Immaculate*.

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IMMANENCE, in philosophy and theology a term applied, in contradistinction to "transcendence," to the fact or condition of being entirely within something (from Lat. *immanere*, to dwell in, remain). Its most important use is for the theological conception of God as existing in and throughout the created world, as opposed, for example, to deism (*q.v.*), which conceives him as separate from and above the universe. This conception has been expressed in a great variety of forms. *See* PANTHEISM; THEISM.

IMMANUEL: *see* EMMANUEL.

IMMANUEL BEN SOLOMON (1260–*c.* 1328), Hebrew poet who lived mainly in Rome. Probably a wandering teacher by profession, he was a prolific writer of Hebrew verses, sacred and secular (some of the latter being highly erotic), which he collected within a rough narrative framework in *Mahberot Immanuel* ("The Compositions of Immanuel"), frequently published. The last section of this work consists of a vision of heaven and hell in the style of Dante, composed immediately after the latter's death in 1321. As Manoello Giudeo, Immanuel was known also as a writer of Italian poetry, including an interchange of sonnets with Bosone da Gubbio on Dante's death. Immanuel also wrote philosophical commentaries on certain books of the Bible and introduced the sonnet form, thereafter very popular, into Hebrew. (C. R.)

IMMERMANN, KARL LEBERECHT (1796–1840), German dramatist and novelist. Two of his works were precursors, *Die Epigonen* as a novel of the contemporary social scene and *Der Oberhof* as a realistic story of village life. Immermann was born on April 24, 1796, in Magdeburg, Saxony, the son of a civil servant. He interrupted his legal studies in Halle (1813–17) to fight in the last phase of the Napoleonic Wars. While working in the military court in Münster (1819–24), he fell in love with Elisa von Lützow, the brilliant wife of the Prussian general Adolf, Freiherr von Lützow. Their passionate love affair ended 14 years after

the Lützow divorce (1825) because Elisa unwaveringly refused to enter upon a second marriage. At the beginning of 1824 Immermann became judge in the criminal court at Magdeburg, moving to the provincial court at Düsseldorf three years later. In Düsseldorf he built up a "model" theatre where, in accordance with Goethe's theories, he especially cultivated ensemble. There he attempted to help the dramatist C. D. Grabbe (*q.v.*). Outside circumstances put an end to the theatrical undertaking after four years. In 1839 Immermann was married to the 20-year-old Marianne Niemeyer and the new life and new happiness that his marriage gave him found expression in his unfinished epic, *Tristan und Isolde,* which was interrupted by his death in Düsseldorf on Aug. 25, 1840.

Immermann's writing is deeply marked by the transitional nature of his time. He was painfully conscious of being overshadowed by the Goethe period, which seemed to deny any new, distinctive development to its posthumous sons. He was an eyewitness of the dissolution of the old social conditions through industrialism and liberalism and sought for some compensation. These problems are more evident in his novels than in his plays. He was faithful to the drama all his life, but without any lasting success. His tragedies and comedies alike show to what an extent he felt himself to be the feeble successor of a greater generation. His plays include *Trauerspiel in Tirol* (1828; remodeled in 1835 as *Andreas Hofer*), which was ridiculed by A. W. von Schlegel and Graf von Platen-Hallermünde; *Merlin* (1832), a play richer in ideas than in drama; and the trilogy *Alexis* (1832). His comic epic *Tulifäntchen* (1830) is a witty parody of the decline of the nobility and of romantic chivalry. Immermann's novels, however, with their acute diagnosis of the period, are more important than his plays. Burdened by the feeling of being born too late, in *Die Epigonen* (1836) he gives a cross section of the society of his own period and thus, in spite of his indebtedness to Goethe's *Wilhelm Meister,* created the first German "contemporary" novel. *Münchhausen* (1838–39) is a twofold novel: in the form of the hero he slates the humbug of the time with grotesque satire, full of innuendo, while in the realistic "Oberhof" part of the novel, he sets against this the strength of the national heritage in which he sees the hope of a happier future. His *Memorabilien* (1840–43) in the course of describing his boyhood gives an illuminating analysis of conditions before 1813.

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(K. Sc.)

IMMIGRATION: *see* MIGRATION; POPULATION.

IMMIGRATION LAW. The immigration laws of the various nations of the world regulate the admission, exclusion, conduct and deportation of aliens or noncitizens who reside or seek to reside temporarily or permanently within their borders. The immigration laws of some countries, like the United States, also contain provisions which govern the acquisition and loss of citizenship. Persons who enter a country for permanent residence are known as immigrants (United States) or landed immigrants (Canada). The term "emigrant" refers to someone who leaves a country, while the word "immigrant" refers to someone who enters a country. Those who come as temporary visitors are called nonimmigrants under the laws of the United States and tourists under the laws of other countries. Immigration laws apply to those seeking permanent as well as temporary admission to a country. However, most countries are more lenient with tourists, and the principal restrictions of immigration laws, such as quota, racial and in some cases even documentary limitations, may be inapplicable to those applying for temporary entry. Some countries require no passports, permits or visas for short visits from nationals of designated countries. Thus, a U.S. citizen may visit Canada as a tourist without any passport, Canadian permit or other restriction.

With the discovery of new and unsettled continents, steps were taken by European countries to colonize and populate these lands. The United States, Canada, Australia, New Zealand, Argentina and Brazil have been the principal immigrant-receiving countries. From early in the 19th century to 1930, at least 60% of the total world immigration was to the United States. The greatest international migration has been the movement of old world peoples to the western hemisphere, and especially of European peoples to the United States during the 19th and 20th centuries. There were other population movements, such as migrations of the Chinese, Japanese and Indians, as well as international movements between American countries, but none of these compared in size and scope with the migration of peoples from Europe to the United States. It is estimated that there was a total recorded European migration of approximately 63,500,000 persons during the period 1820–1931. As a result, the population of three of the more recently settled continents, North America, South America and Australia, are largely of European origin. Of a total immigration to the United States of 41,000,000 persons admitted from 1820 to 1960, 34,000,000 were from European countries. (*See* also MIGRATION.)

U.S. Legislation.—Prior to World War I, the laws of the United States permitted immigration without numerical limitation and were concerned chiefly with barring undesirables. The initial federal limitation upon immigration prohibited the importation of oriental slave labour, prostitutes and alien convicts pursuant to laws enacted in 1862 and 1875. The mentally ill, epileptics, physical defectives, tubercular persons, anarchists, beggars, those likely to become public charges, Chinese labourers, contract labourers, those suffering from loathesome or dangerous diseases, polygamists, paupers, persons whose passages were paid by others, and aliens convicted of crimes involving moral turpitude were added by successive enactments in 1882, 1885, 1891, 1903 and 1907. In 1907 an agreement was concluded with Japan limiting the entry of labourers from that country. In the same year an immigration commission was appointed; its report in 1911 led to the Immigration act of 1917, which remained one of the basic immigration statutes until its repeal by the Immigration and Nationality act of 1952 (the McCarran-Walter act). To the class of aliens previously inadmissible were added Hindus and other Asians, illiterates, persons of constitutional inferiority, those seeking entry for an immoral purpose, alcoholics, stowaways and vagrants. The 1917 act was proposed as a restrictive measure to stem the tide of free immigration of the past. Its literacy provisions were widely debated and became law despite the vetoes of Pres. Woodrow Wilson and previous objections by Pres. Grover Cleveland and William Howard Taft. In 1918 additional provisions were enacted to exclude anarchists and subversives and to require passports for arriving aliens.

A temporary quota law, restricting the number of admissible aliens, was enacted in 1921. This was followed by the first permanent quota law in 1924. Under the 1924 Immigration act and presidential proclamations issued thereunder, quotas were distributed on the basis of the national origin of the population of the United States in 1920. Aliens seeking entry into the United States were divided into three categories: those racially ineligible for citizenship (Asians) were barred from permanent admission; those who were born in western hemisphere countries came in without any quota limitation; all others were subject to a numerical limit assigned on the basis of their country of birth. In this way immigration from northern and western Europe was encouraged and immigration from the southern and eastern parts discouraged. The 1924 act also initiated the visa requirement; *i.e.,* the procuring of a permit from a U.S. consular officer abroad as a condition to immigration to the United States. In 1929 a prior deportation without permission to re-enter the United States and a prior exclusion within one year were added to the grounds of inadmissibility. In 1940 congress promulgated a law requiring the fingerprinting and registration of aliens. The national emergency and World War II produced additional grounds for barring the entry of aliens. In 1941 authority was granted to U.S. consuls to refuse visas to those whom they believed might seek entry into the United States for the purpose of engaging in activities which would endanger the public safety, or whose entry might be prejudicial

to the best interests of the United States. In 1943 the laws barring Chinese were repealed, and in 1946 persons of Philippine and East Indian origin likewise became eligible for citizenship and permanent admission to the United States. In 1950, under the Internal Security act, the provisions barring present and past members of the Communist party and subversives were strengthened.

In 1952 the U.S. congress enacted the McCarran-Walter act, known as the Immigration and Nationality act of 1952 (Public Law 414, 82nd cong., 66 Stat. 163, 8 U.S.C. 1101). The law was passed over the veto of Pres. Harry S. Truman and has been the subject of heated controversy. It retains the national-origin quota system which grants annual quotas to various nations. Each quota area is given an annual quota equivalent to one-sixth of 1% of the inhabitants in the United States in 1920, attributable by national origins to such quota area. Minimum quotas of 100 are given to a quota area which is defined as an independent country, self-governing dominion, mandated or trustee territory, other than the United States and its outlying possessions and the countries of the western hemisphere. The annual quotas are allotted on July 1 of each year. Except for the last two months of the fiscal year, not more than 10% of the annual quota allotment may be utilized in any calendar month; any quota numbers not utilized in the fiscal year lapse. There are 156,687 quota numbers allotted annually and more than two-thirds of each year's quotas are given to Great Britain, Germany and Ireland. As these countries, and particularly Great Britain, do not utilize their shares of quota numbers, quota immigration to the United States does not reach its total annual allotment. Thus, in the fiscal year ended 1962, 90,319 quota immigrants were admitted. On the other hand, quotas from southeastern European and eastern countries are generally oversubscribed.

Under the 1952 act, race is eliminated as a complete bar to immigration. However, Asians, no matter where they are born, must enter the United States on the basis of small racial quotas. Non-Asians, on the contrary, are chargeable to the country of their birth. Aliens from independent countries of the western hemisphere and spouses and minor children of U.S. citizens are not subject to quota limitations. Aliens born in colonies are limited to colonial quotas of 100 and cannot enter under the larger quotas of the mother country. The latter provision is aimed at curtailing Negro immigration from the West Indies. First preference under the quotas of each country to the extent of 50% is given to skilled persons whose ability will benefit the United States, and to their accompanying families; second preference to the extent of 30% is given to the parents of adult U.S. citizens and unmarried children of U.S. citizens; third preference to the extent of the remaining 20% is allotted to the unmarried children or spouses of lawfully resident aliens. If any quota numbers are unused for the first three preferences, they are to be granted to a so-called fourth preference category consisting of brothers, sisters and married children of U.S. citizens. Practically all the former grounds of exclusion are included in the new law. Provision is made for excluding persons, without hearings, on the basis of confidential information. Aliens who claimed draft exemption and those convicted of narcotic offenses are specifically added to the prohibited classes. There are 31 subsections of the law stating the categories of persons to be excluded and enumerating several hundred grounds of excludability. It is undoubtedly the longest and most complicated immigration statute in the world.

In addition to these permanent immigration laws, the United States has enacted temporary statutes authorizing the admission of refugees. In 1948 the Displaced Persons act was enacted, and under its terms 395,000 persons displaced as a result of World War II were resettled in the United States. Under the Refugee Relief act of 1953 special nonquota visas were authorized to Germans, Italians, Greeks, far eastern and other refugees and expellees from Communist dominated countries. In 1958 special provisions were made for admitting refugees from the 1956 uprising in Communist Hungary, and in 1958 legislation also provided for the admission of persons displaced by flood, earthquakes and other causes in the Azores and the Netherlands. The year July 1, 1959, to June 30, 1960, was proclaimed in the United States and many other countries as the World Refugee year. Its objective was to focus interest on the refugee problem, encourage financial contributions and promote opportunities for permanent refugee solutions for those left homeless after World War II. Legislation enacted in 1960 authorizes the admission to the United States of limited numbers of refugee-escapees from Communist countries. (*See* also REFUGEES.)

Comparative Practices.—The laws of the various nations of the world regulating the admission and exclusion of aliens seeking permanent residence differ considerably. Marked contrast also appears in the manner in which immigration laws are administered.

Administration.—In the United States prior to 1940 the department of labour administered and enforced the exclusion and deportation laws. Since 1940, however, the laws have been enforced in the department of justice, under the attorney general. The attorney general's subordinate in direct charge of these laws is the commissioner of the immigration and naturalization service in Washington, D.C. The immigration and naturalization service is divided into four regional and 32 district offices throughout the United States. Special inquiry officers in the immigration and naturalization service conduct hearings for aliens against whom orders of exclusion or deportation are sought. With some exceptions, appeals may be taken to the board of immigration appeals in the department of justice in Washington, D.C. For aliens outside the United States seeking to obtain visas, the issuing authority is the U.S. consul abroad, who operates under the visa office of the department of state.

In Australia, the minister of trade and customs is in charge of the issuance of landing permits and the admission of aliens. The director of the immigration branch in the department of mines and resources administers the immigration laws in Canada; a board of inquiry determines admissibility with an appeal to the minister of mines and resources. In New Zealand the immigration laws are administered by the customs department. The Republic of South Africa lodges the power to issue entry permits in the department of interior, and the department of labour is authorized to declare classes of persons undesirable for economic and other reasons; there is also an immigration selection board. The Argentine government maintains immigration commissions in Europe to select needed rural workers and also has a bureau of immigration and commissioners of immigration at the capital of each province and certain ports of arrival. Liberal provisions are made for the reception, care and maintenance of immigrants after arrival: those who cannot pay for transportation to Argentina are financed, and upon arrival they are housed temporarily in a government immigration hotel prior to being shipped to their eventual destination; the government furnishes these immigrants a plot of land for which they pay over a period of years. Illiterates are taught the language and history of the country. In Brazil the minister of foreign relations supervises immigration. There is in addition a council on immigration and colonization, composed of 12 ministers who meet at specified intervals to report on various aspects and effects of immigration.

Qualifications and Restrictions.—Each country is said to have the sovereign right to select those aliens whom it desires to admit to its shores and permit to reside within its borders. Although nations subscribing to the United Nations Universal Declaration of Human Rights are pledged to treat individuals without distinction of any kind, such as race, colour, sex, language, religion, political or other opinion, national or social origin, property, birth or other status, many countries do not follow this pledge in their immigration laws.

Immigration laws vary from the complex and lengthy statute of the United States to those of several pages constituting the laws of England. In England there was no restriction on the entry of immigrants from the Commonwealth of Nations until the Commonwealth Immigrants act, 1962, introduced a number of limitations applicable to commonwealth citizens other than those from certain exempted countries and students. The future of other immigration restrictions into the United Kingdom was in doubt following the latter's application in 1961 to enter the European Common Market, one of the salient features of which was that

citizens of countries signatory to the treaty of Rome should be free to reside in any country within the community that offered them employment. Race, literacy tests, quota restrictions and political views determine admissibility in other countries.

Most countries impose no numerical restrictions or quotas on the entry of aliens. The exceptions are the United States, the Republic of South Africa, the Philippine Republic and Brazil. The United States, Australia, Canada, New Zealand, the Republic of South Africa, Argentina and the Philippine Republic discriminate in varying degrees against the immigration of persons of Asian or Negro ancestry. Preferential systems are employed to maintain designated racial characteristics of the population of the countries employing such policies. The United States through its quota system favours immigration from countries of North and South America, northern and western Europe. Australia's preference is for persons of British stock; Canada leans to persons from the United Kingdom, the United States and France; Argentina prefers the nationalities of its early settlers, including the Spanish, Italian, Portuguese, German and Swiss. Brazil gives preferential treatment to Portuguese and to a lesser degree to Italians and Spanish.

A number of countries have established educational qualifications for entry. The United States requires aliens over 16 years of age, with some limited exceptions, to be able to read in at least one language. Australia has a dictation test which has been administered to arbitrarily exclude unwanted immigrants. The Australian immigration official may select the language to be employed in the test. Canada excludes illiterates. New Zealand's immigrants must have a knowledge of the English language. Reading or writing a European language or Yiddish is necessary in the Republic of South Africa. England, Brazil, Argentina and many other countries have no literacy limitations.

Financial qualifications are set forth in many immigration laws. Under the laws of the United States an alien must establish to the satisfaction of a U.S. consul abroad and to immigration authorities upon arrival that he will not become a public charge. This is done by proof of his financial resources or by affidavits demonstrating that he will have employment. England, Australia and Canada have similar provisions excluding those who are likely to become public charges. The Republic of South Africa excludes those whose occupations are not needed. New Zealand authorities bar even British subjects by reason of economic conditions. Brazil can exclude immigrants who do not have sufficient funds.

Physical and, in some cases, mental conditions are grounds of inadmissibility under the laws of many nations. This is based either upon the desire to bar diseased aliens from the country or to protect it against the entry of those who might not be able to support themselves. The United States, Australia, Canada, New Zealand and the Republic of South Africa exclude those with physical or mental defects. Other countries merely bar those with physical, incurable or contagious disabilities.

Persons with criminal records may be denied entrance to many countries. The United States forbids residence to those who have been convicted of a crime involving moral turpitude, except that a single so-called petty offense may be overlooked and criminal convictions may be waived for those with close family ties where hardship would result. Foreign pardons are not recognized and there can be no waiver of narcotic offenses. Only serious crimes bar entry into England. Canada follows the moral-turpitude standard. New Zealand refuses criminals for two years after they have served a term of imprisonment for a serious crime. Conviction for any serious crime is a barrier in the Republic of South Africa. Other countries and particularly those in South America merely require that a person present a police certificate revealing that he has not been convicted within a prescribed number of years.

Immoral aliens, such as prostitutes and procurers, are specifically denied entrance by the United States, Canada and the Philippine Republic. Other countries do not specifically prohibit the entry of those classes but may do so under provisions authorizing them to bar undesirables.

Subversives are denied entrance to the United States, Australia and Canada by provisions in their immigration laws excluding aliens who are revolutionists, anarchists, members of the Communist party or otherwise disloyal. In New Zealand aliens over 15 years of age are required to take an oath of allegiance. In the Republic of South Africa persons considered undesirable may be excluded. In England, however, no alien is excluded by reason of political views.

The United States requires aliens to secure passports from the country of their nationality (provision is made for waiver of this requirement in some cases) and visas, which are written permits signed by a U.S. consul. Failure to present these documents is a basis for exclusion. Australia, New Zealand and the Republic of South Africa prescribe that permits be secured for arriving immigrants. Some countries, like Argentina, have agents stationed abroad to encourage and assist immigration. Others have immigration selection boards (Republic of South Africa) to determine to whom permits shall be issued.

Rights and Duties of Aliens.—The right of asylum is recognized by many countries and is granted to aliens fleeing from political, racial or religious persecution in their countries of birth or citizenship. The United States will not grant permanent residence to aliens who are persecutees unless they can enter under its regular immigration laws. However, it will decline to deport an alien when it is established that he will be subject to physical persecution. (*See* also ASYLUM, RIGHT OF.)

The majority of the nations of the world do not require fingerprinting or registration of aliens. All aliens who apply for permanent admission to the United States, and generally visitors coming to the United States for 30 days or more who are 14 years of age or more, are required to be registered at the time visas are issued to them abroad. All immigrants are required to be fingerprinted when they apply for visas. Fingerprinting, however, has been waived for visitors or tourists when they apply for visas, but they are required to be fingerprinted if they remain in the United States longer than one year. Every alien 18 years of age or older who is required to register must carry with him at all times his certificate of alien registration. Failure to do so may result in fine and imprisonment. All aliens subject to registration who are in the United States on Jan. 1 of each year must notify the U.S. immigration and naturalization service of their current address before Feb. 1. They must also notify the service of each change of address within ten days following the date of such change. Aliens who are temporarily in the United States must send notification of their address every three months regardless of whether they have changed it. Aliens may be fined and imprisoned for failure to comply with the address requirements; moreover, unless the failure was excusable or not willful, they may be deported. England requires aliens to register with the police after three months. In France aliens residing more than three months are required to secure written permission in the form of a *carte de sejour.* The U.S.S.R. requires registration with the police, who issue certificates granting permission to reside. Similarly, the laws of Nationalist China require aliens to register with the local police within ten days after arrival and to obtain residence certificates. Failure to register as an alien is a crime in Australia.

Very few countries require aliens to serve in their military forces. There are treaties which sometimes govern this situation. In the United States every male alien admitted for permanent residence who is between the age of 18½ and 26 is subject to military service. Visitors of this age group who are in the country for more than a year are likewise required to serve, but may be exempt upon a claim of alienage which forever debars them from citizenship and permanent residence.

Aliens admitted to the United States for permanent residence are authorized under the immigration laws to engage in any occupation. However, some state laws require U.S. citizenship as a prerequisite to practising certain professions such as law, medicine, dentistry or engineering. Generally, U.S. citizenship is required for many positions in federal and state governments. Visitors are not permitted to engage in employment in the United States without the permission of the immigration and naturalization service. Aliens may own real estate and other property and are permitted access to the courts. They do not have the right to vote. In Canada,

domiciled aliens are accorded all the civil rights of citizens except the right to vote or hold public office. In New Zealand aliens may acquire both real and personal property and may even vote in municipal elections. In the Republic of South Africa, Asians may not acquire immovable property in certain parts of the country. Foreigners generally enjoy the same civil rights as citizens in Argentina but are restricted in the practice of certain professions. Brazil assures aliens of equality with Brazilians in the enjoyment of civil rights but restricts them in the exercise of certain professions and businesses. In France, in the absence of treaty rights, an alien who desires to engage in business must secure permission in the form of a *carte d'identité*, and one desiring to work secures a *carte de travail*. (*See* also ALIEN.)

Deportation.—Deportation laws contain wide variations. It has been estimated that there are 700 different grounds for deporting or expelling aliens from the United States. Aliens who enter illegally, who overstay their visits, become public charges, commit crimes involving moral turpitude, engage in immoral conduct or who are considered subversive may be deported. Except for those who become public charges, an alien may be deported no matter how long he has been a resident of the United States. He secures a hearing and may appeal to the board of immigration appeals in the department of justice and to the courts. In England, where an alien is tried for a crime for which imprisonment may be imposed, the court can impose deportation in addition or in lieu of the criminal sentence. In Canada aliens who enter illegally or overstay a visit, become connected with prostitution, are convicted of criminal offenses, become public charges, inmates of an insane asylum or of a public charitable institution, or are considered subversive, are subject to deportation. A hearing is held with an appeal to the minister of mines and resources. Aliens who enter legally as landed immigrants and remain in Canada for five years may not be deported except for subversive grounds. In Australia an alien may not be deported after he has maintained a residence of three years. In some countries, such as Peru, an alien's admission for permanent residence exempts him from deportation. In Brazil, aliens who are married to citizens and who are responsible for the support of citizen children may not be deported. In some countries deportation is limited to aliens who enter illegally or who enter as transients. Others generally exempt from deportation are aliens who have maintained a residence of five years. (*See* also DEPORTATION AND EXILE.)

Citizenship.—In the United States an alien who is 18 years of age, has been lawfully admitted for permanent residence, has been physically present in the United States for five years, is able to read, write and speak words in ordinary usage in the English language, has knowledge and understanding of the fundamentals of history and of the principles and form of government of the United States, is loyal to the United States and willing to bear arms when required by law, has not claimed draft exemption as an alien and is of good moral character may become a citizen. For those married to a U.S. citizen, the period of physical presence is reduced to three years. In Argentina residence of two years is required, and in the case of persons married to a citizen the residence period is waived. In England the period of residence is five years, in Australia and Canada it is five, in the Republic of South Africa it is six and in New Zealand it is seven. Canada requires an adequate knowledge of French or English, and the Republic of South Africa prescribes ability to read and write English or Afrikaans. In England, knowledge of the language is a prerequisite. Other countries make no such requirement. The age limits vary from 18 to 21. Some demand proof of good moral character, others have no such specification. Only the United States bars aliens from citizenship who have claimed draft exemption. *See* CITIZENSHIP; NATURALIZATION LAWS; *see* also references under "Immigration Law" in the Index.

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For annual statistics on quota and other immigrants, registrations and deportations, *see* the article "Immigration and Naturalization" in the *Britannica Book of the Year*. (JK. W.)

IMMINGHAM, a seaport in the Parts of Lindsey, Lincolnshire, Eng., lies on the southern shore of the Humber estuary, 5 mi. N.W. of Grimsby along the shore and 10 mi. by road. Pop. (1963 est.) 4,000. The docks (with graving dock) have a water area of 45 ac. with 9,097 ft. of quays and berthage. The port was built there (1906–12) because the deep water enabled vessels to enter and leave unaided at all levels of the tide. The principal imports are oil and petroleum, iron ore for Scunthorpe's steel mills, pyrites, ilmenite and sulfur for factories on the Humber bank, and timber and pitwood. Chemical fertilizers, manufactured iron and steel products and building and road materials are important cargoes exported. There are two coaling appliances, each of which can ship up to 1,350 tons an hour but the export coal trade has declined. A granite monument, erected in 1925 by the Anglo-American society at South Killingholme haven (near the old Immingham creek), marks the place where the Pilgrim Fathers embarked for Holland in 1609. (F. T. BA.)

IMMORTALITY. The term "immortal" has been used in a wide general sense for everlasting, as in such statements that the writings of Plato, the plays of Shakespeare, the music of Mozart, are immortal. But in its chief use the term "immortality" has had reference to a continuity of men's spiritual existence after the death of their bodies. This article is limited to that conception, which is of course quite distinct from that of the resurrection of the body.

The earlier anthropologists, as Sir E. B. Tylor and Sir James Frazer, assembled convincing evidence that the belief in a future life was widespread in the regions of primitive culture. Among most peoples the belief has continued through the centuries. But the nature of future existence has been conceived in very different ways. As Tylor showed, in the earliest known times there was little, often no, ethical relation between conduct on earth and the life beyond. M. Jastrow wrote of "the almost complete absence of all ethical considerations in connection with the dead" in ancient Babylonia and Assyria. Motoöri, an 18th-century Japanese thinker, said that "Hades is a land beneath the earth, whither, when they die, all men go, mean and noble, virtuous and wicked, without distinction." In some regions it came to be declared that warriors who died in battle went to a place of happiness. Later, there was a general development of the ethical idea that the afterlife would be one of rewards and punishments for conduct on earth. So in ancient Egypt at death the individual was represented as coming before judges as to that conduct. The Persian followers of Zoroaster accepted the notion of Chinvat, a bridge to be crossed after death, broad for the righteous, narrow for the wicked who fell from it into hell. In India, the steps upward—or downward—in the series of future incarnated lives have been (and still are) regarded as consequences of conduct and attitudes in the actual present life. The idea of future rewards and punishments dominated many Christians in the middle ages and is held today by many Christians of all denominations. In contrast many contemporary secular thinkers maintain that the morally good is to be sought for itself, and evil shunned on its own account, irrespective of any belief in a future life.

That the belief in immortality has been widespread through history is no proof of its truth. It may be a superstition that arose from dreams or other natural experiences. Thus, the question of its validity has been raised philosophically from the earliest times that men came to intelligent reflection. In the Hindu Katha-Upanishad, Naciketas says: "This doubt there is about a man departed—some say: He is; some: He does not exist. Of this would I know." The Upanishads, the basis of most philosophy in India, are predominantly a discussion of the nature of man and his ultimate destiny. Immortality was one of the chief problems of

Plato's thought. With the contention that reality, as such, is fundamentally spiritual, he tried to prove immortality, maintaining that nothing could destroy the soul. Aristotle conceived reason as eternal, but did not defend personal immortality as he thought the soul could not exist disembodied. The Epicureans, from a materialistic standpoint, held that there is no consciousness after death, and thus it is not to be feared. The Stoics mostly considered that it is the rational universe as a whole that persists. Individual men, as Marcus Aurelius wrote, simply have their allotted periods in the drama of existence. However, Cicero (*see* below) finally accepted personal immortality. Augustine, following Neoplatonism, regarded men's souls as being in essence eternal. The Muslim philosopher Avicenna declared the soul immortal, but his coreligionist Averroes, keeping closer to Aristotle, accepted the eternity only of universal reason. Albertus Magnus defended immortality on the ground that the soul, in itself a cause, is an independent reality. Johannes Scotus Erigena contended that personal immortality cannot be proved or disproved by reason. Spinoza, taking God as ultimate reality, as a whole maintained his eternity, but not the immortality of individual persons within him. Leibniz contended that reality is constituted of spiritual monads. Men, as finite monads, not capable of origination by composition, are created by God. He could also annihilate them. However, in that he has planted in men a striving for spiritual perfection there may be faith that he will ensure their continued existence giving them the possibility to achieve it. Kant, admitting that the soul cannot cease by disintegration suggested that it might end by the loss of its own power. Immortality cannot be demonstrated by pure reason, but it may be believed as a postulate of morality. Holiness, "the perfect accordance of the will with the moral law," demands endless progress "only possible on the supposition of an endless duration of the existence and personality of the same rational being (which is called the immortality of the soul)." Joseph Butler, insisting that probability is the guide to life, urged, on ethical grounds similar to those of Kant, that immortality should be accepted as probable. Hegel's philosophy has been interpreted by some as pointing to a cessation of finite individualities in the absolute, and by others as pointing to their persistence as constituents of the absolute. Schopenhauer conceived ultimate redemption from the misery of life as a lapse from conscious personality into the unconscious universal will. The foregoing illustrates the chief positions held in philosophical treatments. After 1925 there was little philosophical discussion of the problem. There was a widespread impression that no conclusions could be reached concerning it and its consideration might be avoided. W. E. Hocking challenged this attitude as an "idleness of mind."

Any form of spiritual continuity has been rejected by some thinkers on the basis of an assumption that all is physical. Few philosophers in the occident or the orient have adopted a definite materialism. In the 20th century it was most widespread among Marxists, who found in it a ground for rejection of the belief in immortality, taken to be promulgated by priests and others to exploit the masses of the world. Some contemporary thinkers, discarding the term materialism for naturalism, treated man as part of nature. Though their position was metaphysically indefinite, they endeavoured to describe human psychical life without the admission of a spiritual soul or a spiritual deity. Gilbert Ryle describes the soul as a ghost. Corliss Lamont considers immortality an illusion, probably a delusion. The fundamental difficulty that should be regarded as definitely ruling out materialism and all forms of contemporary naturalism is that it is impossible to describe the difference between truths and errors in terms of physical processes. In dismissing the soul as a ghost, Ryle gives no satisfactory account of himself as the thinker of his own theories. Lamont similarly ignores the being who distinguishes between realities and illusions. The contention that we do not know *how* a spiritual mind and a material body may interact is met by the reply that we do not know *how* one material body may affect another. The ultimate problem in both is that of change. Changes have to be accepted; they cannot be explained in terms of the changeless. From the standpoints of science and philosophy the position in the second half of the 20th century was not fundamentally different from what it was for William James in 1905: that the relations of mind and body may be described in terms of the interactions of a spiritual being and a physical organism. But even if the soul is different from the body, they are so intimately related that it is extremely difficult to conceive of the continuance of a bodyless soul. This difficulty has been in part met, especially in the orient by the doctrine of reincarnation, and in the occident among Christians with the belief that the soul will have a spiritual body.

In contrast with materialism and naturalism is the theory that reality is ultimately one universal spirit and individual human beings only transitory manifestations of it. Though the one spirit is called eternal, human beings are not to expect personal immortality. The fundamental difficulty of this theory is that both truths and errors are manifestations of the one spirit, who alone is their ultimate thinker. The spirit, the absolute, is in a condition of self-contradiction. The conflicts of good and evil are within it. There is no escape from the difficulty by calling the contradictions and conflicts mere appearances, for the appearances must be in the absolute as they appear.

Discussions of immortality have frequently been obscured by the contention that what men seek is the "eternal." Rudolf Eucken spoke of immortality as experiencing the eternal "in the midst of time." W. R. Inge interpreted it as a participation in eternal values and seemed to have a contempt for the idea of a future life for individual minds. The two conceptions of eternity, (1) that it is a now inclusive of all the past, the present and the future; and (2) that it is something in itself timeless or transcending time, are products of abstract reflection. It cannot be said that men have any experience of either. For those other than the few philosophers and theologians who use these conceptions, immortality normally means temporal personal continuity. But within the now of this life and the future of a next one, the religious mind may have an enduring communion with an everliving God that may give a satisfaction greater than that in values that may not persist. That may be what is sometimes called, indefinitely, an experience of the eternal.

It has frequently been argued that there is a universal desire for personal immortality—as though instinctive, involving its eventual satisfaction. But Sir William Osler, with wide experience of persons near to death, declared that one minority of them ardently desired a future life, another minority hoped for final extinction, and the majority appeared indifferent. The scientist Elie Metchnikoff, after a critical examination of the philosophical and religious arguments for immortality, argued that the discontent of men is due to their failure to obtain complete satisfaction of their natural impulses. If they could live to a ripe old age and attain that satisfaction they would accept death as the natural end of life. Such longevity and satisfaction may eventually be achieved by science, and then all desire for immortality would cease. But, as Shakespeare suggested in Hamlet's soliloquy, there may be a future life whether we desire it or not.

In some ancient literatures there are stories of reappearances of and communications with the dead. In modern times there have been attempts to investigate scientifically such alleged phenomena. (*See* PSYCHICAL RESEARCH.) Communications have been supposed to be received by writing on a planchette, by knocks made by a moving table, and through mediums; *i.e.*, persons accredited with special capacities for transmission of communications, usually in states of trance. After World War I, many who had lost loved ones in the war resorted to persons claiming to be mediums. A number of eminent persons avowed their belief in this kind of phenomena. Popular interest soon ceased, however, probably in the main because the messages supposed received had little, if any, significance. The research into the alleged phenomena came to be limited chiefly to a few whose interest is more intellectual than emotional. There were no signs of any comparable interest in such mediums among the general public after World War II.

It is seriously doubted whether scientific methods can make human life as satisfactory as Metchnikoff imagined. According to some scientists changing conditions may lead to the degradation

and eventual cessation of terrestrial human life. Most followers of naturalism, like Metchnikoff, do not take adequately into account the character of men's ethical aspirations. Some theists would maintain that nature is not intended to give men complete satisfaction. The ethical argument has always been recognized as one of the strongest in justification of belief in personal immortality. It is frustrating that mankind, having developed so far intellectually, aesthetically, morally and religiously, should end entirely with death. Cicero expressed such a conviction in his *Tusculan Disputations:* "For we are not born or created idly or fortuitously; but doubtless there is some power which takes thought for the race of men, and which was not likely to create and foster what—when it had accomplished all its toils—would sink into everlasting misery in death." So Hastings Rashdall wrote in 1907: "Only if we suppose that the present life of human beings has an end which lies in part beyond the limits of the present natural order, in so far as that order is accessible to present human observation, can we find a rational meaning and explanation for human life as we know it; and by far the most natural and intelligible form of such a world-end is the belief in Immortality for the individual souls who have lived there."

There is a fundamental ethical implication in the belief in a series of reincarnations—a belief common to all the indigenous religions of India—Hinduism, Jainism, Buddhism and, in part, Sikhism. That belief is inseparably associated with the so-called law of karma (*q.v.*), which is taken as axiomatic. According to that law, the consequences of one's attitudes and conduct follow as inevitably as effects follow causes in the physical world. The conditions into which an individual is born into this world depend on his conduct in previous lives. He looks forward to a sequence of future lives. By his spiritual efforts in them he may progress toward ultimate bliss. Under the influence of philosophical thinkers different conceptions of that final goal have been developed. In popular religion, and in some philosophies like those of Ramanuja and Madhava Acharya, the individual is believed to retain what in the occident is called his particular personality. He is to achieve infinity in harmonious relations with God and all others. In other philosophies, as in that of Shankara, the final goal is conceived as consciousness of complete identity with the One Reality; in short, it is pantheistic as previously discussed. It may be asked how belief in reincarnation is justified. It seems to offer an explanation of the inequalities into which men are born. But it is also declared that in states of trance the religious devotee may recall experiences of past lives. It is impossible to discover if such claims are true. What is asserted to be from past lives may be due to a play of imagination with reference to otherwise forgotten or similar experiences in this life. The belief in reincarnation has been held by only a few occidental thinkers. There are suggestions of it in the works of Plato, and it was accepted by the Cambridge philosopher John McTaggart. (*See* METEMPSYCHOSIS.)

The profoundly religious have a faith in immortality which is a firm conviction affecting their outlook on life. Though, in the use of the term *hope*, there may be at times the suggestion of a possible doubt, the faith is more than the acceptance of an intellectual hypothesis. It is a fact of history that the idea of immortality has been sustained within the religions. The one firm basis for the belief has been, and is, in religious experience, in the soul's immediate communion with God. He must know whether men are immortal, and may bring a conviction of it to individuals, *when they are truly ready to receive it.* If God creates selves at the beginning of their terrestrial lives, he may sustain in future lives either all (universal immortality) or only those who merit continuance (conditional immortality). This religious basis for belief in immortality is accepted by most Christian thinkers today, with the admission that adherents to other religions may experience it. However, traditionally orthodox theologians have maintained—and many still maintain—that certainty of a future life was given to men by Jesus. He promised the robber crucified with him that he should go to paradise. More important, he manifested a future life by his resurrection and ascension. This view is bound up with doctrines as to Jesus Christ that philosophy can neither prove nor disprove, and with accounts of events as to the truth or falsity of which historians seem unable to give a certain decision. It is interesting to note that the philosopher A. E. Taylor accepted the traditional Christian view. He contended that all rests on belief that Jesus was God-incarnate, divine and human. "To whittle away either his divinity or his humanity is to surrender the very ground of all our hopes."

The contemporary neglect of philosophical consideration of human immortality has adverse effects on the philosophy of history. A door must be either open or shut. Those who do not definitely accept the belief in immortality think, act, and write as though they explicitly reject it, even if occasionally they admit doubts. The two attitudes involve important differences for philosophy of history. If there is an open door to future lives for individuals there may be significance in terrestrial history with reference to a nonterrestrial future. The religions maintain that there is. Their implied or expressed philosophies of history are affected by it. With the implication that there is no such open door, the significance of history is treated by many contemporary historians and philosophers as being entirely terrestrial. The Marxist theory of history is of that type. For philosophy of history the problem of human immortality needs to be seriously discussed.

Some modern humanists contend that belief in immortality takes attention from and reduces efforts for the goods of the present life. It did that in some periods in the past, and may still do so for a few individuals. Religious teachers now insist that God has put mankind into this life and the best is to be done for the fulfillment of its duties and the enjoyment of its possibilities. Faith in immortality has given men a wider vision. Some of the greatest sacrifices for mankind have been made by men with that faith.

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IMMUNITY, in law, denotes exemption or freedom from liability.

Legislative immunity is affirmed in England in the Bill of Rights (1689), which established the inviolability of the persons of members of parliament and provided that no member of parliament might be questioned in any other place for statements made in parliamentary debate (*see* PARLIAMENT: *The Two Houses of Parliament*). The constitution of the United States contains a similar provision (art. 1, sec. 6). English and U.S. practice limits legislative immunity primarily to civil action; a member of the legislature is subject to process, although not to arrest.

French law and practice, dating from 1790, prohibits arrest of a member of the legislature during a session without authorization by his chamber. This practice prevails in many other nations; *e.g.*, Belgium, Switzerland, Italy, Spain and Japan.

Diplomatic immunity is firmly established in international law and in domestic legislation and customarily covers: inviolability of the person of a diplomatic representative; exemption from local jurisdiction, both civil and criminal; exemption from taxation; immunity of places of office and residence; freedom of communication; and freedom of religious worship. The same courtesies are commonly extended to *ad hoc* representatives, such as United Nations delegates. (*See* CONSUL: *Privilege;* DIPLOMACY: *Diplomatic Immunities.*)

The immunities enjoyed by the British sovereign and other heads of state are described in the articles PREROGATIVE; EXTERRITORIALITY. For the immunities or privileges relating to the admission of evidence, such as the privilege against self incrimination, spousal privileges and professional confidences, *see* EVIDENCE: *Privilege and Public Policy. See* also PRIVILEGE. (F. H. HE.)

IMMUNITY AND IMMUNIZATION. In medicine, immunity is defined as a state of lessened liability to injury by microorganisms and by certain complex poisons formed by animals and plants. An animal that recovers from a disease caused by a microorganism is at the time of recovery immune; the invading microorganism has been present in the body in force and, though it may not have been destroyed completely, is incapable for the time of doing further harm. Immunity is not, therefore, a constant state of freedom from the risk of disease but is a state of defense that may rise to a peak in response to an attack and may lapse at other times.

There are several types of immunity. The type that excites most interest is the long-lasting immunity that follows attacks of certain diseases. It is rare that a person, however much exposed to infection, gets a second attack of those fevers—*e.g.,* smallpox, chicken pox, measles, mumps—that are caused by viruses, or of typhoid fever and diphtheria, which are caused by bacteria. This immunity is specific: for example, an attack of measles protects against measles but not against chicken pox. The methods of this specific protection involve reactions with relatively simple constituents of the microorganisms that resemble reactions used in dealing with other foreign substances. These reactions are called immune reactions, although they may have nothing to do with protection and the foreign substances involved may be harmless.

The physics and chemistry of such reactions have been studied, free from the complicating secondary reactions that occur in a living animal, and the substances taking part can be isolated and measured. The terminology used in discussions of immunity is very largely that developed in the early studies of protection of animals against harmful substances; but the meanings of the words and modes of thought that are used in the discussion of protection are largely derived in turn from these studies of simpler reactions.

Many nonmedical uses of the antigen-antibody reactions were developed after World War II. The reactions described in this article between antigen and antibody are the prototype of reactions between large molecules and are of much interest to physicists and chemists interested in this field. In addition, they are the most specific methods known for identifying different proteins and are used for this purpose by biologists.

The process of stimulating immunity in an individual through the use of vaccines or other antigens is called immunization. Excellent results have been obtained through the use of immunizing agents against diphtheria, tetanus, whooping cough, yellow fever and smallpox; good results are produced in poliomyelitis, influenza, typhus, Rocky Mountain spotted fever, equine and Japanese encephalitis and typhoid fever; and poor or no results are recorded in bacillary dysentery, cholera, scrub typhus and infectious hepatitis.

For supplemental information on immunity and immunization the reader should consult the separate articles on the various diseases (*e.g.,* MEASLES AND GERMAN MEASLES; POLIOMYELITIS) and the following general articles: ALLERGY AND ANAPHYLAXIS: *Allergy and Immunity;* BACTERIAL AND INFECTIOUS DISEASES: *Virulence and Immunity;* BLOOD: *Individuality of Human Blood;* EPIDEMIOLOGY: *Human Host-Parasite Interaction;* PARASITOLOGY: *Host-Endoparasite Relationships; Prevention of Disease;* PATHOLOGY: *Immunity;* PROTEINS: *Proteins and Immunity;* SERUM THERAPY; TRANSPLANTS, TISSUE AND ORGAN; VACCINE THERAPY; VIRUSES: *Artificial Immunization Against Virus Diseases.*

This article is divided into the following main sections:

I. Immune Reactions
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  2. Antigens and Antibodies
  3. The Mechanism of the Precipitin Reaction
  4. More Complex Immune Reactions
  5. The Common Basis of Immune Reactions
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II. Defense
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  5. Noninjection Methods
  6. Evaluation Procedures

I. IMMUNE REACTIONS

1. The Precipitin Reaction.—The nature of these reactions is best illustrated by an example. If crystalline albumin prepared from chicken eggs is injected into a rabbit, a new or modified globulin begins to appear in the blood serum of the rabbit in about a week. If the injections are repeated the amount of such globulin increases. This globulin is called a precipitin; in solution it has the characteristic property of forming a precipitate when mixed with a solution of chicken egg albumin. The most remarkable feature of this reaction is its specificity. A solution of the precipitin forms a precipitate with albumin from the eggs of related birds; the amount of precipitate depends on the closeness of the relation. The amount formed with turkey egg albumin is only about one-half, and that formed with duck egg albumin one-sixth, of the amount formed with chicken egg albumin. No precipitate is formed with other proteins, even with the serum albumin of a chicken.

Other animals besides rabbits can be used and other proteins will stimulate the formation of precipitins when injected. Thus, injection of albumin from horse blood serum will lead to the formation of a precipitin that will form a precipitate with horse serum albumin, a considerably smaller precipitate with ox serum albumin but none with any kind of egg albumin.

2. Antigens and Antibodies.—Precipitins are typical examples of the substances called antibodies (in the strict sense of the word). The proteins that are injected are examples of antigens; that is, of foreign substances that, when introduced into the body of an animal, stimulate the formation of antibodies that react in some observable way with the antigen. The animals are said to be immunized with the antigen although egg albumin is not *ab initio* poisonous to a rabbit while it may, as will be shown later, become harmful as a direct result of immunization.

In carrying out reactions between antigen and antibody, the whole serum is used, as a rule, without any attempt to isolate the reacting antibody; a serum containing antibody is called an antiserum.

Most antigens are proteins or contain proteins as an essential part. Proteins are split up by the digestive enzymes in the intestine into their constituent amino acids and lose all their specific characters. For this reason antigens are, as a rule, relatively ineffective if given by mouth: they must be injected. But in some instances small amounts of partially digested protein may be absorbed and may stimulate the formation of sufficient antibody to be detectable by the more delicate reactions.

3. The Mechanism of the Precipitin Reaction.—Shortly after the precipitin reaction was discovered, it was shown that relatively crude chemical changes in a protein would change its specificity. During World War I Karl Landsteiner introduced a method of attaching chemical groups to proteins, forming azoproteins. The nature of such attached groups, which are called determinant groups, can be varied almost at will. These azoproteins can be used as antigens for immunizing rabbits. The antiserums obtained will form a precipitate with any protein to which the same chemical groups have been attached; they will also form smaller precipitates with proteins containing determinant groups whose composition and structure closely resemble those in the original antigen; but they will form no precipitate with proteins containing determinant groups that do not closely resemble those of the original antigen. It has been possible to correlate the antigenic structure

with antigenic specificity in relatively few natural, unmodified proteins, but the composition and structure of some of the gumlike antigens of bacteria are known. The capsules of the different types of pneumococci are made of gums of different compositions. Each of these type-specific gums forms a precipitate with the serum of an animal that has been immunized with pneumococci of the type from which the gum was derived. The specificity of these gums depends on the structure and composition of the gums exactly as specificity of the azoproteins depends on the composition and structure of their determinant groups. In some cases the antiserums formed by immunization with pneumococci of one type will form precipitates with gums derived from pneumococci of another type or with unrelated bacteria; these "cross reactions" are caused by common features in the compositions of the gums of the pneumococci used for immunization and of the other gums with which they form precipitates. It may be inferred that the specificity of all antigen-antibody reactions is determined by special composition and structure of certain groups in the antigen.

Specific Combination.—By Landsteiner's method it was shown that the remarkable specificity of the reaction between antigen and antibody lies in the combination between antibody and the determinant groups of the antigen. For many antigens, the determinant group can be obtained in relatively simple compounds that are called partial antigens or haptenes. These haptenes do not stimulate antibody formation but they do play a major role in determining the specificity of the antibody. Some show a visible reaction with the antibody and some do not. All, however, can react with the antibody to specifically block the reaction between the immunizing antigen and antibody.

Precipitation.—A molecule of antigen may have several determinant groups and a molecule of precipitin probably has two combining sites. Large aggregates can be built up in which each molecule of antigen is linked to several molecules of antibody, whereas haptenes with only one determinant group cannot link two antibody molecules and therefore cannot build such aggregates. A change in physical properties that reduces solubility in water follows this aggregation of antigen and antibody; like other insoluble substances the aggregates form precipitates.

4. More Complex Immune Reactions.—A series of other specific reactions, which have a more obvious connection with immunity in the ordinary sense of the word, depends on a mechanism that is exactly similar to that of the precipitin reaction.

Agglutination.—In this type of reaction an antiserum causes a suspension of small particles coated with antigen to run together into clumps; this clumping is called agglutination and the reacting antibody is an agglutinin. Antiserums prepared by immunizing with a single substance, egg albumin for example, will agglutinate particles that have this substance on their surfaces. Most commonly the antiserums are produced by immunizing with a suspension of cells, such as bacteria or red blood corpuscles, that are relatively complex structures. In this case the substances that stimulate the formation of antibodies are constituents of the cells injected.

Complement.—Certain constituents of blood serum are grouped together under the name complement. Until recently complement was known solely by its actions. It is absorbed by the complexes formed by most antigens and antibodies; for example, by the aggregates formed by a protein antigen and the corresponding precipitin or by cells and the corresponding agglutinin.

Lysis.—The complement absorbed has a further action on cells, such as red blood corpuscles and certain bacteria, that have combined with antibodies. The surface membranes of the cells are so changed that substances retained in normal cells diffuse out. This process is called lysis and the antibodies involved are then lysins.

The substances that act as complement are not specific in their action; the same complement will co-operate with the appropriate antibody in the lysis of bacteria and of the red blood corpuscles of various species of animals. Nor is the amount of complement in serum changed by immunization. The absorption of complement is the basis of such tests as the Wassermann reaction. Complement is absorbed by the compound formed by the syphilitic antibody and Wassermann antigen; the removal of this complement from the solution in which the reaction is carried out is demonstrated by the fact that it is no longer available for the lysis of red blood corpuscles that have been treated with an antiserum to the same red blood corpuscles.

Phagocytosis: Opsonins.—Certain cells of the body can surround or ingest foreign material with which they come in contact; this is called phagocytosis (*q.v.*). The chief phagocytes of the body are the polymorphonuclear leukocytes of the blood and the fixed and free macrophages in various tissues, such as the spleen, liver and lungs. The polymorphonuclear leukocytes function as a first line of phagocytic defense. They are, however, short-lived cells and cannot measure up to the macrophages, which are not only more phagocytic but also are long lived, can proliferate and have varying degrees of capacity to develop into other types of cells active in defense.

Cells that normally resist phagocytosis are ingested much more readily after they have been treated with the serum of an animal that has been immunized with the cells in question. This change is caused by the combination of antibody with antigen on the surface of the cell and by a subsequent change in the physical properties. Bacteria that have been treated with specific antiserum are ingested more rapidly than untreated bacteria. Normal serum has the same ability but to a much smaller degree. Sir Almroth Edward Wright called these substances, which make bacteria more suitable for ingestion by leukocytes, opsonins or appetizers. The serum can be said to opsonize the bacteria. Opsonins in antisera are typical antibodies. There is no general agreement on the nature of the opsonizing factors in normal serum or on the action of complement alone or as an accessory factor during immune opsonic action.

Anaphylaxis.—Injection of a small amount of a protein, such as egg albumin, of the order of one milligram or less into a guinea pig has no apparent effect. However, a second injection of the same protein after a latent period of about eight days will be followed within a minute by the first signs of a violent shock, of which the most conspicuous feature is contraction of the muscles that constrict the small air passages of the lungs, similar to that in human asthma. If the shock is sufficiently severe the guinea pig dies in less than half an hour. The amount required to sensitize guinea pigs is remarkably small; the limit is of the order of one ten-thousandth milligram and the amount commonly used is about one milligram. Hypersensitivity reaches a peak in about three weeks after the sensitizing dose and remains sufficient for a second dose to produce a fatal shock for about six months; possibly the guinea pig remains somewhat sensitive for its whole life. A guinea pig may be desensitized, in that shock will not occur, either by surviving the second injection or by being given a very small amount of the specific protein.

The condition of hypersensitivity is called anaphylaxis. It can be produced in other animals, although larger doses are needed and the shock may take a different form. The hypersensitiveness is caused by the presence of antibodies, for an animal can be sensitized by injection of antiserum derived from another animal; hypersensitiveness induced in this way is called passive anaphylaxis. However, the shock that follows an injection of antigen into an animal that has been sensitized passively is not caused by reaction between antigen and antibody circulating in the blood. There is a latent period after the injection of the antiserum during which injection of a dose of antigen will not cause a shock; during this period antibodies become fixed to cells of the tissues. After the latent period, organs that have been isolated and freed from blood by transfusion will react by contracting on treatment with the antigen. This reaction, again, is specific: the contraction occurs only on addition of the antigen that was used for preparing the immune serum.

It might well be supposed that the aggregation of antigen and antibody on the surface of cells would be enough to account for anaphylactic shock. However, histamine produces symptoms very similar to those of anaphylactic shock; there is evidence that histamine or a substance resembling it is released from the tissues when antigen and antibody react and that it is this substance that

produces reactions, such as the contraction of the muscles of the small air passages.

Neutralization of Toxins.—The reactions hitherto considered have not involved protection against a harmful substance. Toxins of certain bacteria (*see* below), of snakes and of some plants, however, are harmful agents that can be isolated as single chemical substances. An animal immunized with a toxin forms an antiserum (antitoxin) that will combine with and neutralize this toxin. A mixture of toxin with sufficient antitoxin is not poisonous; if antitoxin is injected into an animal before an injection of toxin, the animal is protected; if antitoxin is injected after toxin, it will to some extent mitigate the effects of the toxin. The action of antitoxin is not limited to combination and neutralization. Antitoxin and toxin when mixed in sufficiently strong concentrations form a precipitate comparable to those formed in precipitin reactions. The precipitate (toxin-antitoxin floccules) contains both toxin and antitoxin and is nontoxic if the amount of antitoxin added is sufficient. Toxins are not destroyed by antitoxins and can, in some cases, be set free, in toxic form, from their combination with antibody. Diphtheria toxin has been liberated, unintentionally, from toxin-antitoxin floccules by shaking with a disinfectant that destroyed the antitoxin, with disastrous results when the mixture was used for immunizing human beings. (*See* also ANTITOXIN; TOXIN.)

5. The Common Basis of Immune Reactions.—All these reactions, like the precipitin reaction, are specific. By Landsteiner's method it has been shown that the specificity of agglutination, of opsonization and of anaphylaxis depends on the composition and structure of antigens used for immunization or sensitization. As in the precipitin reaction the essential stage is specific combination of antigen and antibody; it is followed by secondary manifestations that depend on the nature of the antigen and on its situation (on the surface of a cell or other particle), on the situation of the antibody (in solution on the surface of a particle or, again, on the surface of a tissue cell) and on the presence of cooperating nonspecific substances such as complement.

It is not necessary to postulate a series of different antibodies—precipitins, agglutinins, complement fixers, lysins, opsonins and sensitizing antibodies. Antibodies have been prepared in pure form that will not only precipitate but also will agglutinate, fix complement and sensitize guinea pigs.

6. Antibodies: Properties and Formation.—Although the same antibody may act in different ways under different conditions, antibodies of the same specificity may vary widely in their physicochemical characteristics. Thus, they may differ in their avidity, *i.e.*, the firmness of the antigen-antibody union; some localize during electrophoresis with the gamma-1 globulins, others with the gamma-2 globulins; some are globulins of normal size with a molecular weight of about 160,000, others are macroglobulins of about 1,000,000 molecular weight.

After antigen is injected into an animal there is always a latent period before antibody appears in the blood. There are excellent reasons for assuming that the latent period involves nucleic acid metabolism that leads to the induction of the antibody response and to the development of a synthesizing mechanism that will form the antibody. Almost nothing is known about the events that occur during induction except that they seem to determine the kind and amount of antibody that will be formed. It is not known whether the process is selective or instructive. Selective theories such as Sir F. M. Burnet's clonal theory of antibody formation assume that previously dormant cells that already have the genetic mechanism to form the specific antibody are stimulated by antigen to divide and to produce a clone of antibody-forming cells. Such theories keep intact the general idea that protein synthesis is rigidly controlled by the genetic make-up (DNA) of the cell, but it taxes the imagination of many to suppose that the body has cells with the genetic capacity to make antibodies to the tremendous range of possible antigens. Instructive theories generally assume a genetic change induced by fragments of the antigen carrying the specific reacting group.

When an animal is immunized the amount of globulin in its serum usually increases and the increase is greater than that which the antibody formed will account for. Work on germ-free animals suggests that this so-called normal globulin consists of antibodies to antigens so far undetermined.

There is no generally accepted explanation for the fact that antibodies may be found in the serum long after antigen has been given, but it must depend in part on the persistence of the original antigen or fragments of it. In fact, many immunologists believe the presence of such antigenic stimulation is necessary for the formation of antibody at any time.

Antibodies, like the other serum proteins, are not static but once formed are continuously being degraded into their constituent amino acids and, as long as antibody formation occurs, are being synthesized from the free amino acid pool of the animal. The metabolic half life of two antibodies of the same immunologic specificity in the same animal may vary widely. Thus, in the rabbit the anti-Forssman hemolysin of the gamma-1 type has a biological half life of 2.8 days and the gamma-2 anti-Forssman hemolysin has a half life of 5.6 days.

The Site of Formation.—Recent evidence indicates that antibodies are formed in lymphatic tissues by hemocytoblasts or lymphoid cells that develop into plasma cells.

Incomplete Antibodies.—According to the definition given, antibodies should give some observable reaction with antigens. It has been realized for some time that globulins in the serums of immunized animals might combine specifically with antigen but not produce the visible reaction that would be expected with the type of antigen used. These incomplete antibodies have come into special prominence because the serums of Rh-negative mothers who have Rh-positive babies may contain Rh antibodies that cannot be detected unless special techniques are used. They may pass through the placenta into the circulation of the unborn baby, break down the baby's red blood cells and cause severe anemia.

II. DEFENSE

1. Defense Against Invasion.—The entry of microorganisms into the bodies of the higher animals is checked by purely mechanical barriers. The horny layer of the skin has gaps only at the openings of sweat glands and hair follicles. The air breathed is filtered in the nose; a large proportion of the microorganisms it contains are caught in mucus and are either passed down into the esophagus or ejected through the nostrils. Even those that escape and get down into the air passages of the lungs are again caught in mucus on the walls and cleared out in the current set up by the cilia of the epithelium. The lining of the intestine is almost impermeable to microorganisms. In the stomach the concentration of hydrochloric acid is normally high enough to kill some microorganisms and check the growth of others. Bile salts inhibit the growth of some microorganisms in the upper part of the intestine. It is only in the large intestine that bacteria multiply freely.

There are other more subtle outer defenses of the body. Many species of bacteria disappear rapidly when spread on clean skin; typhoid bacilli, for example, cannot be recovered from the skin ten minutes after application. However, other bacteria, in particular staphylococci, which normally live on the skin, do not disappear in this way. Tears, nasal secretion and many tissues contain a substance, lysozyme, which breaks down a mucinous substance that is an essential part of the structure of some bacteria and thereby kills them. This apparently is not the main agent responsible for the disinfection of the skin, but it may contribute to the protection of the eye.

2. Course After Invasion.—*Cellular Mechanism.*—When suspensions of particles, such as India ink and certain dyes, are injected into the veins of an animal they may be found in various organs for weeks and months. Actually, they have been phagocytosed by macrophages in the tissues, where they are slowly digested or mechanically removed from the body.

Nonspecific Bactericidal Action of Blood.—Attention has been focused on the two mechanisms of defense, the formation of specific antibodies and the phagocytosis of foreign particles. However, blood contains other substances, besides specific antibodies, that kill bacteria or check their growth. It is a common observa-

tion that blood serum "keeps" much better than other solutions of protein, such as egg albumin; that is to say, the growth of putrefactive organisms is checked in serum. The serum of some animals contains a substance, apparently not a specific antibody, that will kill anthrax bacilli. A rather similar substance can be extracted from polymorphonuclear leukocytes. During the early stages of fevers, before specific antibodies appear, this power of killing certain bacteria is much increased. The mechanism of this, which must be one of the most important weapons of defense, has been studied but little.

Weapons of the Invader.—Bacteria do not multiply in the body to such an extent that they interfere with its activities by sheer bulk. The size of such particles is not apparently injurious. The damage, whether local or general, is done by poisons (toxins) formed by the bacteria. It is customary to divide the toxins of bacteria into two classes, exotoxins and endotoxins. The exotoxins appear in the culture medium in which bacteria are grown. Diphtheria toxin, the exotoxin that has been most fully studied, is a protein with a molecular weight approximately equal to that of serum albumin. It is extremely poisonous: the minimal lethal dose for a guinea pig is about one ten-thousandth milligram. On a weight basis the minimal lethal dose for a man would be about one-thirtieth milligram; this may be compared with the fatal dose of aconitine, one of the most poisonous of the alkaloids, which is about one milligram. Animals that are immunized with the exotoxins form large amounts of antibody (antitoxin). The endotoxins include complex compounds of carbohydrates and fatty substances (glycolipides); *e.g.,* those that have been isolated from typhoid and dysentery bacilli. These endotoxins are very poisonous, but their minimal lethal doses are considerably higher than those of exotoxins. Some bacteria, particularly *Streptococcus pyogenes,* form substances called leucocidins that kill polymorphonuclear leukocytes. It appears that the harmful effects of viruses are entirely local and arise from their ability to establish themselves inside the cells of the tissues of the host's body.

Bacteria have their defenses against the weapons of the host. Resistance to phagocytosis depends on the nature of the surface of bacteria. In the case of pneumococci this resistance is caused by the presence of the capsule. The most virulent strains of typhoid bacilli have a surface constituent, the Vi antigen; strains that have this Vi antigen are less readily ingested by phagocytes than are those that do not have it. Antibodies that agglutinate, lyse or promote phagocytosis combine with the constituents of the surface of bacteria. These constituents, such as the gums that form the capsules of pneumococci, may be produced in excess and cast off into the surrounding fluid, where they combine with antibodies and put them out of action. Such substances, though harmless in themselves, have been called aggressins. Pneumonia is more commonly fatal when the amount of this capsular gum in the patient's blood is more than enough to neutralize all the circulating antibody. The virulence of bacteria may therefore depend on the poisonousness of their toxins, as in the case of the diphtheria bacillus, or on the presence of a defensive capsule and the formation of aggressins, as in the case of pneumococci.

3. Course of a Generalized Infection in the Blood.—Untreated nonlethal infections, such as malaria in monkeys induced by injections of infected blood, are characterized by a prepatent period when no parasites are detectable in the blood, an acute rise of the infection when parasites increase more or less regularly, a peak in density, a parasite decline that may be rapid enough to be called a crisis, a developed or chronic infection when parasites may still be found in small numbers, and a subpatent period when parasites are not easily found but may increase in number temporarily during relapses. Defense against such infections involves nonspecific cellular and humoral mechanisms and acquired immunity. During the early part of such an infection, nonspecific natural factors of immunity are operative. The parasites are sluggishly phagocytosed and important changes in the tissues, such as the spleen, take place involving the production of new phagocytic cells to cope with the infection. The crisis of the infection is associated with the rise of acquired immunity that is superimposed on innate immunity. During this time, antibodies, especially opsonins, make the parasites more easily phagocytosed. The parasites are thus more rapidly disposed of than during innate immunity.

The extent and acuteness of the infection, the sharpness of the parasite decline, the frequency of relapse and the tendency to spontaneous recovery all depend upon the virulence of the parasite, and the size of the infecting dose, as well as upon the nonspecific and acquired immunity of the host. There is, therefore, no typical stereotyped infection for any given disease, but the over-all effect of immunity, and especially of acquired immunity, generally arrests and eventually eradicates the majority of infections.

Some invading organisms, however, particularly diphtheria and typhoid bacteria, may persist and may even multiply and be discharged from the body. Persons with such persistent foci of virulent bacteria are called carriers and may infect susceptible persons directly or through food and water.

After an animal has recovered from erysipelas, which is produced by a type of streptococcus, injection of streptococci of the same type into the area of skin that was affected will not produce a second attack, although it may produce erysipelas if injected into the skin elsewhere. The animal therefore appears to have a local immunity. However, most evidence indicates that local immunity has the same antibody and cellular basis as general immunity.

(J. R. Mar.; W. H. T.)

4. Immunity to Virus Infections.—The most striking examples of immunity are against diseases caused by viruses. Long before viruses had been identified as a distinct group of microorganisms at the end of the 19th century, Edward Jenner had recognized the significance of immunity following a viral disease and in 1798 described a method of prevention. He noticed that farm workers who developed cowpox (a mild infection of the skin contracted from infected cows) seldom had a second attack and were usually resistant to smallpox (variola). Jenner deliberately inoculated several individuals with cowpox matter and a few weeks later reinoculated them with variolous matter. They did not develop smallpox because of the previous immunizing effect of cowpox virus. From these 18th-century observations stems the modern practice of vaccination (Latin, *vacca,* "a cow"; derivative *vaccinus;* hence, to vaccinate) and of other immunizing procedures (*see* Vaccination).

Viruses are responsible for a wide range of infectious diseases of human beings, animals and plants and, as they are all unaffected by antibiotics, their role in disease assumes added significance. The predominant acute infections of children—measles, mumps, chicken pox and poliomyelitis—are viral in origin; so also are many of the world-wide epidemic diseases; *e.g.,* influenza, encephalitis, smallpox and yellow fever. Many veterinary and plant diseases of great economic importance, such as cattle plague, foot-and-mouth disease and tobacco mosaic disease, are also caused by viruses.

Some degree of immunity follows any infection with an animal virus. Against some, it lasts a lifetime, as in measles; in others, such as influenza, immunity can be measured in months. The basic mechanisms of immunity are the same and are essentially similar to those that operate in bacterial infections. However, viral immune reactions differ in one important respect. As intracellular parasites, viruses have their being in cells; they exert their destructive effect on cells and it is only by the use of living cells that they can be detected. Hence a living culture system, either in the form of laboratory animals, fertile eggs or tissue culture, plays an essential part in all reactions for viral antigen and antibody. Two main factors—one humoral, the other cellular—are concerned in viral immunity.

Humoral Immunity.—The main weapon of defense is circulating antibody. Infection in the first few months of life is rare, as in most cases the newborn child derives protection from the mother by passive transfer of antibody across the placenta. The degree of protection is directly related to the antibody spectrum of the mother derived from previous virus infections. For example, it is rare for an infant to develop measles in the first few months of life if the mother has had measles in the past. On the other hand, some virus infections can produce an unusually severe

effect in the newborn. This is seen particularly in herpes simplex infections in premature infants, in fulminating infections such as neonatal myocarditis caused by Coxsackie B viruses and in poliomyelitis infections occurring in the first three months of life. The severity of these infections cannot be ascribed solely to the absence of specific antibody. Maternal antibody persists for about six months; thereafter the infant is susceptible. Following infections that may be so mild as to be symptomless (subclinical), antibody appears in the blood stream. Viral antibody, as is the case with bacterial antibody, is highly specific and of the same nature. Antibody usually appears toward the end of the first week and reaches a maximum titre in three to four weeks. Several types of antibody have been described.

Neutralizing Antibody.—This defense mechanism is probably the most important as it is directly concerned with protection. It appears after all virus infections and after active immunization except in rare cases of agammaglobulinemia. Antibody can be detected by in vitro tests such as complement fixation, red cell agglutinin-inhibition, flocculation and precipitation and by fluorescent antibody tests. These tests are of great value in diagnosis of virus disease.

Cellular Immunity.—Another form of immunity operates at the cellular level. If an animal is inoculated or infected with two viruses simultaneously, one virus may prevent infection with the other. This "blocking" action in superimposed infections has been termed viral interference and is independent of antibody. As long ago as 1804, Jenner observed that it was often difficult to vaccinate children suffering from herpes infections. One can postulate that this was due to interference between cowpox and herpes simplex viruses. Interference is of practical importance in active immunization with oral polio vaccine as the attenuated vaccine strains may be "blocked" if the vaccinee is already harbouring another virus in the alimentary tract. It has been shown that interference is caused by a substance called interferon. It is a protein with a molecular weight of the order of 80,000 and is produced by the action of many different viruses on living cells. Interferon produced in the laboratory has a wide range of antiviral activity but it is to a great extent species specific; *i.e.*, interferon produced in rabbit cells is effective when tested in the rabbit but not in the monkey, and vice versa. Interferon probably plays an important role in terminating an infection as it has been detected in virus-infected tissues before antibody appears.

Persistence of Virus Immunity.—The mechanism by which immunity persists is not fully understood. Antibody can persist for many years after an attack of measles or poliomyelitis. This may be due to continued reinfection, but it does not explain why high levels of antibody are often found in isolated communities; for example, in Eskimos. Repeated exposure seems an unlikely explanation for the persistence of immunity in these circumstances. Some viruses such as herpes simplex remain latent after initial infection and produce recurrent infections from time to time. It may be that this also occurs with other viruses but apart from herpes this latent state has only been demonstrated in adeno-virus infections of tonsils and adenoids. In terms of immunity, virus infections can be placed in three groups:

1. Long-term immunity such as in the viral exanthems (measles and chicken pox). The distinguishing features are (*a*) long incubation period, (*b*) blood stream spread of virus and (*c*) single or closely related antigenic type of causative virus.

2. Short-term immunity as in influenza and the common cold, in which there is a short incubation period and spread of virus along a mucosal surface. The causative viruses consist of multiple antigenic types and antigenic variation (mutation) also occurs at periodic intervals. This is of particular significance in influenza.

3. Partial immunity, as occurs in herpes simplex. Reactivation of latent virus occurs despite high levels of circulating antibody. Recurrent attacks are usually localized and one can postulate that antibody limits the extent of the recurrent infection. (J. A. D.)

5. The Importance of Antibodies in Defense.—If the antigen-antibody concepts are correct, specific immunity depends on the presence of specific antibodies, their appearance in the circulation and the establishment of the machinery for the rapid formation of a large amount of antibody in response to a fresh stimulus. The most striking examples of the importance of antibodies are seen in newborn animals. They come into the world from sterile surroundings with no experience of even the less virulent organisms that they will encounter as soon as they are born. They have had no occasion to make antibodies to these organisms and it appears that their capacity to make antibodies is relatively undeveloped. They are, however, supplied with antibodies from the serum of their mothers. Antibody proteins similar to those in the plasma of the mother hen are found in the yolk of eggs, and they persist in the egg although other proteins of the yolk are used up to make the tissues of the chick. The placentas of rodents, apes and humans allow antibodies to pass from the blood of the mother to that of the fetus in the last stages of pregnancy. However, the placentas of ruminants, mares and pigs do not allow the passage of antibodies. The concentration of antibodies in the first milk of these animals is higher than in the plasma of the mother; these antibodies are not split up in the intestines of the newborn animal as they would be in the intestines of an adult or as other proteins are split in the intestines of the young animal; they are absorbed unchanged into the blood.

The great susceptibility of premature babies to infection is probably a result of the lack of antibodies that should be supplied by the mother during the last weeks of pregnancy. The importance of these antibodies can be shown more clearly in the case of ruminants. Newborn calves and foals have in their blood serum neither antibodies nor the fraction of globulin in which antibodies appear. Within a few hours after they have sucked their first milk both antibodies and the corresponding globulin appear. If the first milk is withheld neither antibodies nor the globulin fraction appear and the calves are very susceptible to common bacteria, particularly to *Escherichia coli*. In the same way, antibodies appear in the serum of lambs only if they get the first milk, and lambs that do not get this milk are susceptible to lamb dysentery.

Such a transfer to an individual of antibodies made by another individual of the same or of another species is called passive immunization. If all goes well the newborn animal gets its quota of antibodies from its mother before it encounters any infection. To confer this passive immunity on older animals antiserums must be injected; if given by mouth the antibodies are split up in the intestine. Much depends on the relation of the time of injection to the time of attack by microorganisms. If the injection is made shortly beforehand it will, as long as the antibodies persist in the circulation, confer a high degree of immunity against disease. Thus, mice that have received an injection of antiserum against a type of pneumococcus will survive subsequent injection of 1,000,000 times the number of pneumococci of the same type, which would kill mice that had not been protected in this way.

When antiserums are used to treat human beings they are rarely injected before clinical symptoms appear; that is, before the microorganisms have invaded the host and have multiplied. Antiserums, other than those containing antibodies to exotoxins, then have little effect on the course of the disease. Investigations have been made on a large scale into the value of treating pneumonia with antiserums to pneumococci of the type with which the patients are infected. Only in the case of type I pneumonia caused by type I pneumococci was there any significant difference between the death rates of patients who were treated with serum and of those who were not so treated. It is the same with infections with a virus. In experiments on animals antiserum will not prevent disease unless it is injected before or with the virus. In the treatment of contacts of cases of measles by convalescent serums, which contain antibodies to the measles virus, it may be possible to forestall the multiplication of the virus and invasion of the body cells. If the serum is injected early in the incubation period, *i.e.*, within four days after exposure to infection, measles does not usually develop. If the injection is delayed until the eighth day after exposure, it rarely prevents an attack but this attack is usually mild. Injections given still later have little or no effect on the course of the disease.

Treatment of diseases such as diphtheria and tetanus, in which

the damage is mainly caused by exotoxins, may be successful after the symptoms have appeared. But again the antiserums are much more effective if given before or early in the course of a disease. With passive immunization this difficulty always arises: if the antiserum is given beforehand the antibodies may have disappeared from the circulation when they are needed for defense; if they are injected after a disease is diagnosed they may have little effect on its course.

When a person is immunized actively by an actual attack of a disease or by inoculation with bacteria or viruses, by bacterial toxins or by these agents modified in some way, the formation of antibodies may continue for years; even when the amount of antibody circulating in the plasma has fallen to a low level the capacity to form antibody rapidly remains. A fresh infection can be met with antibody before the infective agent has time to multiply.

It is not possible to put a definite term to the duration of immunity. Individuals vary, and for a long time after the remaining antibodies have become insufficient to prevent disease the latent capacity to make fresh antibodies may be awakened early enough in the course of the disease to mitigate it considerably.

Attacks of some diseases, such as smallpox and typhoid, are almost always followed by lifelong protection. It is to be expected that inoculation with the organisms that give rise to these diseases, killed or attenuated in some way, or inoculation with a cross-reacting organism would confer protection for a considerable time. On the other hand, a person may suffer more than one attack of pneumonia, several attacks of influenza and innumerable colds. It would be surprising if inoculation against these diseases afforded anything more than a very transitory protection. Fuller investigations cast doubt on the claim that the incidence of pneumonia in South African mines was lowered by inoculation; other changes occurred at the same time that might have accounted for the fall in the incidence. In further trials little evidence of protection was found.

6. Natural Immunity.—Some species of animals are not harmed by toxins that are very poisonous to other animals, although the insusceptible animals have no special protective antibodies. Birds and cold-blooded animals, for example, are not poisoned by tetanus toxin. This insusceptibility appears comparable to the insusceptibility of hedgehogs to strychnine. Probably, because of some peculiarity in the composition of the constituents of the cells of these animals, the toxins are not able to combine with the cells as they do in susceptible animals. But insusceptibility of this type seems to be exceptional.

The antibodies that young animals get from their mothers disappear during the first year of life. But through adult life, when these maternal antibodies have gone, many species are still immune to some diseases and this immunity appears to be due to the presence of antibodies in their serum. For example, repeated exposure to diphtheria bacilli, without the development of recognizable disease, accounts for the presence of diphtheria antitoxin in the blood of human beings who have never been deliberately immunized with diphtheria toxin or toxoid and have not had diphtheria. But pigs and oxen may frequently have antibodies to typhoid and cholera bacilli, among other organisms, in their serums; and it is unlikely that they have been exposed to these organisms. These antibodies may be formed as a result of exposure to some other organisms that contain antigens identical with or similar to those in these bacilli. There are unquestioned examples of such cross reactions; the immunity to smallpox that follows vaccination is one of them. It is hardly conceivable, though, that such accidents could account for the immunity and for the antibodies in the serum found consistently in some species.

How could it arise that chickens have specific antibodies in their serums for three types of pneumococci? There is no doubt that the presence of the group specific agglutinins in human serums is determined by genetic factors; these agglutinins are not formed in response to the stimulus of foreign substances. It is possible that the presence of other antibodies may be part of the inborn constitution of certain species.

Serum, as already noted, may contain some substances that will break up anthrax bacilli but do not resemble antibodies. It appears that animals that are naturally immune to anthrax have a large amount of this substance in their serum, whereas susceptible animals have considerably less.

There is another kind of immunity that is familiar in everyday life and in experimental studies of the transmission of disease. In most cases, experimental animals cannot be infected with certain human diseases, particularly the diseases caused by viruses. This immunity is not caused by the presence of antibodies in the serum. Bacteria are better adapted to one environment than another; for example, tubercle bacilli injected into the blood stream will settle down and infect one organ in one animal and another in another. The viruses may be still more susceptible to the chemical composition of the cells of the host they enter and may therefore be able to thrive in the cells of hosts belonging to a few species only.

III. THE INFLUENCE OF EXTRANEOUS FACTORS

1. Nutrition.—Malnutrition is commonly associated with a lowered resistance to disease, especially to tuberculosis. With the growth of the new knowledge of nutrition during the 20th century, attempts were made to pin the lowering of resistance to infections on deficiency of one or more constituents of the diet. A clear distinction must be drawn between diseases (such as pneumonia) caused by infection and those (such as beriberi and rickets) caused by lack of some necessary constituents of the diet, in which there is no element of infection. A loss of resistance to infection has been ascribed to lack of various food constituents, particularly vitamin A. In experimental animals that are deprived of vitamin A the cells that line surfaces, such as those of the air passages, change to form a horny layer like the surface of skin. Such a horny layer lacks the cilia that clear mucus and organisms entangled in it out of the air passages. Consequently, harmful microorganisms have an opportunity to establish themselves in the air passages; the outer defenses are breached. Because lack of vitamin A increases the risk of infection in this way it has been called the "anti-infective vitamin." It bears, however, no relation to the development of specific immunity; animals deprived of vitamin A can form antibodies as well as normal animals can.

Antibodies are proteins and must be made, in the end, from the constituent amino acids of the proteins of the food. It might be expected that animals that were not getting enough protein in their food would fail to make antibodies; this has been found by experiment. When an infection begins in an animal already depleted of protein, a vicious circle is set up; for a diseased animal wastes protein and the depletion therefore becomes more severe. In consequence, the formation of antibodies is defective; the animal is not able to throw off the infection and wastes more protein.

The effects of folic acid illustrate the importance of leukocytes in defense. The number of leukocytes in the blood of monkeys falls when they are fed on a diet that lacks folic acid; these monkeys become very susceptible to diseases, particularly to dysentery.

Vitamin C (ascorbic acid) is needed for the proper formation of fibrous tissue. In scurvy, the disease caused by lack of vitamin C, wounds heal slowly or not at all on account of defects in the fibrous tissue that should close them: breaches in the outer defenses remain open to invasion by microorganisms. Apart from this, the barrier of fibrous tissue formed around areas that bacteria have invaded is weak and incomplete; the invasion is not localized as in normal animals.

Several trials have involved the effects of giving large supplements of vitamins for many months to people eating their usual diets. If the subjects of the experiments were already getting enough vitamins in their food, no benefit accrued from the supplements. The usual diet of most of the subjects contained an excess of some vitamins and a deficiency of others. The only constant difference, however, between the people given supplements of vitamin A and the controls (who were not given supplements) was a slight reduction in the severity and duration of colds (but not in their frequency).

2. Cold and Injury.—Resistance may be lowered by cold or injury; the degree of injury needed to turn the scale in favour of the invader may be very slight. When foot-and-mouth virus is injected into the muscle of a guinea pig, blisters appear on the pads of the feet in three or four days. If one foot is protected from pressure by being wrapped in cotton wool, no blisters develop on this foot, although they appear on the unprotected feet. The virus of herpes, which commonly gives rise to blisters on the lips, often causes inflammation of the mouth in young children. The virus appears to lie latent in the tissues after this attack. The latent virus may cause blisters on the lips when resistance is lowered locally by burns, etc., or when it is lowered generally by colds or pneumonia; hence the name fever blisters.

IV. HYPERSENSITIVITY

The same antigen-antibody reactions that are involved in immunity may produce disagreeable or even fatal disease. The production of anaphylaxis has already been described. Another type of hypersensitivity, hay fever (*q.v.*), is produced by a heat-labile, skin-sensitizing, nonprecipitating antibody. Interestingly, when this type of antibody is made in response to diphtheria toxoid, it neutralizes diphtheria toxin approximately as well as the typical precipitating antitoxin.

A delayed type of hypersensitivity has been most studied in tuberculosis, but it occurs in many infections and can be observed after immunization with common protein antigens under special conditions. It is of interest because it is associated with a widespread sensitization of cells that does not occur in other hypersensitive states. It cannot be passively transferred with serum but can be transferred with sensitized lymphocytes from sensitive animals and man.

V. TRANSPLANTATION IMMUNITY

It is now agreed that in general it is impossible to transplant permanently a graft from one individual to another unless the donor and host are identical twins; *i.e.*, of identical genetic make-up. The rejection of such a transplant follows the acquisition of immunity by the host in response to the antigens of the graft. Transplantation immunity may be associated with antibodies but most immunologists believe it is closely allied to the delayed type of hypersensitivity and that it is mediated by sensitized lymphocytes. (J. R. Mar.; W. H. T.)

VI. PROPHYLACTIC PRODUCTION OF ACTIVE IMMUNITY

By means of artificial immunization man has attempted to improve on natural processes of immunization that occur whenever a human or animal population is exposed to certain infections. This natural phenomenon often fails to reach and immunize all of the susceptibles in the population, and unfortunately many of those exposed develop the disease in a severe or fatal form before immunity develops. Through artificial procedures it became increasingly possible to cause people to become immune to a certain disease at a desired time and age and to do so without causing them to be exposed to the hazards of the fully developed illness.

The advent of chemotherapy and the antibiotics did not decrease the importance of active immunization. It was still more important to prevent disease than to employ even a good method of treatment after a person became ill. People still died of infectious diseases in spite of the miracle drugs. The threat of bacteriological warfare was sufficient reason for continuing to immunize against those diseases for which prophylactic agents were available and to seek vaccines not yet available.

1. Types of Antigens and Vaccines.—Artificial immunization may be brought about by the introduction into man or animals of a variety of antigens. These antigens may be living or dead bacteria or other microorganisms; chemically purified derivatives of bacteria; toxins elaborated by bacteria; mixtures of toxin and the specific counteracting antitoxin; or toxoids, which are toxins treated in such a manner that they are no longer poisonous but still capable of stimulating immunity.

Living, unmodified microorganisms are rarely used to immunize man because of the dangers associated with this practice. Before the discovery of smallpox vaccine in 1796 people were immunized against smallpox by injecting them with material taken from the skin eruption of persons ill with the disease. Some individuals inoculated in this way became seriously ill with smallpox but, so great was the fear of this disease, many people preferred to take the smaller chance of dying from the inoculated disease than of developing the more often fatal natural one. Probably, even in this case, there was some weakening of the virus through the handling it received before being injected. The route of inoculation was probably responsible for the lesser virulence of the inoculated material.

Bacteria or viruses that have been weakened or attenuated in some way are more useful as vaccines than are fully virulent microorganisms. A variety of procedures are used for this purpose, including growing the organisms under conditions not optimum for their development, exposing them to physical and chemical agents, or adapting them to another animal so thoroughly that they become relatively nonvirulent for man. The latter procedure has proved to be especially valuable. Yellow fever vaccine, for example, was developed through application of this principle. The virus of this disease was first passed through many generations of mice, then was grown in tissue culture and finally was propagated in developing chick embryos. The virus by then was so altered that an amount of living virus equivalent to millions of infectious doses of the original, unattenuated virus could be injected into humans without causing yellow fever. Millions of people have been protected against yellow fever with this type of vaccine.

BCG (Bacillus Calmette-Guérin), the vaccine widely used against tuberculosis, is made from attenuated tubercle bacilli. In this case the bovine-type tubercle bacilli, originally virulent for man and animals, were rendered harmless by growing them for many generations on a potato-bile culture medium. (*See* also Tuberculosis: *Prevention and Control.*)

In the 1950s there was a resurgence of interest in the use of living, attenuated viruses and bacteria as immunizing agents for animals and man. Vaccines of this type have been developed, largely through the researches of H. R. Cox and H. Koprowski and their colleagues, against such animal diseases as rabies, canine distemper and hog cholera. Attenuated microorganisms were employed in making vaccines against human diseases such as tularemia, influenza, poliomyelitis and measles. The attenuated tularemia vaccine is the only antigen that has been demonstrated to be effective against virulent types of that disease.

In the production of living vaccines against bacterial diseases, such as tularemia, there is only one serious problem, that of producing the desired degree of attenuation. Since the bacteria are grown on sterile, nonliving culture media, no adventitious disease agents should gain entrance during cultivation. In the production of live virus vaccines not only must the desired degree of attenuation be achieved and maintained but the wild viruses found in the animal tissue culture, which serves as the growth medium for the virus being cultivated, must be excluded from the final vaccine. Monkey kidney tissue was the principal medium on which polio virus and measles virus were grown prior to 1961 and it, unfortunately, may contain the viruses of many diseases acquired by the monkeys while living in the jungle. Some of these viruses are detected easily but it appears that new ones can be found whenever new methods for their detection are developed.

Another type of vaccine, and possibly the most desirable, is one containing killed or inactivated microorganisms. Vaccination against such diseases as typhoid fever, whooping cough, poliomyelitis (with Salk vaccine), rabies and influenza is accomplished with killed vaccines. In the inactivation of the microorganisms a great variety of physical and chemical agents are employed. Moderate heat and low concentrations of formaldehyde solution and phenol are most commonly used. Ultraviolet light employed under rigidly controlled conditions is capable of inactivating viruses with less impairment of their immunogenic capacity than occurs when other physical or chemical agents are employed. An improved procedure, using ultraviolet light as the killing agent, is used for

commercial production of some types of vaccine, especially viral vaccines.

It was once thought that immunization would be carried out increasingly with purified antigens; *i.e.*, antigens freed from the extraneous materials that are inactive in the production of immunity but sometimes cause undesirable reactions in the persons inoculated. These preparations, usually proteins or complex polysaccharides, are concentrated so as to have their immunizing power enhanced several thousand times as compared with an equivalent volume of the unpurified vaccine. By 1960, however, it appeared that purified antigens extracted from bacteria were less satisfactory than the whole organism.

In some instances it is more important to stimulate protection against the toxin produced by a bacterium than against the organism itself since the symptoms of the disease may be due primarily to the toxin and not to the presence of the bacteria in the body. Inoculation with repeated graduated doses of toxin, beginning with amounts insufficient to cause local or systemic reactions, produces immunity to the toxin. This method has rarely been used because it required too many injections and was also likely to give rise to undesirable reactions. However, it has been used in the Dick method of immunization against scarlet fever. It has not been possible to produce a scarlet fever toxoid with any degree of immunizing potency.

Mixtures of toxin and antitoxin, prepared in such a manner that there is a very slight excess of toxin, were the first prophylactics to be used in diphtheria immunization. They had the disadvantage, however, of sensitizing against horse serum. Furthermore, they were inferior to toxoid in immunizing potency and were almost entirely replaced by the latter.

2. Manufacture of Toxoid.—Toxoid is usually made by exposing toxin to the action of formaldehyde solution for several weeks. The resulting product seems to be identical with the original toxin in every respect except for the loss or reduction of its ability to produce poisonous effects in man or animals. Toxoids are widely used in immunization against diphtheria and tetanus and to a less extent as prophylactic agents against gas gangrene and staphylococcus infections (boils, carbuncles, septicemia). Toxoids made from purified toxins are more potent and less likely to give rise to undesirable side reactions than are those made from unpurified toxins. In 1946 L. Pillemer and his associates announced that they had been able to produce purified crystalline tetanus toxin. Later it was found possible to purify toxoids by various chemical methods. The ability is of considerable importance because of the increasing need to immunize adolescents and adults in whom undesirable reactions, following the injection of impure toxoids, are likely to be severe.

Earlier attempts at immunization usually employed a single injection of antigen. In instances where a living vaccine is used, *i.e.*, in smallpox immunization, a single injection suffices because the organisms originally inoculated multiply manyfold. On the other hand, a single injection of vaccine consisting of killed bacteria or inactivated virus is usually only partially effective or offers complete protection for relatively short periods of time. The ideal method would be to administer repeated injections of the vaccine over a relatively long period of time. Practical considerations usually require that the number of injections for most diseases be limited to something like three or, at most, five.

With the small number of injections ordinarily employed, better immunity can be stimulated if the doses are given at considerable intervals. Originally, doses were spaced not more than seven to ten days apart for fear of encountering undesirable reactions of the anaphylactic type. Experience showed that the vaccines and toxoids in use were not likely to cause these undesirable reactions, and the tendency is to space the injections at greater and greater intervals. Three or four weeks is the usual spacing between injections but even better results can be obtained with intervals of three months or more.

The number of injections used and their spacing is determined to a large extent by whether the antigen contains an adjuvant. Potassium alum (aluminum potassium sulfate) has been the most widely used adjuvant but there are others such as protamine, aluminum phosphate or calcium phosphate. The mode of action of adjuvants is not fully understood but it appears that they may act in at least two ways. Antigens containing adjuvants are absorbed very slowly so that the effect is as if many repeated injections had been given. They also apparently stimulate the mechanism responsible for the production of immunity.

By adding alum to diphtheria toxoid it was found that the percentage of individuals successfully immunized with two doses of this material was as great as when three doses of fluid toxoid (not containing alum) were used. It was demonstrated by several investigators that it is possible to immunize very young infants with whooping cough vaccine containing alum but not with vaccine lacking alum. Since about half the deaths from whooping cough occur in children under six months of age, this discovery offered new lifesaving possibilities. On the other hand, alum was of no value in enhancing the potency of influenza vaccine. Unfortunately, adjuvants not only potentiate the desirable features of a vaccine or toxoid but also may enhance its capacity to produce undesirable side reactions.

3. Need for Boosters.—As stated above, ridding vaccines and toxoids of their potentialities for producing undesirable reactions became of greater importance because of the need to immunize adolescents and adults. For example, when artificial immunization against diphtheria was first begun, it appeared that one course of injections would lead to lifelong immunity. It was not appreciated at that time that, because there was still a great deal of the disease in the community, the original artificial immunization was being bolstered continuously by the natural immunization process. Parallel with the reduced prevalence of diphtheria occurred a reduction in the opportunities for natural immunization.

Consequently it became recognized that reimmunization is necessary at some time subsequent to the primary immunization. Usually only a single injection is given as a "booster" dose and the amount of antigen used may be much smaller than that considered necessary in the primary immunization. In the U.S. it is believed that primary immunization should be done in early infancy with booster injections at about one year of age, at school entrance and at some later date such as at the age of ten or at graduation from grammar school.

4. Combinations of Antigens.—In order to make it unnecessary for persons, especially children, to be subjected to numerous injections of vaccines and toxoids the practice of combining antigens became more prevalent. Diphtheria toxoid, tetanus toxoid, pertussis vaccine and poliomyelitis vaccine were combined with apparently excellent results. (It was formerly thought that immunization against diphtheria could not be successfully carried out at an earlier age than six months but this was found to be untrue.) V. K. Volk's studies reported in 1947 seemed to indicate that there was a definite limit to the number of antigens that could be combined unless some way was found to forestall the high incidence of unwanted reactions that follow the use of combinations of four or five of the following antigens: diphtheria toxoid, tetanus toxoid, pertussis vaccine, typhoid vaccine and scarlet fever toxin. It was also evident that, unless markedly improved antigens were developed the dilution effect inherent in the combination would place a limit upon the number of component antigens. Combining purified, concentrated antigens is an obvious way to circumvent both of these unwanted effects and pharmaceutical manufacturers have done a great deal in this direction.

5. Noninjection Methods.—Attempts to prevent an undue number of injections also took another course; *i.e.*, introduction of the antigens by some method not requiring deposition in the tissues. Numerous investigators experimented with intranasal immunization by drops or by spraying the mucosa. Oral immunization was also tried by a number of research workers and has become a routine procedure in poliomyelitis vaccination.

6. Evaluation Procedures.—From the earliest work in this field it has been the practice to study immunizing materials extensively in laboratory animals until adequate proof of their value could be adduced. These laboratory studies were usually followed by careful field studies in human populations, designed to

evaluate the products further. Even after they came into general use, the various antigens used in artificial immunization continued to be on trial. Many vaccines and other immunogens failed to survive this rigorous sort of evaluation and sooner or later dropped out of use. Because vaccines and toxoids in use survived this vigorous process of elimination, they are, in general, admirably effective and are in large part responsible for the great reduction in the number of cases and deaths from such diseases as smallpox, diphtheria and poliomyelitis.

See also references under "Immunity and Immunization" in the Index.

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(H. J. SY.)

IMOLA (ancient FORUM CORNELII), a town and episcopal see of Bologna province, Emilia-Romagna region, Italy, lies 33.5 km. (21 mi.) S.E. of Bologna by road. Pop. (1957 est.) 48,754 (commune). Among buildings of interest are the palaces of Pighini (13th century), Sersanti, Calderini and Della Volpe (all 15th century); the churches of S. Domenico with a Gothic portal of 1340 and Sta. Maria in Regola with a Romanesque campanile of 1180; and the cathedral of S. Cassiano. A map of Imola by Leonardo da Vinci is kept in Windsor castle. There are a museum and a library with 170,000 volumes, incunabula and manuscripts. Imola is on the main railway and road from Bologna to Bari. It manufactures earthenware and machinery and is a centre of fruit production, especially strawberries. (V. GA.)

IMPALA (IMPALLA, PALLA), a golden brown south African antelope (*Aepyceros melampus*), about the size of a fallow deer, known for its ability to bound off quickly when aroused. It is characterized by the large black lyre-shaped horns of the buck (the female has no horns) and by the presence in both sexes of glands associated with a tuft of black hairs on the back of both hind feet. The impalas, which gather in large herds near water, range as far north as Kenya in the east and Angola in the west. *See* ANTELOPE: *Subfamily Antilopinae.*

END OF VOLUME ELEVEN

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